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ENCYCLOPÆDIA BRITANNICA.

POETRY, Part II. Sect. 2. continued.

THE variety of subjects, which are allowed the *lyric* poet, makes it necessary to consider this species of poetry under the following heads, viz. the *sublime* ode, the *lesser* ode, and the *song*. We shall begin with the lowest, and proceed to that which is more eminent.

120 The song.

I. *Songs* are little poetical compositions, usually set to a tune, and frequently sung in company by way of entertainment and diversion. Of these we have in our language a great number; but, considering that number, not many which are excellent; for, as the duke of Buckingham observes,

> Though nothing seems more easy, yet no part
> Of poetry requires a nicer art.

The song admits of almost any subject; but the greatest part of them turn either upon *love*, *contentment*, or the *pleasures* of a *country life*, and *drinking*. Be the subject, however, what it will, the verses should be easy, natural, and flowing, and contain a certain harmony, so that poetry and music may be agreeably united. In these compositions, as in all others, obscene and profane expressions should be carefully avoided, and indeed every thing that tends to take off that respect which is due to religion and virtue, and to encourage vice and immorality. As the best songs in our language are already in every hand, it would seem superfluous to insert examples. For further precepts, however, as well as select examples, in this species of composition, we may refer the reader to the elegant *Essay on Song Writing*, by Mr Aikin.

121 The distinguishing character of the lesser ode.

II. The *lesser ode*. The distinguishing character of this is sweetness; and as the pleasure we receive from this sort of poem arises principally from its soothing and affecting the passions, great regard should be paid to the language as well as to the thoughts and numbers.

> Th' expression should be easy, fancy high;
> Yet that not seem to creep, nor this to fly:
> No words transpos'd, but in such order all,
> As, though hard wrought, may seem by chance to fall.
>
> D. BUCKINGHAM's *Essay*.

The style, indeed, should be easy: but it may be also florid and figurative. It solicits delicacy, but disdains affectation. The thoughts should be natural, chaste, and elegant; and the numbers various, smooth, and harmonious. A few examples will sufficiently explain what we mean.

Longinus has preserved a fragment of Sappho, an ancient Greek poetess, which is in great reputation amongst the critics, and has been so happily translated by Mr Philips as to give the English reader a just idea of the spirit, ease, and elegance of that admired author; and show how exactly she copied nature. To enter into the beauties of this ode, we must suppose a lover sitting by his mistress, and thus expressing his passion:

122 The Sapphic ode.

> Blest as th' immortal gods is he,
> The youth who fondly sits by thee,
> And sees and hears thee all the while
> Softly speak, and sweetly smile.
> 'Twas this depriv'd my soul of rest,
> And rais'd such tumults in my breast;
> For while I gaz'd, in transport tost,
> My breath was gone, my voice was lost.
> My bosom glow'd, the subtle flame
> Ran quick through all my vital frame:
> O'er my dim eyes a darkness hung;
> My ears with hollow murmurs rung.
> In dewy damps my limbs were chill'd,
> My blood with gentle horrors thrill'd;
> My feeble pulse forgot to play;
> I fainted, sunk, and dy'd away.

123 The Anacreontic ode.

After this instance of the Sapphic ode, it may not be improper to speak of that sort of ode which is called *Anacreontic;* being written in the manner and taste of Anacreon, a Greek poet, famous for the delicacy of his wit, and the exquisite, yet easy and natural, turn of his poesy. We have several of his odes still extant, and many modern ones in imitation of him, which are mostly composed in verses of seven syllables, or three feet and a half.

We shall give the young student one or two examples of his manner from Mr Fawkes's excellent translation.

The following ode on the power of gold, which had been often attempted but with little success, this gentleman has translated very happily.

> Love's a pain that works our wo;
> Not to love is painful too:
> But, alas! the greatest pain
> Waits the love that meets disdain.
> What avails ingenuous worth,
> Sprightly wit, or noble birth?
> All these virtues useless prove;
> Gold alone engages love.

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May he be completely curst,
Who the sleeping mischief first
Wak'd to life, and, vile before,
Stamp'd with worth the sordid ore.
Gold creates in brethren strife;
Gold destroys the parent's life;
Gold produces civil jars,
Murders, massacres, and wars;
But the worst effect of gold,
Love, alas! is bought and sold.

His ode on the vanity of riches is of a piece with the above, and conveys a good lesson to those who are over anxious for wealth.

If the treasur'd gold could give
Man a longer term to live,
I'd employ my utmost care
Still to keep, and still to spare;
And, when death approach'd, would say,
'Take thy fee, and walk away.'
But since riches cannot save
Mortals from the gloomy grave,
Why should I myself deceive,
Vainly sigh, and vainly grieve?
Death will surely be my lot,
Whether I am rich or not.
Give me freely while I live
Generous wines, in plenty give
Soothing joys my life to cheer,
Beauty kind, and friends sincere;
Happy! could I ever find
Friends sincere, and beauty kind.

But two of the most admired, and perhaps the most imitated, of Anacreon's odes, are that of Mars wounded by one of the darts of Love, and Cupid stung by a Bee; both which are wrought up with fancy and delicacy, and are translated with elegance and spirit.—Take that of Cupid stung by a bee.

Once as Cupid, tir'd with play,
On a bed of roses lay,
A rude bee, that slept unseen,
The sweet breathing buds between,
Stung his finger, cruel chance!
With its little pointed lance.
Straight he fills the air with cries,
Weeps, and sobs, and runs, and flies;
'Till the god to Venus came,
Lovely, laughter-loving dame:
Then he thus began to plain;
"Oh! undone——I die with pain——
"Dear mamma, a serpent small,
"Which a bee the ploughman call,
"Imp'd with wings, and arm'd with dart,
"Oh!—has stung me to the heart."
Venus thus reply'd, and smil'd:
'Dry those tears for shame! my child;
'If a bee can wound so deep,
'Causing Cupid thus to weep,
'Think, O think! what cruel pains
'He that's stung by thee sustains.'

Of Lyric Poetry.

124 Imitation of Anacreon and

Among the most successful of this poet's English imitators may be reckoned Dr Johnson and Mr Prior. The following ode on *Evening* by the former of these writers has, if we mistake not, the very spirit and air of Anacreon.

Evening now from purple wings
Sheds the grateful gifts she brings;
Brilliant drops bedeck the mead;
Cooling breezes shake the reed;
Shake the reed and curl the stream
Silver'd o'er with Cynthia's beam;
Near the chequer'd lonely grove
Hears, and keeps thy secrets, Love.
Stella, thither let us stray!
Lightly o'er the dewy way.
Phœbus drives his burning car
Hence, my lovely Stella, far:
In his stead the queen of night
Round us pours a lambent light;
Light that seems but just to show
Breasts that beat, and cheeks that glow:
Let us now, in whisper'd joy,
Evening's silent hours employ;
Silence best, and conscious shades,
Please the hearts that love invades:
Other pleasures give them pain;
Lovers all but love disdain.

But of all the imitations of the playful bard of Greece that we have ever met with, the most perfect is the following Anacreontic by the regent duke of Orleans.

I.

Je suis né pour les plaisirs;
Bien fou que s'en passe:
Je ne veux pas les choisir;
Souvent le choix m'embarrasse:
Aime t'on? J'aime soudain;
Bois t'on? J'ai la verre à la main;
Je tiens par tout ma place.

II.

Dormir est un temps perdu;
Faut il qu'on s'y livre?
Sommeil, prends ce qui t'est du;
Mais attends que je sois yvre:
Saisis moi dans cet instant;
Fais moi dormir promptement;
Je suis pressé de vivre.

III.

Mais si quelque objet charmant,
Dans un songe aimable,
Vient d'un plaisir seduisant
M'offrir l'image agréable;
Sommeil, allons doucement;
L'erreur est en ce moment
Un bonheur veritable.

Translation of the Regent's Anacreontic (E).

Frolic and free, for pleasure born,
The self-denying fool I scorn.

The

(E) We give this translation, both because of its excellence, and because it is said to have been the production of no less a man than the late Lord Chatham.

The proffer'd joy I ne'er refuse;
'Tis oft-times troublesome to chuse.
Lov'st thou, my friend? I love at sight:
Drink'st thou? this bumper does thee right.
At random with the stream I flow,
And play my part where'er I go.

Great God of Sleep, since we must be
Oblig'd to give some hours to thee,
Invade me not till the full bowl
Glows in my cheek, and warms my soul.
Be *that* the only time to snore,
When I can love and drink no more:
Short, very short, then be thy reign;
For I'm in haste to live again.

But O! if melting in my arms,
In some soft dream, with all her charms,
The nymph belov'd should then surprise,
And grant what waking she denies;
Then prithee, gentle Slumber, stay;
Slowly, ah slowly, bring the day:
Let no rude noise my bliss destroy;
Such sweet delusion's real joy.

125 Sappho. We have mentioned Prior as an imitator of Anacreon; but the reader has by this time had a sufficient specimen of Anacreontics. The following *Answer to Cloe jealous*, which was written when Prior was sick, has much of the elegant tenderness of Sappho.

Yes, fairest proof of beauty's power,
  Dear idol of my panting heart,
Nature points this my fatal hour:
  And I have liv'd: and we must part.
While now I take my last adieu,
  Heave thou no sigh, nor shed a tear;
Lest yet my half-clos'd eye may view
  On earth an object worth its care.
From jealousy's tormenting strife
  For ever be thy bosom freed;
That nothing may disturb thy life,
  Content I hasten to the dead.
Yet when some better-fated youth
  Shall with his am'rous parly move thee,
Reflect one moment on his truth
  Who, dying, thus persists to love thee.

There is much of the softness of Sappho, and the sweetness of Anacreon and Prior, in the following ode, which is ascribed to the unfortunate Dr Dodd; and was written in compliment to a lady, who, being sick, had sent the author a moss rose-bud, instead of making his family a visit. This piece is particularly to be esteemed for the just and striking moral with which it is pointed.

The slightest of favours bestow'd by the fair,
With rapture we take, and with triumph we wear;
But a moss-woven rose-bud, Eliza, from thee,
A well-pleasing gift to a monarch would be.
—Ah! that illness, too cruel, forbidding should stand,
And refuse me the gift from thy own lovely hand!
With joy I receive it, with pleasure will view,
Reminded of thee, by its odour and hue:
"Sweet rose, let me tell thee, though charming thy bloom,
Tho' thy fragrance excels Seba's richest perfume;
Thy breath to Eliza's no fragrance hath in't,
And but dull is thy bloom to her cheek's blushing tint.
Yet, alas! my fair flow'r, that bloom will decay,
And all thy lov'd beauties soon wither away;
Tho' pluck'd by her hand, to whose touch we must own,
Harsh and rough is the cygnet's most delicate down:"
Thou too, snowy hand; nay, I mean not to preach;
But the rose, lovely moralist, suffer to teach.
"Extol not, fair maiden, thy beauties o'er mine;
They too are short-liv'd, and they too must decline;
And small, in conclusion, the diff'rence appears,
In the bloom of few days, or the bloom of few years!
But remember a virtue the rose hath to boast,
—Its fragrance remains when its beauties are lost!"

126 Odes more florid and figurative. We come now to those odes of the more florid and figurative kind, of which we have many in our language that deserve particular commendation. Mr Warton's Ode to Fancy has been justly admired by the best judges; for though it has a distant resemblance of Milton's l'Allegro and Il Penseroso, yet the work is original; the thoughts are mostly new and various, and the language and numbers elegant, expressive, and harmonious.

  O parent of each lovely muse,
Thy spirit o'er my soul diffuse!
O'er all my artless songs preside,
My footsteps to thy temple guide!
To offer at thy turf-built shrine
In golden cups no costly wine,
No murder'd fatling of the flock,
But flow'rs and honey from the rock.
O nymph, with loosely flowing hair,
With buskin'd leg, and bosom bare;
Thy waist with myrtle-girdle bound,
Thy brows with Indian feathers crown'd;
Waving in thy snowy hand
An all-commanding magic wand,
Of pow'r to bid fresh gardens blow
'Mid cheerless Lapland's barren snow:
Whose rapid wings thy flight convey,
Through air, and over earth and sea;
While the vast various landscape lies
Conspicuous to thy piercing eyes.
O lover of the desert, hail!
Say, in what deep and pathless vale,
Or on what hoary mountain's side,
'Midst falls of water, you reside;
'Midst broken rocks, a rugged scene,
With green and grassy dales between;
'Midst forests dark of aged oak,
Ne'er echoing with the woodman's stroke;
Where never human art appear'd,
Nor ev'n one straw-roof'd cott was rear'd;
Where Nature seems to sit alone,
Majestic on a craggy throne.
Tell me the path, sweet wand'rer! tell,
To thy unknown sequester'd cell,
Where woodbines cluster round the door,
Where shells and moss o'erlay the floor,
And on whose top an hawthorn blows,
Amid whose thickly-woven boughs
Some nightingale still builds her nest,
Each ev'ning warbling thee to rest.
Then lay me by the haunted stream,
Wrapt in some wild poetic dream;

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In converse while methinks I rove
With Spenser through a fairy grove;
Till suddenly awak'd, I hear
Strange whisper'd music in my ear;
And my glad soul in bliss is drown'd
By the sweetly soothing sound!
Me, goddess, by the right-hand lead,
Sometimes through the yellow mead;
Where Joy and white-rob'd Peace resort,
And Venus keeps her festive court;
Where Mirth and Youth each ev'ning meet,
And lightly trip with nimble feet,
Nodding their lily-crowned heads,
Where Laughter rose-lip'd Hebe leads;
Where Echo walks steep hills among,
List'ning to the shepherd's song.
Yet not these flow'ry fields of joy
Can long my pensive mind employ;
Haste, Fancy, from the scenes of Folly,
To meet the matron Melancholy!
Goddess of the tearful eye,
That loves to fold her arms and sigh.
Let us with silent footsteps go
To charnels, and the house of wo;
To Gothic churches, vaults, and tombs,
Where each sad night some virgin comes,
With throbbing breast and faded cheek,
Her promis'd bridegroom's urn to seek:
Or to some abbey's mould'ring tow'rs,
Where, to avoid cold wint'ry show'rs,
The naked beggar shivering lies,
While whistling tempests round her rise,
And trembles lest the tott'ring wall
Should on her sleeping infants fall.
  Now let us louder strike the lyre,
For my heart glows with martial fire;
I feel, I feel, with sudden heat,
My big tumultuous bosom beat;
The trumpet's clangors pierce my ear,
A thousand widows shrieks I hear:
Give me another horse, I cry;
Lo, the base Gallic squadrons fly!
Whence is this rage?—what spirit, say,
To battle hurries me away?
'Tis Fancy, in her fiery car,
Transports me to the thickest war;
There whirls me o'er the hills of slain,
Where tumult and destruction reign;
Where, mad with pain, the wounded steed,
Tramples the dying and the dead;
Where giant Terror stalks around,
With sullen joy surveys the ground,
And, pointing to th' ensanguin'd field,
Shakes his dreadful gorgon shield!
O guide me from this horrid scene
To high arch'd walks and alleys green,
Which lovely Laura seeks, to shun
The fervors of the mid-day sun.
The pangs of absence, O remove,
For thou can'st place me near my love;
Can'st fold in visionary bliss,
And let me think I steal a kiss;
While her ruby lips dispense
Luscious nectar's quintessence!
When young ey'd Spring profusely throws
From her green lap the pink and rose;
When the soft turtle of the dale
To Summer tells her tender tale;
When Autumn cooling caverns seeks,
And stains with wine his jolly cheeks;
When Winter, like poor pilgrim old,
Shakes his silver beard with cold;
At ev'ry season let my ear
Thy solemn whispers, Fancy, hear.
O warm enthusiastic maid!
Without thy powerful, vital aid,
That breathes an energy divine,
That gives a soul to ev'ry line,
Ne'er may I strive with lips profane,
To utter an unhallow'd strain;
Nor dare to touch the sacred string,
Save when with smiles thou bid'st me sing.
O hear our pray'r, O hither come
From thy lamented Shakespeare's tomb,
On which thou lov'st to sit at eve,
Musing o'er thy darling's grave.
O queen of numbers, once again
Animate some chosen swain,
Who, fill'd with unexhausted fire,
May boldly smite the sounding lyre;
Who with some new, unequall'd song,
May rise above the rhyming throng:
O'er all our list'ning passions reign,
O'erwhelm our souls with joy and pain;
With terror shake, with pity move,
Rouze with revenge, or melt with love.
O deign t'attend his evening walk,
With him in groves and grottoes talk;
Teach him to scorn, with frigid art,
Feebly to touch th' enraptur'd heart;
Like lightning, let his mighty verse
The bosom's inmost foldings pierce;
With native beauties win applause,
Beyond cold critics studied laws:
O let each muse's fame increase!
O bid Britannia rival Greece!

The following ode, written by Mr Smart on the 5th of December (being the birth-day of a beautiful young lady), is much to be admired for the variety and harmony of the numbers, as well as for the beauty of the thoughts, and the elegance and delicacy of the compliment. It has great fire, and yet great sweetness, and is the happy issue of genius and judgment united.

'Hail eldest of the monthly train,
  Sire of the winter drear,
December! in whose iron reign
  Expires the chequer'd year.
Hush all the blust'ring blasts that blow,
And proudly plum'd in silver snow,
  Smile gladly on this blest of days;
The livery'd clouds shall on thee wait,
And Phœbus shine in all his state
  With more than summer rays.

Though jocund June may justly boast
  Long days and happy hours;
Though August be Pomona's host,
  And May be crown'd with flow'rs:

Tell

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Tell June his fire and crimson dies,
By Harriot's blush, and Harriot's eyes,
Eclips'd and vanquish'd, fade away;
Tell August, thou canst let him see
A richer, riper fruit than he,
A sweeter flow'r than May.

127 A pastoral and elegiac ode.

The ensuing ode, written by Mr Collins on the death of Mr Thomson, is of the pastoral and elegiac kind, and both picturesque and pathetic. To perceive all the beauties of this little piece, which are indeed many, we must suppose them to have been delivered on the river Thames near Richmond.

In yonder grave a Druid lies,
Where slowly winds the stealing wave;
The year's best sweets shall duteous rise
To deck its poet's silvan grave!
In yon deep bed of whisp'ring reeds
His airy harp * shall now be laid,
That he, whose heart in sorrow bleeds,
May love through life the soothing shade.
Then maids and youths shall linger here,
And, while its sounds at distance swell,
Shall sadly seem in pity's ear
To hear the woodland pilgrim's knell.
Remembrance oft shall haunt the shore,
When Thames in summer wreaths is drest,
And oft suspend the dashing oar,
To bid his gentle spirit rest!
And oft as ease and health retire
To breezy lawn, or forest deep,
The friend shall view yon whitening spire †,
And 'mid the varied landscape weep.
But thou, who own'st that earthy bed,
Ah! what will ev'ry dirge avail?
Or tears, which love and pity shed,
That mourn beneath the gliding sail?
Yet lives there one, whose heedless eye,
Shall scorn thy pale shrine glimm'ring near?
With him, sweet bard, may fancy die,
And joy desert the blooming year.
But thou, lorn stream, whose sullen tide
No sedge-crown'd sisters now attend,
Now waft me from the green hill's side,
Whose cold turf hides the buried friend.
And see, the fairy valleys fade,
Dim night has veil'd the solemn view!
Yet once again, dear parted shade,
Meek nature's child, again adieu!
The genial meads, assign'd to bless
Thy life, shall mourn thy early doom;
Their hinds, and shepherd girls, shall dress,
With simple hands, thy rural tomb.
Long, long, thy stone and pointed clay
Shall melt the musing Briton's eyes;
O vales and wild woods, shall he say,
In yonder grave your Druid lies!

* The harp of Æolus.

† Richmond church.

128 The hymn.

Under this species of the ode, notice ought to be taken of those written on divine subjects, and which are usually called *hymns*. Of these we have many in our language, but none perhaps that are so much admired as Mr Addison's. The beauties of the following hymn are too well known, and too obvious, to need any commendation; we shall only observe, therefore, that in this hymn (intended to display the power of the Almighty) he seems to have had a psalm of David in his view, which says, that "the heavens declare the glory of God, and the firmament sheweth his handywork."

The spacious firmament on high,
With all the blue ethereal sky,
And spangled heav'ns, a shining frame,
Their great original proclaim:
Th' unwearied sun, from day to day,
Does his Creator's pow'r display,
And publishes to ev'ry land
The work of an Almighty hand.
Soon as the ev'ning shades prevail,
The moon takes up the wond'rous tale,
And nightly to the list'ning earth
Repeats the story of her birth:
While all the stars that round her burn,
And all the planets in their turn,
Confirm the tidings as they roll,
And spread the truth from pole to pole.
What tho' in solemn silence all
Move round the dark terrestrial ball?
What tho' no real voice or sound
Amid their radiant orbs be found?
In reason's ear they all rejoice,
And utter forth a glorious voice,
For ever singing, as they shine,
"The hand that made us is divine."

The following pastoral hymn is a version of the 23d *Psalm* by Mr Addison; the peculiar beauties of which have occasioned many translations; but we have seen none that is so poetical and perfect as this. And in justice to Dr Boyce, we must observe, that the music he has adapted to it is so sweet and expressive, that we know not which is to be most admired, the poet or the musician.

The Lord my pasture shall prepare,
And feed me with a shepherd's care;
His presence shall my wants supply,
And guard me with a watchful eye;
My noon-day walks he shall attend,
And all my midnight hours defend.
When in the sultry glebe I faint,
Or on the thirsty mountain pant,
To fertile vales and dewy meads
My weary wand'ring steps he leads;
Where peaceful rivers soft and slow
Amid the verdant landscape flow.
Tho' in the paths of death I tread,
With gloomy horrors overspread,
My stedfast heart shall fear no ill:
For thou, O Lord, art with me still;
Thy friendly crook shall give me aid,
And guide me through the dreadful shade.
Tho' in a bare and rugged way,
Through devious lonely wilds I stray,
Thy bounty shall my pains beguile:
The barren wilderness shall smile,
With sudden greens and herbage crown'd;
And streams shall murmur all around.

129 The sublime ode.

III. We are now to speak of those odes which are of the sublime and noble kind, and distinguished from others by their elevation of thought and diction, as well by the variety or irregularity of their numbers as the frequent

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frequent transitions and bold excursions with which they are enriched.

To give the young student an idea of the sudden and frequent transitions, digressions, and excursions, which are admitted into the odes of the ancients, we cannot do better than refer him to the celebrated song or ode of Moses; which is the oldest that we know of, and was penned by that divine author immediately after the children of Israel crossed the Red sea.

At the end of this song, we are told, that "Miriam the prophetess, the sister of Aaron, took a timbrel in her hand, and all the women went out after her with timbrels and with dances. And Miriam answered them, Sing ye to the Lord, for he hath triumphed gloriously; the horse and his rider hath he thrown into the sea."

From this last passage it is plain, that the ancients very early called in music to the aid of poetry; and that their odes were usually sung, and accompanied with their lutes, harps, lyres, timbrels, and other instruments: nay, so essential, and in such reputation, was music held by the ancients, that we often find in their lyric poets, addresses or invocations to the harp, the lute, or the lyre; and it was probably owing to the frequent use made of the last-mentioned instrument with the ode, that this species of writing obtained the name of *Lyric poetry*.

This ode, or hymn, which some believe was composed by Moses in Hebrew verse, is incomparably better than any thing the heathen poets have produced of the kind, and is by all good judges considered as a master-piece of ancient eloquence. The thoughts are noble and sublime: the style is magnificent and expressive: the figures are bold and animated: the transitions and excursions are sudden and frequent: but they are short, and the poet, having digressed for a moment, returns immediately to the great object that excited his wonder, and elevated his soul with joy and gratitude. The images fill the mind with their greatness, and strike the imagination in a manner not to be expressed.

If there be any thing that in sublimity approaches to it, we must look for it in the east, where perhaps we shall find nothing superior to the following Hindoo hymn to *Narrayna*, or "the spirit of God," taken, as Sir William Jones informs us, from the writings of the ancient Bramins.

Spirit of spirits, who, through every part
Of space expanded, and of endless time,
Beyond the reach of lab'ring thought sublime,
Bad'st uproar into beauteous order start;
Before heav'n was, thou art.
Ere spheres beneath us roll'd, or spheres above,
Ere earth in firmamental æther hung,
Thou sat'st alone, till, through thy mystic love,
Things unexisting to existence sprung,
And grateful descant sung.
Omniscient Spirit, whose all-ruling pow'r
Bids from each sense bright emanations beam;
Glows in the rainbow, sparkles in the stream,
Smiles in the bud, and glistens in the flow'r
That crowns each vernal bow'r;
Sighs in the gale, and warbles in the throat
Of every bird that hails the bloomy spring,
Or tells his love in many a liquid note,
Whilst envious artists touch the rival string,
Till rocks and forests ring;
Breathes in rich fragrance from the sandal grove,
Or where the precious musk-deer playful rove;
In dulcet juice, from clust'ring fruit distils,
And burns salubrious in the tasteful clove:
Safe banks and verd'rous hills
Thy present influence fills:
In air, in floods, in caverns, woods, and plains,
Thy will inspirits all, thy sovereign Maya reigns.
Blue crystal vault, and elemental fires,
That in th' ethereal fluid blaze and breathe;
Thou, tossing main, whose snaky branches wreathe
This pensile orb with intertwisting gyres;
Mountains, whose lofty spires,
Presumptuous, rear their summits to the skies,
And blend their em'rald hue with sapphire light;
Smooth meads and lawns, that glow with varying dyes
Of dew-bespangled leaves and blossoms bright,
Hence! vanish from my sight
Delusive pictures! unsubstantial shows!
My soul absorb'd one only Being knows,
Of all perceptions one abundant source,
Whence ev'ry object, ev'ry moment flows:
Suns hence derive their force,
Hence planets learn their course;
But suns and fading worlds I view no more;
God only I perceive; God only I adore (F).

The Pindaric ode.

We come now to the *Pindaric ode*, which (if we except the hymns in the Old Testament, the psalms of King David, and such hymns of the Hindoos as that just quoted) is the most exalted part of lyric poetry; and was so called from *Pindar*, an ancient Greek poet, who is celebrated for the boldness of his flights, the impetuosity of his style, and the seeming wildness and irregularity that runs through his compositions, and which are said to be the effect of the greatest art. See PINDAR. 130

The odes of Pindar were held in such high estimation by the ancients, that it was fabled, in honour of their sweetness, that the bees, while he was in the cradle, brought honey to his lips: nor did the victors at the Olympic and other games think the crown a sufficient reward for their merit, unless their achievements were celebrated in Pindar's songs; most wisely presaging, that the first would decay, but the other would endure for ever.

This poet did not always write his odes in the same measure, or with the same intention with regard to their being sung. For the ode inscribed to Diagoras (the concluding stanza of which we inserted at the beginning of this section) is in heroic measure, and all the stanzas are equal: there are others also, as Mr West observes, made

(F) For the philosophy of this ode, which represents the Deity as the soul of the world, or rather as the only Being (the το εν of the Greeks), see METAPHYSICS, N° 269. and PHILOSOPHY, N° 6.

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made up of *strophes* and *antistrophes*, without any *epode;* and some composed of *strophes* only, of different lengths and measures: but the greatest part of his odes are divided into *strophe, antistrophe*, and *epode;* in order, as Mr Congreve conjectures, to their being sung, and addressed by the performers to different parts of the audience. "They were sung (says he) by a chorus, and adapted to the lyre, and sometimes to the lyre and pipe. They consisted oftenest of three stanzas. The first was called the *strophe*, from the version or circular motion of the singers in that stanza from the right hand to the left. The second stanza was called the *antistrophe*, from the contraversion of the chorus; the singers in performing that, turning from the left hand to the right, contrary always to their motion in the *strophe*. The third stanza was called the *epode* (it may be as being the after-song), which they sung in the middle, neither turning to one hand nor the other. But Dr West's * friend is of opinion, that the performers also danced one way while they were singing the *strophe*, and danced back as they sung the *antistrophe*, till they came to the same place again, and then standing still they sung the *epode*. He has translated a passage from the *Scholia* on *Hephæstion*, in proof of his opinion; and observes, that the dancing the *strophe* and *antistrophe* in the same space of ground, and we may suppose the same space of time also, shows why those two parts consisted of the same length and measure.

* Vid. *Pref. to West's Pindar.*

As the various measures of Pindar's odes have been the means of so far misleading some of our modern poets, as to induce them to call compositions Pindaric odes, that were not written in the method of Pindar, it is necessary to be a little more particular on this head, and to give an example from that poet, the more effectually to explain his manner; which we shall take from the translation of Dr West.

The eleventh NEMEAN ODE.

This ode is ascribed to Aristagoras, upon occasion of his entering on his office of president or governor of the island of Tenedos: so that, although it is placed among the Nemean odes, it has no sort of relation to those games, and is indeed properly an inauguration ode, composed to be sung by a chorus at the sacrifices and the feasts made by Aristagoras and his colleagues, in the town-hall, at the time of their being invested with the magistracy, as is evident from many expressions in the first *strophe* and *antistrophe*.

ARGUMENT.

Pindar opens this ode with an invocation to Vesta (the goddess who presided over the courts of justice, and whose statue and altar were for that reason placed in the town-halls, or *Prytanæums*, as the Greeks called them), beseeching her to receive favourably Aristagoras and his colleagues, who were then coming to offer sacrifices to her, upon their entering on their office of Prytans or magistrates of Tenedos, which office continuing for a year, he begs the goddess to take Aristagoras under her protection during that time, and to conduct him to the end of it without trouble or disgrace. From Aristagoras, Pindar turns himself in the next place to his father Arcesilas, whom he pronounces happy, as well upon account of his son's merit and honour, as upon his own great endowments and good fortune: such as beauty, strength, courage, riches, and glory, resulting from his many victories in the games. But lest he should be too much puffed up with these praises, he reminds him at the same time of his mortality, and tells him that his clothing of flesh is perishable, that he must e'er long be clothed with earth, the *end of all things;* and yet, continues he, it is but justice to praise and celebrate the worthy and deserving, who from good citizens ought to receive all kinds of honour and commendation; as Aristagoras, for instance, who hath rendered both himself and his country illustrious by the many victories he hath obtained, to the number of sixteen, over the neighbouring youth, in the games exhibited in and about his own country. From whence, says the poet, I conclude he would have come off victorious even in the Pythian and Olympic games, had he not been restrained from engaging in those famous lists by the too timid and cautious love of his parents. Upon which he falls into a moral reflection upon the vanity of man's hopes and fears; by the former of which they are oftentimes excited to attempts beyond their strength, which accordingly issue in their disgrace; as, on the other hand, they are frequently restrained, by unreasonable and ill-grounded fears, from enterprises, in which they would in all probability have come off with honour. This reflection he applies to Aristagoras, by saying it was very easy to foresee what success he was like to meet with, who both by father and mother was descended from a long train of great and valiant men. But here again, with a very artful turn of flattery to his father Arcesilas, whom he had before represented as strong and valiant, and famous for his victories in the games, he observes that every generation, even of a great and glorious family, is not equally illustrious any more than the fields and trees are every year equally fruitful; that the gods had not given mortals any certain tokens by which they might foreknow when the *rich years of virtue should succeed;* whence it comes to pass, that men, out of self-conceit and presumption, are perpetually laying schemes, and forming enterprises, without previously consulting prudence or wisdom, whose *streams*, says he, lie remote and out of the common road. From all which he infers, that it is better to moderate our desires, and set bounds to our avarice and ambition; with which moral precept he concludes the ode.

STROPHE I.

Daughter of Rhea! thou, whose holy fire
Before the awful seat of justice flames!
Sister of heaven's almighty sire!
Sister of Juno, who coequal claims
With Jove to share the empire of the gods!
O virgin Vesta! to thy dread abodes,
Lo! Aristagoras directs his pace!
Receive and near thy sacred sceptre place
Him, and his colleagues, who, with honest zeal,
O'er Tenedos preside, and guard the public weal.

ANTISTROPHE I.

And lo! with frequent off'rings, they adore
Thee *, first invok'd in every solemn pray'r!
To thee unmix'd libations pour,
And fill with od'rous fumes the fragrant air.
Around

* It was usual in all solemn sacrifices and prayers to begin with invoking Vesta.

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Around in festive songs the hymning choir
Mix the melodious voice and sounding lyre,
While still, prolong'd with hospitable love,
Are solemniz'd the rites of genial Jove:
Then guard him, Vesta, through his long career,
And let him close in joy his ministerial year.

Epode I.

But hail, Arcesilas! all hail
To thee, bless'd father of a son so great!
Thou whom on fortune's highest scale
The favourable hand of heav'n hath set,
Thy manly form with beauty hath refin'd,
And match'd that beauty with a valiant mind.
Yet let not man too much presume,
Tho' grac'd with beauty's fairest bloom;
Tho' for superior strength renown'd;
Tho' with triumphal chaplets crown'd:
Let him remember, that, in flesh array'd,
Soon shall he see that mortal vestment fade;
Till lost, imprison'd in the mould'ring urn,
To earth, the end of all things, he return.

Strophe II.

Yet should the worthy from the public tongue
Receive their recompense of virtuous praise;
By ev'ry zealous patriot sung,
And deck'd with ev'ry flow'r of heav'nly lays.
Such retribution in return for fame,
Such, Aristagoras, thy virtues claim,
Claim from thy country; on whose glorious brows
The wrestler's chaplet still unfaded blows;
Mix'd with the great Pancratiastic crown,
Which from the neighb'ring youth thy early valour won.

Antistrophe II.

And (but his timid parents' cautious love,
Disturbing ever his too forward hands,
Forbade their tender son to prove
The toils of Pythia or Olympia's sands),
Now by the Gods I swear, his valorous might
Had 'scap'd victorious in each bloody fight;
And from Castalia †, or where dark with shade
The mount of Saturn ‡ rears its olive head,
Great and illustrious home had he return'd;
While, by his fame eclips'd, his vanquish'd foes had [mourn'd.

† A river, upon whose banks the Pythian games were exhibited.

‡ A small hill planted with olives, that overlooked the stadium at Olympia.

Epode II.

Then his triumphal tresses bound
With the dark verdure of th' Olympic grove,
With joyous banquets had he crown'd
The great quinquennial festival of Jove;
And cheer'd the solemn pomp with choral lays,
Sweet tribute, which the muse to virtue pays.
But, such is man's prepost'rous fate!
Now, with o'er-weening pride elate,
Too far he aims his shaft to throw,
And straining bursts his feeble bow:
Now pusillanimous, depress'd with fear,
He checks his virtue in the mid career;
And of his strength distrustful, coward flies
The contest, tho' empow'rd to gain the prize.

Strophe III.

But who could err in prophesying good
Of him, whose undegenerating breast
Swells with a tide of Spartan blood,
From sire to sire in long succession trac'd
Up to Pisander; who in days of yore
From old Amyclæ to the Lesbian shore
And Tenedos, colleagu'd in high command
With great Orestes, led th' Æolian band?
Nor was his mother's race less strong and brave,
Sprung from a stock that grew on fair * Ismenus' wave.

* Ismenus was a river of Bœotia, of which country was Menalippus, the ancestor of Aristagoras by the mother's side.

Antistrophe III.

Tho' for long intervals obscur'd, again
Oft-times the seeds of lineal worth appear.
For neither can the furrow'd plain
Full harvests yield with each returning year;
Nor in each period will the pregnant bloom
Invest the smiling tree with rich perfume.
So, barren often, and inglorious, pass
The generations of a noble race;
While nature's vigour, working at the root,
In after-ages swells, and blossoms into fruit.

Epode III.

Nor hath Jove giv'n us to foreknow
When the rich years of virtue shall succeed:
Yet bold and daring on we go,
Contriving schemes of many a mighty deed;
While hope, fond inmate of the human mind,
And self-opinion, active, rash, and blind,
Hold up a false illusive ray,
That leads our dazzled feet astray
Far from the springs, where, calm and slow,
The secret streams of wisdom flow.
Hence should we learn our ardour to restrain,
And limit to due bounds the thirst of gain.
To rage and madness oft that passion turns,
Which with forbidden flames despairing burns.

131 Distinguishing characters of it.

From the above specimen, and from what we have already said on this subject, the reader will perceive, that odes of this sort are distinguished by the happy transitions and digressions which they admit, and the surprising yet natural returns to the subject. This requires great judgment and genius; and the poet who would excel in this kind of writing, should draw the plan of his poem, in manner of the argument we have above inserted, and mark out the places where those elegant and beautiful sallies and wanderings may be made, and where the returns will be easy and proper.

Pindar, it is universally allowed, had a poetical and fertile imagination, a warm and enthusiastic genius, a bold and figurative expression, and a concise and sententious style: but it is generally supposed that many of those pieces which procured him such extravagant praises and extraordinary testimonies of esteem from the ancients are lost; and if they were not, it would be perhaps impossible to convey them into our language; for beauties of this kind, like plants of an odoriferous and delicate nature, are not to be transplanted into another clime without losing much of their fragrance or essential quality.

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132 Modern odes commonly called Pindaric.

With regard to those compositions which are usually called *Pindaric odes*, (but which ought rather to be distinguished by the name of *irregular odes*), we have many in our language that deserve particular commendation: the criticism which Mr Congreve has given us on that subject, has too much asperity and too great latitude; for if other writers have, by mistaking Pindar's measures, given their odes an improper title, it is a crime, one would think, not so dangerous to the commonwealth of letters as to deserve such severe reproof. Besides which, we may suppose that some of these writers did not deviate from Pindar's method through ignorance, but by choice; and that as their odes were not to be performed with both singing and dancing, in the manner of Pindar's, it seemed unnecessary to confine the first and second stanzas to the same exact number as was done in his strophes and antistrophes. The poet therefore had a right to indulge himself with more liberty: and we cannot help thinking, that the ode which Mr Dryden has given us, entitled, *Alexander's Feast*, or *the Power of Music*, is altogether as valuable in loose and wild numbers, as it could have been if the stanzas were more regular, and written in the manner of Pindar. In this ode there is a wonderful sublimity of thought, a loftiness and sweetness of expression, and a most pleasing variety of numbers.

'Twas at the royal feast, by Persia won
By Philip's warlike son,
Aloft in awful state,
The god-like hero sate
On his imperial throne:
His valiant peers were plac'd around;
Their brows with roses and with myrtles bound,
(So should desert in arms be crown'd):
The lovely Thais by his side
Sat like a blooming eastern bride,
In flow'r of youth and beauty's pride.
Happy, happy, happy pair!
None but the brave,
None but the brave,
None but the brave deserve the fair.
Chor. *Happy Happy*, &c.

Timotheus, plac'd on high
Amid the tuneful quire,
With flying fingers touch'd the lyre:
The trembling notes ascend the sky,
And heav'nly joys inspire.
The song began from Jove,
Who left his blissful seats above,
(Such is the pow'r of mighty love!)
A dragon's fiery form bely'd the god:
Sublime on radiant spires he rode,
When he to fair Olympia press'd;
And while he sought her snowy breast:
Then round her slender waist he curl'd,
And stamp'd an image of himself, a sovereign of the world.
The list'ning crowd admire the lofty sound.
A present deity, they shout around;
A present deity, the vaulted roofs rebound:
With ravish'd ears
The monarch hears,
Assumes the god,
Affects to nod,
And seems to shake the spheres.
Chor. *With ravish'd ears*, &c.

The praise of Bacchus then the sweet musician sung;
Of Bacchus ever fair and ever young:
The jolly god in triumph comes;
Sound the trumpets, beat the drums:
Flush'd with a purple grace,
He shows his honest face:
Now give the hautboys breath; he comes, he comes!
Bacchus, ever fair and young,
Drinking joys did first ordain:
Bacchus' blessings are a treasure,
Drinking is the soldier's pleasure:
Rich the treasure,
Sweet the pleasure:
Sweet the pleasure after pain.
Chor. *Bacchus' blessings*, &c.

Sooth'd with the sound, the king grew vain,
Fought all his battles o'er again;
And thrice he routed all his foes, and thrice he slew the slain.
The master saw the madness rise;
His glowing cheeks, his ardent eyes;
And while he heav'n and earth defy'd,
Chang'd his hand, and check'd his pride.
He chose a mournful muse
Soft pity to infuse:
He sung Darius great and good,
By too severe a fate,
Fallen, fallen, fallen, fallen,
Fallen from his high estate,
And welt'ring in his blood;
Deserted at his utmost need,
By those his former bounty fed,
On the bare earth expos'd he lies,
With not a friend to close his eyes.
With downcast looks the joyless victor sat,
Revolving in his alter'd soul
The various turns of chance below;
And now and then a sigh he stole,
And tears began to flow.
Chor. *Revolving*, &c.

The mighty master smil'd to see
That love was in the next degree:
'Twas but a kindred sound to move;
For pity melts the mind to love.
Softly sweet, in Lydian measures.
Soon he sooth'd his soul to pleasures.
War, he sung, is toil and trouble;
Honour but an empty bubble,
Never ending, still beginning,
Fighting still, and still destroying.
If the world be worth thy winning,
Think, O think, it worth enjoying.
Lovely Thais sits beside thee,
Take the good the gods provide thee.
The many rend the skies with loud applause;
So love was crown'd, but music won the cause.
The prince, unable to conceal his pain,
Gaz'd on the fair,
Who caus'd his care,

And sigh'd and look'd, sigh'd and look'd,
Sigh'd and look'd, and sigh'd again:
At length, with love and wine at once oppress'd,
The vanquish'd victor sunk upon her breast.
Chor. *The prince*, &c.

Now strike the golden lyre again;
A louder yet, and yet a louder strain.
Break his bands of sleep asunder,
And rouse him, like a rattling peal of thunder.
Hark! hark; the horrid sound,
Has rais'd up his head,
As awake from the dead,
And amaz'd he stares around.
Revenge, revenge, Timotheus cries,
See the furies arise:
See the snakes that they rear,
How they hiss in their hair,
And the sparkles that flash from their eyes!
Behold a ghastly band,
Each a torch in his hand!
Those are Grecian ghosts that in battle were slain,
And unbury'd remain,
Inglorious on the plain:
Give the vengeance due
To the valiant crew.
Behold how they toss their torches on high,
How they point to the Persian abodes,
And glitt'ring temples of their hostile gods.
The princes applaud with a furious joy;
And the king seiz'd a flambeau, with zeal to destroy;
Thais led the way
To light him to his prey,
And, like another Helen, she fir'd another Troy.
Chor. *And the king seiz'd*, &c.

Thus long ago,
Ere heaving bellows learnt to blow,
While organs yet were mute;
Timotheus, to his breathing flute,
And sounding lyre,
Could swell the soul of rage, or kindle soft desire.
At last divine Cecilia came,
Inventress of the vocal frame;
The sweet enthusiast, from her sacred store,
Enlarg'd the former narrow bounds,
And added length to solemn sounds,
With nature's mother-wit, and arts unknown before.
Let old Timotheus yield the prize,
Or both divide the crown:
He rais'd a mortal to the skies;
She drew an angel down.
Grand chor. *At last*, &c.

There is another poem by Dryden, on the death of Mrs Anne Killegrew, a young lady eminent for her skill in poetry and painting, which a great critic * has pronounced to be "undoubtedly the noblest ode that our language has ever produced." He owns, that as a whole it may perhaps be inferior to *Alexander's Feast;* but he affirms that the first stanza of it is superior to any single part of the other. This famous stanza, he says, flows with a torrent of enthusiasm: *Fervet immensusque ruit.* How far this criticism is just, the public must determine.

* Dr Johnson.

I.

Thou youngest virgin-daughter of the skies,
Made in the last promotion of the bless'd;
Whose palms, new-pluck'd from Paradise,
In spreading branches more sublimely rise,
Rich with immortal green above the rest;
Whether, adopted to some neighb'ring star,
Thou roll'st above us, in thy wand'ring race,
Or in procession fix'd and regular,
Mov'd with the heav'n's majestic pace;
Or call'd to more superior bliss,
Thou tread'st with seraphims the vast abyss:
Whatever happy region is thy place,
Cease thy celestial song a little space;
Thou wilt have time enough for hymns divine,
Since heaven's eternal year is thine.
Hear then a mortal muse thy praise rehearse
In no ignoble verse;
But such as thy own voice did practise here,
When thy first fruits of poesy were giv'n
To make thyself a welcome inmate there,
While yet a young probationer,
And candidate of heav'n.

II.

If by traduction came thy mind,
Our wonder is the less to find
A soul so charming from a stock so good;
Thy father was transfus'd into thy blood,
So wert thou born into a tuneful strain,
An early, rich, and inexhausted vein.
But if thy pre-existing soul
Was form'd at first with myriads more,
It did through all the mighty poets roll,
Who Greek or Latin laurels wore,
And was that Sappho last which once it was before.
If so, then cease thy flight, O heaven-born mind!
Thou hast no dross to purge from thy rich ore,
Nor can thy soul a fairer mansion find,
Than was the beauteous frame she left behind:
Return to fill or mend the choir of thy celestial kind.

III.

May we presume to say, that, at thy birth,
New joy was sprung in heav'n, as well as here on earth?
For sure the milder planets did combine
On thy auspicious horoscope to shine,
And e'en the most malicious were in trine.
Thy brother angels at thy birth
Strung each his lyre, and tun'd it high,
That all the people of the sky
Might know a poetess was born on earth.
And then, if ever, mortal ears
Had heard the music of the spheres.
And if no clust'ring swarm of bees
On thy sweet mouth distill'd their golden dew,
'Twas that such vulgar miracles
Heav'n had not leisure to renew:
For all thy bless'd fraternity of love
Solemniz'd there thy birth, and kept thy holy day above.

IV.

O gracious God! how far have we
Profan'd thy heav'nly gift of poesy?
Made prostitute and profligate the Muse,
Debas'd to each obscene and impious use,
Whose harmony was first ordain'd above
For tongues of angels, and for hymns of love?
O wretched me! why were we hurry'd down
This lubrique and adult'rate age,

(Nay

(Nay added fat pollutions of our own)
T'increase the streaming ordures of the stage!
What can we say t'excuse our second fall?
Let this thy vestal, Heaven, atone for all:
Her Arethusian stream remains unsoil'd,
Unmix'd with foreign filth, and undefil'd;
Her wit was more than man, her innocence a child.

V.

Art she had none, yet wanted none;
For nature did that want supply:
So rich in treasure of her own,
She might our boasted stores defy:
Such noble vigour did her verse adorn,
That it seem'd borrow'd where 'twas only born.
Her morals, too, were in her bosom bred,
By great examples daily fed,
What in the best of books, her father's life, she read.
And to be read herself, she need not fear;
Each test, and every light, her Muse will bear,
Tho' Epictetus with his lamp were there.
Even love (for love sometimes her Muse express'd)
Was but a lambent flame which play'd about her breast,
Light as the vapours of a morning dream,
So cold herself, while she such warmth express'd,
'Twas Cupid bathing in Diana's stream.

VI.

Born to the spacious empire of the Nine,
One would have thought she should have been content
To manage well that mighty government;
But what can young ambitious souls confine?
To the next realm she stretch'd her sway,
For *Painture* near adjoining lay,
A plenteous province and alluring prey.
A *Chamber of Dependencies* was fram'd.
(As conquerors will never want pretence,
When arm'd, to justify th' offence)
And the whole fief, in right of poetry, she claim'd.
The country open lay without defence:
For poets frequent inroads there had made,
And perfectly could represent
The shape, the face, with ev'ry lineament,
And all the large domains which the *dumb sister* sway'd.
All bow'd beneath her government,
Receiv'd in triumph wheresoe'er she went.
Her pencil drew whate'er her soul design'd,
And oft the happy draught surpass'd the image in her mind.
The sylvan scenes of herds and flocks,
And fruitful plains and barren rocks,
Of shallow brooks that flow'd so clear,
The bottom did the top appear;
Of deeper, too, and ampler floods,
Which, as in mirrors, show'd the woods:
Of lofty trees, with sacred shades,
And perspectives of pleasant glades,
Where nymphs of brightest form appear,
And shaggy satyrs standing near,
Which them at once admire and fear.
The ruins too of some majestic piece,
Boasting the power of ancient Rome or Greece,
Whose statues, friezes, columns, broken lie,
And, though defac'd, the wonder of the eye;
What nature, art, bold fiction, e'er durst frame,
Her forming hand gave feature to the name.
So strange a concourse ne'er was seen before,
But when the peopl'd ark the whole creation bore.

VII.

The scene then chang'd, with bold erected look
Our martial king the sight with rev'rence struck:
For not content t'express his outward part,
Her hand call'd out the image of his heart:
His warlike mind, his soul devoid of fear,
His high-designing thoughts were figur'd there,
As when, by magic, ghosts are made appear.
Our phœnix queen was pourtray'd too so bright,
Beauty alone could beauty take so right:
Her dress, her shape, her matchless grace,
Were all observ'd, as well as heav'nly face.
With such a peerless majesty she stands,
As in that day she took the crown from sacred hands;
Before a train of heroines was seen,
In beauty foremost, as in rank, the queen.
Thus nothing to her genius was denied,
But like a ball of fire the further thrown,
Still with a greater blaze she shone,
And her bright soul broke out on ev'ry side.
What next she had design'd, Heaven only knows:
To such immod'rate growth her conquest rose,
That fate alone its progress could oppose.

VIII.

Now all those charms, that blooming grace,
The well-proportion'd shape, and beauteous face,
Shall never more be seen by mortal eyes;
In earth the much lamented virgin lies.
Nor wit nor piety could fate prevent;
Nor was the cruel *Destiny* content
To finish all the murder at a blow,
To sweep at once her life and beauty too;
But like a harden'd felon, took a pride
To work more mischievously slow,
And plunder'd first, and then destroy'd.
O double sacrilege on things divine,
To rob the relick, and deface the shrine!
But thus Orinda died:
Heav'n, by the same disease, did both translate;
As equal were their souls, so equal was their fate.

IX.

Meantime her warlike brother on the seas
His waving streamers to the winds displays,
And vows for his return, with vain devotion, pays.
Ah generous youth! that wish forbear,
The winds too soon will waft thee here!
Slack all thy sails, and fear to come,
Alas, thou know't not, thou art wreck'd at home!
No more shalt thou behold thy sister's face,
Thou hast already had her last embrace.
But look aloft, and if thou kenn'st from far,
Among the Pleiads a new kindled star,
If any sparkles than the rest more bright,
'Tis she that shines in that propitious light.

X.

When in mid-air the golden trump shall sound,
To raise the nations under ground;
When in the valley of Jehoshaphat,
The judging God shall close the book of fate;
And there the last *assises* keep
For those who wake and those who sleep:
When rattling bones together fly
From the four corners of the sky;
When sinews o'er the skeletons are spread,
Those cloth'd with flesh, and life inspires the dead;

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The sacred poets first shall hear the sound,
And foremost from the tomb shall bound,
For they are cover'd with the lightest ground;
And straight with in-born vigour, on the wing,
Like mounting larks to the new morning sing.
There thou, sweet saint, before the quire shalt go
As harbinger of heav'n, the way to show,
The way which thou so well hast learnt below.

That this is a fine ode, and not unworthy of the genius of Dryden, must be acknowledged; but that it is the noblest which the English language has produced, or that any part of it runs with the torrent of enthusiasm which characterizes *Alexander's Feast*, are positions which we feel not ourselves inclined to admit. Had the critic by whom it is so highly praised, inspected it with the eye which scanned the odes of Gray, we cannot help thinking that he would have perceived some parts of it to be tediously minute in description, and others not very perspicuous at the first perusal. It may perhaps, upon the whole, rank as high as the following ode by Collins on the Popular Superstitions of the Highlands of Scotland; but to a higher place it has surely no claim.

I.

HOME, thou return'st from Thames, whose Naiads long
Have seen thee ling'ring with a fond delay,
Mid those soft friends, whose heart some future day,
Shall melt, perhaps, to hear thy tragic song,
Go, not unmindful of that cordial youth (G)
Whom, long endear'd, thou leav'st by Lavant's side;
Together let us wish him lasting truth,
And joy untainted with his destin'd bride.
Go! nor regardless, while these numbers boast
My short-liv'd bliss, forget my social name;
But think, far off, how, on the southern coast,
I met thy friendship with an equal flame!
Fresh to that soil thou turn'st, *where* * ev'ry vale
Shall prompt the poet, and his song demand:
To thee thy copious subjects ne'er shall fail;
Thou need'st but take thy pencil to thy hand,
And paint what all believe who own thy genial land.

* whose.

II.

There must thou wake perforce thy Doric quill;
'Tis fancy's land to which thou sett'st thy feet;
Where still, 'tis said, the Fairy people meet,
Beneath each birken shade, on mead or hill.
There, each trim lass, that skims the milky store,
To the swart tribes their creamy bowl allots;
By night they sip it round the cottage-door,
While airy minstrels warble jocund notes.
There, ev'ry herd, by sad experience, knows,
How, wing'd with Fate, their elf-shot arrows fly,
When the sick ewe her summer food foregoes,
Or, stretch'd on earth, the heart-smit heifers lie.
Such airy beings awe th' untutor'd swain:
Nor thou, tho' learn'd, his homelier thoughts neglect:
Let thy sweet Muse the rural faith sustain;
These are the themes of simple, sure effect,
That add new conquests to her boundless reign,
And fill, with double force, her heart-commanding [strain.

III.

Ev'n yet preserv'd, how often may'st thou hear,
Where to the pole the Boreal mountains run,
Taught by the father to his list'ning son,
Strange lays, whose pow'r had charm'd a Spenser's ear.
At every pause, before thy mind possest,
Old Runic bards shall seem to rise around,
With uncouth lyres in many-colour'd vest,
Their matted hair with boughs fantastic crown'd:
Whether thou bidd'st the well-taught hind repeat
The choral dirge that mourns some chieftain brave,
When ev'ry shrieking maid her bosom beat,
And strew'd with choicest herbs his scented grave;
Or whether sitting in the shepherd's shiel (H),
Thou hear'st some sounding tale of war's alarms,
When, at the bugle's call, with fire and steel,
The sturdy clans pour'd forth their *brawny* * swarms,
And hostile brothers met to prove each other's arms.

* bony.

IV.

'Tis thine to sing how framing hideous spells,
In Sky's lone isle the gifted wizzard-*seer* †,
Lodg'd in the wintry cave with Fate's fell spear (I),
Or in the depths of Uist's dark forest dwells:
How they whose sight such dreary dreams engross,
With their own visions oft astonish'd droop,
When, o'er the wat'ry strath, or quaggy moss,
They see the gliding ghosts *unbodied* ‡ troop.
Or, if in sports, or on the festive green,
Their *destin'd* § glance some fated youth descry,
Who now, perhaps, in lusty vigour seen,
And rosy health, shall soon lamented die.
For them the viewless forms of air obey;
Their bidding heed, and at their beck repair.
They know what spirit brews the stormful day,
And heartless, oft like moody madness, stare
To see the phantom train their secret work prepare.

† sitter.
‡ embodied.
§ piercing.

V.

To monarchs dear (K), some hundred miles astray,
Oft have they seen Fate give the fatal blow!
The seer in Sky shriek'd as the blood did flow
When headless Charles warm on the scaffold lay!

As

(G) A gentleman of the name of *Barrow*, who introduced Home to Collins.

(H) A summer hut, built in the high part of the mountains, to tend their flocks in the warm season, when the pasture is fine.

(I) Waiting in wintery cave his wayward fits.

(K) Of this beautiful ode two copies have been printed: one by Dr Carlyle, from a manuscript which he acknowledges to be mutilated; another by an editor who seems to hope that a nameless somebody will be believed, when he declares, that "he discovered a *perfect copy* of this admirable ode among some old papers in the concealed drawers of a bureau left him by a relation." The present age has been already too much amused with pretended discoveries of poems in the bottoms of *old chests*, to pay full credit to an assertion of this kind, even though the scene of discovery be laid in a *bureau*. As the ode of the anonymous editor differs, however, very little from that of Dr Carlyle, and as what is affirmed by a GENTLEMAN *may* be true, though "he chooses not at present

Of Lyric Poetry.

As Boreas threw his young Aurora (L) forth,
In the first year of the first George's reign,
And battles rag'd in welkin of the North,
They mourn'd in air, fell, fell rebellion, slain!
And as of late they joy'd in Preston's fight,
Saw at sad Falkirk all their hopes near crown'd!
They rav'd divining through their second-sight (M),
Pale, red Culloden, where these hopes were drown'd!
Illustrious William (N)! Britain's guardian name!
One William sav'd us from a tyrant's stroke;
He, for a sceptre, gain'd heroic fame,
But thou, more glorious, Slavery's chain hast broke,
To reign a private man, and bow to Freedom's yoke!

VI.

These, too, thou'lt sing! for well thy magic muse
Can to the topmost heav'n of grandeur soar!
Or stoop to wail the swain that is no more!
Ah, homely swains! your homeward steps ne'er lose;
Let not dank *Will* (O) mislead you to the heath:
Dancing in mirky night, o'er fen and lake,
He glows, to draw you downward to your death,
In his bewitch'd, low, marshy, willow brake!
What though far off, from some dark dell espied,
His glimm'ring mazes cheer th' excursive sight,
Yet turn, ye wand'rers, turn your steps aside,
Nor trust the guidance of that faithless light;
For watchful, lurking, 'mid th' unrustling reed,
At those mirk hours the wily monster lies,
And listens oft to hear the passing steed,
And frequent round him rolls his sullen eyes,
If chance his savage wrath may some weak wretch surprise.

VII.

Ah, luckless swain, o'er all unblest, indeed!
Whom late bewilder'd in the dank, dark fen,
Far from his flocks, and smoking hamlet, then!
To that dark spot ** where hums the sedgy weed.*

* his wayward fate shall lead.

On him, enrag'd, the fiend, in angry mood,
Shall never look with pity's kind concern,
But instant, furious, raise the whelming flood
O'er its drown'd banks, forbidding all return!
Or, if he meditate his wish'd escape,
To some dim hill that seems uprising near,
To his faint eye, the grim and grisly shape,
In all its terrors clad, shall wild appear.
Meantime the wat'ry surge shall round him rise,
Pour'd sudden forth from ev'ry swelling source!
What now remains but tears and hopeless sighs?
His fear-shook limbs have lost their youthly force,
And down the waves he floats, a pale and breathless corse!

VIII.

For him in vain his anxious wife shall wait,
Or wander forth to meet him on his way;
For him in vain, at to-fall of the day,
His babes shall linger at th' unclosing gate!
Ah, ne'er shall he return! Alone, if night
Her travell'd limbs in broken slumbers steep!
With drooping willows drest, his mournful sprite
Shall visit sad, perchance, her silent sleep:
Then he, perhaps, with moist and wat'ry hand,
Shall fondly seem to press her shudd'ring cheek,
And with his blue-swoln face before her stand,
And, shiv'ring cold, these piteous accents speak:
"Pursue, dear wife, thy daily toils pursue,
"At dawn or dusk, industrious as before;
"Nor e'er of me one ** helpless* thought renew,
"While I lie welt'ring on the ozier'd shore,
"Drown'd by the kelpie's† wrath, nor e'er shall aid thee more!"

* hapless.
† the water fiend.

IX.

Unbounded is thy range; with varied *skill* ‡
Thy muse may, like those feath'ry tribes which spring
From their rude rocks, extend her skirting wing
Round the moist marge of each cold Hebrid isle,
To-

‡ style.

---

present to publish his name," we have inserted into our work the copy which pretends to be perfect, nothing at the bottom or margin of the page the different readings of Dr Carlyle's edition. In the Doctor's manuscript, which appeared to have been nothing more than the *prima cura*, or first sketch of the poem, the fifth stanza and half of the sixth were wanting; and to give a continued context, he prevailed with Mr M'Kenzie, the ingenious author of the *Man of Feeling*, to fill up the chasm. This he did by the following beautiful lines, which we cannot help thinking much more happy than those which occupy their place in the copy said to be perfect:

"Or on some bellying rock that shades the deep,
They view the lurid signs that cross the sky,
Where in the west the brooding tempests lie;
And hear their first, faint, rustling pennons sweep.
Or in the arched cave, where deep and dark
The broad unbroken billows heave and swell,
In horrid musings wrapt, they sit to mark
The lab'ring moon; or list the nightly yell
Of that dread spirit, whose gigantic form
The seer's entranced eye can well survey,
Through the dim air who guides the driving storm,
And points the wretched bark its destin'd prey.
Or him who hovers on his flagging wing,
O'er the dire whirlpool, that in ocean's waste,
Draws instant down whate'er devoted thing
The falling breeze within its reach hath plac'd——
The distant seaman hears, and flies with trembling haste.

Or if on land the fiend exerts his sway,
Silent he broods o'er quicksand, bog, or fen,
Far from the shelt'ring roof and haunts of men,
When witched darkness shuts the eye of day,
And shrouds each star that wont to cheer the night;
Or if the drifted snow perplex the way,
With treach'rous gleam he lures the fated wight
And leads him flound'ring on and quite astray."

(L) By young Aurora, Collins undoubtedly meant the first appearance of the northern lights, which is commonly said to have happened about the year 1715.

(M) Second-sight is the term that is used for the divination of the Highlanders.

(N) The late duke of Cumberland, who defeated the Pretender at the battle of Culloden.

(O) A fiery meteor, called by various names, such as *Will with the Wisp*, *Jack with the Lanthorn*, &c. It hovers in the air over marshy and fenny places.

To that hoar pile (P) which still its ruin shows:
In whose small vaults a pigmy-folk is found,
Whose bones the delver with his spade upthrows,
And culls them, wond'ring, from the hallow'd ground!
Or, thither (Q), where beneath the show'ry west,
The mighty kings of three fair realms are laid:
Once foes, perhaps, together now they rest,
No slaves revere them, and no wars invade:
Yet frequent now, at midnight solemn hour,
The rifted mounds their yawning cells unfold,
And forth the monarchs stalk with sov'reign pow'r
In pageant robes; and, wreath'd with sheeny gold,
And on their twilight tombs aerial council hold.

X.

But, oh! o'er all, forget not Kilda's race,
On whose bleak rocks, which brave the wasting tides,
Fair Nature's daughter, Virtue, yet abides.
Go! just as they, their blameless manners trace!
Then to my ear transmit some gentle song,
Of those whose lives are yet sincere and plain,
Their bounded walks the rugged cliffs along,
And all their prospect but the wintry main.
With sparing temp'rance at the needful time,
They drain the scented spring; or, hunger-prest,
Along th' Atlantic rock, undreading, climb,
And of its eggs despoil the solan's nest *.
Thus, blest in primal innocence, they live,
Suffic'd, and happy with that frugal fare
Which tasteful toil and hourly danger give.
Hard is their shallow soil, and bleak and bare;
Nor ever vernal bee was heard to murmur there!

* See *Bird-catching*, p. 237. and *Pelicanus*, N° 3.

XI.

Nor need'st thou blush that such false themes engage
Thy gentle mind, of fairer stores possest;
For not alone they touch the village breast,
But fill'd in elder time th' historic page.
There, Shakespeare's self, with every garland crown'd,
Flew to those fiery climes his fancy sheen (R),
In musing hour; his wayward sisters found,
And with their terrors dress'd the magic scene.
From them he sung, when, 'mid his bold design,
Before the Scot, afflicted, and aghast!
The shadowy kings of Banquo's fated line,
Thro' the dark cave in gleamy pageant pass'd.
Proceed! nor quit the tales, which, simply told,
Could once so well my answ'ring bosom pierce;
Proceed, in forceful sounds, and colours bold,
The native legends of thy land rehearse;
To such adapt thy lyre, and suit thy pow'rful verse.

XII.

In scenes like these, which, daring to depart
From sober truth, are still to nature true,
And call forth fresh delight to fancy's view,
Th' heroic muse employ'd her Tasso's art!
How have I trembl'd, when, at Tancred's stroke,
Its gushing blood the gaping cypress pour'd,
When each live plant with mortal accents spoke,
And the wild blast upheav'd the vanish'd sword!
How have I sat, when pip'd the pensive wind,
To hear his harp by British Fairfax strung!
Prevailing poet! whose undoubting mind,
Believ'd the magic wonders which he sung!
Hence, at each sound, imagination glows!
Hence, at each picture, vivid life starts here! (S)
Hence his warm lay with softest sweetness flows!
Melting it flows, pure, *murm'ring* *, strong, and clear,
And fills the impassion'd heart, and wins th' harmonious [ear.

* numerous.

XIII.

All hail, ye scenes that o'er my soul prevail!
Ye *splendid* † friths and lakes, which, far away,
Are by smooth Annan ‡ fill'd, or past'ral Tay ‡,
Or Don's romantic springs, at distance, hail!
The time shall come, when I, perhaps, may tread
Your lowly *glens* *, o'erhung with spreading broom;
Or o'er your stretching heaths, by fancy led,
Or o'er your mountains creep, in awful gloom! (T)
Then will I dress once more the faded bow'r,
Where Jonson (U) sat in Drummond's *classic* † shade;
Or crop, from Tiviotdale, each lyric flow'r,
And mourn, on Yarrow's banks, *where Willy's laid* ‡!
Meantime, ye pow'rs that on the plains which bore
The cordial youth, on Lothian's plains (X), attend!
Where'er HOME *dwells* §, on hill, or lowly moor,
To him I *loose* ||, your kind protection lend,
And, touch'd with love like mine, preserve my absent friend!

† spacious. ‡ Three rivers in Scotland.
* valleys.
† social.
‡ the widowed maid!
§ he dwell.
|| lose.

Dr Johnson, in his life of Collins, informs us, that Dr Warton and his brother, who had seen this ode in the author's possession, thought it superior to his other works. The taste of the Wartons will hardly be questioned: but we are not sure that the following *Ode to the Passions* has much less merit, though it be merit of a different kind, than the Ode on the Superstitions of the Highlands:

WHEN Music, heav'nly maid, was young,
While yet in early Greece she sung,
The Passions oft, to hear her shell,
Throng'd around her magic cell,
Exulting, trembling, raging, fainting,
Possest beyond the Muse's painting;
By turns they felt the glowing mind
Disturb'd, delighted, rais'd, refin'd.
Till once, 'tis said, when all were fir'd,
Fill'd with fury, rapt, inspir'd,
From the supporting myrtles round
They snatch'd her instruments of sound:

And

(P) One of the Hebrides is called the *Isle of Pigmies*, where it is reported, that several miniature bones of the human species have been dug up in the ruins of a chapel there.

(Q) Icolmkill, one of the Hebrides, where many of the ancient Scottish, Irish, and Norwegian kings, are said to be interred.

(R) This line wanting in Dr Carlyle's edition.

(S) This line wanting in Dr Carlyle's edition.

(T) This line wanting in Dr Carlyle's edition.

(U) Ben Jonson paid a visit on foot in 1619 to the Scotch poet Drummond, at his seat of Hawthornden, within seven miles of Edinburgh.

(X) Barrow, it seems, was at the university of Edinburgh, which is in the county of Lothian.

And as they oft had heard apart
Sweet lessons of her forceful art,
Each, for madness rul'd the hour,
Would prove his own expressive power.

First Fear his hand, its skill to try,
Amid the chords bewilder'd laid,
And back recoil'd, he knew not why,
Ev'n at the sound himself had made.

Next Anger rush'd; his eyes on fire,
In lightnings own'd his secret stings;
In one rude clash he struck the lyre,
And swept with hurried hand the strings.

With woeful measures wan Despair—
Low sullen sounds his grief beguil'd;
A solemn, strange, and mingled air;
'Twas sad by fits, by starts 'twas wild.

But thou, O Hope! with eyes so fair,
What was thy delighted measure?
Still it whisper'd promis'd pleasure,
And bade the lovely scenes at distance hail!—
Still would her touch the strain prolong,
And from the rocks, the woods, the vale,
She call'd on Echo still through all her song;
And where her sweetest theme she chose,
A soft responsive voice was heard at every close,
And Hope enchanted smil'd, and wav'd her golden hair.

And longer had she sung;—but, with a frown,
Revenge impatient rose;
He threw his blood-stain'd sword in thunder down,
And, with a withering look,
The war-denouncing trumpet took,
And blew a blast so loud and dread,
Were ne'er prophetic sounds so full of woe.
And ever and anon he beat
The doubling drum with furious heat;
And though sometimes, each dreary pause between,
Dejected Pity at his side
Her soul-subduing voice applied,
Yet still he kept his wild unalter'd mien,
While each strain'd ball of sight seem'd bursting from his head.

Thy numbers, Jealousy, to nought were fix'd,
Sad proof of thy distressful state;
Of differing themes the veering song was mix'd;
And now it courted Love, now raving call'd on Hate.

With eyes up-rais'd, as one inspir'd,
Pale Melancholy sat retir'd,
And from her wild sequester'd seat,
In notes by distance made more sweet,
Pour'd through the mellow horn her pensive soul,
And dashing soft from rocks around,
Bubbling runnels join'd the sound;
Through glades and glooms the mingled measure stole,
Or o'er some haunted streams with fond delay,
Round an holy calm diffusing,
Love of peace, and lonely musing,
In hollow murmurs died away.

But O! how alter'd was its sprightlier tone!
When Cheerfulness, a nymph of healthiest hue,
Her bow across her shoulder flung,
Her buskins gemm'd with morning dew,
Blew an inspiring air, that dale and thicket rung,
The hunter's call to Faun and Dryad known;
The oak-crown'd sisters, and their chaste-ey'd queen,
Satyrs and sylvan boys were seen,
Peeping from forth their alleys green;
Brown Exercise rejoic'd to hear,
And Sport leapt up, and seiz'd his beechen spear.

Last came Joy's ecstatic trial;
He, with viny crown advancing,
First to the lively pipe his hand addrest,
But soon he saw the brisk awak'ning viol,
Whose sweet entrancing voice he lov'd the best.
They would have thought who heard the strain,
They saw in Tempe's vale her native maids,
Amidst the festal sounding shades,
To some unwearied minstrel dancing,
While, as his flying fingers kiss'd the strings,
Love fram'd with Mirth a gay fantastic round:
Loose were her tresses seen, her zone unbound:
And he amidst his frolic play,
As if he would the charming air repay,
Shook thousand odours from his dewy wings.

O music! sphere-descended maid,
Friend of pleasure, wisdom's aid,
Why, Goddess, why to us denied?
Lay'st thou thy ancient lyre aside?
As in that lov'd Athenian bower,
You learn'd an all-commanding power:
Thy mimic soul, O nymph endear'd,
Can well recal what then it heard.
Where is thy native simple heart,
Devote to virtue, fancy, art?
Arise, as in that elder time,
Warm, energic, chaste, sublime!
Thy wonders, in that god-like age,
Fill thy recording sister's page—
'Tis said, and I believe the tale,
Thy humblest reed could more prevail,
Had more of strength, diviner rage,
Than all which charms this laggard age;
Ev'n all at once together found
Cæcilia's mingled world of sound—
O! bid our vain endeavours cease,
Revive the just designs of Greece,
Return in all thy simple state!
Confirm the tales her sons relate.

We shall conclude this section, and these examples, with Gray's *Progress of Poesy*, which, in spite of the severity of Johnson's criticism, certainly ranks high among the odes which pretend to sublimity. The first stanza, when examined by the frigid rules of grammatical criticism, is certainly not faultless: but its faults will be overlooked by every reader who has any portion of the author's fervour:

I. 1.

Awake, Æolian lyre, awake,
And give to rapture all thy trembling strings:
From Helicon's harmonious springs
A thousand rills their mazy progress take;
The laughing flowers, that round them blow,
Drink life and fragrance as they flow.
Now the rich stream of music winds along,
Deep, majestic, smooth, and strong,

Thro'

Thro' verdant vales, and Ceres' golden reign:
Now rolling down the steep amain,
Headlong, impetuous, see it pour:
The rocks and nodding groves rebellow to the roar.

I. 2.

Oh! Sovereign of the willing soul,
Parent of sweet and solemn-breathing airs,
Enchanting shell! the sullen cares,
And frantic passions, hear thy soft controul.
On Thracia's hills the lord of war
Has curb'd the fury of his car,
And dropp'd his thirsty lance at thy command.
Perching on the sceptred hand
Of Jove, thy magic lulls the feather'd king
With ruffled plumes, and flagging wing;
Quench'd in dark clouds of slumber lie
The terror of his beak, and lightnings of his eye.

I. 3.

Thee the voice, the dance, obey,
Temper'd to thy warbled lay:
O'er Idalia's velvet green
The rosy-crowned loves are seen.
On Cytherea's day,
With antic sports, and blue-ey'd pleasures,
Frisking light in frolic measures;
Now pursuing, now retreating,
Now in circling troops they meet;
To brisk notes, in cadence beating,
Glance their many twinkling feet.
Slow melting strains their queen's approach declare:
Where'er she turns, the Graces homage pay.
With arms sublime that float upon the air,
In gliding state she wins her easy way:
O'er her warm cheek, and rising bosom, move
The bloom of young desire, and purple light of love.

II. 1.

Man's feeble race what ills await:
Labour, and penury, the racks of pain,
Disease, and sorrow's weeping train,
And death, sad refuge from the storms of fate!
The fond complaint, my song, disprove,
And justify the laws of Jove.
Say, has he giv'n in vain the heav'nly muse?
Night, and all her sickly dews,
Her spectres wan, and birds of boding cry,
He gives to range the dreary sky;
Till down the eastern cliffs afar,
Hyperion's march they spy, and glitt'ring shafts of war.

II. 2.

In climes beyond the solar road,
Where shaggy forms o'er ice-built mountains roam,
The Muse has broke the twilight-gloom,
To cheer the shiv'ring native's dull abode.
And oft, beneath the od'rous shade
Of Chili's boundless forests laid,
She deigns to hear the savage youth repeat,
In loose numbers wildly sweet,
Their feather-cinctur'd chiefs, and dusky loves.
Her track, where'er the goddess roves,
Glory pursue, and gen'rous shame,
Th' unconquerable mind, and freedom's holy flame.

II. 3.

Woods, that wave o'er Delphi's steep,
Isles, that crown the Ægean deep,
Fields, that cool Ilissus laves,
Or where Mæander's amber waves
In ling'ring lab'rinths creep,
How do your tuneful echoes languish,
Mute, but to the voice of anguish!
Where each old poetic mountain
Inspiration breath'd around:
Ev'ry shade and hallow'd fountain
Murmur'd deep a solemn sound:
Till the sad nine, in Greece's evil hour,
Left their Parnassus for the Latian plains.
Alike they scorn the pomp of tyrant power,
And coward vice that revels in her chains.
When Latium had her lofty spirit lost,
They sought, oh Albion! next thy sea encircled coast.

III. 1.

Far from the sun, and summer-gale,
In thy green lap was nature's * darling laid,
What time, where lucid Avon stray'd,
To him the mighty mother did unveil
Her awful face: the dauntless child
Stretch'd forth his little arms, and smil'd.
This pencil take (she said) whose colours clear
Richly paint the vernal year:
Thine too these golden keys, immortal boy!
This can unlock the gates of joy;
Of horror that, and thrilling fears,
Or ope the sacred source of sympathetic tears.

* Shakespeare.

III. 2.

Nor second he †, that rode sublime
Upon the seraph wings of ecstacy,
The secrets of th' abyss to spy.
He pass'd the flaming bounds of place and time:
The living throne, the sapphire blaze,
Where angels tremble while they gaze,
He saw: but, blasted with excess of light,
Clos'd his eyes in endless night.
Behold, where Dryden's less presumptuous car,
Wide o'er the fields of glory bear
Two coursers of ethereal race,
With necks in thunder cloth'd, and long-resounding pace.

† Milton.

III. 3.

Hark, his hands the lyre explore!
Bright-ey'd fancy, hov'ring o'er,
Scatters from her pictur'd urn
Thoughts that breathe, and words that burn.
But ah! 'tis heard no more—
Oh! Lyre divine, what daring spirit
Wakes thee now! tho' he inherit
Nor the pride, nor ample pinion,
That the Theban eagle bear,
Sailing with supreme dominion
Through the azure deep of air:
Yet oft before his infant eyes would run
Such forms as glitter in the Muse's ray,
With orient hues, unborrow'd of the sun:
Yet shall he mount, and keep his distant way
Beyond the limits of a vulgar fate,
Beneath the good how far—but far above the great.

Sect. III. *Of the Elegy.*

133 The elegy.

The *Elegy* is a *mournful* and *plaintive*, but yet sweet and engaging, kind of poem. It was first invented to bewail

Elegy.

bewail the death of a friend; and afterwards used to express the complaints of lovers, or any other melancholy subject. In process of time, not only matters of grief, but joy, wishes, prayers, expostulations, reproaches, admonitions, and almost every other subject, were admitted into elegy; however, funeral lamentations and affairs of love seem most agreeable to its character, which is gentleness and tenuity.

The plaintive elegy, in mournful state,
Dishevell'd weeps the stern decrees of fate:
Now paints the lover's torments and delights;
Now the nymph flatters, threatens, or invites.
But he, who would these passions well express,
Must more of love than poetry possess.
I hate those lifeless writers whose forc'd fire
In a cold style describes a hot desire;
Who sigh by rule, and, raging in cold blood,
Their sluggish muse spur to an am'rous mood.
Their ecstasies insipidly they feign;
And always pine, and fondly hug their chain;
Adore their prison, and their suff'rings bless;
Make sense and reason quarrel as they please.
'Twas not of old in this affected tone,
That smooth Tibullus made his am'rous moan;
Or tender Ovid, in melodious strains,
Of love's dear art the pleasing rules explains.
You, who in elegy would justly write,
Consult your heart; let that alone endite.
[*From the French of* Despreux.] SOAMES.

134 How to be made.

The plan of an elegy, as indeed of all other poems, ought to be made before a line is written; or else the author will ramble in the dark, and his verses have no dependence on each other. No *epigrammatic points* or conceits, none of those *fine things* which most people are so fond of in every sort of poem, can be allowed in this, but must give place to nobler beauties, those of *nature* and the *passions*. Elegy rejects whatever is facetious, satirical, or majestic, and is content to be plain, decent, and unaffected; yet in this humble state is she sweet and engaging, elegant and attractive. This poem is adorned with frequent *commiserations*, *complaints*, *exclamations*, *addresses to things or persons*, short and proper *digressions*, *allusions*, *comparisons*, *prosopopœias* or feigned persons, and sometimes with short *descriptions*. The diction ought to be made free from any *harshness; neat, easy, perspicuous, expressive of the manners, tender*, and *pathetic;* and the numbers should be *smooth* and *flowing*, and captivate the ear with their uniform sweetness and delicacy.

Of elegies on the subject of death, that by Mr Gray, written in a country churchyard, is one of the best that has appeared in our language, and may be justly esteemed a masterpiece. But being so generally known, it would be superfluous to insert it here.

On the subject of love, we shall give an example from the elegies of Mr Hammond.

Let others boast their heaps of shining gold,
　And view their fields with waving plenty crown'd,
Whom neighb'ring foes in constant terror hold,
　And trumpets break their slumbers, never sound:
While, calmly poor, I trifle life away,
　Enjoy sweet leisure by my cheerful fire,
No wanton hope my quiet shall betray,
　But cheaply bless'd I'll scorn each vain desire.
With timely care I'll sow my little field,
　And plant my orchard with its master's hand;
Nor blush to spread the hay, the hook to wield,
　Or range my sheaves along the sunny land.
If late at dusk, while carelessly I roam,
　I meet a strolling kid or bleating lamb,
Under my arm I'll bring the wand'rer home,
　And not a little chide its thoughtless dam.
What joy to hear the tempest howl in vain,
　And clasp a fearful mistress to my breast?
Or lull'd to slumber by the beating rain,
　Secure and happy sink at last to rest.
Or if the sun in flaming Leo ride,
　By shady rivers indolently stray,
And, with my DELIA walking side by side,
　Hear how they murmur as they glide away;
What joy to wind along the cool retreat,
　To stop and gaze on DELIA as I go!
To mingle sweet discourse with kisses sweet,
　And teach my lovely scholar all I know!
Thus pleas'd at heart, and not with fancy's dream,
　In silent happiness I rest unknown;
Content with what I am, not what I seem,
　I live for DELIA and myself alone.
Ah foolish man! who, thus of her possess'd,
　Could float and wander with ambition's wind,
And, if his outward trappings spoke him blest,
　Not heed the sickness of his conscious mind.
With her I scorn the idle breath of praise,
　Nor trust to happiness that's not our own;
The smile of fortune might suspicion raise,
　But here I know that I am lov'd alone.
STANHOPE, in wisdom as in wit divine,
　May rise and plead Britannia's glorious cause,
With steady rein his eager wit confine,
　While manly sense the deep attention draws.
Let STANHOPE speak his list'ning country's wrong,
　My humble voice shall please one partial maid;
For her alone I pen my tender song,
　Securely sitting in his friendly shade.
STANHOPE shall come, and grace his rural friend;
　DELIA shall wonder at her noble guest,
With blushing awe the riper fruit commend,
　And for her husband's patron cull the best.
Her's be the care of all my little train,
　While I with tender indolence am blest,
The favourite subject of her gentle reign,
　By love alone distinguish'd from the rest.
For her I'll yoke my oxen to the plough,
　In gloomy forests tend my lonely flock,
For her a goatherd climb the mountain's brow,
　And sleep extended on the naked rock.
Ah! what avails to press the stately bed,
　And far from her 'midst tasteless grandeur weep,
By marble-fountains lay the pensive head,
　And, while they murmur, strive in vain to sleep!
DELIA alone can please and never tire,
　Exceed the paint of thought in true delight;
With her, enjoyment wakens new desire,
　And equal rapture glows thro' every night.
Beauty and worth in her alike contend
　To charm the fancy, and to fix the mind;
In her, my wife, my mistress, and my friend,
　I taste the joys of sense and reason join'd.

Pastoral.

On her I'll gaze when others loves are o'er,
And dying press her with my clay-cold hand——
Thou weepst already, as I were no more,
Nor can that gentle breast the thought withstand.
Oh! when I die, my latest moments spare,
Nor let thy grief with sharper torments kill:
Wound not thy cheeks, nor hurt that flowing hair;
Tho' I am dead, my soul shall love thee still.
Oh quit the room, oh quit the deathful bed,
Or thou wilt die, so tender is thy heart!
Oh leave me, DELIA! ere thou see me dead,
These weeping friends will do thy mournful part.
Let them, extended on the decent bier,
Convey the corse in melancholy state,
Thro' all the village spread the tender tear,
While pitying maids our wond'rous love relate.

SECT. IV. *Of the Pastoral.*

135 The pastoral. THIS poem takes its name from the Latin word *pastor*, a "shepherd;" the subject of it being something in the pastoral or rural life; and the persons, interlocutors, introduced in it, either shepherds or other rustics.

These poems are frequently called *eclogues*, which signifies "select or choice pieces;" though some account for this name in a different manner. They are also called *bucolics*, from Βουκολος, "a herdsman."

136 Why it generally pleases. This kind of poem, when happily executed, gives great delight; nor is it a wonder, since innocence and simplicity generally please: to which let us add, that the scenes of pastorals are usually laid in the country, where both poet and painter have abundant matter for the exercise of genius, such as enchanting prospects, purling streams, shady groves, enamelled meads, flowery lawns, rural amusements, the bleating of flocks, and the music of birds; which is of all melody the most sweet and pleasing, and calls to our mind the wisdom and taste of Alexander, who, on being importuned to hear a man that imitated the notes of the nightingale, and was thought a great curiosity, replied, that *he had had the happiness of hearing the nightingale herself.*

137 Its characters and The character of the pastoral consists in simplicity, brevity, and delicacy; the two first render an eclogue *natural*, and the last *delightful*. With respect to nature, indeed, we are to consider, that as a pastoral is an image of the ancient times of innocence and undesigning plainness, we are not to describe shepherds as they really are at this day, but as they may be conceived then to have been, when the best of men, and even princes, followed the employment. For this reason, an air of piety should run through the whole poem; which is visible in the writings of antiquity.

To make it natural with respect to the present age, some knowledge in rural affairs should be discovered, and that in such a manner as if it was done by chance rather than by design; lest by too much pains to seem natural, that simplicity be destroyed from whence arises the delight; for what is so engaging in this kind of poesy proceeds not so much from the idea of a country life itself, as in exposing only the best part of a shepherd's life, and concealing the misfortunes and miseries which sometimes attend it. Besides, the subject must contain some particular beauty in itself, and each eclogue present a scene or prospect to our view enriched with variety: which variety is in a great measure obtained by frequent comparisons drawn from the most agreeable objects of the country; by interrogations to things inanimate; by short and beautiful digressions; and by elegant turns on the words, which render the numbers more sweet and pleasing. To this let us add, that the connections must be negligent, the narrations and descriptions short, and the periods concise.

Riddles, parables, proverbs, antique phrases, and superstitious fables, are fit materials to be intermixed with this kind of poem. They are here, when properly applied, very ornamental; and the more so, as they give our modern compositions the air of the ancient manner of writing.

The style of the pastoral ought to be humble, yet pure; neat, but not florid; easy, and yet lively: and the numbers should be smooth and flowing. 138 style.

This poem in general should be short, and ought never much to exceed 100 lines; for we are to consider that the ancients made these sort of compositions their amusement, and not their business: but however short they are, every eclogue must contain a plot or fable, which must be simple and one; but yet so managed as to admit of short digressions. Virgil has always observed this.——We shall give the plot or argument of his first pastoral as an example. Melibœus, *an unfortunate shepherd, is introduced with* Tityrus, *one in more fortunate circumstances; the former addresses the complaint of his sufferings and banishment to the latter, who enjoys his flocks and folds in the midst of the public calamity, and therefore expresses his gratitude to the benefactor from whom this favour flowed: but* Melibœus *accuses fortune, civil wars, and bids adieu to his native country.* This is therefore a dialogue.

But we are to observe, that the poet is not always obliged to make his eclogue *allegorical*, and to have real persons represented by the fictitious characters introduced; but is in this respect entirely at his own liberty.

Nor does the nature of the poem require it to be always carried on by way of dialogue; for a shepherd may with propriety sing the praises of his love, complain of her inconstancy, lament her absence, her death, &c. and address himself to groves, hills, rivers, and and such like rural objects, even when alone.

We shall now give an example from each of those authors who have eminently distinguished themselves by this manner of writing, and introduce them in the order of time in which they were written.

Theocritus, who was the father or inventor of this kind of poetry, has been deservedly esteemed by the best critics; and by some, whose judgment we cannot dispute, preferred to all other pastoral writers, with perhaps the single exception of the tender and delicate Gesner. We shall insert his third *idyllium*, not because it is the best, but because it is within our compass. 139 Examples of the pastoral from Theocritus.

To Amaryllis, lovely nymph, I speed,
Meanwhile my goats upon the mountains feed.
O Tityrus, tend them with assiduous care,
Lead them to crystal springs and pastures fair,
And of the ridgling's butting horns beware.
Sweet Amaryllis, have you then forgot
Our secret pleasures in the conscious grott,

Where

Pastoral.

Where in my folding arms you lay reclin'd?
Blest was the shepherd, for the nymph was kind.
I whom you call'd *your Dear*, *your Love*, so late,
Say, am I now the object of your hate?
Say, is my form displeasing to your sight?
This cruel love will surely kill me quite.
Lo! ten large apples, tempting to the view,
Pluck'd from your favourite tree, where late they grew.
Accept this boon, 'tis all my present store;
To-morrow will produce as many more.
Meanwhile these heart-consuming pains remove,
And give me gentle pity for my love.
Oh! was I made by some transforming power
A bee to buzz in your sequester'd bow'r!
To pierce your ivy shade with murmuring sound,
And the light leaves that compass you around.
I know thee, Love, and to my sorrow find,
A god thou art, but of the savage kind;
A lioness sure suckled the fell child,
And with his brothers nurst him in the wild;
On me his scorching flames incessant prey,
Glow in my bones, and melt my soul away.
Ah, nymph, whose eyes destructive glances dart,
Fair is your face, but flinty is your heart:
With kisses kind this rage of love appease;
For me, fond swain! ev'n empty kisses please.
Your scorn distracts me, and will make me tear
The flow'ry crown I wove for you to wear,
Where roses mingle with the ivy-wreath,
And fragrant herbs ambrosial odours breathe.
Ah me! what pangs I feel; and yet the fair
Nor sees my sorrows nor will hear my pray'r.
I'll doff my garments, since I needs must die,
And from yon rock that points its summit high,
Where patient Alpis snares the finny fry,
I'll leap, and, though perchance I rise again,
You'll laugh to see me plunging in the main.
By a prophetic poppy-leaf I found
Your chang'd affection, for it gave no sound,
Though in my hand struck hollow as it lay,
But quickly wither'd like your love away.
An old witch brought sad tidings to my ears,
She who tells fortunes with the sieve and sheers;
For leasing barley in my fields of late,
She told me, I should love, and you should hate!
For you my care a milk-white goat supply'd.
Two wanton kids run frisking at her side;
Which oft the nut-brown maid, Erithacis,
Has begg'd and paid before-hand with a kiss;
And since you thus my ardent passion slight,
Her's they shall be before to-morrow night.
My right eye itches; may it lucky prove,
Perhaps I soon shall see the nymph I love;
Beneath yon pine I'll sing distinct and clear,
Perhaps the fair my tender notes shall hear;
Perhaps may pity my melodious moan;
She is not metamorphos'd into stone.
Hippomenes, provok'd by noble strife,
To win a mistress, or to lose his life,
Threw golden fruit in Atalanta's way:
The bright temptation caus'd the nymph to stay;
She look'd, she languish'd, all her soul took fire,
She plung'd into the gulf of deep desire.
To Pyle from Othrys sage Melampus came,
He drove the lowing herd, yet won the dame;
Fair Pero blest his brother Bias' arms,
And in a virtuous race diffus'd unfading charms.
Adonis fed his cattle on the plain,
And sea-born Venus lov'd the rural swain;
She mourn'd him wounded in the fatal chace,
Nor dead dismiss'd him from her warm embrace.
Though young Endymion was by Cynthia blest,
I envy nothing but his lasting rest.
Jasion slumb'ring on the Cretan plain
Ceres once saw, and blest the happy swain
With pleasures too divine for ears profane.
My head grows giddy, love affects me sore;
Yet you regard not; so I'll sing no more——
Here will I put a period to my care—
Adieu, false nymph, adieu ungrateful fair;
Stretch'd near the grotto, when I've breath'd my last,
My corse will give the wolves a rich repast,
As sweet to them as honey to your taste.

FAWKES.

140 Virgil.

Virgil succeeds Theocritus, from whom he has in some places copied, and always imitated with success. As a specimen of his manner, we shall introduce his first pastoral, which is generally allowed to be the most perfect.

MELIBŒUS and TITYRUS.

Mel. Beneath the shade which beechen boughs diffuse,
You, Tityrus, entertain your sylvan muse.
Round the wide world in banishment we roam,
Forc'd from our pleasing fields and native home;
While stretch'd at ease you sing your happy loves,
And Amaryllis fills the shady groves.
Tit. These blessings, friend, a deity bestow'
For never can I deem him less than god.
The tender firstling of my woolly breed
Shall on his holy altar often bleed.
He gave me kine to graze the flow'ry plain,
And so my pipe renew'd the rural strain.
Mel. I envy not your fortune; but admire,
That while the raging sword and wasteful fire
Destroy the wretched neighbourhood around,
No hostile arms approach your happy ground.
Far diff'rent is my fate; my feeble goats
With pains I drive from their forsaken cotes:
And this you see I scarcely drag along,
Who yeaning on the rocks has left her young,
The hope and promise of my falling fold.
My loss by dire portents the gods foretold;
For, had I not been blind, I might have seen
Yon riven oak, the fairest on the green,
And the hoarse raven on the blasted bough
By croaking from the left presag'd the coming blow.
But tell me, Tityrus, what heav'nly pow'r
Preserv'd your fortunes in that fatal hour?
Tit. Fool that I was, I thought imperial Rome
Like Mantua, where on market-days we come,
And thither drive our tender lambs from home.
So kids and whelps the sires and dams express;
And so the great I measur'd by the less:
But country-towns, compar'd with her, appear
Like shrubs when lofty cypresses are near.
Mel. What great occasion call'd you hence to Rome?
Tit. Freedom, which came at length, tho' slow to come:

Pastoral.

Nor did my search of liberty begin
Till my black hairs were chang'd upon my chin;
Nor Amaryllis would vouchsafe a look,
Till Galatea's meaner bonds I broke.
Till then a helpless, hopeless, homely swain,
I sought not freedom, nor aspir'd to gain:
Tho' many a victim from my folds was bought,
And many a cheese to country markets brought,
Yet all the little that I got I spent,
And still return'd as empty as I went.
Mel. We stood amaz'd to see your mistress mourn,
Unknowing that she pin'd for your return;
We wonder'd why she kept her fruit so long,
For whom so late th' ungather'd apples hung:
But now the wonder ceases, since I see
She kept them only, Tityrus, for thee:
For thee the bubb'ling springs appear'd to mourn,
And whisp'ring pines made vows for thy return.
Tit. What should I do? while here I was enchain'd,
No glimpse of godlike liberty remain'd;
Nor could I hope in any place but there
To find a god so present to my pray'r.
There first the youth of heav'nly birth I view'd,
For whom our monthly victims are renew'd.
He heard my vows, and graciously decreed
My grounds to be restor'd my former flocks to feed.
Mel. O fortunate old man! whose farm remains
For you sufficient, and requites your pains,
Though rushes overspread the neighb'ring plains,
Tho' here the marshy grounds approach your fields,
And there the soil a stony harvest yields.
Your teeming ewes shall no strange meadows try,
Nor fear a rot from tainted company.
Behold yon bord'ring fence of sallow trees
Is fraught with flow'rs, the flow'rs are fraught with bees:
The busy bees, with a soft murm'ring strain,
Invite to gentle sleep the lab'ring swain:
While from the neighb'ring rock with rural songs
The pruner's voice the pleasing dream prolongs;
Stock doves and turtles tell their am'rous pain,
And, from the lofty elms, of love complain.
Tit. Th' inhabitants of seas and skies shall change,
And fish on shore and stags in air shall range,
The banish'd Parthian dwell on Arar's brink,
And the blue German shall the Tigris drink;
Ere I, forsaking gratitude and truth,
Forget the figure of that godlike youth.
Mel. But we must beg our bread in climes unknown,
Beneath the scorching or the freezing zone;
And some to far Oaxis shall be sold,
Or try the Libyan heat or Scythian cold;
The rest among the Britons be confin'd,
A race of men from all the world disjoin'd.
O! must the wretched exiles ever mourn!
Nor after length of rolling years return?
Are we condemn'd by Fate's unjust decree,
No more our houses and our homes to see?
Or shall we mount again the rural throne,
And rule the country, kingdoms once our own?
Did we for these barbarians plant and sow,
On these, on these, our happy fields bestow?
Good heav'n, what dire effects from civil discords flow!
Now let me graft my pears, and prune the vine;
The fruit is theirs, the labour only mine.
Farewel my pastures, my paternal stock!
My fruitful fields and my more fruitful flock!
No more, my goats, shall I behold you climb
The steepy cliffs, or crop the flow'ry thyme;
No more extended in the grot below,
Shall see you browzing on the mountain's brow
The prickly shrubs, and after on the bare
Lean down the deep abyss and hang in air!
No more my sheep shall sip the morning dew;
No more my song shall please the rural crew:
Adieu, my tuneful pipe! and all the world, adieu!
Tit. This night, at least, with me forget your care;
Chesnuts and curds and cream shall be your fare:
The carpet-ground shall be with leaves o'erspread,
And boughs shall weave a cov'ring for your head:
For see yon sunny hill the shade extends,
And curling smoke from cottages ascends.

DRYDEN.

Spenser was the first of our countrymen who acquired any considerable reputation by this method of writing. We shall insert his sixth eclogue, or that for June, which is allegorical, as will be seen by the

ARGUMENT. "Hobbinol, from a description of the pleasures of the place, excites Colin to the enjoyment of them. Colin declares himself incapable of delight by reason of his ill success in love, and his loss of Rosalind, who had treacherously forsaken him for Menalcas another shepherd. By Tityrus (mentioned before in Spenser's second eclogue, and again in the twelfth) is plainly meant Chaucer, whom the author sometimes professed to imitate. In the person of Colin is represented the author himself; and Hobbinol's inviting him to leave the hill country, seems to allude to his leaving the north, where, as is mentioned in his life, he had for some time resided."

Hob. Lo! Colin, here the place, whose pleasant sight
From other shades hath wean'd my wand'ring mind:
Tell me, what wants me here, to work delight?
The simple air, the gentle warbling wind,
So calm, so cool, as nowhere else I find:
The grassy ground with dainty daisies dight,
The bramble-bush, where birds of every kind
To th' water's fall their tunes attemper right.
Col. O! happy Hobbinol, I bless thy state,
That paradise hast found which Adam lost.
Here wander may thy flock early or late,
Withouten dread of wolves to been ytost;
Thy lovely lays here mayst thou freely boast:
But I, unhappy man! whom cruel fate,
And angry gods, pursue from coast to coast,
Can nowhere find to shroud my luckless pate.
Hob. Then if by me thou list advised be,
Forsake the soil that so doth thee bewitch:
Leave me those hills, where harbroughnis to see,
Nor holly bush, nor brere, nor winding ditch;
And to the dales resort, where shepherds rich,
And fruitful flocks been everywhere to see:
Here no night-ravens lodge, more black than pitch,
Nor elvish ghosts, nor ghastly owls do flee.
But friendly fairies met with many graces,
And light-foot nymphs can chace the ling'ring night,
With heydeguies, and trimly trodden traces;
Whilst sisters nine, which dwell on Parnass' height,

Do

Pastoral.

Do make them music, for their more delight;
And Pan himself to kiss their crystal faces,
Will pipe and dance, when Phœbe shineth bright:
Such peerless pleasures have we in these places.
Col. And I whilst youth, and course of careless years,
Did let me walk withouten links of love,
In such delights did joy amongst my peers:
But riper age such pleasures doth reprove,
My fancy eke from former follies move
To strayed steps: for time in passing wears
(As garments doen, which waxen old above)
And draweth new delights with hoary hairs.
Though couth I sing of love, and tune my pipe
Unto my plaintive pleas in verses made:
Though would I seek for queen-apples unripe
To give my Rosalind, and in sommer shade
Dight gawdy girlonds was my common trade,
To crown her golden locks: but years more ripe,
And loss of her, whose love as life I wayde,
Those weary wanton toys away did wipe.
Hob. Colin, to hear thy rhymes and roundelays,
Which thou wert wont on wasteful hills to sing,
I more delight, than lark in sommer days:
Whose echo made the neighbour groves to ring,
And taught the birds, which in the lower spring
Did shroud in shady leaves from sunny rays,
Frame to thy song their cheerful cheriping,
Or hold their peace, for shame of thy sweet lays.
I saw Calliope with muses moe,
Soon as thy oaten pipe began to sound,
Their ivory lutes and tamburins forego,
And from the fountain, where they sate around,
Ren after hastily thy silver sound.
But when they came, where thou thy skill didst show,
They drew aback, as half with shame confound,
Shepherd to see, them in their art outgo.
Col. Of muses, Hobbinol, I con no skill.
For they been daughters of the highest Jove,
And holden scorn of homely shepherds quill:
For sith I heard that Pan with Phœbus strove
Which him to much rebuke and danger drove,
I never list presume to Parnass' hill,
But piping low, in shade of lowly grove,
I play to please myself, albeit ill.
Nought weigh I, who my song doth praise or blame,
Ne strive to win renown, or pass the rest:
With shepherds fits not follow flying fame,
But feed his flocks in fields, where falls him best.
I wot my rimes been rough, and rudely drest;
The fitter they, my careful case to frame:
Enough is me to paint out my unrest,
And pour my piteous plaints out in the same.
The God of shepherds, Tityrus, is dead,
Who taught me homely, as I can, to make:
He, whilst he lived, was the sov'reign head
Of shepherds all, that been with love ytake.
Well couth he wail his woes, and lightly slake
The flames which love within his heart had bred,
And tell us merry tales to keep us wake,
The while our sheep about us safely fed.
Now dead he is, and lieth wrapt in lead,
(O why should death on him such outrage show!)
And all his passing skill with him is fled,
The fame whereof doth daily greater grow.
But if on me some little drops would flow

Of that the spring was in his learned bed,
I soon would learn these woods to wail my woe,
And teach the trees their trickling tears to shed.
Then would my plaints, caus'd of discourtesee,
As messengers of this my painful flight,
Fly to my love, wherever that she be,
And pierce her heart with point of worthy wight;
As she deserves, that wrought so deadly spight.
And thou, Menalcas, that by treachery
Didst underfong my lass to wax so light,
Should'st well be known for such thy villany.
But since I am not, as I wish I were,
Ye gentle shepherds, which your flocks do feed,
Whether on hills or dales, or other where,
Bear witness all of this so wicked deed:
And tell the lass, whose flower is wore a weed,
And faultless faith is turn'd to faithless seere,
That she the truest shepherd's heart made bleed,
That lives on earth, and loved her most dear.
Hob. O! careful Colin, I lament thy case,
Thy tears would make the hardest flint to flow!
Ah! faithless Rosalind, and void of grace,
That art the root of all this rueful woe!
But now is time, I guess, homeward to go;
Then rise, ye blessed flocks, and home apace
Lest night with stealing steps do you foreslo,
And wet your tender lambs that by you trace.

By the following eclogue the reader will perceive that Mr Philips has, in imitation of Spenser, preserved in his pastorals many antiquated words, which, though they are discarded from polite conversation, may naturally be supposed still to have place among the shepherds and other rustics in the country. We have made choice of his second eclogue, because it is brought home to his own business, and contains a complaint against those who had spoken ill of him and his writings. 142 Philips.

THENOT, COLINET.

Th. Is it not Colinet I lonesome see
Leaning with folded arms against the tree?
Or is it age of late bedims my sight?
'Tis Colinet, indeed, in woful plight.
Thy cloudy look, why melting into tears,
Unseemly, now the sky so bright appears?
Why in this mournful manner art thou found,
Unthankful lad, when all things smile around?
Or hear'st not lark and linnet jointly sing,
Their notes blithe-warbling to salute the spring?
Co. Tho' blithe their notes, not so my wayward fate;
Nor lark would sing, nor linnet, in my state.
Each creature, Thenot, to his task is born;
As they to mirth and music, I to mourn.
Waking, at midnight, I my woes renew,
My tears oft mingling with the falling dew.
Th. Small cause, I ween, has lusty youth to plain;
Or who may then the weight of eld sustain,
When every slackening nerve begins to fail,
And the load presseth as our days prevail?
Yet though with years my body downward tend,
As trees beneath their fruit in autumn bend,
Spite of my snowy head and icy veins,
My mind a cheerful temper still retains;
And why should man, mishap what will, repine,
Sour every sweet, and mix with tears his wine?
But tell me then; it may relieve thy woe,
To let a friend thine inward ailment know.

Co.

Pastoral

Co. Idly 'twill waste thee, Thenot, the whole day,
Should'st thou give ear to all my grief can say.
Thine ewes will wander; and the heedless lambs,
In loud complaints, require their absent dams.
Th. See Lightfoot; he shall tend them close: and I,
'Tween whiles, across the plain will glance mine eye.
Co. Where to begin I know not, where to end.
Does there one smiling hour my youth attend?
Though few my days, as well my follies show,
Yet are those days all clouded o'er with wo:
No happy gleam of sunshine doth appear,
My low'ring sky and wint'ry months to cheer.
My piteous plight in yonder naked tree,
Which bears the thunder-scar too plain, I see:
Quite destitute it stands of shelter kind,
The mark of storms, and sport of every wind;
The riven trunk feels not the approach of spring;
Nor birds among the leafless branches sing:
No more, beneath thy shade, shall shepherds throng
With jocund tale, or pipe, or pleasant song.
Ill-fated tree! and more ill-fated I!
From thee, from me, alike the shepherds fly.
Th. Sure thou in hapless hour of time was born,
When blightning mildews spoil the rising corn.
Or blasting winds o'er blossom'd hedge-rows pass,
To kill the promis'd fruits, and scorch the grass,
Or when the moon, by wizard charm'd, foreshows,
Blood-stain'd in foul eclipse, impending woes.
Untimely born, ill luck betides thee still.
Co. And can there, Thenot, be a greater ill?
Th. Nor fox, nor wolf, nor rot among our sheep:
From these good shepherd's care his flock may keep;
Against ill luck, alas! all forecast fails;
Nor toil by day, nor watch by night, avails.
Co. Ah me, the while! ah me, the luckless day!
Ah luckless lad! befits me more to say.
Unhappy hour! when fresh in youthful bud,
I left, Sabrina fair, thy silv'ry flood.
Ah silly I! more silly than my sheep,
Which on thy flow'ry banks I wont to keep.
Sweet are thy banks; oh, when shall I once more
With ravish'd eyes review thine amell'd shore?
When in the crystal of thy waters, scan
Each feature faded, and my colour wan?
When shall I see my hut, the small abode
Myself did raise and cover o'er with sod?
Small though it be, a mean and humble cell,
Yet is there room for peace and me to dwell.
Th. And what inticement charm'd thee far away
From thy lov'd home, and led thy heart astray?
Co. A lewd desire strange lands and swains to know.
Ah me! that ever I should covet woe.
With wand'ring feet unblest, and fond of fame,
I sought I know not what besides a name.
Th. Or, sooth to say, didst thou not hither rome
In search of gains more plenty than at home?
A rolling stone is ever bare of moss;
And, to their cost, green years old proverbs cross.
Co. Small need there was, in random search of gain,
To drive my pining flock athwart the plain
To distant Cam. Fine gain at length, I trow,
To hoard up to myself such deal of woe!
My sheep quite spent through travel and ill fare,
And like their keeper ragged grown and bare.
The damp cold green sward for my nightly bed,
And some slaunt willow's trunk to rest my head.
Hard is to bear of pinching cold the pain;
And hard is want to the unpractis'd swain;
But neither want, nor pinching cold, is hard,
To blasting storms of calumny compar'd:
Unkind as hail it falls; the pelting show'r.
Destroys the tender herb and budding flow'r.
Th. Slander we shepherds count the vilest wrong:
And what wounds sorer than an evil tongue?
Co. Untoward lads, the wanton imps of spite
Make mock of all the ditties I endite.
In vain, O Colinet, thy voice so shrill,
Charms every vale, and gladdens every hill:
In vain thou seek'st the coverings of the grove,
In the cool shade to sing the pains of love:
Sing what thou wilt, ill-nature will prevail;
And every elf hath skill enough to rail.
But yet, though poor and artless be my vein,
Menalcas seems to like my simple strain:
And while that he delighteth in my song,
Which to the good Menalcas doth belong,
Nor night nor day shall my rude music cease;
I ask no more, so I Menalcas please.
Th. Menalcas, lord of these fair fertile plains,
Preserves the sheep, and o'er the shepherds reigns;
For him our yearly wakes and feasts we hold,
And choose the fairest firstlings from the fold;
He, good to all who good deserves, shall give
Thy flock to feed, and thee at ease to live,
Shall curb the malice of unbridled tongues,
And bounteously reward thy rural songs.
Co. First then shall lightsome birds forget to fly,
The briny ocean turn to pastures dry,
And every rapid river cease to flow,
Ere I unmindful of Menalcas grow.
Th. This night thy care with me forget, and fold
Thy flock with mine, to ward th' injurious cold.
New milk, and clouted cream, mild cheese and curd,
With some remaining fruit of last year's hoard,
Shall be our ev'ning fare; and, for the night,
Sweet herbs and moss, which gentle sleep invite:
And now behold the sun's departing ray,
O'er yonder hill, the sign of ebbing day:
With songs the jovial hinds return from plow;
And unyok'd heifers, loitering homeward, low.

Mr Pope's Pastorals next appeared, but in a different dress from those of Spenser or Philips; for he has discarded all antiquated words, drawn his swains more modern and polite, and made his numbers exquisitely harmonious: his eclogues therefore may be called *better poems*, but not better pastorals. We shall insert the eclogue he has inscribed to Mr Wycherly, the beginning of which is in imitation of Virgil's first pastoral. 143 Pope.

Beneath the shade a spreading beech displays,
Hylas and Ægon sung their rural lays:
This mourn'd a faithless, that an absent love,
And Delia's name and Doris fill'd the grove.
Ye Mantuan nymphs, your sacred succour bring;
Hylas and Ægon's rural lays I sing.
Thou, whom the nine with Plautus' wit inspire,
The art of Terence, and Menander's fire:
Whose sense instructs us, and whose humour charms,
Whose judgment sways us, and whose spirit warms! Oh

Pastoral

Oh, skill'd in nature! see the hearts of swains,
Their artless passions, and their tender pains.
Now setting Phœbus shone serenely bright,
And fleecy clouds were streak'd with purple light;
When tuneful Hylas, with melodious moan,
Taught rocks to weep, and made the mountains groan.
Go, gentle gales, and bear my sighs away!
To Delia's ear the tender notes convey.
As some sad turtle his lost love deplores,
And with deep murmurs fills the sounding shores;
Thus, far from Delia, to the winds I mourn,
Alike unheard, unpity'd, and forlorn.
Go, gentle gales, and bear my sighs along!
For her the feather'd quires neglect their song;
For her, the limes their pleasing shades deny;
For her, the lilies hang their head and die.
Ye flow'rs, that droop forsaken by the spring;
Ye birds, that left by summer cease to sing;
Ye trees, that fade when autumn's heats remove;
Say, is not absence death to those who love?
Go, gentle gales, and bear thy sighs away!
Curs'd be the fields that cause my Delia's stay:
Fade ev'ry blossom, wither ev'ry tree,
Die ev'ry flow'r, and perish all but she.
What have I said? where'er my Delia flies,
Let spring attend, and sudden flow'rs arise;
Let opening roses knotted oaks adorn,
And liquid amber drop from ev'ry thorn.
Go, gentle gales, and bear my sighs along!
The birds shall cease to tune their ev'ning song,
The winds to breathe, the waving woods to move,
And streams to murmur ere I cease to love.
Not bubbling fountains to the thirsty swain,
Not balmy sleep to lab'rers faint with pain,
Not show'rs to larks, or sunshine to the bee,
Are half so charming as thy sight to me.
Go, gentle gales, and bear my sighs away!
Come, Delia, come! ah, why this long delay?
Through rocks and caves the name of Delia sounds;
Delia, each cave and echoing rock rebounds.
Ye pow'rs, what pleasing frenzy soothes my mind!
Do lovers dream, or is my Delia kind?
She comes, my Delia comes!—now cease, my lay;
And cease, ye gales, to bear my sighs away!
Next Ægon sung, while Windsor groves admir'd;
Rehearse, ye muses, what yourselves inspir'd.
Resound, ye hills, resound my mournful strain!
Of perjur'd Doris, dying, I complain:
Here where the mountains, less'ning as they rise,
Lose the low vales, and steal into the skies;
While lab'ring oxen, spent with toil and heat,
In their loose traces from the field retreat;
While curling smoke from village-tops are seen,
And the fleet shades glide o'er the dusky green.
Resound, ye hills, resound my mournful lay!
Beneath yon poplar oft we pass'd the day;
Oft on the rind I carv'd her am'rous vows,
While she with garlands hung the bending boughs:
The garlands fade, the boughs are worn away;
So dies her love, and so my hopes decay.
Resound, ye hills, resound my mournful strain!
Now bright Arcturus glads the teeming grain;
Now golden fruits in loaded branches shine,
And grateful clusters swell with floods of wine;
Now blushing berries paint the yellow grove:
Just gods! shall all things yield return but love?
Resound, ye hills, resound my mournful lay!
The shepherds cry, "Thy flocks are left a prey."——
Ah! what avails it me the flocks to keep,
Who lost my heart, while I preserv'd my sheep?
Pan came, and ask'd, what magic caus'd my smart,
Or what ill eyes malignant glances dart?
What eyes but hers, alas! have pow'r to move?
And is there magic but what dwells in love?
Resound, ye hills, resound my mournful strains!
I'll fly from shepherds, flocks, and flow'ry plains.——
From shepherds, flocks, and plains, I may remove,
Forsake mankind, and all the world—but love!
I know thee, Love! wild as the raging main,
More fell than tygers on the Libyan plain:
Thou wert from Ætna's burning entrails torn,
Got by fierce whirlwinds, and in thunder born.
Resound, ye hills, resound my mournful lay!
Farewel, ye woods, adieu the light of day!
One leap from yonder cliff shall end my pains.
No more, ye hills, no more resound my strains!
Thus sung the shepherds till th' approach of night,
The skies yet blushing with departing light,
When falling dews with spangles deck the glade,
And the low sun had lengthen'd ev'ry shade.

144 Gay.

To these pastorals, which are written agreeably to the taste of antiquity, and the rules above prescribed, we shall beg leave to subjoin another that may be called *burlesque pastoral*, wherein the ingenious author, Mr Gay, has ventured to deviate from the beaten road, and described the shepherds and ploughmen of our own time and country, instead of those of the golden age, to which the modern critics confine the pastoral. His six pastorals, which he calls the *Shepherd's Week*, are a beautiful and lively representation of the manners, customs, and notions of our rustics. We shall insert the first of them, intitled *The Squabble*, wherein two clowns try to outdo each other in singing the praises of their sweethearts, leaving it to a third to determine the controversy. The persons named are *Lobbin Clout*, *Cuddy*, and *Cloddipole*.

Lob. Thy younglings, Cuddy, are but just awake;
No throstle shrill the bramble-bush forsake;
No chirping lark the welkin sheen * invokes;
No damsel yet the swelling udder strokes;
O'er yonder hill does scant † the dawn appear;
Then why does Cuddy leave his cott so rear ‡?
Cud. Ah Lobbin Clout! I ween § my plight is guest;
For *he that loves, a stranger is to rest.*
If swains belye not, thou hast proved the smart,
And Blouzalinda's mistress of thy heart.
This rising tear betokeneth well thy mind;
Those arms are folded for thy Blouzalind.
And well, I trow, our piteous plights agree;
Thee Blouzalinda smites, Buxoma me.
Lob. Ah Blouzalind! I love thee more by half,
Than deer their fawns, or cows the new-fall'n calf.
Woe worth the tongue, may blisters sore it gall,
That names *Buxoma Blouzalind* withal.
Cud. Hold, witless Lobbin Clout, I thee advise,
Lest blisters sore on thy own tongue arise.
Lo yonder Cloddipole, the blithsome swain,
The wisest lout of all the neighb'ring plain!

* Shining or bright sky.
† Scarce.
‡ Early.
§ Conceive.

From

Pastoral. From Cloddipole we learnt to read the skies,
To know when hail will fall, or winds arise.
* Formerly. He taught us erst * the heifer's tail to view,
When stuck aloft, that show'rs would straight ensue:
He first that useful secret did explain,
That pricking corns foretold the gath'ring rain.
When swallows fleet soar high and sport in air,
He told us that the welkin would be clear.
Let Cloddipole then hear us twain rehearse,
And praise his sweetheart in alternate verse.
I'll wager this same oaken staff with thee,
That Cloddipole shall give the prize to me.
Lob. See this tobacco-pouch, that's lin'd with hair,
Made of the skin of sleekest fallow-deer:
This pouch, that's tied with tape of reddest hue,
I'll wager, that the prize shall be my due.
Cud. Begin thy carrols, then, thou vaunting slouch;
Be thine the oaken staff, or mine the pouch.
Lob. My Blouzalinda is the blithest lass,
Than primrose sweeter, or the clover-grass.
Fair is the king-cup that in meadows blows;
Fair is the daisy that beside her grows;
Fair is the gilly-flow'r of gardens sweet;
Fair is the marygold, for pottage meet:
But Blouzalind's than gilly-flower more fair,
Than daisy, marygold, or king-cup rare.
Cud. My brown Buxoma is the featest maid
That e'er at wake delightsome gambol play'd;
Clean as young lambkins, or the goose's down,
And like the goldfinch in her Sunday gown.
The witless lamb may sport upon the plain,
The frisking kid delight the gaping swain;
The wanton calf may skip with many a bound,
† Nimblest. And my cur Tray play deftest † feats around:
But neither lamb, nor kid, nor calf, nor Tray,
Dance like Buxoma on the first of May.
Lob. Sweet is my toil when Blouzalind is near;
Of her bereft, 'tis winter all the year.
With her no sultry summer's heat I know;
In winter, when she's nigh, with love I glow.
Come, Blouzalinda, ease thy swain's desire,
My summer's shadow, and my winter's fire!
Cud. As with Buxoma once I work'd at hay,
E'en noon-tide labour seem'd an holiday;
And holidays, if haply she were gone,
Like worky-days I wish'd would soon be done.
‡ Very soon. Eftsoons ‡, O sweetheart kind, my love repay,
And all the year shall then be holiday.
Lob. As Blouzalinda, in a gamesome mood,
Behind a hay-cock loudly laughing stood,
I slily ran and snatch'd a hasty kiss;
She wip'd her lips, nor took it much amiss.
Believe me, Cuddy, while I'm bold to say,
Her breath was sweeter than the ripen'd hay.
Cud. As my Buxoma, in a morning fair,
With gentle finger stroak'd her milky care,
§ Waggishly. I quaintly § stole a kiss; at first, 'tis true,
She frown'd, yet after granted one or two.
Lobbin, I swear, believe who will my vows,
Her breath by far excell'd the breathing cows.
Lob. Leek to the Welsh, to Dutchmen butter's dear,
Of Irish swains potatoes are the cheer;
Oats for their feasts the Scottish shepherds grind,
Sweet turnips are the food of Blouzalind:
While she loves turnips, butter I'll despise, Pastoral.
Nor leeks, nor oatmeal, nor potatoes prize.
Cud. In good roast beef my landlord sticks his knife,
The capon fat delights his dainty wife;
Pudding our parson eats, the squire loves hare;
But white-pot thick is my Buxoma's fare.
While she loves white-pot, capon ne'er shall be,
Nor hare, nor beef, nor pudding, food for me.
Lob. As once I play'd at blind man's buff, it hapt
About my eyes the towel thick was wrapt:
I miss'd the swains, and seiz'd on Blouzalind;
True speaks that ancient proverb, Love is blind.
Cud. As at hot-cockles once I laid me down,
And felt the weighty hand of many a clown;
Buxoma gave a gentle tap, and I
Quick rose, and read soft mischief in her eye.
Lob. On two near elms the slacken'd cord I hung;
Now high, now low, my Blouzalinda swung;
With the rude wind her rumpled garment rose,
And show'd her taper leg and scarlet hose.
Cud. Across the fallen oak the plank I laid,
And myself pois'd against the tott'ring maid!
High leapt the plank, and down Buxoma fell;
I spy'd—but faithful sweethearts never tell.
Lob. This riddle, Cuddy, if thou canst, explain,
This wily riddle puzzles every swain:
What flow'r is that which bears the virgin's name,
The richest metal joined with the same *? * Marigold.
Cud. Answer, thou carle, and judge this riddle right,
I'll frankly own thee for a cunning wight:
What flow'r is that which royal honour craves,
Adjoin the virgin, and 'tis strown on graves †? † Rosemary.
Clod. Forbear, contending louts, give o'er your strains;
An oaken staff each merits for his pains.
But see the sun-beams bright to labour warn,
And gild the thatch of goodman Hodge's barn.
Your herds for want of water stand a-dry;
They're weary of your songs—and so am I.

We have given the rules usually laid down for pastoral writing, and exhibited some examples written on this plan; but we have to observe that this poem may take very different forms. It may appear either as a comedy or as a ballad. As a pastoral comedy, there is perhaps nothing which possesses equal merit with Ramsay's *Gentle Shepherd*, and we know not where to find in any language a rival to the *Pastoral Ballad* of Shenstone. That the excellence of this poem is great can hardly be questioned, since it compelled a critic, who was never lavish of his praise, and who on all occasions was ready to vilify the pastoral, to express himself in terms of high encomium. "In the first part (says he) are two passages, to which if any mind denies its sympathy, it has no acquaintance with love or nature: 145 Shenstone.

I priz'd every hour that went by,
  Beyond all that had pleas'd me before;
But now they are past, and I sigh,
  And I grieve that I priz'd them no more.
When forc'd the fair nymph to forego,
  What anguish I felt in my heart!
Yet I thought—but it might not be so,
  'Twas with pain that she saw me depart.

She

Pastoral.

She gaz'd, as I slowly withdrew,
My path I could hardly discern;
So sweetly she bade me adieu,
I thought that she bade me return.

"In the second (continues the same critic) this passage has its prettiness, though it be not equal to the former:"

I have found out a gift for my fair;
I have found where the wood pigeons breed:
But let me that plunder forbear,
She would say 'twas a barbarous deed:
For he ne'er could be true, she averr'd,
Who could rob a poor bird of its young;
And I lov'd her the more when I heard
Such tenderness fall from her tongue.

Sect. V. *Of Didactic or Preceptive Poetry.*

146 Origin and use of didactic poetry.

The method of writing precepts in verse, and embellishing them with the graces of poetry, had its rise, we may suppose, from a due consideration of the frailties and perverseness of human nature; and was intended to engage the affections, in order to improve the mind and amend the heart.

Didactic or preceptive poetry, has been usually employed either to illustrate and explain our moral duties, our philosophical inquiries, our business and pleasures; or in teaching the art of criticism or poetry itself. It may be adapted, however, to any other subject; and may in all cases, where instruction is designed, be employed to good purpose. Some subjects, indeed, are more proper than others, as they admit of more poetical ornaments, and give a greater latitude to genius; but whatever the subject is, those precepts are to be laid down that are the most useful; and they should follow each other in a natural easy method, and be delivered in the most agreeable engaging manner. What the prose writer tells you ought to be done, the poet often conveys under the form of a narration, or shows the necessity of in a description; and by representing the action as done, or doing, conceals the precept that should enforce it. The poet likewise, instead of telling the whole truth, or laying down all the rules that are requisite, selects such parts only as are the most pleasing, and communicates the rest indirectly, without giving us an open view of them; yet takes care that nothing shall escape the reader's notice with which he ought to be acquainted. He discloses just enough to lead the imagination into the parts that are concealed; and the mind, ever gratified with its own discoveries, is complimented with exploring and finding them out; which, though done with ease, seems so considerable, as not to be obtained but in consequence of its own adroitness and sagacity.

147 Rules to be observed in its composition.

But this is not sufficient to render didactic poetry always pleasing: for where precepts are laid down one after another, and the poem is of considerable length, the mind will require some recreation and refreshment by the way; which is to be procured by seasonable moral reflections, pertinent remarks, familiar similies, and descriptions naturally introduced, by allusions to ancient histories or fables, and by short and pleasant digressions and excursions into more noble subjects, so aptly brought in, that they may seem to have a remote relation, and be of a piece with the poem. By thus varying the form of instruction, the poet gives life to his precepts, and awakens and secures our attention, without permitting us to see by what means we are thus captivated: and his art is the more to be admired, because it is so concealed as to escape the reader's observation.

Didactic.

The style, too, must maintain a dignity suitable to the subject, and every part be drawn in such lively colours, that the things described may seem as if presented to the reader's view.

But all this will appear more evident from example; and though entire poems of this kind are not within the compass of our design, we shall endeavour to select such passages as will be sufficient to illustrate the rules we have here laid down.

We have already observed, that, according to the usual divisions, there are four kinds of didactic poems, viz. those that respect our moral duties, our philosophical speculations, our business and pleasures, or that give precepts for poetry and criticism.

I. On the first subject, indeed, we have scarce any thing that deserves the name of poetry, except Mr Pope's *Essay on Man*, his *Ethic Epistles*, Blackmore's *Creation*, and part of Young's *Night Thoughts*; to which therefore we refer as examples.

II. Those preceptive poems that concern philosophical speculations, though the subject is so pregnant with matter, affords such a field of fancy, and is so capable of every decoration, are but few. Lucretius is the most considerable among the ancients who has written in this manner; among the moderns we have little else but small detached pieces, except the poem called *Anti-Lucretius*, which has not yet received an English dress; Dr Akenside's *Pleasures of the Imagination*, and Dr Darwin's *Botanic Garden*; which are all worthy of our admiration. Some of the small pieces in this department are also well executed; and there is one entitled the *Universe*, written by Mr Baker, from which we shall borrow an example.

The author's scheme is in some measure coincident with Mr Pope's, so far especially as it tends to restrain the pride of man, with which design it was professedly written.

The passage we have selected is that respecting the planetary system.

148 Example in didactic poetry.

Unwise! and thoughtless! impotent! and blind!
Can wealth, or grandeur, satisfy the mind?
Of all those pleasures mortals most admire,
Is there one joy sincere, that will not tire?
Can love itself endure? or beauty's charms
Afford that bliss we fancy in its arms?—
Then let thy soul more glorious aims pursue:
Have thy Creator and his works in view.
Be these thy study: hence thy pleasures bring:
And drink large draughts of wisdom from its spring;
That spring, whence perfect joy, and calm repose,
And blest content, and peace eternal, flows.
Observe how regular the planets run,
In stated times, their courses round the Sun.
Diff'rent their bulk, their distance, their career,
And diff'rent much the compass of their year:
Yet all the same eternal laws obey,
While God's unerring finger points the way.
First Mercury, amidst full tides of light,
Rolls next the sun, through his small circle bright.

Didactic.

All that dwell here must be refin'd and pure :
Bodies like ours such ardour can't endure :
Our earth would blaze beneath so fierce a ray,
And all its marble mountains melt away.
Fair Venus, next, fulfils her larger round,
With softer beams, and milder glory crown'd.
Friend to mankind, she glitters from afar,
Now the bright ev'ning, now the morning star.
More distant still, our earth comes rolling on,
And forms a wider circle round the sun :
With her the moon, companion ever dear :
Her course attending through the shining year.
See, Mars, alone, runs his appointed race,
And measures out, exact, the destin'd space :
Nor nearer does he wind, nor farther stray,
But finds the point whence first he roll'd away.
More yet remote from day's all-cheering source,
Vast Jupiter performs his constant course :
Four friendly moons, with borrow'd lustre, rise,
Bestow their beams divine, and light his skies.
Farthest and last, scarce warm'd by Phœbus' ray,
Through his vast orbit Saturn wheels away.
How great the change could we be wafted there !
How slow the seasons ! and how long the year !
One moon, on us, reflects its cheerful light :
There, five attendants brighten up the night.
Here, the blue firmament bedeck'd with stars ;
There, over-head, a lucid arch appears.
From hence, how large, how strong, the sun's bright ball !
But seen from thence, how languid and how small !—
When the keen north with all its fury blows,
Congeals the floods, and forms the fleecy snows,
'Tis heat intense to what can there be known :
Warmer our poles than is its burning zone.
Who there inhabits must have other pow'rs,
Juices, and veins, and sense, and life, than ours.
One moment's cold, like theirs, would pierce the bone,
Freeze the heart-blood, and turn us all to stone.
Strange and amazing must the diff'rence be
'Twixt this dull planet and bright Mercury :
Yet reason says, nor can we doubt at all,
Millions of beings dwell on either ball,
With constitutions fitted for the spot,
Where Providence, all wise, has fix'd their lot.
Wondrous art thou, O God, in all thy ways !
Their eyes to thee let all thy creatures raise ;
Adore thy grandeur, and thy goodness praise.
Ye sons of men ! with satisfaction know,
God's own right hand dispenses all below :
Nor good nor evil does by chance befall ;
He reigns supreme, and he directs it all.
At his command, affrighting human-kind,
Comets drag on their blazing lengths behind :
Nor, as we think, do they at random rove,
But, in determin'd times, through long ellipses move.
And tho' sometimes they near approach the sun ;
Sometimes beyond our system's orbit run ;
Throughout their race they act their Maker's will,
His pow'r declare, his purposes fulfil.

III. Of those preceptive poems that treat of the business and pleasures of mankind, Virgil's *Georgics* claim our first and principal attention. In these he has laid down the rules of husbandry in all its branches with the utmost exactness and perspicuity, and at the same time embellished them with all the beauties and graces of poetry. Though his subject was husbandry, he has delivered his precepts, as Mr Addison observes, not with the simplicity of a ploughman, but with the address of a poet : the meanest of his rules are laid down with a kind of grandeur ; *and he breaks the clods, and tosses about the dung, with an air of gracefulness.* Of the different ways of conveying the same truth to the mind, he takes that which is pleasantest ; and this chiefly distinguishes poetry from prose, and renders Virgil's rules of husbandry more delightful and valuable than any other.

These poems, which are esteemed the most perfect of the author's works, are, perhaps, the best that can be proposed for the young student's imitation in this manner of writing ; for the whole of his *Georgics* is wrought up with wonderful art, and decorated with all the flowers of poetry.

IV. Of those poems which give precepts for the recreations and pleasures of a country life, we have several in our own language that are justly admired. As the most considerable of those diversions, however, are finely treated by Mr Gay in his *Rural Sports*, we particularly refer to that poem.

We should here treat of those preceptive poems that teach the art of poetry itself, of which there are many that deserve particular attention ; but we have anticipated our design, and rendered any farther notice of them in a manner useless, by the observations we have made in the course of this treatise. We ought however to remark, that Horace was the only poet among the ancients who wrote precepts for poetry in verse ; at least his epistles to the Pisos is the only piece of the kind that has been handed down to us ; and that is so perfect, it seems almost to have precluded the necessity of any other. Among the moderns we have several that are justly admired ; as Boileau, Pope, &c.

Poets who write in the preceptive manner should take care to choose such subjects as are worthy of their muse, and of consequence to all mankind ; for to bestow both parts and pains to teach people trifles that are unworthy of their attention, is to the last degree ridiculous.

Among poems of the useful and interesting kind, Dr Armstrong's *Art of Preserving Health* deserves particular recommendation, as well in consideration of the subject, as of the elegant and masterly manner in which he has treated it ; for he has made those things, which are in their own nature dry and unentertaining, perfectly agreeable and pleasing, by adhering to the rules observed by Virgil and others in the conduct of these poems.

149 Its proper style.

With regard to the style or dress of these poems, it should be so rich as to hide the nakedness of the subject, and the barrenness of the precepts should be lost in the lustre of the language. "It ought to abound in the most bold and forcible metaphors, the most glowing and picturesque epithets ; it ought to be elevated and enlivened by pomp of numbers and majesty of words, and by every figure that can lift a language above the vulgar and current expressions." One may add, that in no kind of poetry (not even in the sublime ode) is beauty of expression so much to be regarded as in this. For the epic writer should be very cautious of indulging himself in too florid a manner of expression,

Warton on Didactic Poetry.

Didactic

expression, especially in the dramatic parts of his fable, where he introduces dialogue: and the writer of tragedy cannot fall into so nauseous and unnatural an affectation, as to put laboured descriptions, pompous epithets, studied phrases, and high-flown metaphors, into the mouths of his characters. But as the didactic poet speaks in his own person, it is necessary and proper for him to use a brighter colouring of style, and to be more studious of ornament. And this is agreeable to an admirable precept of Aristotle, which no writer should ever forget,—"That diction ought most to be laboured in the unactive, that is, the descriptive, parts of a poem, in which the opinions, manners, and passions of men are not represented; for too glaring an expression obscures the manners and the sentiments."

We have already observed that any thing in nature may be the subject of this poem. Some things, however, will appear to more advantage than others, as they give a greater latitude to genius, and admit of more poetical ornaments. Natural history and philosophy are copious subjects. Precepts in these might be decorated with all the flowers in poetry; and, as Dr Trapp observes, how can poetry be better employed, or more agreeably to its nature and dignity, than in celebrating the works of the great Creator, and describing the nature and generation of animals, vegetables, and minerals; the revolutions of the heavenly bodies; the motions of the earth; the flux and reflux of the sea; the cause of thunder, lightning, and other meteors; the attraction of the magnet; the gravitation, cohesion, and repulsion of matter; the impulsive motion of light; the slow progression of sounds; and other amazing phenomena of nature? Most of the arts and sciences are also proper subjects for this poem; and none are more so than its two sister arts, painting and music. In the former, particularly, there is room for the most entertaining precepts concerning the disposal of colours; the arrangement of lights and shades; the secret attractives of beauty; the various ideas which make up the one; the distinguishing between the attitudes proper to either sex, and every passion; the representing prospects of buildings, battles, or the country; and, lastly, concerning the nature of imitation, and the power of painting. What a boundless field of invention is here? What room for description, comparison, and poetical fable? How easy the transition, at any time, from the draught to the original, from the shadow to the substance? and from hence, what noble excursions may be made into history, into panegyric upon the greatest beauties or heroes of the past or present age?

Sect. VI. *Of the Epistle.*

150 The character of the epistle.

This species of writing, if we are permitted to lay down rules from the examples of our best poets, admits of great latitude, and solicits ornament and decoration; yet the poet is still to consider, that the true character of the epistle is ease and elegance; nothing therefore should be forced or unnatural, laboured or affected, but every part of the composition should breathe an easy, polite, and unconstrained freedom.

It is suitable to every subject; for as the epistle takes place of discourse, and is intended as a sort of distant conversation, all the affairs of life and researches into nature may be introduced. Those, however, which are fraught with compliment or condolence, that contain a description of places, or are full of pertinent remarks, and in a familiar and humorous way describe the manners, vices, and follies of mankind, are the best; because they are most suitable to the true character of epistolary writing, and (business set apart) are the usual subjects upon which our letters are employed.

Epistle.

All farther rules and directions are unnecessary; for this kind of writing is better learned by example and practice than by precept. We shall, therefore, in conformity to our plan, select a few epistles for the reader's imitation; which, as this method of writing has of late much prevailed, may be best taken, perhaps, from our modern poets.

The following letter from Mr Addison to Lord Halifax, contains an elegant description of the curiosities and places about Rome, together with such reflections on the inestimable blessings of liberty as must give pleasure to every Briton, especially when he sees them thus placed in direct opposition to the baneful influence of slavery and oppression, which are ever to be seen among the miserable inhabitants of those countries.

151 Examples in epistolary poetry from Addison.

While you, my lord, the rural shades admire,
And from Britannia's public posts retire,
Nor longer, her ungrateful sons to please,
For their advantage sacrifice your ease;
Me into foreign realms my fate conveys,
Through nations fruitful of immortal lays,
Where the soft season and inviting clime
Conspire to trouble your repose with rhime.
For wheresoe'er I turn my ravish'd eyes,
Gay gilded scenes and shining prospects rise,
Poetic fields encompass me around,
And still I seem to tread on classic ground;
For here the muse so oft her harp has strung,
That not a mountain rears its head unsung,
Renown'd in verse each shady thicket grows,
And ev'ry stream in heav'nly numbers flows.
How am I pleas'd to search the hills and woods
For rising springs and celebrated floods;
To view the Nar, tumultuous in his course,
And trace the smooth Clitumnus to his source;
To see the Mincia draw its wat'ry store
Through the long windings of a fruitful shore,
And hoary Albula's infected tide
O'er the warm bed of smoking sulphur glide!
Fir'd with a thousand raptures, I survey
Eridanus thro' flow'ry meadows stray,
The king of floods! that, rolling o'er the plains,
The tow'ring Alps of half their moisture drains,
And, proudly swoln with a whole winter's snows,
Distributes wealth and plenty where he flows.
Sometimes, misguided by the tuneful throng,
I look for streams immortaliz'd in song,
That lost in silence and oblivion lie,
(Dumb are their fountains and their channels dry)
Yet run for ever by the muse's skill,
And in the smooth description murmur still.
Sometimes to gentle Tiber I retire,
And the fam'd river's empty shores admire,
That, destitute of strength, derives its course
From thirsty urns, and an unfruitful source;

Yet

Epistle.

Yet sung so often in poetic lays,
With scorn the Danube and the Nile surveys;
So high the deathless muse exalts her theme!
Such was the Boyn, a poor inglorious stream,
That in Hibernian vales obscurely stray'd,
And unobserv'd in wild meanders play'd;
Till, by your lines, and Nassau's sword renown'd,
Its rising billows through the world resound,
Where'er the hero's godlike acts can pierce,
Or where the fame of an immortal verse.
Oh cou'd the muse my ravish'd breast inspire
With warmth like yours, and raise an equal fire,
Unnumber'd beauties in my verse should shine,
And Virgil's Italy should yield to mine!
See how the golden groves around me smile,
That shun the coasts of Britain's stormy isle,
Or when transplanted and preserv'd with care,
Curse the cold clime, and starve in northern air.
Here kindly warmth their mounting juice ferments
To nobler tastes, and more exalted scents:
Ev'n the rough rocks with tender myrtles bloom,
And trodden weeds send out a rich perfume.
Bear me, some god, to Baiæ's gentle seats,
Or cover me in Umbria's green retreats;
Where western gales eternally reside,
And all the seasons lavish all their pride:
Blossoms, and fruits, and flow'rs together rise,
And the whole year in gay confusion lies.
Immortal glories in my mind revive,
And in my soul a thousand passions strive,
When Rome's exalted beauties I descry
Magnificent in piles of ruin lie.
An amphitheatre's amazing height
Here fills my eye with terror and delight,
That on its public shows unpeopled Rome,
And held uncrowded nations in its womb;
Here pillars rough with sculpture pierce the skies:
And here the proud triumphal arches rise,
Where the old Romans deathless acts display'd,
Their base degenerate progeny upbraid:
Whole rivers here forsake the fields below,
And wond'ring at their height thro' airy channels flow.
Still to new scenes my wand'ring muse retires;
And the dumb show of breathing rocks admires;
Where the smooth chissel all its force has shown,
And soften'd into flesh the rugged stone.
In solemn silence, a majestic band,
Heroes, and gods, and Roman consuls stand,
Stern tyrants, whom their cruelties renown,
And emperors in Parian marble frown:
While the bright dames, to whom they humbly su'd,
Still show the charms that their proud hearts subdu'd.
Fain would I Raphael's godlike art rehearse,
And show th' immortal labours in my verse,
Where from the mingled strength of shade and light
A new creation rises to my sight,
Such heavenly figures from his pencil flow,
So warm with life his blended colours glow.
From theme to theme with secret pleasure tost,
Amidst the soft variety I'm lost.
Here pleasing airs my ravish'd soul confound
With circling notes and labyrinths of sound;
Here domes and temples rise in distant views,
And opening palaces invite my muse.
How has kind heav'n adorn'd the happy land,
And scatter'd blessings with a wasteful hand!
But what avail her unexhausted stores,
Her blooming mountains, and her sunny shores,
With all the gifts that heav'n and earth impart,
The smiles of nature, and the charms of art,
While proud oppression in her valleys reigns,
And tyranny usurps her happy plains?
The poor inhabitant beholds in vain
The red'ning orange and the swelling grain:
Joyless he sees the growing oils and wines,
And in the myrtle's fragrant shade repines:
Starves, in the midst of nature's bounty curst,
And in the loaded vineyard dies for thirst.
O liberty, thou goddess heav'nly bright,
Profuse of bliss, and pregnant with delight!
Eternal pleasures in thy presence reign,
And smiling plenty leads thy wanton train;
Eas'd of her load, subjection grows more light,
And poverty looks cheerful in thy sight;
Thou mak'st the gloomy face of nature gay,
Giv'st beauty to the sun, and pleasure to the day.
Thee, goddess, thee, Britannia's isle adores;
How has she oft exhausted all her stores,
How oft in fields of death thy presence sought,
Nor thinks the mighty prize too dearly bought!
On foreign mountain may the sun refine
The grape's soft juice, and mellow it to wine,
With citron groves adorn a distant soil,
And the fat olive swell with floods of oil:
We envy not the warmer clime, that lies
In ten degrees of more indulgent skies,
Nor at the coarseness of our heav'n repine,
Tho' o'er our heads the frozen Pleiads shine:
'Tis liberty that crowns Britannia's isle,
And makes her barren rocks and her bleak mountains [smile.
Others with tow'ring piles may please the sight,
And in their proud aspiring domes delight;
A nicer touch to the stretch'd canvas give,
Or teach their animated rocks to live:
'Tis Britain's care to watch o'er Europe's fate,
And hold in balance each contending state,
To threaten bold presumptuous kings with war,
And answer her afflicted neighbour's pray'r.
The Dane and Swede, rous'd up by fierce alarms,
Bless the wise conduct of her pious arms:
Soon as her fleets appear, their terrors cease,
And all the northern world lies hush'd in peace.
Th' ambitious Gaul beholds with secret dread
Her thunder aim'd at his aspiring head,
And fain her godlike sons would disunite
By foreign gold, or by domestic spite;
But strives in vain to conquer or divide,
Whom Nassau's arms defend and counsels guide.
Fir'd with the name, which I so oft have found
The distant climes and diff'rent tongues resound,
I bridle in my struggling muse with pain,
That longs to launch into a bolder strain.
But I've already troubled you too long,
Nor dare attempt a more advent'rous song:
My humble verse demands a softer theme,
A painted meadow, or a purling stream;
Unfit for heroes; whom immortal lays,
And lines like Virgil's, or like yours, should praise.

There

Epistle.

There is a fine spirit of freedom, and love of liberty, displayed in the following letter from Lord Lyttleton to Mr Pope; and the message from the shade of Virgil, which is truly poetical, and justly preceptive, may prove an useful lesson to future bards.

From Rome, 1730.

152 Lyttleton.
IMMORTAL bard! for whom each muse has wove
The fairest garlands of the Aonian grove;
Preserv'd, our drooping genius to restore,
When Addison and Congreve are no more;
After so many stars extinct in night,
The darken'd age's last remaining light!
To thee from Latian realms this verse is writ,
Inspir'd by memory of ancient wit:
For now no more these climes their influence boast,
Fall'n is their glory, and their virtue lost;
From tyrants, and from priests, the muses fly,
Daughters of reason and of liberty.
Nor Baiæ now nor Umbria's plain they love,
Nor on the banks of Nar or Mincia rove;
To Thames's flow'ry borders they retire,
And kindle in thy breast the Roman fire.
So in the shades, where cheer'd with summer rays
Melodious linnets warbled sprightly lays,
Soon as the faded, falling leaves complain
Of gloomy winter's inauspicious reign,
No tuneful voice is heard of joy or love,
But mournful silence saddens all the grove.
Unhappy Italy! whose alter'd state
Has felt the worst severity of fate:
Not that barbarian hands her fasces broke,
And bow'd her haughty neck beneath their yoke;
Nor that her palaces to earth are thrown,
Her cities desert, and her fields unsown;
But that her ancient spirit is decay'd,
That sacred wisdom from her bounds is fled,
That there the source of science flows no more,
Whence its rich streams supply'd the world before.
Illustrious names! that once in Latium shin'd,
Born to instruct and to command mankind;
Chiefs, by whose virtue mighty Rome was rais'd,
And poets, who those chiefs sublimely prais'd!
Oft I the traces you have left explore,
Your ashes visit, and your urns adore;
Oft kiss, with lips devout, some mould'ring stone,
With ivy's venerable shade o'ergrown;
Those hallow'd ruins better pleas'd to see,
Than all the pomp of modern luxury.
As late on Virgil's tomb fresh flow'rs I strow'd,
While with th' inspiring muse my bosom glow'd,
Crown'd with eternal bays, my ravish'd eyes
Beheld the poet's awful form arise:
Stranger, he said, whose pious hand has paid
These grateful rites to my attentive shade,
When thou shalt breathe thy happy native air,
To Pope this message from his master bear.
Great bard, whose numbers I myself inspire,
To whom I gave my own harmonious lyre,
If high exalted on the throne of wit,
Near me and Homer thou aspire to sit,
No more let meaner satire dim the rays
That flow majestic from thy noble bays.
In all the flow'ry paths of Pindus stray:
But shun that thorny, that unpleasing way;
Nor, when each soft engaging muse is thine,
Address the least attractive of the nine.
Of thee more worthy were the task to raise
A lasting column to thy country's praise,
To sing the land, which yet alone can boast
That liberty corrupted Rome has lost;
Where science in the arms of peace is laid,
And plants her palm beneath the olive's shade.
Such was the theme for which my lyre I strung,
Such was the people whose exploits I sung;
Brave, yet refin'd, for arms and arts renown'd,
With diff'rent bays by Mars and Phœbus crown'd,
Dauntless opposers of tyrannic sway,
But pleas'd a mild AUGUSTUS to obey.
If these commands submissive thou receive,
Immortal and unblam'd thy name shall live;
Envy to black Cocytus shall retire,
And howl with furies in tormenting fire;
Approving time shall consecrate thy lays,
And join the patriot's to the poet's praise.

The following letter from Mr Philips to the earl of Dorset is entirely descriptive; but is one of those descriptions which will be ever read with delight.

Copenhagen, March 9. 1709.

From frozen climes, and endless tracts of snow, 153 Philips.
From streams which northern winds forbid to flow,
What present shall the muse to Dorset bring,
Or how, so near the pole, attempt to sing?
The hoary winter here conceals from sight
All pleasing objects which to verse invite.
The hills and dales, and the delightful woods,
The flow'ry plains, and silver-streaming floods,
By snow disguis'd, in bright confusion lie,
And with one dazzling waste fatigue the eye.
No gentle breathing breeze prepares the spring,
No birds within the desert region sing:
The ships, unmov'd, the boist'rous winds defy,
While rattling chariots o'er the ocean fly.
The vast Leviathan wants room to play,
And spout his waters in the face of day:
The starving wolves along the main sea sprowl,
And to the moon in icy valleys howl.
O'er many a shining league the level main
Here spreads itself into a glassy plain:
There solid billows of enormous size,
Alps of green ice, in wild disorder rise.
And yet but lately have I seen ev'n here,
The winter in a lovely dress appear.
Ere yet the clouds let fall the treasur'd snow,
Or winds began through hazy skies to blow,
At ev'ning a keen eastern breeze arose,
And the descending rain unsully'd froze;
Soon as the silent shades of night withdrew,
The ruddy morn disclos'd at once to view
The face of nature in a rich disguise,
And brighten'd every object to my eyes:
For ev'ry shrub, and ev'ry blade of grass,
And ev'ry pointed thorn, seem'd wrought in glass;
In pearls and rubies rich the hawthorns show,
While through the ice the crimson berries glow.
The thick sprung reeds, which watery marshes yield,
Seem'd polish'd lances in a hostile field.
The stag in limpid currents with surprise,
Sees crystal branches on his forehead rise:

Epistle

The spreading oak, the beech, and tow'ring pine,
Glaz'd over, in the freezing æther shine.
The frighted birds the rattling branches shun,
Which wave and glitter in the distant sun.
When if a sudden gust of wind arise,
The brittle forest into atoms flies,
The crackling wood beneath the tempest bends,
And in a spangled shower the prospect ends:
Or, if a southern gale the region warm,
And by degrees unbend the wint'ry charm,
The traveller a miry country sees,
And journeys sad beneath the dropping trees:
Like some deluded peasant Merlin leads
Thro' fragrant bow'rs and thro' delicious meads,
While here enchanted gardens to him rise,
And airy fabrics there attract his eyes,
His wandering feet the magic paths pursue,
And while he thinks the fair illusion true,
The trackless scenes disperse in fluid air,
And woods, and wilds, and thorny ways appear;
A tedious road the weary wretch returns,
And, as he goes, the transient vision mourns.

The great use of medals is properly described in the ensuing elegant epistle from Mr Pope to Mr Addison; and the extravagant passion which some people entertain only for the colour of them, is very agreeably and very justly ridiculed.

154 Pope.

SEE the wild waste of all devouring years!
How Rome her own sad sepulchre appears!
With nodding arches, broken temples spread!
The very tombs now vanish like their dead!
Imperial wonders rais'd on nations spoil'd,
Where mix'd with slaves the groaning martyr toil'd!
Huge theatres, that now unpeopled woods,
Now drain'd a distant country of her floods!
Fanes, which admiring gods with pride survey,
Statues of men, scarce less alive than they!
Some felt the silent stroke of mould'ring age,
Some hostile fury, some religious rage;
Barbarian blindness, Christian zeal conspire,
And papal piety, and Gothic fire.
Perhaps, by its own ruin sav'd from flame,
Some bury'd marble half preserves a name:
That name the learn'd with fierce disputes pursue,
And give to Titus old Vespasian's due.
Ambition sigh'd: She found it vain to trust
The faithless column and the crumbling bust;
Huge moles, whose shadow stretch'd from shore to shore,
Their ruins perish'd, and their place no more;
Convinc'd, she now contracts her vast design,
And all her triumphs shrink into a coin.
A narrow orb each crowded conquest keeps,
Beneath her palm here sad Judæa weeps;
Now scantier limits the proud arch confine,
And scarce are seen the prostrate Nile or Rhine;
A small Euphrates through the piece is roll'd,
And little eagles wave their wings in gold.
The medal, faithful to its charge of fame,
Through climes and ages bears each form and name:
In one short view subjected to our eye,
Gods, emp'rors, heroes, sages, beauties, lie.
With sharpen'd sight pale antiquaries pore,
Th' inscription value, but the rust adore.
This the blue varnish, that the green endears,
The sacred rust of twice ten hundred years:
To gain Pescennius one employs his schemes,
One grasps a Cecrops in ecstatic dreams.
Poor Vadius, long with learned spleen devour'd,
Can taste no pleasure since his shield was scour'd:
And Curio, restless by the fair one's side,
Sighs for an Otho, and neglects his bride.
Their's is the vanity, the learning thine:
Touch'd by thy hand, again Rome's glories shine;
Her gods and god-like heroes rise to view,
And all her faded garlands bloom anew.
Nor blush these studies thy regard engage;
These pleas'd the fathers of poetic rage;
The verse and sculpture bore an equal part,
And art reflected images to art.
Oh when shall Britain, conscious of her claim,
Stand emulous of Greek and Roman fame?
In living medals see her wars enroll'd,
And vanquish'd realms supply recording gold?
Here, rising bold, the patriot's honest face;
There, warriors frowning in historic brass?
Then future ages with delight shall see
How Plato's, Bacon's Newton's, looks agree;
Or in fair series laurell'd bards be shown,
A Virgil there, and here an Addison.
Then shall thy CRAGGS (and let me call him mine)
On the cast ore, another Pollio shine;
With aspect open shall erect his head,
And round the orb in lasting notes be read,
"Statesman, yet friend to truth! of soul sincere,
"In action faithful, and in honour clear;
"Who broke no promise, serv'd no private end,
"Who gain'd no title, and who lost no friend;
"Ennobled by himself, by all approv'd,
"Prais'd, wept, and honour'd, by the muse he lov'd."

We have already observed, that the essential, and indeed the true characteristic of epistolary writing, is ease; and on this account, as well as others, the following letter from Mr Pope to Miss Blount is to be admired.

To Miss BLOUNT, on her leaving the Town after the Coronation.

As some fond virgin, whom her mother's care
Drags from the town to wholesome country air;
Just when she learns to roll a melting eye,
And hear a spark, yet think no danger nigh,
From the dear man unwilling she must sever,
Yet takes one kiss before she parts for ever;
Thus from the world fair Zephalinda flew,
Saw others happy, and with sighs withdrew:
Not that their pleasures caus'd her discontent;
She sigh'd, not that they stay'd, but that she went.
She went, to plain-work, and to purling brooks,
Old-fashion'd halls, dull aunts, and croaking rooks:
She went from op'ra, park, assembly, play,
To morning walks, and pray'rs three hours a-day;
To part her time 'twixt reading and bohea,
To muse, and spill her solitary tea,
Or o'er cold coffee trifle with the spoon,
Count the slow clock, and dine exact at noon;

2 Diver

Epistle. Divert her eyes with pictures in the fire,
Hum half a tune, tell stories to the 'squire;
Up to her godly garret after seven,
There starve and pray, for that's the way to heav'n.
Some 'squire, perhaps, you take delight to rack;
Whose game is whisk, whose treat's a toast in sack;
Who visits with a gun, presents you birds,
Then gives a smacking buss, and cries,—no words!
Or with his hound comes hollowing from the stable,
Makes love with nods, and knees beneath a table;
Whose laughs are hearty, tho' his jests are coarse,
And loves you best of all things—but his horse.
In some fair ev'ning, on your elbow laid,
You dream of triumphs in the rural shade;
In pensive thought recal the fancy'd scene,
See coronations rise on every green;
Before you pass th' imaginary sights
Of lords, and earls, and dukes, and garter'd knights,
While the spread fan o'ershades your closing eyes:
Then give one flirt, and all the vision flies.
Thus vanish sceptres, coronets, and balls,
And leave you in lone woods, or empty walls!
So when your slave, at some dear idle time,
(Not plagu'd with headachs, or the want of rhyme)
Stands in the streets, abstracted from the crew,
And while he seems to study, thinks of you:
Just when his fancy points your sprightly eyes,
Or sees the blush of soft Parthenia rise,
Gay pats my shoulder, and you vanish quite,
Streets, chairs, and coxcombs, rush upon my sight;
Vex'd to be still in town, I knit my brow,
Look sour, and hum a tune, as you may now.

SECT. VII. *Of Descriptive Poetry.*

155 Descriptive poetry. DESCRIPTIVE poetry is of universal use, since there is nothing in nature but what may be described. As poems of this kind, however, are intended more to delight than to instruct, great care should be taken to make them agreeable. Descriptive poems are made beautiful by similies properly introduced, images of feigned persons, and allusions to ancient families or historical facts; as will appear by a perusal of the best of these poems, especially Milton's *L'Allegro* and *Il Penseroso*, Denham's *Cooper Hill*, and Pope's *Windsor Forest*. Every body being in possession of Milton's works, we forbear inserting the two former; and the others are too long for our purpose. That inimitable poem, *The Seasons*, by Mr Thomson, notwithstanding some parts of it are didactic, may be also with propriety referred to this head.

SECT. VIII. *Of Allegorical Poetry.*

156 Origin of allegorical poetry. COULD truth engage the affections of mankind in her native and simple dress, she would require no ornaments or aid from the imagination; but her delicate light, though lovely in itself, and dear to the most discerning, does not strike the senses of the multitude so as to secure their esteem and attention: the poets therefore dressed her up in the manner in which they thought she would appear the most amiable, and called in allegories and airy disguises as her auxiliaries in the cause of virtue.

An allegory is a fable or story, in which, under the disguise of imaginary persons or things, some real action or instructive moral is conveyed to the mind. Every allegory therefore has two senses, the one literal and the other mystical; the first has been aptly enough compared to a dream or vision, of which the last is the true meaning or interpretation.

157 Its character. From this definition of allegorical poetry the reader will perceive that it gives great latitude to genius, and affords such a boundless scope for invention, that the poet is allowed to soar beyond all creation; to give life and action to virtues, vices, passions, diseases, and natural and moral qualities; to raise floating islands, enchanted palaces, castles, &c. and to people them with the creatures of his own imagination.

The poet's eye, in a fine frenzy rolling,
Doth glance from heav'n to earth, from earth to heav'n;
And, as imagination bodies forth
The forms of things unknown, the poet's pen
Turns them to shape, and gives to airy nothing
A local habitation and a name. SHAKESPEARE.

But whatever is thus raised by the magic of his mind must be visionary and typical, and the mystical sense must appear obvious to the reader, and inculcate some moral or useful lesson in life; otherwise the whole will be deemed rather the effects of a distempered brain, than the productions of real wit and genius. The poet, like Jason, may sail to parts unexplored, but will meet with no applause if he returns without a golden fleece: for these romantic reveries would be unpardonable but for the mystical meaning and moral that is thus artfully and agreeably conveyed with them, and on which account only the allegory is indulged with a greater liberty than any other sort of writing.

The ancients justly considered this sort of allegory as the most essential part of poetry; for the power of raising images of things not in being, giving them a sort of life and action, and presenting them as it were before the eyes, was thought to have something in it like creation; but then, in such compositions, they always expected to find a meaning couched under them of consequence; and we may reasonably conclude, that the allegories of their poets would never have been handed down to us, had they been deficient in this respect.

158 Essentials of a just fable. As the *fable* is the part immediately offered to the reader's consideration, and intended as an agreeable vehicle to convey the moral, it ought to be bold, lively, and surprising, that it may excite curiosity and support attention; for if the fable be spiritless and barren of invention, the attention will be disengaged, and the moral, however useful and important in itself, will be little regarded.

There must likewise be a justness and propriety in the fable, that is, it must be closely connected with the subject on which it is employed; for notwithstanding the boundless compass allowed the imagination in these writings, nothing absurd or useless is to be introduced. In epic poetry some things may perhaps be admitted for no other reason but to surprise, and to raise what is called the *wonderful*, which is as necessary to the epic as the *probable*; but in allegories, however wild and extravagant the fable and the persons introduced, each must correspond with the subject they are applied to, and, like the members of a well-written simile, bear a due proportion and relation to each other: for we are

to

Allegorical. to consider, that the allegory is a sort of extended or rather multiplied simile, and therefore, like that, should never lose the subject it is intended to illustrate. Whence it will appear, that genius and fancy are here insufficient without the aid of taste and judgment: these first, indeed, may produce a multitude of ornaments, a wildernesss of sweets; but the last must be employed to accommodate them to reason, and to arrange them so as to produce pleasure and profit.

But it is not sufficient that the fable be correspondent with the subject, and have the properties above described; for it must also be consistent with itself. The poet may invent what story he pleases, and form any imaginary beings that his fancy shall suggest; but here, as in dramatic writings, when persons are once introduced, they must be supported to the end, and all speak and act in character: for notwithstanding the general licence here allowed, some order must be observed; and however wild and extravagant the characters, they should not be absurd. To this let me add, that the whole must be clear and intelligible; for the "fable (as Mr Hughes observes) being designed only to clothe and adorn the moral, but not to hide it, should resemble the draperies we admire in some of the ancient statues, in which the folds are not too many nor too thick, but so judiciously ordered, that the shape and beauty of the limbs may be seen through them."—But this will more obviously appear from a perusal of the best compositions of this class; such as Spenser's Fairy Queen, Thomson's Castle of Indolence, Addison and Johnson's beautiful allegories in the Spectator and Rambler, &c. &c.

The word *allegory* has been used in a more extensive sense than that in which we have here applied it: for all writings, where the moral is conveyed under the cover of borrowed characters and actions, by which other characters and actions (that are real) are represented, have obtained the name of *allegories*; though the fable or story contains nothing that is visionary or romantic, but is made up of real or historical persons, and of actions either probable or possible. But these writings should undoubtedly be distinguished by some other name, because the literal sense is consistent with right reason, and may convey an useful moral, and satisfy the reader, without putting him under the necessity of seeking for another.

Some of the ancient critics, as Mr Addison observes, were fond of giving the works of their poets this second or concealed meaning, though there was no apparent necessity for the attempt, and often but little show of reason in the application. Thus the Iliad and Odyssey of Homer are said to be fables of this kind, and that the gods and heroes introduced are only the affections of the mind represented in a visible shape and character. They tell us, says he, that Achilles in the first Iliad represents anger, or the irascible part of human nature: that upon drawing his sword against his superior, in a full assembly, Pallas (which, say they, is another name for reason) checks and advises him on the occasion, and at her first appearance touches him upon the head; that part of the man being looked upon as the seat of reason. In this sense, as Mr Hughes has well observed, the whole Æneis of Virgil may be said to be an allegory, if you suppose Æneas to represent Augustus Cæsar, and that his conducting the remains of his countrymen from the ruins of Troy, to a new settlement in Italy, is an emblem of Augustus's forming a new government out of the ruins of the aristocracy, and establishing the Romans, after the conclusion of the civil war, in a peaceable and flourishing condition. However ingenious this coincidence may appear, and whatever design Virgil had in view, he has avoided a particular and direct application, and so conducted his poem, that it is perfect without any allegorical interpretation; for whether we consider Æneas or Augustus as the hero, the morals contained are equally instructive. And indeed it seems absurd to suppose, that because the epic poets have introduced some allegories into their works, every thing is to be understood in a mystical manner, where the sense is plain and evident without any such application. Nor is the attempt that Tasso made to turn his Jerusalem into a mystery, any particular recommendation of the work: for notwithstanding he tells us, in what is called the *allegory*, printed with it, that the Christian army represents man, the city of Jerusalem civil happiness, Godfry the understanding, Rinaldo and Tancred the other powers of the soul, and that the body is typified by the common soldiers and the like; yet the reader will find himself as little delighted as edified by the explication: for the mind has little pleasure in an allegory that cannot be opened without a key made by the hand of the same artist; and indeed every allegory that is so dark, and, as it were, inexplicable, loses its very essence, and becomes an enigma or riddle, that is left to be interpreted by every crude imagination.

This last species of writing, whether called an *allegory*, or by any other name, is not less eminent and useful; for the introducing of real or historical persons may not abridge or lessen either our entertainment or instruction. In these compositions we often meet with an uncommon moral conveyed by the fable in a new and entertaining manner; or with a known truth so artfully decorated, and placed in such a new and beautiful light, that we are amazed how any thing so charming and useful should so long have escaped our observation. Such, for example, are many of Johnson's pieces published in the Rambler under the title of *Eastern Stories*, and by Hawkesworth in the Adventurer.

The ancient parables are of this species of writing: and it is to be observed, that those in the New Testament have a most remarkable elegance and propriety; and are the most striking, and the most instructive, for being drawn from objects that are familiar.—The more striking, because, as the things are seen, the moral conveyed becomes the object of our senses, and requires little or no reflection:—the more instructive, because every time they are seen, the memory is awakened, and the same moral is again exhibited with pleasure to the mind, and accustoms it to reason and dwell on the subject. So that this method of instruction improves nature, as it were, into a book of life; since every thing before us may be so managed, as to give lessons for our advantage. Our Saviour's parables of the sower and the seed, of the tares, of the mustard-seed, and of the leaven (Matthew xiii.), are all of this kind, and were obviously taken from the harvest just ripening before him; for *his disciples plucked the ears of corn and did eat, rubbing them in their hands.* See the articles ALLEGORY, and METAPHOR *and Allegory*, in the general alphabet.

SECT.

Of Fables.

Sect. IX. *Of Fables.*

160
The apologue or fable.

No method of instruction has been more ancient, more universal, and probably none more effectual, than that by apologue or fable. In the first ages, amongst a rude and fierce people, this perhaps was the only method that would have been borne: and even since the progress of learning has furnished other helps, the fable, which at first was used through necessity, is retained from choice, on account of the elegant happiness of its manner, and the refined address with which, when well conducted, it insinuates its moral.

As to the actors in this little drama, the fabulist has authority to press into his service, every kind of existence under heaven; not only beasts, birds, insects, and all the animal creation; but flowers, shrubs, trees, and all the tribe of vegetables. Even mountains, fossils, minerals, and the inanimate works of nature, discourse articulately at his command, and act the part which he assigns them. The virtues, vices, and every property of beings, receive from him a local habitation and a name. In short, he may personify, bestow life, speech, and action, on whatever he thinks proper.

It is easy to imagine what a source of novelty and variety this must open to a genius capable of conceiving and of employing these ideal persons in a proper manner; what an opportunity it affords him to diversify his images, and to treat the fancy with changes of objects, while he strengthens the understanding, or regulates the passions, by a succession of truths. To raise beings like these into a state of action and intelligence, gives the fabulist an undoubted claim to that first character of the poet, a *creator*.

161
Rules for its construction.

When these persons are once raised, we must carefully enjoin them proper tasks, and assign them sentiments and language suitable to their several natures and respective properties. A raven should not be extolled for her voice, nor a bear be represented with an elegant shape. It were a very obvious instance of absurdity, to paint a hare cruel, or a wolf compassionate. An ass were but ill qualified to be general of an army, though he may well enough serve, perhaps, for one of the trumpeters. But so long as popular opinion allows to the lion magnanimity, rage to the tiger, strength to the mule, cunning to the fox, and buffoonery to the monkey; why may not they support the characters of an Agamemnon, Achilles, Ajax, Ulysses, and Thersites? The truth is, when moral actions are with judgment attributed to the brute creation, we scarce perceive that nature is at all violated by the fabulist. He appears at most to have only translated their language. His lions, wolves, and foxes, behave and argue as those creatures would, had they originally been endowed with the human faculties of speech and reason.

But greater art is yet required whenever we personify inanimate beings. Here the copy so far deviates from the great lines of nature, that, without the nicest care, reason will revolt against the fiction. However, beings of this sort, managed ingeniously and with address, recommend the fabulist's invention by the grace of novelty and of variety. Indeed the analogy between things natural and artificial, animate and inanimate, is often so very striking, that we can, with seeming propriety, give passions and sentiments to every individual part of existence. Appearance favours the deception. The vine may be enamoured of the elm; her embraces testify her passion. The swelling mountain may, naturally enough, be delivered of a mouse. The gourd may reproach the pine, and the sky-rocket insult the stars. The axe may solicit a new handle of the forest; and the moon, in her female character, request a fashionable garment. Here is nothing incongruous; nothing that shocks the reader with impropriety. On the other hand, were the axe to desire a periwig, and the moon petition for a new pair of boots, probability would then be violated, and the absurdity become too glaring.

162
The proper style of fable.

The most beautiful fables that ever were invented may be disfigured by the language in which they are clothed. Of this poor Æsop, in some of his English dresses, affords a melancholy proof. The ordinary style of fable should be familiar, but also elegant.

The familiar, says M. La Motte, is the general tone or accent of fable. It was thought sufficient, on its first appearance, to lend the animals our most common language. Nor indeed have they any extraordinary pretensions to the sublime; it being requisite they should speak with the same simplicity that they behave.

The familiar also is more proper for insinuation than the elevated; this being the language of reflection, as the former is the voice of sentiment. We guard ourselves against the one, but lie open to the other; and instruction will always the most effectually sway us, when it appears least jealous of its rights and privileges.

The familiar style, however, that is here required, notwithstanding that appearance of ease which is its character, is perhaps more difficult to write than the more elevated or sublime. A writer more readily perceives when he has risen above the common language, than he perceives, in speaking this language, whether he has made the choice that is most suitable to the occasion: and it is nevertheless, upon this happy choice that all the charms of the familiar depend. Moreover, the elevated style deceives and seduces, although it be not the best chosen; whereas the familiar can procure itself no sort of respect, if it be not easy, natural, just, delicate, and unaffected. A fabulist must therefore bestow great attention upon his style; and even labour it so much the more, that it may appear to have cost him no pains at all.

The authority of Fontaine justifies these opinions in regard to style. His fables are perhaps the best examples of the genteel familiar, as Sir Roger l'Estrange affords the grossest of the indelicate and low. When we read, that "while the frog and the mouse were disputing it at swords-point, down comes a kite powdering upon them in the interim, and gobbles up both together to part the fray; and "where the fox reproaches a bevy of jolly gossipping wenches making merry over a dish of pullets, that if he but peeped into a hen-roost, they always made a bawling with their dogs and their bastards; while you yourselves (says he) can lie stuffing your guts with your hens and capons, and not a word of the pudding." This may be familiar; but it is also coarse and vulgar, and cannot fail to disgust a reader that has the least degree of taste or delicacy.

The style of fable then must be simple and familiar; and it must likewise be correct and elegant. By the former, Of Fables. former, we mean, that it should not be loaded with figure and metaphor; that the disposition of words be natural, the turn of sentences easy, and their construction unembarrassed. By elegance, we would exclude all coarse and provincial terms; all affected and puerile conceits; all obsolete and pedantic phrases. To this we would adjoin, as the word perhaps implies, a certain finishing polish, which gives a grace and spirit to the whole; and which, though it have always the appearance of nature, is almost ever the effect of art.

But notwithstanding all that has been said, there are some occasions on which it is allowable, and even expedient, to change the style. The language of a fable must rise or fall in conformity to the subject. A lion, when introduced in his regal capacity, must hold discourse in a strain somewhat more elevated than a country mouse. The lioness then becomes his queen, and the beasts of the forest are called his subjects; a method that offers at once to the imagination both the animal and the person he is designed to represent. Again, the buffoon-monkey should avoid that pomp of phrase, which the owl employs as her best pretence to wisdom. Unless the style be thus judiciously varied, it will be impossible to preserve a just distinction of character.

Descriptions, at once concise and pertinent, add a grace to fable; but are then most happy when included in the action: whereof the fable of Boreas and the Sun affords us an example. An epithet well chosen is often a description in itself; and so much the more agreeable, as it the less retards us in our pursuit of the catastrophe.

Lastly, little strokes of humour when arising naturally from the subject, and incidental reflections when kept in due subordination to the principal, add a value to these compositions. These latter, however, should be employed very sparingly, and with great address; be very few, and very short: it is scarcely enough that they naturally spring out of the subject; they should be such as to appear necessary and essential parts of the fable. And when these embellishments, pleasing in themselves, tend to illustrate the main action, they then afford that nameless grace remarkable in Fontaine and some few others, and which persons of the best discernment will more easily conceive than they can explain.

Sect. X. *Of Satire.*

163
Origin of satire.

This kind of poem is of very ancient date, and (if we believe Horace) was introduced, by way of interlude, by the Greek dramatic poets in their tragedies, to relieve the audience, and take off the force of those strokes which they thought too deep and affecting. In these satirical interludes, the scene was laid in the country; and the persons were rural deities, satyrs, country peasants, and other rustics.

The first Tragedians found that serious style
Too grave for their uncultivated age,
And so brought wild and naked satyrs in
(Whose motion, words, and shape were all a farce)
As oft as decency would give them leave;
Because the mad, ungovernable rout,
Full of confusion and the fumes of wine,
Lov'd such variety and antic tricks.

Roscommon's Horace.

Of Satire. The satire we now have is generally allowed to be of Roman invention. It was first introduced without the decorations of scenes and action; but written in verses of different measures by Ennius, and afterwards moulded into the form we now have it by Lucilius, whom Horace has imitated, and mentions with esteem. This is the opinion of most of the critics, and particularly of Boileau, who says,

Lucilius led the way, and bravely bold,
To Roman vices did the mirror hold;
Protected humble goodness from reproach,
Show'd worth on foot, and rascals in a coach.
Horace his pleasing wit to this did add,
That none, uncensur'd, might be fools or mad:
And Juvenal, with rhetorician's rage,
Scourg'd the rank vices of a wicked age;
Tho' horrid truths thro' all his labours shine,
In what he writes there's something of divine.

Our satire, therefore, may be distinguished into two kinds; the *jocose*, or that which makes sport with vice and folly, and sets them up to ridicule; and the *serious*, or that which deals in asperity, and is severe and acrimonious. Horace is a perfect master of the first, and Juvenal much admired for the last. The one is facetious, and smiles: the other is angry, and storms. The foibles of mankind are the object of one; but crimes of a deeper dye have engaged the other. They both agree, however, in being pungent and biting: and from a due consideration of the writings of these authors, who are our masters in this art, we may define satire to be, 164
A free, (and often jocose), witty, and sharp poem, Definition of it.
wherein the follies and vices of men are lashed and ridiculed in order to their reformation. Its subject is whatever deserves our contempt or abhorrence, (including every thing that is ridiculous and absurd, or scandalous and repugnant to the golden precepts of religion and virtue). Its manner is *invective;* and its end, *shame.* So that satire may be looked upon as the physician of a distempered mind, which it endeavours to cure by bitter and unsavoury, or by pleasant and salutary, applications.

A good satirist ought to be a man of wit and address, sagacity and eloquence. 165
Qualities of a good satirist.
He should also have a great deal of good-nature, as all the sentiments which are beautiful in this way of writing must proceed from that quality in the author. It is good-nature produces that disdain of all baseness, vice, and folly, which prompts the poet to express himself with such smartness against the errors of men, but without bitterness to their persons. It is this quality that keeps the mind even, and never lets an offence unseasonably throw the satirist out of his character.

In writing satire, care should be taken that it be true and general; that is, levelled at abuses in which numbers are concerned: for the personal kind of satire, or lampoon, which exposes particular characters, and affects the reputation of those at whom it is pointed, is scarcely to be distinguished from scandal and defamation. The poet also, whilst he is endeavouring to correct the guilty, must take care not to use such expressions as may corrupt the innocent: he must therefore avoid all obscene words and images that tend to debase and mislead the mind. Horace and Juvenal, the chief satirists among

Of Satire. among the Romans, are faulty in this respect, and ought to be read with caution.

166 Proper style of satire. The style proper for satire is sometimes grave and animated, inveighing against vice with warmth and earnestness; but that which is pleasant, sportive, and, with becoming raillery, banters men out of their bad dispositions, has generally the best effect, as it seems only to play with their follies, though it omits no opportunity of making them feel the lash. The verses should be smooth and flowing, and the language manly, just, and decent.

> Of well-chose words some take not care enough,
> And think they should be as the subject rough:
> But satire must be more exactly made,
> And sharpest thoughts in smoothest words convey'd.
>
> DUKE OF BUCKS's *Essay*.

Satires, either of the *jocose* or *serious* kind, may be written in the epistolary manner, or by way of dialogue. Horace, Juvenal, and Persius, have given us examples of both. Nay, some of Horace's satires may, without incongruity, be called *epistles*, and his epistles *satires*. But this is obvious to every reader.

Of the facetious kind, the second satire of the second book of Horace imitated by Mr Pope, and Swift's verses on his own death, may be referred to as examples.

As to those satires of the serious kind, for which Juvenal is so much distinguished, the characteristic properties of which are, morality, dignity, and severity; a better example cannot be mentioned than the poem entitled *London*, written in imitation of the third satire of Juvenal, by Dr Johnson, who has kept up to the spirit and force of the original.

Nor must we omit to mention Dr Young's *Love of Fame the Universal Passion*, in seven satires; which, though characteristical, abound with morality and good sense. The characters are well selected, the ridicule is high, and the satire well pointed and to the purpose.

We have already observed, that personal satire approaches too near defamation, to deserve any countenance or encouragement. Dryden's *Mack Flecknoe* is for this reason exceptionable, but as a composition it is inimitable.

167 Benefits of well conducted satire. We have dwelt thus long on the present subject, because there is reason to apprehend, that the benefits arising from well-conducted satire have not been sufficiently considered. A satire may often do more service to the cause of religion and virtue than a sermon; since it gives pleasure, at the same time that it creates fear or indignation, and conveys its sentiments in a manner the most likely to captivate the mind.

> Of all the ways that wisest men could find
> To mend the age and mortify mankind,
> Satire well writ has most successful prov'd,
> And cures, because the remedy is lov'd.
>
> DUKE OF BUCKS's *Essay*.

But to produce the desired effect, it must be jocose, free, and impartial, though severe. The satirist should always preserve good humour; and, however keen he cuts, should cut with kindness. When he loses temper, his weapons will be inverted, and the ridicule he threw at others will retort with contempt upon himself; for the reader will perceive that he is angry and hurt, and consider his satire as the effect of malice, not of judgement; and that it is intended rather to wound persons than reform manners. Of Satire.

> Rage you must hide, and prejudice lay down:
> A satyr's smile is sharper than his frown.

The best, and indeed the only, method to expose vice and folly effectually, is to turn them to ridicule, and hold them up for public contempt; and as it most offends these objects of satire, so it least hurts ourselves. One passion frequently drives out another; and as we cannot look with indifference on the bad actions of men (for they must excite either our wrath or contempt), it is prudent to give way to that which most offends vice and folly, and least affects ourselves; and to sneer and laugh, rather than be angry and scold. 168

Burlesque poetry, which is chiefly used by way of drollery and ridicule, falls properly to be spoken of under the head of satire. An excellent example of this kind is a poem in blank verse, intitled *The Splendid Shilling*, written by Mr John Philips, which, in the opinion of one of the best judges of the age, is the finest burlesque in the English language. In this poem the author has handled a low subject in the lofty style and numbers of Milton; in which way of writing Mr Philips has been imitated by several, but none have come up to the humour and happy turn of the original. When we read it, we are betrayed into a pleasure that we could not expect; though, at the same time, the sublimity of the style, and gravity of the phrase, seem to chastise that laughter which they provoke. Burlesque poetry.—Splendid Shilling—Hudibras.

There is another sort of verse and style, which is most frequently made use of in treating any subject in a ludicrous manner, viz. that which is generally called *Hudibrastic*, from Butler's admirable poem intitled *Hudibras*. Almost every one knows, that this poem is a satire upon the authors of our civil dissensions in the reign of King Charles I. wherein the poet has, with abundance of wit and humour, exposed and ridiculed the hypocrisy or blind zeal of those unhappy times. In short, it is a kind of burlesque epic poem, which, for the oddity of the rhymes, the quaintness of the similies, the novelty of the thoughts, and that fine raillery which runs through the whole performance, is not to be paralleled.

SECT. XI. *Of the Epigram.*

169

THE *epigram is a little poem, or composition in verse, treating of one thing only, and whose distinguishing characters are*, brevity, beauty, and point. Character of the epigram.

The word *epigram* signifies "inscription;" for epigrams derive their origin from those inscriptions placed by the ancients on their statues, temples, pillars, triumphal arches, and the like; which, at first, were very short, being sometimes no more than a single word; but afterwards, increasing their length, they made them in verse, to be the better retained by the memory. This short way of writing came at last to be used upon any occasion or subject; and hence the name of *epigram* has been given to any little copy of verses, without regard to the original application of such poems.

Its usual limits are from two to 20 verses, though sometimes it extends to 50; but the shorter, the better it is, and the more perfect, as it partakes more of the nature

Epigram. nature and character of this kind of poem: besides, the epigram, being only a single thought, ought to be expressed in a little compass, or else it loses its force and strength.

The beauty required in an epigram is an harmony and apt agreement of all its parts, a sweet simplicity, and polite language.

The point is a sharp, lively, unexpected turn of wit, with which an epigram ought to be concluded. There are some critics, indeed, who will not admit the point in an epigram; but require that the thought be equally diffused through the whole poem, which is usually the practice of Catullus, as the former is that of Martial. It is allowed there is more delicacy in the manner of Catullus; but the point is more agreeable to the general taste, and seems to be the chief characteristic of the epigram.

170 Of what subjects it admits.

This sort of poem admits of all manner of subjects, provided that brevity, beauty, and point, are preserved; but it is generally employed either in praise or satire.

Though the best epigrams are said to be such as are comprised in two or four verses, we are not to understand it as if none can be perfect which exceed those limits. Neither the ancients nor moderns have been so scrupulous with respect to the length of their epigrams; but, however, brevity in general is always to be studied in these compositions.

171 Examples of English epigrams remarkable for their delicacy, and

For examples of good epigrams in the English language, we shall make choice of several in the different tastes we have mentioned; some remarkable for their delicate turn and simplicity of expression; and others for their salt and sharpness, their equivocating pun, or pleasant allusion. In the first place, take that of Mr Pope, said to be written on a glass with the earl of Chesterfield's diamond-pencil.

Accept a miracle, instead of wit;
See two dull lines by Stanhope's pencil writ.

The beauty of this epigram is more easily seen than described; and it is difficult to determine, whether it does more honour to the poet who wrote it, or to the nobleman for whom the compliment is designed.—The following epigram of Mr Prior is written in the same taste, being a fine encomium on the performance of an excellent painter.

On a Flower, painted by VARELST.

When fam'd Varelst this little wonder drew,
Flora vouchsaf'd the growing work to view;
Finding the painter's science at a stand,
The goddess snatch'd the pencil from his hand,
And, finishing the piece, she smiling said,
Behold one work of mine which ne'er shall fade.

Another compliment of this delicate kind he has made Mr Howard in the following epigram.

VENUS *Mistaken.*

When Chloe's picture was to Venus shown;
Surpris'd, the goddess took it for her own.
And what, said she, does this bold painter mean?
When was I bathing thus, and naked seen?
Pleas'd Cupid heard, and check'd his mother's pride:
And who's blind now, mamma? the urchin cry'd.
'Tis Chloe's eye, and cheek, and lip, and breast:
Friend Howard's genius fancy'd all the rest.

Most of Mr Prior's epigrams are of this delicate cast, and have the thought, like those of Catullus, diffused through the whole. Of this kind is his address

To CHLOE *Weeping.*

See, whilst thou weep'st, fair Chloe, see
The world in sympathy with thee.
The cheerful birds no longer sing,
Each drops his head, and hangs his wing.
The clouds have bent their bosom lower,
And shed their sorrow in a shower.
The brooks beyond their limits flow,
And louder murmurs speak their wo:
The nymphs and swains adopt thy cares;
They heave thy sighs, and weep thy tears.
Fantastic nymph! that grief should move
Thy heart obdurate against love.
Strange tears! whose pow'r can soften all
But that dear breast on which they fall.

The epigram written on the leaves of a fan by Dr Atterbury, late bishop of Rochester, contains a pretty thought, expressed with ease and conciseness, and closed in a beautiful manner.

On a FAN.

Flavia the least and slightest toy
Can with resistless art employ.
This fan in meaner hands would prove
An engine of small force in love.
Yet she, with graceful air and mien,
Not to be told or safely seen,
Directs its wanton motion so,
That it wounds more than Cupid's bow,
Gives coolness to the matchless dame,
To ev'ry other breast a flame.

We shall now select some epigrams of the biting and satirical kind, and such as turn upon the *pun* or *equivoque*, as the French call it: in which sort the point is more conspicuous than in those of the former character.

The following distich is an admirable epigram, having all the necessary qualities of one, especially point and brevity.

On a Company of bad DANCERS *to good Music.*

How ill the motion with the music suits!
So Orpheus fiddled, and so danc'd the brutes.

This brings to mind another epigram upon a bad fiddler, which we shall venture to insert merely for the humour of it, and not for any real excellence it contains.

To a bad FIDDLER.

Old Orpheus play'd so well, he mov'd Old Nick;
But thou mov'st nothing but thy fiddle stick.

One of Martial's epigrams, where he agreeably rallies the foolish vanity of a man who hired people to make verses for him, and publish them as his own, has been thus translated into English.

Paul, so fond of the name of a poet is grown,
With gold he buys verses, and calls them his own.

Epigram.

Go on, master Paul, nor mind what the world says,
They are surely his own for which a man pays.

Some bad writer having taken the liberty to censure Mr Prior, the poet very wittily lashed his impertinence in this epigram:

While faster than his costive brain indites
Philo's quick hand in flowing letters writes,
His case appears to me like honest Teague's
When he was run away with by his legs.
Phœbus, give Philo o'er himself command;
Quicken his senses, or restrain his hand:
Let him be kept from paper, pen, and ink;
So he may cease to write, and learn to think.

Mr Wesley has given us a pretty epigram, alluding to a well-known text of Scripture on the setting up a monument in Westminster Abbey, to the memory of the ingenious Mr Butler, author of *Hudibras*.

While Butler, needy wretch, was yet alive,
No generous patron would a dinner give.
See him when starv'd to death, and turn'd to dust,
Presented with a monumental bust!
The poet's fate is here in emblem shown;
He ask'd for *Bread*, and he receiv'd a *Stone*.

We shall close this section with an epigram written on the well known story of Apollo and Daphne, by Mr Smart.

When Phœbus was am'rous and long'd to be rude,
Miss Daphne cried Pish! and ran swift to the wood;
And rather than do such a naughty affair,
She became a fine laurel to deck the god's hair.
The nymph was, no doubt of a cold constitution;
For sure, to turn tree was an odd resolution!
Yet in this she behav'd like a true modern spouse,
For she fled from his arms to distinguish his brows.

Sect. XII. *Of the Epitaph.*

173 Character of the epitaph.

These compositions generally contain some eulogium of the virtues and good qualities of the deceased, and have a turn of seriousness and gravity adapted to the nature of the subject. Their elegance consists in a nervous and expressive brevity; and sometimes they are closed with an epigrammatic point. In these compositions, no mere epithet (properly so called) should be admitted: for here illustration would impair the strength, and render the sentiment too diffuse and languid. Words that are synonymous are also to be rejected.

Though the true characteristic of the epitaph is seriousness and gravity, yet we may find many that are jocose and ludicrous: some likewise have true metre and rhyme; while others are between prose and verse, without any certain measure, though the words are truly poetical; and the beauty of this last sort is generally heightened by an apt and judicious antithesis. We shall give examples of each.

The following epitaph on Sir Philip Sydney's sister, the countess of Pembroke, said to be written by the famous Ben Jonson, is remarkable for the noble thought with which it concludes.

Epitaph.

On Mary Countess-dowager of Pembroke.

174 Epitaphs in verse, with remarks upon them.

Underneath this marble hearse,
Lies the subject of all verse,
Sidney's sister, Pembroke's mother:
Death, ere thou hast kill'd another
Fair, and learn'd, and good as she,
Time shall throw a dart at thee.

Take another epitaph of Ben Johnson's, on a beautiful and virtuous lady, which has been deservedly admired by very good judges.

Underneath this stone doth lie
As much virtue as could die;
Which when alive did vigour give
To as much beauty as could live.

The following epitaph by Dr Samuel Johnson, on a musician much celebrated for his performance, will bear a comparison with these, or perhaps with any thing of the kind in the English language.

Philips? whose touch harmonious could remove
The pangs of guilty pow'r and hapless love,
Rest here, distrest by poverty no more;
Find here that calm thou gav'st so oft before;
Sleep undisturb'd within this peaceful shrine,
Till angels wake thee with a note like thine.

It is the just observation of an eminent critic, that the best subject for epitaphs is private virtue; virtue exerted in the same circumstances in which the bulk of mankind are placed, and which, therefore, may admit of many imitators. He that has delivered his country from oppression, or freed the world from ignorance and error, besides that he stands in no need of monumental panegyric, can excite the emulation of a very small number. The bare name of such men answers every purpose of a long inscription, because their achievements are universally known, and their fame is immortal.—But the virtues of him who has repelled the temptations of poverty, and disdained to free himself from distress at the expence of his honour or his conscience, as they were practised in private, are fit to be told, because they may animate multitudes to the same firmness of heart and steadiness of resolution. On this account, there are few epitaphs of more value than the following, which was written by Pope on Mrs Corbet, who died of a cancer in her breast.

Here rests a woman, good without pretence,
Blest with plain reason, and with sober sense;
No conquest she, but o'er herself desir'd;
No arts essay'd, but not to be admir'd.
Passion and pride were to her soul unknown,
Convinc'd that virtue only is our own.
So unaffected, so compos'd a mind,
So firm, yet soft, so strong, yet so refin'd,
Heav'n, as its purest gold, by tortures try'd;
The saint sustain'd it, but the woman dy'd.

This epitaph, as well as the second quoted from Ben Johnson, has indeed one fault; the name is omitted. The end of an epitaph is to convey some account of the dead; and to what purpose is any thing told of him, whose

Epitaph.

whose name is concealed? The name, it is true, may be inscribed by itself upon the stone; but such a shift of the poet is like that of an unskilful painter, who is obliged to make his purpose known by adventitious help.

Amongst the epitaphs of a punning and ludicrous cast, we know of none prettier than that which is said to have been written by Mr Prior on himself, wherein he is pleasantly satirical upon the folly of those who value themselves upon account of the long series of ancestors through which they can trace their pedigree.

Nobles and heralds, by your leave,
Here lie the bones of Matthew Prior,
The son of Adam and of Eve:
Let Bourbon or Nassau go higher.

The following epitaph on a miser contains a good caution and an agreeable raillery.

Reader, beware immod'rate love of pelf:
Here lies the worst of thieves, who robb'd himself.

But Dr Swift's epitaph on the same subject is a masterpiece of the kind.

Beneath this verdant hillock lies
Demer, the wealthy and the wise.
His heirs, that he might safely rest,
Have put his carcase in a chest:
The very chest, in which, they say,
His other Self, his money, lay.
And if his heirs continue kind
To that dear self he left behind,
I dare believe that four in five
Will think his better half alive.

We shall give but one example more of this kind which is a merry epitaph on an old fiddler, who was remarkable (we may suppose) for beating time to his own music.

On STEPHEN *the Fiddler.*

Stephen and time are now both even;
Stephen beat time, now time's beat Stephen.

175 Epitaphs in prose encomiastic and

We are come now to that sort of epitaph which rejects rhyme, and has no certain and determinate measure; but where the diction must be pure and strong, every word have weight, and the antithesis be preserved in a clear and direct opposition. We cannot give a better example of this sort of epitaph than that on the tomb of Mr Pulteney in the cloisters of Westminster-abbey.

Reader,
If thou art a BRITON,
Behold this Tomb with Reverence and Regret:
Here lie the Remains of
DANIEL PULTENEY,
The kindest Relation, the truest Friend,
The warmest Patriot, the worthiest Man.
He exercised Virtues in this Age,
Sufficient to have distinguished him even in the best.
Sagacious by Nature,
Industrious by Habit,
Inquisitive with art;
He gain'd a complete Knowledge of the state of Britain,
Foreign and Domestic;
In most the backward Fruit of tedious Experience,
In him the early acquisition of undissipated Youth.
He serv'd the Court several Years:
Abroad, in the auspicious reign of Queen Anne;
At home, in the reign of that excellent prince K. George I
He serv'd his Country always,
At Court independent,
In the Senate unbiass'd,
At every age, and in every Station,
This was the bent of his generous Soul,
This the business of his laborious Life.
Public Men, and Public Things,
He judged by one constant Standard,
The True Interest of Britain:
He made no other Distinction of Party,
He abhorred all other.
Gentle, humane, disinterested, beneficent,
He created no Enemies on his own Account:
Firm, determined, inflexible,
He feared none he could create in the Cause of Britain
Reader,
In this Misfortune of thy Country lament thy own:
For know
The Loss of so much private Virtue
Is a public Calamity.

That poignant satire, as well as extravagant praise may be conveyed in this manner, will be seen by the following epitaph written by Dr Arbuthnot on Franc. Charteris; which is too well known, and too much admired, to need our commendation.

HERE continueth to rot
The body of FRANCIS CHARTERIS,
Who with an INFLEXIBLE CONSTANCY,
And INIMITABLE UNIFORMITY of Life,
PERSISTED,
In spite of AGE and INFIRMITIES,
In the Practice of EVERY HUMAN VICE,
Excepting PRODIGALITY and HYPOCRISY:
His insatiable AVARICE exempted him from the first
His matchless IMPUDENCE from the second.
Nor was he more singular
In the undeviating *Pravity* of his *Manners*,
Than successful
In *Accumulating* WEALTH:
For, without TRADE or PROFESSION,
Without TRUST of PUBLIC MONEY,
And without BRIBE-WORTHY SERVICE,
He acquired, or more properly created,
A MINISTERIAL ESTATE.
He was the only Person of his Time
Who could CHEAT without the Mask of HONESTY;
Retain his Primæval MEANNESS
When possessed of TEN THOUSAND a-year;
And having daily deserved the GIBBET for what he *di*
Was at last condemned to it for what he *could* not *do*
Oh indignant reader!
Think not his Life useless to Mankind;
PROVIDENCE conniv'd at his execrable designs,
To give to After-ages
A conspicuous PROOF and EXAMPLE
Of how small Estimation is EXORBITANT WEALTH
In the Sight of GOD,
By His bestowing it on the most UNWORTHY of AL
MORTALS.

W

Epitaph.

We shall conclude this species of poetry with a droll and satirical epitaph written by Mr Pope, which we transcribed from a monument in Lord Cobham's gardens at Stow in Buckinghamshire.

To the Memory
of
SIGNIOR FIDO,
An *Italian* of good extraction;
Who came into *England*,
Not to bite us, like most of his Countrymen,
But to gain an honest Livelihood.
He hunted not after Fame,
Yet acquir'd it;
Regardless of the Praise of his Friends,
But most sensible of their Love,
Though he liv'd amongst the Great,
He neither learnt nor flatter'd any Vice.
He was no Bigot,
Though he doubted of none of the 39 Articles.
And if to follow Nature,
And to respect the laws of Society,
Be Philosophy,
He was a perfect Philosopher,
A faithful Friend,
An agreeable Companion,
A loving Husband
Distinguish'd by a numerous offspring,
All which he liv'd to see take good Courses.
In his old Age he retired
To the house of a Clergyman in the country,
Where he finished his earthly Race,
And died an Honour and an Example to the whole Species.
Reader,
This Stone is guiltless of Flattery;
For he to whom it is inscrib'd
Was not a MAN,
But a
GRE-HOUND.

PART III. ON VERSIFICATION.

On this subject it is meant to confine our inquiry to Latin or Greek hexameters, and to French and English heroic verse; as the observations we shall have occasion to make, may, with proper variations, be easily transferred to the composition of other sorts of verse.

177 Essentials of verse.

Before entering upon particulars, it must be premised in general, that to verse of every kind five things are of importance. 1st, The number of syllables that compose a line. 2d, the different lengths of syllables, i. e. the difference of time taken in pronouncing. 3d, The arrangement of these syllables combined in words. 4th, The pauses or stops in pronouncing. 5th, Pronouncing syllables in a high or a low tone. The three first mentioned are obviously essential to verse: if any of them be wanting, there cannot be that higher degree of melody which distinguisheth verse from prose. To give a just notion of the fourth, it must be observed,

178 Regulation of pauses.

that pauses are necessary for three different purposes: one, to separate periods, and members of the same period, according to the sense: another, to improve the melody of verse: and the last to afford opportunity for drawing breath in reading. A pause of the first kind is variable, being long or short, frequent or less frequent, as the sense requires. A pause of the second kind being determined by the melody, is in no degree arbitrary. The last sort is in a measure arbitrary, depending on the reader's command of breath. But as one cannot read with grace, unless, for drawing breath, opportunity be taken of a pause in the sense or in the melody, this pause ought never to be distinguished from the others; and for that reason shall be laid aside. With respect then to the pauses of sense and of melody, it may be affirmed without hesitation, that their coincidence in verse is a capital beauty: but as it cannot be expected, in a long work especially, that every line should be so perfect; we shall afterward have occasion to see, that unless the reader be uncommonly skilful, the pause necessary for the sense must often, in some degree, be sacrificed to the verse-pause, and the latter sometimes to the former.

The pronouncing syllables in a high or low tone contributes also to melody. In reading, whether verse or prose, a certain tone is assumed, which may be called the *key-note*; and in that tone the bulk of the words are sounded. Sometimes to humour the sense, and sometimes the melody, a particular syllable is sounded in a higher tone, and this is termed *accenting a syllable*, or gracing it with an accent. Opposed to the accent is the cadence, which, however, being entirely regulated by the sense, hath no peculiar relation to verse. The cadence is a falling of the voice below the key-note at the close of every period; and so little is it essential to verse, that in correct reading the final syllable of every line is accented, that syllable only excepted which closes the period, where the sense requires a cadence.

Though the five requisites above mentioned enter the composition of every species of verse, they are however governed by different rules, peculiar to each species. Upon quantity only, one general observation may be 179 Quantity.
premised, because it is applicable to every species of verse. That syllables, with respect to the time taken in pronouncing, are long or short; two short syllables, with respect to time, being precisely equal to a long one. These two lengths are essential to verse of all kinds; and to no verse, it is believed, is a greater variety of time necessary in pronouncing syllables. The voice indeed is frequently made to rest longer than usual upon a word that bears an important signification; but this is done to humour the sense, and is not necessary for melody. A thing not more necessary for melody occurs with respect to accenting, similar to that now mentioned: A word signifying any thing humble, low, or dejected, is naturally, in prose as well as in verse, pronounced in a tone below the key-note.

We are now sufficiently prepared for particulars; beginning with Latin or Greek hexameter, which are the same. The observations upon this species of verse will come under the four following heads: number, arrangement, pause, and accent; for as to quantity, what is observed above may suffice.

I. HEXAMETER

Versification.

150 Hexameter verses of the Greeks and Romans consist of what feet.

I. HEXAMETER LINES, as to time, are all of the same length; being equivalent to the time taken in pronouncing twelve long syllables or twenty four short. An hexameter line may consist of seventeen syllables; and when regular and not spondaic it never has fewer than thirteen; whence it follows, that where the syllables are many, the plurality must be short; where few, the plurality must be long.

This line is susceptible of much variety as to the succession of long and short syllables. It is, however, subjected to laws that confine its variety within certain limits: and for ascertaining these limits, grammarians have invented a rule by dactyles and spondees, which they denominate *feet*.

Among the ancient Greeks and Romans, these feet regulated the pronunciation, which they are far from doing among us; of which the reason will be discovered from the explanation that we shall give of the English accent. We shall at present content ourselves with pointing out the difference between our pronunciation and that of the Romans in the first line of Virgil's eclogues, where it is scarcely credible how much we pervert the quantity.

Tit'yre tù pat'ulæ rec'ubans sub teg'mine fági.

It will be acknowledged by every reader who has an ear, that we have placed the accentual marks upon every syllable, and the letter of every syllable, that an Englishman marks with the *ictus* of his voice when he recites the line. But, as will be seen presently, a syllable which is pronounced with the stress of the voice upon a consonant is uttered in the shortest time possible. Hence it follows, that in this verse, as recited by us, there are but two long syllables, *tú* and *fá*; though it is certain, that, as recited by a Roman, it contained no fewer than eight long syllables.

Tī'ȳrĕ | tū pătŭ|lāe rĕcŭ|bāns sūb | tēgmĭnĕ | fāgī.

But though to pronounce it in this manner with the voice dwelling on the vowel of each long syllable would undoubtedly be correct, and preserve the true movement of the verse, yet to an English ear, prejudiced in behalf of a different movement, it sounds so very uncouth, that Lord Kames has pronounced the true feet of the Greek and Roman verses extremely artificial and complex; and has substituted in their stead the following rules, which he thinks more simple and of more easy application. 1st, The line must always commence with a long syllable, and close with two long preceded by two short. 2d, More than two short can never be found together, nor fewer than two. And, 3d, Two long syllables which have been preceded by two short cannot also be followed by two short. These few rules fulfil all the conditions of a hexameter line with relation to order or arrangement. For these again a single rule may be substituted, which has also the advantage of regulating more affirmatively the construction of every part. To put this rule into words with perspicuity, a hint is taken from the twelve long syllables that compose an hexameter line, to divide it into twelve equal parts or portions, being each of them one long syllable or two short. The rule then is: "The 1st, 3d, 5th, 7th, 9th, 11th, and 12th portions, must each of them be one long syllable; the 10th must always be two short syllables; the 2d, 4th, 6th, and 8th, may either be one long or two short." Or to express the thing still mor shortly, "The 2d, 4th, 6th, and 8th portions may b one long syllable or two short; the 10th must be tw short syllables; all the rest must consist each of one lon syllable." This fulfils all the conditions of an hexame ter line, and comprehends all the combinations of dactyl and spondees that this line admits.

Elem. of Criticism, chap. xviii. sect. 4.

Next in order comes the pause. At the end of ever hexameter line, every one must be sensible of a complet close or full pause; the cause of which follows. Th two long syllables preceded by two short, which alwa close an hexameter line, are a fine preparation for pause: for long syllables, or syllables pronounced slov resembling a slow and languid motion tending to res naturally incline the mind to rest, or, which is the sam to pause; and to this inclination the two preceding sho syllables contribute, which, by contrast, make the slo pronunciation of the final syllables the more conspicuou Beside this complete close or full pause at the end, othe are also requisite for the sake of melody; of which tw are clearly discoverable, and perhaps there may be mor The longest and most remarkable succeeds the 5th po tion: the other, which, being shorter and more fain may be called the *semipause*, succeeds the 8th portio So striking is the pause first mentioned, as to be disti guished even by the rudest ear: the monkish rhym are evidently built upon it; in which, by an invariab rule, the final word always chimes with that which in mediately precedes the pause:

De planctu cudo || metrum cum carmine nudo
Mingere cum bumbis || res est saluberrima lumbis.

The difference of time in the pause and semipause o casions another difference not less remarkable; that is lawful to divide a word by a semipause, but never b a pause, the bad effect of which is sensibly felt in th following examples:

Effusus labor, at||que inmitis rupta Tyranni

Again:
Observans nido im||plumes detraxit; at illa

Again:
Loricam quam De||moleo detraxerat ipse

The dividing a word by a semipause has not the san bad effect:

Jamque pedem referens || casus e|vaserat omnes.

Again:
Qualis populea || mœrens Philo|mela sub umbra

Again:
Ludere quæ vellem || calamo per|misit agresti.

Lines, however, where words are left entire, withou being divided even by a semipause, run by that mea much the more sweetly.

Nec gemere aërea || cessabit | turtur ab ulmo.

Again:
Quadrupedante putrem || sonitu quatit | ungula campu

Again:
Eurydicen toto || referebant | flumine ripæ.

The reason of these observations will be evident up the slightest reflection. Between things so intimate connect

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connected in reading aloud as are sense and sound, every degree of discord is unpleasant: and for that reason it is a matter of importance to make the musical pauses coincide as much as possible with those of sense; which is requisite more especially with respect to the pause, a deviation from the rule being less remarkable in a semipause. Considering the matter as to melody solely, it is indifferent whether the pauses be at the end of words or in the middle; but when we carry the sense along, it is disagreeable to find a word split into two by a pause, as if there were really two words: and though the disagreeableness here be connected with the sense only, it is by an easy transition of perceptions transferred to the sound; by which means we conceive a line to be harsh and grating to the ear, when in reality it is only so to the understanding.

To the rule that fixes the pause after the 5th portion there is one exception and no more. If the syllable succeeding the 5th portion be short, the pause is sometimes postponed to it.

Pupillis quos dura || premit custodia matrum

Again:

In terras oppressa || gravi sub religione

Again:

Et quorum pars magna || fui; quis talia fando

This contributes to diversify the melody; and, where the words are smooth and liquid, is not ungraceful; as in the following examples:

Formosam resonare || doces Amaryllida sylvas

Again:

Agricolas, quibus ipsa || procul discordibus armis.

If this pause, placed as aforesaid after the short syllable, happen also to divide a word, the melody by these circumstances is totally annihilated. Witness the following line of Ennius, which is plain prose:

Romæ mœnia terru||it impiger Hannibal armis.

182 Sense.

Hitherto the arrangement of the long and short syllables of an hexameter line, and its different pauses, have been considered with respect to melody: but to have a just notion of hexameter verse, these particulars must also be considered with respect to sense. There is not perhaps in any other sort of verse such latitude in the long and short syllables; a circumstance that contributes greatly to that richness of melody which is remarkable in hexameter verse, and which made Aristotle pronounce that an epic poem in any other verse would not succeed *. One defect, however, must not be dissembled, that the same means which contribute to the richness of the melody render it less fit than several other sorts for a narrative poem. There cannot be a more artful contrivance, as above observed, than to close an hexameter line with two long syllables preceded by two short: but unhappily this construction proves a great embarrassment to the sense; which will thus be evident. As in general there ought to be a strict concordance between the thought and the words in which it is dressed; so, in particular, every close in the sense ought to be accompanied with a close in the sound. In prose this law may be strictly observed, but in verse the same strictness would occasion insuperable difficulties. Willing to sacrifice to the melody of verse some share of the concordance between thought and expression, we freely excuse the separation of the musical pause from that of the sense during the course of a line; but the close of an hexameter line is too conspicuous to admit this liberty: for which reason there ought always to be some pause in the sense at the end of every hexameter line, were it but such a pause as is marked by a comma; and for the same reason there ought never to be a full close in the sense but at the end of a line, because there the melody is closed. An hexameter line, to preserve its melody, cannot well admit any great relaxation; and yet, in a narrative poem, it is extremely difficult to adhere strictly to the rule even with these indulgences. Virgil, the chief of poets for versification, is forced often to end a line without any close in the sense, and as often to close the sense during the running of a line; though a close in the melody during the movement of the thought, or a close in the thought during the movement of the melody, cannot be agreeable.

* Poet. cap. 25.

183 Observations on the accent.

The accent, to which we proceed, is not less essential than the other circumstances above noticed. By a good ear it will be discerned, that in every line there is one syllable distinguishable from the rest by a capital accent: That syllable, being the seventh portion, is invariably long.

Nec bene promeritis || capitûr nec | tangitur ira

Again:

Non sibi sed toto || genitûm se | credere mundo

Again:

Qualis spelunca || subitò commota columba

In these examples the accent is laid upon the last syllable of a word; which is favourable to the melody in the following respect, that the pause, which for the sake of reading distinctly must follow every word, gives opportunity to prolong the accent. And for that reason, a line thus accented has a more spirited air than when the accent is placed on any other syllable. Compare the foregoing lines with the following.

Alba neque Assyrio || fucâtur | lana veneno

Again:

Panditur interea || domus ômnipo|tentis Olympi

Again:

Olli sedato || respôndit | corde Latinus.

In lines where the pause comes after the short syllable succeeding the 5th portion, the accent is displaced, and rendered less sensible: it seems to be split into two, and to be laid partly on the 5th portion, and partly on the 7th, its usual place; as in

Nuda genu, nodôque || sinûs col|lecta fluentes.

Again:

Formosam resonâre || docês Amar|yllida sylvas.

Beside this capital accent, slighter accents are laid upon other portions; particularly upon the 4th, unless where it consists of two short syllables; upon the 9th, which is always a long syllable; and upon the 11th, where

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where the line concludes with a monosyllable. Such conclusion, by the by, impairs the melody, and for that reason is not to be indulged unless where it is expressive of the sense. The following lines are marked with all the accents.

Ludere quæ vêllem calamô permîsit agresti

Again:

Et duræ quêrcus sudâbunt rôscida mella

Again:

Parturiunt môntes, nascîtur rîdiculûs mus.

184
Order and arrangement do not constitute the whole melody of an hexameter verse.

Reflecting upon the melody of hexameter verse, we find, that order or arrangement doth not constitute the whole of it: for when we compare different lines, equally regular as to the succession of long and short syllables, the melody is found in very different degrees of perfection; which is not occasioned by any particular combination of dactyles and spondees, or of long and short syllables, because we find lines where dactyles prevail, and lines where spondees prevail, equally melodious. Of the former take the following instance:

Æneadum genitrix hominum divumque voluptas.

Of the latter:

Molli paulatim flavescet campus arista.

What can be more different as to melody than the two following lines, which, however, as to the succession of long and short syllables, are constructed precisely in the same manner?

Spond. Dact. Spond. Spond. Dact. Spond.
Ad talos stola dimissa et circumdata palla. HOR.

Spond. Dact. Spond. Spond. Dact. Spond.
Placatumque nitet diffuso lumine cœlum. LUCRET.

In the former, the pause falls in the middle of a word, which is a great blemish, and the accent is disturbed by a harsh elision of the vowel *a* upon the particle *et*. In the latter, the pauses and the accent are all of them distinct and full: there is no elision: and the words are more liquid and sounding. In these particulars consists the beauty of an hexameter line with respect to melody; and by neglecting these, many lines in the satires and epistles of Horace are less agreeable than plain prose; for they are neither the one nor the other in perfection. To draw melody from these lines, they must be pronounced without relation to the sense: it must not be regarded that words are divided by pauses, nor that harsh ellisions are multiplied. To add to the account, prosaic low-sounding words are introduced; and, which is still worse, accents are laid on them. Of such faulty lines take the following instances.

Candida rectaque sit, munda hactenus sit neque longa.

Jupiter exclamat simul atque audirit; at in se

Custodes, lectica, ciniflones, parasitæ

Optimus est modulator, ut Alfenus Vafer omni

Nunc illud tantum quæram, meritone tibi sit.

These observations on pauses and semi-pauses, and on the structure of an hexameter line, are doubtless ingenious; but it is by no means certain that a strict attention to them would assist any man in the writing of such verses as would have been pleasing to a Roman ear. Many of his lordship's rules have no other foundation than what rests on our improper mode of accenting Latin words; which to Virgil or Lucretius would probably have been as offensive as the Scotch accent is to a native of Middlesex.

II. Next in order comes ENGLISH HEROIC VERSE; which shall be examined under the heads of *number*, *accent*, *quantity*, *movement*, and *pause*. These have been treated in so clear and masterly a manner by Sheridan in his Art of Reading, that we shall have little more to do than abridge his doctrine, and point out the few instances in which attachment to a system and partiality to his native tongue seem to have betrayed him into error, or at least made him carry to an extreme what is just only when used with moderation.

"Numbers in the strict sense of the word *, whether with regard to poetry or music, consist in certain impressions made on the ear at stated and regular distances. The lowest species of numbers is a *double* stroke of the same note or sound, repeated a certain number of times, at equal distances. The repetition of the same *single* note in a continued series, and exactly at equal distances, like the ticking of a clock, has in it nothing numerous; but the same note, *twice* struck a certain number of times, with a pause between each *repetition* of double the time of that between the *strokes*, is numerous. The reason is, that the pleasure arising from *numbers*, consists in the observation of *proportion;* now the repetition of the same note, in exactly the *same intervals*, will admit of no proportion. But the same note *twice* struck, with the pause of *one* between the two strokes, and repeated again at the distance of a pause equal to *two*, admits of the proportional measurement in the pauses of *two* to *one*, to which time can be beaten, and is the lowest and simplest species of numbers. It may be exemplified on the drum, as tu'm-tu'm--tu'm-tu'm--tu'm-tu'm, &c.

* *Art of Reading*, vol. ii.

"The next progression of numbers is, when the same note is repeated, but in such a way as that one makes a more sensible impression on the ear than the other, by being more forcibly struck, and therefore having a greater degree of loudness; as tĭ-tu'm--tĭ-tu'm; or, tu'm-tĭ--tu'm-tĭ: or when two weak notes precede a more forcible one, as tĭ-tĭ-tu'm--tĭ-tĭ-tu'm; or when the weak notes follow the forcible one, tu'm-tĭ-tĭ--tu'm-tĭ-tĭ.

"In the first and lowest species of numbers which we have mentioned, as the notes are exactly the same in every respect, there can be no proportion observed but in the time of the pauses. In the second, which rises in a degree just above the other, though the notes are still the same, yet there is a diversity to be observed in their respective loudness and softness, and therefore a measurable proportion of the quantity of sound. In them we must likewise take into consideration the order of the notes, whether they proceed from strong to weak, or from weak to strong; for this diversity of order occasions a great difference in the impressions made upon the ear, and in the effects produced upon the mind. To express the diversity of order in the notes in all its several kinds, the common term *movement* may be used, as the term *measure* will properly enough express the different proportions of time both in the pauses and in the notes."

For

Versification.

For it is to be observed, that all notes are not of the same length or on the same key. In poetry, as well as in music, notes may be high or low, flat or sharp; and some of them may be prolonged at pleasure. "Poetic numbers are indeed founded upon the very same principles with those of the musical kind, and are governed by similar laws (see MUSIC). Proportion and order are the sources of the pleasure which we receive from both; and the beauty of each depends upon a due observation of the laws of measure and movement. The essential difference between them is, that the matter of the one is articulate, that of the other inarticulate sounds: but syllables in the one correspond to notes in the other; poetic feet to musical bars; and verses to strains; in a word, they have all like properties, and are governed by laws of the same kind.

"From what has been said, it is evident, that the *essence* of numbers consists in certain impressions made on the mind through the ear at stated and regular distances of time, with an observation of a relative proportion in those distances; and that the other circumstances of long or short in syllables, or diversity of notes in uttering them, are *not* essentials but only *accidents* of poetic numbers. Should this be questioned, the objector might be silenced by having the experiment tried on a drum, on which, although it is incapable of producing long or short, high or low notes, there is no kind of metre which may not be beat. That, therefore, which regulates the series and movement of the impressions given to the ear by the recitation of an English verse, must, when properly disposed, constitute the essence of English poetic numbers; but it is the accent which particularly impresses the sound of certain syllables or letters upon the ear; for in every word there is a syllable or letter accented. The necessity and use of the accent, as well in prose as in verse, we shall therefore proceed to explain.

"As words may be formed of various numbers of syllables, from one up to eight or nine*, it was necessary that there should be some peculiar mark to distinguish words from disjointed syllables, otherwise speech would be nothing but a continued succession of syllables conveying no ideas. This distinction of one word from another might be made by a perceptible pause at the end of each in speaking, analogous to the distance made between them in writing and in printing. But these pauses would make discourse disgustingly tedious; and though they might render words sufficiently distinct, they would make the meaning of sentences extremely confused. Words might also be distinguished from each other, and from a collection of detached syllables, by an *elevation* or *depression* of the voice upon one syllable of each word; and this, as is well known to the learned, was the practice of the Greeks and Romans. But the English tongue has for this purpose adopted a mark of the easiest and simplest kind, which is called *accent*. By accent is meant, a certain stress of the voice, upon a particular letter of a syllable, which distinguishes it from the rest, and at the same time distinguishes the syllable itself to which it belongs from the other syllables which compose the word. Thus, in the word *hab'it*, the accent upon the *b* distinguishes that letter from the others, and the first syllable from the last; add more syllables to it, and it will still do the same, as *hab'itable*. In the word *accep't*, the *p* is the distinguished letter, and the syllable which contains it the distinguished syllable; but if we add more syllables to it, as in the word *ac'ceptible*, the seat of the accent is changed to the first syllable, of which *c* is the distinguished letter. Every word in our language of more syllables than one has one of the syllables distinguished from the rest in this manner, and every monosyllable has a letter. Thus, in the word *hat'* the *t* is accented, in *háte* the vowel *a*, in *cub'* the *b*, and in *cúbe* the *u*: so that as articulation is the essence of syllables, accent is the essence of words; which without it would be nothing more than a mere succession of syllables."

* Art of Reading, vol. i.

We have said, that it was the practice of the Greeks and Romans to elevate or depress their voice upon one syllable of each word. In this elevation or depression consisted their accent; but the English accent consists in the mere stress of the voice, without any change of note. "Among the Greeks, all syllables were pronounced either in a high, low, or middle note; or else in a union of the high and low by means of the intermediate. The middle note, which was exactly at an equal distance between the high and the low, was that in which the unaccented syllables were pronounced. But every word had one letter, if a monosyllable; or one syllable, if it consisted of more than one, distinguished from the rest; either by a note of the voice perceptibly higher than the middle note, which was called the *acute accent;* or by a note perceptibly, and in an equal proportion, lower than the middle one, which was called the *grave accent;* or by an union of the acute and grave on one syllable, which was done by the voice passing from the acute, through the middle note, in continuity down to the grave, which was called the *circumflex*."

"Now in pronouncing English words, it is true that one syllable is always distinguished from the rest; but it is not by any perceptible elevation or depression of the voice, any high or low note, that it is done, but merely by dwelling longer upon it, or by giving it a more forcible stroke. When the stress or accent is on the vowel, we dwell longer on that syllable than on the rest; as, in the words *glóry, fáther, hóly*. When it is on the consonant, the voice, passing rapidly over the vowel, gives a smarter stroke to the consonant, which distinguishes that syllable from others, as in the words *bat'tle, hab'it, bar'row*."

Having treated so largely of *accent* and *quantity*, the next thing to be considered in verse will be quickly discussed; for in English it depends wholly on the seat of the accent. "When the accent or stress is on the vowel, the syllable is necessarily long, because the accent cannot be made without dwelling on the vowel a longer time than usual. When it is on the consonant, the syllable is short; because the accent is made by passing rapidly over the vowel, and giving a smart stroke of the voice to the following consonants. Thus the words *ad'd, led', bid', cub'*, are all short, the voice passing quickly over the vowel to the consonant; but for the contrary reason, the words *áll, láid, bíde, cúbe*, are long; the accent being on the vowels, on which the voice dwells some time before it takes in the sound of the consonant."

"Obvious as this point is, it has wholly escaped the observation of many an ingenious and learned writer. Lord Kames affirms*, that accenting is confined in English heroic verse to the long syllables; for a short syllable

* El. of Crit. vol. ii.

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syllable (says he) is not capable of an accent: and Dr Forster, who ought to have understood the nature of the English accent better than his Lordship, asks, whether we do not 'employ more time in uttering the *first* syllables of *heavily, hastily, quickly, slowly;* and the *second* in *solicit, mistaking, researches, delusive,* than in the *others*?' To this question Mr Sheridan replies * that " in some of these words we certainly do as the Doctor supposes; in *hástily, slówly, mistáking, delúsive,* for instance; where the accent being on the vowels renders their sound long; but in all the others, *heav'ily, quick'ly, solis'-it, re-sear'ches,* where the accent is on the consonant, the syllables *heav', quick', lis', ser',* are pronounced as rapidly as possible, and the vowels are all short. In the Scotch pronunciation (continues he) they would indeed be all reduced to an equal quantity, as thus; *hái-vily, háis-tily, quéek-ly, slów-ly, so-lée-cit, resáir-ches, de-lú-sive.* But here we see that the four short syllables are changed into four long ones of a different sound, occasioned by their placing the seat of the accent on the vowels instead of the consonants: thus instead of *hev'* they say *háiv;* for *quick', quéek;* for *lis, léece;* and for *ser', sáir.*

* *Art of Reading,* vol. ii.

It appears, therefore, that the quantity of English syllables is adjusted by one easy and simple rule; which is, that when the seat of the accent is on a vowel, the syllable is long; when on a consonant, short; and that all unaccented syllables are short. Without a due observation of quantity in reciting verses there will be no poetic numbers; yet in composing English verses the poet need not pay the least attention to the quantity of his syllables, as measure and movement will result from the observation of other laws, which are now to be explained.

It has been affirmed by a writer † of great authority among the critics, that in English heroic verse every line consists of ten syllables, five short and five long; from which there are but two exceptions, both of them rare. The first is, where each line of a couplet is made eleven syllables, by an additional short syllable at the end.

† *Lord Kames.*

> Thére héroes wit's are kep't in pond'rous váses,
> And beaus' in snuff-boxes and tweezer-cases.

The other exception, he says, concerns the second line of a couplet, which is sometimes stretched out to twelve syllables, termed an *Alexandrine line.*

> A needless Alexandrine ends the song,
> That, like a wounded snake, drags its slow length along.

After what has been just said, it is needless to stop for the purpose of pointing out the ingenious author's mistake respecting long and short syllables. Every attentive reader of what has been already laid down, must perceive, that in the first line of the former couplet, though there are no fewer than six accented syllables when it is properly read, yet of these there are but three that are long, viz. those which have the accent on the vowel. Our business at present is, to show the falsity of the rule which restrains the heroic line to ten syllables; and this we shall do by producing lines of a greater number.

> And the shrill sounds ran echoing through the wood.

This line, though it consists of eleven syllables, and has the last of those accented, or, as Lord Kames would say, long, is yet undoubtedly a heroic verse of very fine sound. Perhaps the advocates for the rule may contend, that the vowel *o* in echoing ought to be struck out by an apostrophe; but as no one reads,

> And the shrill sounds ran ech'ing through the wood,

it is surely very absurd to omit in writing what cannot be omitted in utterance. The two following lines have each eleven syllables, of which not one can be suppressed in recitation.

> Their glittering textures of the filmy dew,
> The great hierarchal standard was to move.

Mr Sheridan quotes as a heroic line,

> O'er many a frozen, many a fiery Alp;

and observes what a monstrous line it would appear, if pronounced,

> O'er man' a frozen, man' a fi'ry Alp,

instead of that noble verse, which it certainly is, when all the thirteen syllables are distinctly uttered. He then produces a couplet, of which the former line has fourteen, and the latter twelve syllables.

> And many an amorous, many a humorous lay,
> Which many a bard had chaunted many a day.

That this is a couplet of very fine sound cannot be controverted; but we doubt whether the numbers of it or of the other quoted line of thirteen syllables be truly heroic. To our ears at least there appears a very perceptible difference between the movement of these verses and that of the verses of Pope or Dryden; and we think, that, though such couplets or single lines may, for the sake of variety or expression, be admitted into a heroic poem, yet a poem wholly composed of them would not be considered as heroic verse. It has a much greater resemblance to the verse of Spenser, which is now broke into two lines, of which the first has eight and the second six syllables. Nothing, however, seems to be more evident, from the other quoted instances, than that a heroic line is not confined to the syllables, and that it is not by the number of syllables that an English verse is to be measured.

But if a heroic verse in our tongue be not composed, as in French, of a certain number of syllables, how is it formed? We answer by feet, as was the hexameter line of the ancients; though between their feet and ours there is at the same time a great difference. The poetic feet of the Greeks and Romans are formed by quantity, those of the English by stress or accent. " Though these terms are in continual use, and in the mouths of all who treat of poetic numbers, very confused and erroneous ideas are sometimes annexed to them. Yet as the knowledge of the peculiar genius of our language with regard to poetic numbers and its characteristical difference from others in that respect, depends upon our having clear and precise notions of those terms, it will be necessary to have them fully explained. The general nature of them has been already sufficiently laid open, and

and we have now only to make some observations on their particular effects in the formation of metre.

"No scholar is ignorant that quantity is a term which relates to the length or the shortness of syllables, and that a long syllable is double the length of a short one. Now the plain meaning of this is, that a long syllable takes up double the time in sounding that a short one does; a fact of which the ear alone can be the judge. When a syllable in Latin ends with a consonant, and the subsequent syllable commences with one, every school-boy knows that the former is long, to use the technical term, by the law of *position*. This rule was in pronunciation strictly observed by the Romans, who always made such syllables long by dwelling on the vowels; whereas the very reverse is the case with us, because a quite contrary rule takes place in English words so constructed, as the accent or stress of the voice is in such cases always transferred to the consonant, and the preceding vowel being rapidly passed over, that syllable is of course short.

"The Romans had another rule of prosody, that when one syllable ending with a vowel, was followed by another beginning with a vowel, the former syllable was pronounced short; whereas in English there is generally an accent in that case on the former syllable, as in the word *píous*, which renders the syllable long. Pronouncing Latin therefore by our own rule, as in the former case, we make these syllables short which were sounded long by them; so in the latter we make those syllables long which with them were short. We say *ar'ma* and *virum'que*, instead of *árma* and *virumqúe*; *scío* and *túus*, instead of *scíó* and *tuus'*.

"Having made these preliminary observations, we proceed now to explain the nature of poetic feet. Feet in verse correspond to bars in music: a certain number of syllables connected form a foot in the one, as a certain number of notes make a bar in the other. They are called feet, because it is by their aid that the voice as it were steps along through the verse in a measured pace; and it is necessary that the syllables which mark this regular movement of the voice should in some measure be distinguished from the others. This distinction, as we have already observed, was made among the ancient Romans, by dividing their syllables into long and short, and ascertaining their quantity by an exact proportion of time in sounding them; the long being to the short as two to one; and the long syllables, being thus the more important, marked the movement of the verse. In English, syllables are divided into accented and unaccented; and the accented syllables being as strongly distinguished from the unaccented, by the peculiar stress of the voice upon them, are as capable of marking the movement, and pointing out the regular paces of the voice, as the long syllables were by their quantity among the Romans. Hence it follows, that our accented syllables corresponding to their long ones, and our unaccented to their short, in the structure of poetic feet, an accented syllable followed by one unaccented in the same foot will answer to their *trochee*; and preceded by an unaccented one, to their *iambus*; and so with the rest.

"All feet used in poetry consist either of two or three syllables; and the feet among the ancients were denominated from the number and quantity of their syllables. The measure of quantity was the short syllable, and the long one in time was equal to two short. A foot could not consist of less than two times, because it must contain at least two syllables; and by a law respecting numbers, which is explained elsewhere (see MUSIC), a poetic foot would admit of no more than four of those times. Consequently the poetic feet were necessarily reduced to eight; four of two syllables, and four of three. Those of two syllables must either consist of two short, called a *pyrrhic*; two long, called a *spondee*; a long and a short, called a *trochee*; or a short and a long, called an *iambus*. Those of three syllables were, either three short, a *tribrach*; a long and two short, a *dactyl*; a short, long, and short, an *amphibrach*; or two short and a long, an *anapæst* (Y).

We are now sufficiently prepared for considering what feet enter into the composition of an English heroic verse.

The Greeks and Romans made use of but two feet in the structure of their hexameters; and the English heroic may be wholly composed of one foot, viz. the *iambic*, which is therefore the foot most congenial to that species of verse. Our poetry indeed abounds with verses into which no other foot is admitted. Such as,

The pow'rs | gave éar | and grán|ted hálf | his práy'r,
The rest' | the winds | dispérs'd | in emp'|ty áir.

Our heroic line, however, is not wholly restrained to the use of this foot. In the opinion of Mr Sheridan, it admits all the eight before enumerated; and it certainly excludes none, unless perhaps the *tribrach*. It is known to every reader of English poetry, that some of the finest heroic verses in our language begin with a *trochee*; and that Pope, the smoothest of all our versifiers, was remarkable for his use of this foot, as is evident from the following example, where four succeeding lines out of six have a trochaic beginning,

> Her lively looks a sprightly mind disclose,
> Quick as | her eyes | and as unfix'd as those:
> Favours | to none | to all she smiles extends,
> O'ft she | rejects | but never once offends.
> Bright as | the sun | her eyes the gazers strike,
> And like the sun she shines on all alike.

The

(Y) For the convenience of the less learned reader we shall here subjoin a scheme of poetic feet, using the marks (- ◡) in use among the Latin grammarians to denote the genuine feet by quantity; and the following marks (′ ◡) to denote the English feet by accents, which answer to those.

	Roman	English		Roman	English
Trochee	− ◡	′ ◡	Dactyl	− ◡ ◡	′ ◡ ◡
Iambus	◡ −	◡ ′	Amphibrach	◡ − ◡	◡ ′ ◡
Spondée	− −	′ ′	Anapæst	◡ ◡ −	◡ ◡ ′
Pyrrhic	◡ ◡	◡ ◡	Tribrach	◡ ◡ ◡	◡ ◡

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The use of this foot, however, is not necessarily confined to the beginning of a line. Milton frequently introduces it into other parts of the verse; of which take the following instances:

That áll | was lost′ | back′ to | the thick′|et slunk—
Of E′ve | whose ey′e | dárted contá|gious fire.

The last line of the following couplet begins with a *pyrrhic:*

She sáid, | and mél|ting as in tears she lay,

Ĭn ă | soft síl|ver stream dissolv'd away.

But this foot is introduced likewise with very good effect into other parts of the verse, as

Pánt on | thy lip′ | and tŏ | thy heárt | be prest.
The phantom flies me | ăs ŭn|kind as you.
Leaps o'er the fence with ease | ĭntŏ | the fold.

Ănd thĕ | shrill′ soūnds | ran echoing through the wood.

In this last line we see that the first foot is a *pyrrhic*, and the second a *spondee;* but in the next the two first feet are *spondees.*

Hill's peép | o'ér hill's | and Alps | on Alps | arise.

In the following verse a trochee is succeeded by two spondees, of which the former is a genuine spondee by quantity, and the latter equivalent to a spondee by accent.

Sée thĕ | bōld yōūth | stráin up′ | the threat|'ning steep.

We shall now give some instances of lines containing both the *pyrrhic* and the *spondee*, and then proceed to the consideration of the other four feet.

Thăt ŏn | weāk wīngs | from far pursues your flight.
Thrŏ' thĕ | fair scēne | rōll slōw | the ling'ring streams.

Ŏn hĕr | white breast′ | a sparkling cross she wore.

Of the four trisyllabic feet, the first, of which we shall give instances in heroic lines, is the *dactyl;* as

Mur′muring, | and with | him′ fled | the shades | of night.
Hov′ering | on wing | un′der | the cápe | of hell.
Tim′orous | and slothful yet he pleas'd the ear.
Of trúth | in word | mightier | than they | in arms.

Of the *anapæst* a single instance shall suffice; for except by Milton it is not often used.

The great | hĭĕrár|chal standard was to move.

The *amphibrach* is employed in the four following verses, and in the three last with a very fine effect.

With wheels | yet hóver|ing o'er the ocean brim.
Rous'd from their slumber on | thăt fíĕ|ry | couch.
While the | prŏmis′cŭ′ous crowd stood yet aloof.

Throws his steep flight | ĭn mány | ăn ai|ry whirl.

Having thus sufficiently proved that the English heroic verse admits of all the feet except the *tribrach*, it may be proper to add, that from the nature of our accent we have duplicates of these feet, viz. such as are formed by quantity, and such as are formed by the mere *ictus* of the voice; an opulence peculiar to our tongue, and which may be the source of a boundless variety. But as feet formed of syllables which have the *accent* or *ictus* on the consonant are necessarily pronounced in less time than similar feet formed by quantity, it may be objected, that the measure of a whole line, constructed in the former manner, must be shorter than that of another line constructed in the latter; and that the intermixture of verses of such different measures in the same poem must have a bad effect on the melody, as being destructive of proportion. This objection would be well-founded, were not the time of the short accented syllables compensated by a small pause at the end of each word to which they belong, as is evident in the following verse:

Then rus′|tling crack′|ling crash|ing thun′|der down.

This line is formed of iambics by accent upon consonants, except the last syllable; and yet by means of these soft pauses or rests, the measure of the whole is equal to that of the following, which consists of pure iambics by quantity.

O'er heāps | of rŭ|in stālk'd | the state|ly hīnd.

Movement, of so much importance in versification, regards the order of syllables in a foot, measure their quantity. The order of syllables respects their progress from short to long or from long to short, as in the Greek and Latin languages; or from strong to weak or weak to strong, i. e. from accented or unaccented syllables, as in our tongue. It has been already observed, that an English heroic verse may be composed wholly of iambics; and experience shows that such verses have a fine melody. But as the stress of the voice in repeating verses of pure iambics, is regularly on every second syllable, such uniformity would disgust the ear in any long succession, and therefore such changes were sought for as might introduce the pleasure of variety without prejudice to melody; or which might even contribute to its improvement. Of this nature was the introduction of the trochee to form the first foot of an heroic verse, which experience has shown us is so far from spoiling the melody, that in many cases it heightens it. This foot, however, cannot well be admitted into any other part of the verse without prejudice to the melody, because it interrupts and stops the usual movement by another directly oppsite. But though it be excluded with regard to pure melody, it may often be admitted into any part of the verse with advantage to expression, as is well known to the readers of Milton.

"The next change admitted for the sake of variety, without prejudice to melody, is the intermixture of pyrrhics and spondees; in which two impressions in the one foot make up for the want of one in the other; and two long syllables compensate two short, so as to make the sum of the quantity of the two feet equal to two iambics. That this may be done without prejudice to the melody, take the following instances:

Ŏn hĕr | whīte brēast | a sparkling cross she wore.—
Nŏr thĕ | dēep trāct | of hell—say first what cause.—

This intermixture may be employed *ad libitum*, in any part of the line; and sometimes two spondees may be placed together in one part of the verse, to be compensated by two pyrrhics in another; of which Mr Sheridan quotes the following lines as instances:

Stōōd rūl'd | stōōd vāst | ĭnfĭn|ĭtŭde | confined.
Shē āll | nīght lōng | hĕr ămŏ|rŏus dĕs|cant sung.

That the former is a proper example, will not perhaps be questioned; but the third foot in the latter is certainly ly no pyrrhic. As it is marked here and by him, it is a tribrach; but we appeal to our English readers, if it ought not to have been marked an amphibrach by accent, and if the fourth foot be not an iambus. To us the feet of the line appear to be as follow:

Shē āll | nīght lŏng hĕr am'ŏ|rŏus des'cănt sun'g.

It is indeed a better example of the proper use of the amphibrach than any which he has given, unless perhaps the two following lines.

Up to | thĕ fíē|ry con|căve tow'ĕr|ing high
Thrōws hĭs | stēēp flight | ĭn man'ȳ | ăn áī|ry whīrl.

That in these three lines the introduction of the amphibrach does not hurt the melody, will be acknowledged by every person who has an ear; and those who have not, are not qualified to judge. But we appeal to every man of taste, if the two amphibrachs succeeding each other in the last line do not add much to the expression of the verse. If this be questioned, we have only to change the movement to the common iambic. and we shall discover how feeble the line will become.

Throws his | steep flight | in man|y ai|ry whirls.

This is simple description, instead of that magical power of numbers which to the imagination produces the object itself, *whirling* as it were round an axis.

Having thus shown that the iambus, spondee, pyrrhic, and amphibrach, by accent, may be used in our measure with great latitude; and that the trochee may at all times begin the line, and in some cases with advantage to the melody; it now remains only to add, that the dactyl, having the same movement, may be introduced in the place of the trochee; and the anapæst in the place of the iambus. In proof of this, were not the article swelling in our hands, we could adduce many instances which would show what an inexhaustible fund of riches, and what an immense variety of materials, are prepared for us, "to build the lofty rhyme." But we hasten to the next thing to be considered in the art of versifying, which is known by the name of *pauses*.

"Of the poetic pauses there are two sorts, the *cesural* and the *final*. The cesural divides the verse into equal or unequal parts; the final closes it. In a verse there may be two or more cesural pauses, but it is evident that there can be but one final. As the final pause concerns the reader more than the writer of verses, it has been seldom treated of by the critics. Yet as it is this final pause which in many cases distinguishes verse from prose, it cannot be improper in the present article to show how it ought to be made. Were it indeed a law of our versification, that every line should terminate with a stop in the sense, the boundaries of the measure would be fixed, and the nature of the final pause could not be mistaken. But nothing has puzzled the bulk of readers, or divided their opinions, more than the manner in which those verses ought to be recited, where the sense does not close with the line; and whose last words have a necessary connection with those that begin the subsequent verse. "Some (says Mr Sheridan) who see the necessity of pointing out the metre, pronounce the last word of each line in such a note as usually accompanies a comma, in marking the smallest member of a sentence. Now this is certainly improper, because it makes that appear to be a complete member of a sentence which is an incomplete one; and by disjoining the sense as well as the words, often confounds the meaning. Others again, but these fewer in number, and of the more absurd kind, drop their voice at the end of every line in the same note which they use in marking a full stop; to the utter annihilation of the sense. Some readers (continues our author) of a more enthusiastic kind, elevate their voices at the end of all verses to a higher note than is ever used in the stops which divide the meaning. But such a continued repetition of the same high note becomes disgusting by its monotony, and gives an air of chanting to such recitation. To avoid these several faults, the bulk of readers have chosen what they think a safer course, which is that of running the lines one into another without the least pause, where they find none in the sense; but by this mode of recitation they reduce poetry to something worse than prose, to verse run mad.

But it may be asked, if this final pause must be marked neither by an elevation nor by a depression of the voice, how is it to be marked at all? To which Mr Sheridan replies, by making no change whatever in the voice before it. This will sufficiently distinguish it from the other pauses, the comma, semicolon, &c. because some change of note, by raising or depressing the voice, always precedes them, whilst the voice is here only suspended.

Now this pause of suspension is the very thing wanting to preserve the melody at all times, without interfering with the sense. For it perfectly marks the bound of the metre: and being made only by a suspension, not by a change of note in the voice, it can never affect the sense; because the sentential stops, or those which affect the sense, being all made with a change of note, where there is no such change the sense cannot be affected. Nor is this the only advantage gained to numbers by this stop of suspension. It also prevents the monotony at the end of lines; which, however pleasing to a rude, is disgusting to a delicate ear. For as this stop has no peculiar note of its own, but always takes that which belongs to the preceding word, it changes continually with the matter, and is as various as the sense.

Having said all that is necessary with regard to the final, we proceed now to consider the cesural, pause. To these two pauses it will be proper to give the denomination of *musical*, to distinguish them from the comma, semicolon, colon, and full stop, which may be called *sentential pauses;* the office of the former being to mark the melody, as that of the latter is to point out the sense. The cesural, like the final pause, sometimes coincides with the sentential; and sometimes takes place where there is no stop in the sense. In this last case, it is exactly of the same nature, and governed by the same laws with the pause of suspension, which we have just described.

The cesure, though not essential, is however a great ornament to verse, as it improves and diversifies the melody, by a judicious management in varying its situation; but it discharges a still more important office than this. Were there no cesure, verse could aspire to no higher ornament than that of simple melody; but by means of this pause there is a new source of delight opened in poetic numbers, correspondent in some sort to harmony in music. This takes its rise from that act of the mind which compares the relative proportions that

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that the members of a verse thus divided bear to each other, as well as to those in the adjoining lines. In order to see this matter in a clear light, let us examine what effect the cesure produces in single lines, and afterwards in comparing contiguous lines with each other.

With regard to the place of the cesure, Mr Pope and others have expressly declared, that no line appeared musical to their ears, where the cesure was not after the fourth, fifth, or sixth syllable of the verse. Some have enlarged its empire to the third and seventh syllables; whilst others have asserted that it may be admitted into any part of the line.

"There needs but a little distinguishing (says Mr Sheridan), to reconcile these different opinions. If melody alone is to be considered, Mr Pope is in the right when he fixes its seat in or as near as may be to the middle of the verse. To form lines of the first melody, the cesure must either be at the end of the second or of the third foot, or in the middle of the third between the two. Of this movement take the following examples:

1. Of the cesure at the end of the second foot.

> Our plenteous stréams || a various race supply;
> The bright-ey'd per'ch || with fins of Tyrian dye;
> The silver eél || in shining volumes roll'd;
> The yellow carp' || in scales bedrop'd with gold.

2. At the end of the third foot.

> With tender billet-doúx || he lights the pyre,
> And breathes three amorous síghs || to raise the fire.

3. Between the two, dividing the third foot.

> The fields are rávish'd || from the industrious swains,
> From men their cíties, || and from gods their fanes.

These lines are certainly all of a fine melody, yet they are not quite upon an equality in that respect. Those which have the cesure in the middle are of the first order; those which have it at the end of the second foot are next; and those which have the pause at the end of the third foot the last. The reason of this preference it may not perhaps be difficult to assign.

In the pleasure arising from comparing the proportion which the parts of a whole bear to each other, the more easily and distinctly the mind perceives that proportion, the greater is the pleasure. Now there is nothing which the mind more instantaneously and clearly discerns, than the division of a whole into two equal parts, which alone would give a superiority to lines of the first order over those of the other two. But this is not the only claim to superiority which such lines possess. The cesure being in them always on an unaccented, and the final pause on an accented syllable, they have a mixture of variety and equality of which neither of the other orders can boast, as in these orders the cesural and final pauses are both on accented syllables.

In the division of the other two species, if we respect quantity only, the proportion is exactly the same, the one being as two to three, and the other as three to two; but it is the order or movement which here makes the difference. In lines where the cesure bounds the second foot, the smaller portion of the verse is first in order, the greater last; and this order is reversed in lines which have the cesure at the end of the third foot. Now, as the latter part of the verse leaves the strongest and most lasting impression on the ear, where the larger portion belongs to the latter part of the line, the impression must in proportion be greater; the effect in sound being the same as that produced by a climax in sense, where one part rises above another.

Having shown in what manner the cesure improves and diversifies the melody of verse, we shall now treat of its more important office, by which it is the chief source of harmony in numbers. But, first, it will be necessary to explain what we mean by the term *harmony*, as applied to verse.

Melody in music regards only the effects produced by successive sounds; and harmony, strictly speaking, the effects produced by different co-existing sounds, which are found to be in concord. Harmony, therefore, in this sense of the word, can never be applied to poetic numbers, of which there can be only one reciter, and consequently the sounds can only be in succession. When therefore we speak of the harmony of verse, we mean nothing more than an effect produced by an action of the mind in comparing the different members of verse already constructed according to the laws of melody with each other, and perceiving a due and beautiful proportion between them.

The first and lowest perception of this kind of harmony arises from comparing two members of the same line with each other, divided in the manner to be seen in the three instances already given; because the beauty of proportion in the members, according to each of these divisions, is founded in nature. But there is a perception of harmony in versification, which arises from the comparison of two lines, and observing the relative proportion of their members; whether they correspond exactly to each other by similar divisions, as in the couplets already quoted; or whether they are diversified by cesures in different places. As,

> See the bold youth || strain up the threatening steep,
> Rush thro' the thickets || down the valleys sweep.

Where we find the cesure at the end of the second foot of the first line, and in the middle of the third foot of the last.

> Hang o'er their coursers heads || with eager speed,
> And earth rolls back || beneath the flying steed.

Here the cesure is at the end of the third foot in the former, and of the second in the latter line.——The perception of this species of harmony is far superior to the former; because, to the pleasure of comparing the members of the same line with each other, there is superadded that of comparing the different members of the different lines with each other; and the harmony is enriched by having four members of comparison instead of two. The pleasure is still increased in comparing a greater number of lines, and observing the relative proportion of the couplets to each other in point of similarity and diversity. As thus,

> Thy forests, Windsor, || and thy green retreats,
> At once the monarch's || and the muse's seats,
> Invite my lays. || Be present sylvan maids,
> Unlock your springs || and open all your shades.

Here we find that the cesure is in the middle of the verse in each line of the first couplet, and at the end of the

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the second foot in each line of the last; which gives a similarity in each couplet distinctly considered, and a diversity when the one is compared with the other, that has a very pleasing effect. Nor is the pleasure less where we find a diversity in the lines of each couplet, and a similarity in comparing the couplets themselves. As in these,

> Not half so swift || the trembling doves can fly,
> When the fierce eagle || cleaves the liquid sky;
> Not half so swiftly || the fierce eagle moves,
> When thro' the clouds || he drives the trembling doves.

There is another mode of dividing lines well suited to the nature of the couplet, by introducing semipauses, which with the cesure divide the line into four portions. By a semipause, we mean a small rest of the voice, during a portion of time equal to half of that taken up by the cesure; as will be perceived in the following fine couplet:

> Warms | in the sun || refreshes | in the breeze,
> Glows | in the stars || and blossoms | in the trees.

That the harmony, and of course the pleasure, resulting from poetic numbers, is increased as well by the semipause as by the cesure, is obvious to every ear; because lines so constructed furnish a greater number of members for comparison: but it is of more importance to observe, that by means of the semipauses, lines which, separately considered, are not of the finest harmony, may yet produce it when opposed to each other, and compared in the couplet. Of the truth of this observation, the following couplet, especially as it succeeds that immediately quoted, is a striking proof:

> Lives | thro' all life || extends | thro' all extent,
> Spreads | undivided || operates | unspent.

What we have advanced upon this species of verse, will contribute to solve a poetical problem thrown out by Dryden as a crux to his brethren: it was to account for the peculiar beauty of that celebrated couplet in Sir John Denham's *Cooper's Hill*, where he thus describes the Thames:

> Tho' deep | yet clear || tho' gentle | yet not dull.
> Strong | without rage || without o'erflowing | full.

This description has great merit independent of the harmony of the numbers; but the chief beauty of the versification lies in the happy disposition of the pauses and semipauses, so as to make a fine harmony in each line when its portions are compared, and in the couplet when one line is compared with the other.

Having now said all that is necessary upon pauses and semipauses, we have done the utmost justice to our subject which the limits assigned us will permit. *Feet* and *pauses* are the constituent parts of verse; and the proper adjustment of them depends upon the poet's knowledge of *numbers*, *accent*, *quantity*, and *movement*, all of which we have endeavoured briefly to explain. In conformity to the practice of some critics, we might have treated separately of rhime and of blank verse; but as the essentials of all heroic verses are the same, such a division of our subject would have thrown no light upon the art of English versification. It may be just worth while to observe, that the pause at the end of a couplet ought to coincide, if possible, with a slight pause in the sense, and that there is no necessity for this coincidence of pauses at the end of any particular blank verse. We might likewise compare our heroic line with the ancient hexameter, and endeavour to appretiate their respective merits; but there is not a reader capable of attending to such a comparison who will not judge for himself; and it may perhaps be questioned, whether there be two who will form precisely the same judgement. Mr Sheridan, and all the mere English critics, give a high degree of preference to our heroic, on account of the vast variety of feet which it admits: whilst the readers of Greek and Latin poetry prefer the hexameter, on account of its more musical notes and majestic length.

Pogge || Poggy islands.

POGGE, the MAILED or ARMED GURNARD, or COTTUS CATAPHRACTUS. See COTTUS, ICHTHYOLOGY, p. 89.

POGGIUS BRACCIOLINUS, a man of great parts and learning, who contributed much to the revival of knowledge in Europe, was born at Terranuova, in the territories of Florence, in 1380. His first public employment was that of writer of the apostolic letters, which he held 10 years, and was then made apostolic secretary, in which capacity he officiated 40 years, under seven popes. In 1453, when he was 72 years of age, he accepted the employment of secretary to the republic of Florence, to which place he removed, and died in 1459. He visited several countries, and searched many monasteries, to recover ancient authors, numbers of which he brought to light: his own works consist of moral pieces, orations, letters, and A History of Florence from 1350 to 1455, which is the most considerable of them.

POGGY ISLANDS, otherwise called Nassau islands, form part of a chain of islands which stretch along the whole length of Sumatra, in the East Indies, and lie at the distance of twenty or thirty leagues from the west coast of that island.

The northern extremity of the northern Poggy lies in latitude 2° 18′ S. and the southern extremity of the southern island in latitude 3° 16′ S. The two are separated from each other by a very narrow passage called the strait of See Cockup, in latitude 3° 40′ S. and longitude about 100° 38′ east from Greenwich.—The number of inhabitants in these islands amounts to no more than 1400. Mr Crisp, who staid about a month among them, carefully collected many particulars respecting their language, customs, and manners. He adverts to one circumstance relative to this people, which may be considered as a curious fact in history:

"From the proximity of the islands (says he), to Sumatra, which, in respect to them, may be considered as a continent, we should naturally expect to find their inhabitants to be a set of people originally derived from the

the Sumatra stock, and look for some affinity in their language and manners; but, to our no small surprise, we find a race of men, whose language is totally different, and whose customs and habits of life indicate a very distinct origin, and bear a striking resemblance to those of the inhabitants of the late discovered islands in the great Pacific ocean."

There is safe riding for ships of any size in the straits, which have no other defect as a harbour than the depth of the water (25 fathoms close in shore). The face of the country, and its vegetable and animal productions, are described in the following words:

"The mountains are covered with trees to their summits, among which are found species of excellent timber; the tree, called by the Malays, *bintangoor*, and which, in the hither India, is called *pohoon*, abounds here. Of this tree are made masts, and some are found of sufficient dimensions for the lower mast of a first-rate ship of war. During my stay here I did not discover a single plant which we have not on Sumatra. The sago trees grows in plenty, and constitutes the chief article of food to the inhabitants, who do not cultivate rice; the cocoa-nut tree and the bamboo, two most useful plants, are found here in great plenty. They have a variety of fruits, common in these climates, such as mangosteens, pine-apples, plantains, *buah*, *chupah*, &c. The woods, in their present state, are impervious to man; the species of wild animals which inhabit them are but few; the large red deer, some hogs, and several kinds of monkeys are to be found here, but neither buffaloes, nor goats; nor are these forests infested, like those of Sumatra, with tigers or any other beast of prey. Of domestic poultry, there is only the common fowl, which probably has been originally brought from Sumatra; but pork and fish constitute the favourite animal food of the natives. Fish are found here in considerable plenty, and very good."

The stature of the inhabitants of these islands seldom exceeds five feet and a half; their colour is like that of the Malays; they practise tattooing, and file their teeth to a point; and though of a mild disposition, they have some of the filthy customs of savages, particularly that of picking vermin from their heads and eating them.

Their mode of tattooing, as well as the treatment of their dead, is represented to be very similar to the practices of the Otaheitans.

"The religion of this people, (says Mr Crisp), if it can be said that they have any, may truly be called the religion of nature. A belief of the existence of some powers more than human cannot fail to be excited among the most uncultivated of mankind, from the observations of various striking natural phenomena, such as the diurnal revolution of the sun and moon; thunder and lightning; earthquakes, &c. &c.: nor will there ever be wanting among them some, of superior talents and cunning, who will acquire an influence over weak minds, by assuming to themselves an interest with, or a power of controuling those super-human agents; and such notions constitute the religion of the inhabitants of the Poggys. Sometimes a fowl, and sometimes a hog, is sacrificed to avert sickness, to appease the wrath of the offended power, or to render it propitious to some projected enterprise; and Mr Best was informed that omens of good or ill fortune were drawn from certain appearances in the entrails of the victim. But they have no form of religious worship, nor do they appear to have the most distant idea of a future state of rewards and punishments. They do not practise circumcision."——*Asiatic Researches*.

POGO, is the name by which the inhabitants of the Philippine islands distinguish their quail, which, though smaller than ours, is in every other respect very like it.

POICTIERS, an ancient, large, and considerable town of France, capital of the department of Vienne. It was a bishop's see, and contained four abbeys, a mint, an university famous for law, 22 parishes, 9 convents for men, and 12 nunneries. There are here several Roman antiquities, and particularly an amphitheatre, but partly demolished, and hid by the houses. There is also a triumphal arch, which serves as a gate to the great street. It is not peopled in proportion to its extent. Near this place Edward the Black Prince gained a decisive victory over the French, taking King John and his son Philip prisoners, in 1356, whom he afterwards brought over into England. See France, N° 71, &c.—It is seated on a hill, on the river Clain, 52 miles south-west of Tours, and 120 north by east of Bourdeaux. E. Long. 0. 25. N. Lat. 46. 35.

POICTOU, a province of France, lying south of the Loire, and comprehending the present departments of Vendee, Deux Sevres and Vienne. The principal rivers are the Vienne, the Deux Sevres, the Gartempe, and the Lay. It is divided into the Upper and Lower; and is fertile in corn and wine, and feeds a great number of cattle, particularly mules. It was in possession of the kings of England for a considerable time, till it was lost by the unfortunate Henry VI. Poictiers is the capital town.

Colic of Poictou. See MEDICINE, N° 303.

POINCIANA, BARBADOES FLOWER FENCE; a genus of plants belonging to the decandria class; and in the natural method ranking under the 33d order, *Lomentaceæ*. See BOTANY *Index*.—Of this genus there is only one species, the *pulcherrima*, which is a native of both Indies, and grows to the height of 10 or 12 feet, producing flowers of a very agreeable odour. In Barbadoes it is planted in hedges to divide the lands, whence it has the name of *flower-fence*. In the West Indies, its leaves are made use of as a purgative instead of senna; and in Jamaica it is called *senna*.

POINT, a term used in various arts.

POINT, in *Grammar*, a character used to mark the divisions of discourse. See COMMA, COLON, &c. A point proper is what we otherwise call a *full stop* or *period*. See PUNCTUATION.

POINT, in *Geometry*, according to Euclid, is that which has neither parts nor magnitude.

POINT, in *Music*, a mark or note anciently used to distinguish the tones or sounds; hence we still call it *simple counter-point*, when a note of the lower part answers exactly to that of an upper; and *figurative counter-point*, when any note is syncopated, and one of the parts makes several notes or inflexions of the voice, while the other holds on one.

We still use a point, to raise the value of a note, and prolong its time by one half, *e. g.* a point added to a semibreve, instead of two minims, makes it equal to three; and so of the other notes. See the article TIME.

POINT,

Point, in *Astronomy*, a term applied to certain points or places marked in the heavens, and distinguished by proper epithets.

The four grand points or divisions of the horizon, viz. the east, west, north, and south, are called the *cardinal points*.

The zenith and nadir are the vertical points; the points wherein the orbits of the planets cut the plane of the ecliptic are called the *nodes:* the points wherein the equator and ecliptic intersect are called the *equinoctial points:* particularly, that whence the sun ascends towards the north pole, is called the *vernal point;* and that by which he descends to the south pole, the *autumnal point.* The points of the ecliptic, where the sun's ascent above the equator, and descent below it, terminate, are called the *solstitial points;* particularly the former of them, the *estival* or *summer point;* the latter, the *brumal* or *winter point.*

Point is also used for a cape or headland jutting out into the sea: thus seamen say, two points of land are in one another, when they are so in a right line, against each other, as that the innermost is hindered from being seen by the outermost.

Point, in *Perspective*, is used for various poles or places, with regard to the perspective plane. See Perspective.

Point is also an iron or steel instrument, used with some variety in several arts. Engravers, etchers, cutters in wood, &c. use points to trace their designs on the copper, wood, stone, &c. See the articles Engraving, &c.

Point, in the *Manufactories*, is a general term, used for all kinds of laces wrought with the needle; such are the point de Venice, point de France, point de Genoa, &c. which are distinguished by the particular economy and arrangement of their points.—*Point* is sometimes used for lace woven with bobbins; as English point, point de Malines, point d'Havre, &c.

Point, in *Poetry*, denotes a lively brisk turn or conceit, usually found or expected at the close of an epigram. See Poetry, N° 169.

Point-Blank, in *Gunnery*, denotes the shot of a gun levelled horizontally, without either mounting or sinking the muzzle of the piece.—In shooting point-blank, the shot or bullet is supposed to go directly forward in a straight line to the mark; and not to move in a curve, as bombs and highly elevated random-shots do.—When a piece stands upon a level plane, and is laid level, the distance between the piece and the point where the shot touches the ground first, is called the *point-blank* range of that piece; but as the same piece ranges more or less, according to a greater or less charge, the point-blank range is taken from that of a piece loaded with such a charge as is used commonly in action. It is therefore necessary that these ranges of all pieces should be known, since the gunner judges from thence what elevation he is to give to his piece when he is either farther from or nearer to the object to be fired at; and this he can do pretty nearly by sight, after considerable practice.

POINTING, in *Grammar*, the art of dividing a discourse by points, into periods and members of periods, in order to show the proper pauses to be made in reading, and to facilitate the pronunciation and understanding thereof. See the article Punctuation.

POINTS, in *Heraldry*, are the several different parts of an escutcheon, denoting the local positions of any figure. See Heraldry.

Points, in *Electricity*, are those acute terminations of bodies which facilitate the passage of the electrical fluid from or to such bodies. See Electricity.

Points, or *Vowel Points*, in the Hebrew language. See Philology, Sect. I. N° 31, &c.

POISON, is any substance which proves destructive to the life of animals in a small quantity, either taken by the mouth, mixed with the blood, or applied to the nerves. See Medicine, N° 261, 269, 303, 322, 408, &c. &c.

Of poisons there are many different kinds, which are exceedingly various in their operations. The mineral poisons, as arsenic and corrosive mercury, seem to attack the solid parts of the stomach, and to produce death by eroding its substance: the antimonial seem rather to attack the nerves, and to kill by throwing the whole system into convulsions; and in this manner also most of the vegetable poisons seem to operate. All of these, however, seem to be inferior in strength to the poisons of some of the more deadly kinds of serpents, which operate so suddenly that the animal bit by them will be dead before another that had swallowed arsenic would be affected.

Much has been written concerning a poison made use of by the African negroes, by the Americans, and by the East Indians. To this very strange effects have been ascribed. It has been said, that by this poison, a man might be killed at any certain time; as, for instance, after the interval of a day, a week, a month, a year, or even several years. These wonderful effects, however, do not seem worthy of credit; as the Abbé Fontana has given a particular account of an American poison called *ticunas*, which in all probability is the same with that used in Africa and the East Indies; and from his account it is extremely improbable that any such effects could be produced with certainty.

With this poison the Abbé was furnished by Dr Heberden. It was closed and sealed up in an earthen pot inclosed in a tin-case. Within the tin-case was a note containing the following words: "Indian poison, brought from the banks of the river of the Amazons by Don Pedro Maldonado. It is one of the sorts mentioned in the Philosophical Transactions, vol. xlvii. N° 12." In the volume of the Philosophical Transactions here quoted, mention is made of two poisons little different in their activity; the one called the *poison of lamas*, and the other of *ticunas*. The poison in the earthen vessel used by the Abbé Fontana was that of the ticunas; he was also furnished with a number of American arrows dipped in poison, but whether that of the lamas or ticunas he could not tell.

Our author begins his account of the nature of this poison with detecting some of the mistakes which had been propagated concerning it.—It had been asserted, that the ticunas poison proves noxious by the mere effluvia, but much more by the steam which exhales from it in boiling or burning: that, among the Indians, it is prepared only by women condemned to die; and that the mark of its being sufficiently prepared, is when the attendant is killed by its steam. All these assertions are by the Abbé refuted in the clearest manner. He exposed a young pigeon to the smell of the poison when the vessel was opened, to the steam of it when boiling, and to the vapour of it when burning to the sides of the vessel, without the animal's being the least injured; on which, concluding that the vapours of this poison were not to be dreaded, he exposed himself to them without any fear.

This poison dissolves very readily even in cold water, and likewise in the vegetable and mineral acids. With oil of vitriol it becomes as black as ink, but not with the rest of the acids. In oil of vitriol it also dissolves more slowly than in any of the rest. It does not effervesce with acids or alkalies; neither does it alter milk, nor tinge it, except with the natural colour of the poison; nor does it tinge the vegetable juices either red or green. When examined by the microscope, there is no appearance of regularity or crystallization; but it for the most part appears made up of very small, irregular, roundish bodies, like vegetable juices. It dries without making any noise, and has an extremely bitter taste when put upon the tongue.

The ticunas poison is harmless when put into the eyes; nor is it fatal when taken by the mouth, unless the quantity is considerable. Six grains of the solid poison, dissolved in water, killed a young pigeon which drank it in less than 20 minutes. Five grains killed a small Guinea-pig in 25 minutes. Eight grains killed a rabbit in an hour and eight minutes, &c. In those experiments it was observed, that much less poison was required to kill an animal whose stomach was empty than one that had a full stomach. Three rabbits and two pigeons were killed in less than 35 minutes, by taking a dose of three grains each on an empty stomach; but when the experiment was repeated on five animals with full stomachs, only one of them died.

The most fatal operation of this poison is when mixed with the blood. The smallest quantity, injected into the jugular vein, killed the animal as if by a stroke of lightning. When applied to wounds in such a manner that the flowing of the blood could not wash it away, the animal fell into convulsions and a train of fatal nervous symptoms, which put an end to its life in a few minutes. Yet, notwithstanding these seeming affections of the nerves, the poison proved harmless when applied to the naked nerves themselves, or even to the medullary substance of them slit open.

The strength of this poison seems to be diminished, and even destroyed, by mineral acids, but not at all by alkalies or ardent spirits; but if the fresh poison was applied to a wound, the application of mineral acids immediately after could not remove the pernicious effects. So far, indeed, was this from being the case, that the application of nitrous acid to the wounded muscle of a pigeon, killed the animal in a short time without any poison at all.—The effects of the arrows were equally fatal with those of the poison itself (A).

The poison of the viper is analogous in its effects to that of ticunas, but inferior in strength; the latter killing more instantaneously when injected into a vein than even the poison of the most venomous rattle snake.

The Abbé has, however, observed a difference in the action of the two poisons upon blood taken out of the body. He cut off the head of a pigeon, and received its blood into warm conical glasses, to the amount of about 80 drops into each. Into the blood contained in one porringer, he put four drops of water; and into the other four drops of the poison dissolved in water as usual, The event of this experiment was, that the blood, with which the water only was mixed, coagulated in a short time; but that in which the poison was mixed did not coagulate at all. The poison of the viper also hinders the blood from coagulating, but gives it a much blacker tinge than the poison of the ticunas. The poison of the viper also proves certainly fatal when injected into the veins, even in very small quantity; but it produces a kind of grumous coagulation and blackness in the blood when drawn from a vein, though it prevents the proper coagulation of that fluid, and its separation into crassamentum and serum as usual.

In the Philosophical Transactions, N° 335. we have a number of experiments which show the effects of many different poisons upon animals; from whence it appears, that many substances which are not at all accounted poisonous, yet prove as certainly fatal when mixed with the blood as even the poison of rattlesnakes, or the ticunas itself.—An ounce of emetic wine, being injected into the jugular vein of a large dog, produced no effect for a quarter of an honr. At the expiration of that space he became sick, had a continual vomiting, and evacuation of some hard excrements by stool. By these evacuations he seemed to be somewhat relieved; but soon grew uneasy, moved from place to place, and vomited again. After this he laid himself down on the ground pretty quietly; but his rest was disturbed by a return of his vomiting, and his strength greatly decreased. An hour and a half after the operation he appeared half dead, but was greatly revived by having some warm broth poured down his throat with a funnel. This, however, proved only a temporary relief; for in a

(A) Mr Paterson, *in his travels in Africa, in the years* 1777-8-9, fell in with an European woman who had been wounded with a poisoned arrow. Great pains had been taken to cure her, but in vain; for at different periods of the year an inflammation came on which was succeeded by a partial mortification. She told him that the wound was easily healed up; but in two months afterwards there was a certainty of its breaking out again, and this had been the case for many years. The Hottentots poison their arrows with a species of euphorbia. The amaryllis disticha, a large bulbous plant growing about the Cape of Good Hope, called *mad poison*, is used for the same purpose. The natives take the bulbs when they are putting out their leaves, cut them transversely, extract a thick fluid, and keep it in the sun till it acquires the consistence of gum, when it is fit for use. With arrows poisoned with this gum, they kill antelopes and other small animals intended for food. After they are wounded, the animals generally run for several miles, and are frequently not found till next day. When the leaves of this plant are young, the cattle are very fond of them, though they occasion instant death. Mr Paterson mentions another shrubby plant producing a nut, called by the Dutch *woolf gift* or *wolf poison*, the only poison useful to the European inhabitants. The nuts are roasted like coffee, pulverized, and stuffed into some pieces of meat or a dead dog, which are thrown into the fields. By this means the voracious hyenas are generally killed.

a short time the vomiting returned, he made urine in great quantity, howled miserably, and died in convulsions.—A dram and a half of sal ammoniac dissolved in an ounce and a half of water, and injected into the jugular vein of a dog, killed him with convulsions almost instantly.—The same effect followed from injecting a dram of salt of tartar dissolved in an ounce of warm water; but a dram and a half of common salt injected into the jugular produced little other bad consequences than a temporary thirst.—A dram of purified white vitriol, injected into the crural vein of a dog, killed him immediately.—Fifteen grains of salt of urine dissolved in an ounce of water, and injected into the crural vein of a dog, threw him into such violent convulsions that he seemed to be dying; nevertheless he recovered from a second dose, though not without a great deal of difficulty: but an ounce of urine made by a man fasting produced no bad effect. Diluted aquafortis injected into the jugular and crural vein of a dog killed him immediately by coagulating the blood. Oil of sulphur (containing some quantity of the volatile vitriolic aid) did not kill a dog after repeated trials. On the contrary, as soon as he was let go, he ran into all the corners of the room searching for meat; and having found some bones, he fell a gnawing them with strange avidity, as if the acid, by injection into his veins, had given him a better appetite.—Another dog, who had oil of tartar injected into his veins, swelled and died, after suffering great torment. His blood was found florid and not coagulated.—A dram and a half of spirit of salt diluted with water, and injected into the jugular vein of a dog, killed him immediately. In the right ventricle of the heart the blood was found partly grumous and concreted into harder clots than ordinary, and partly frothy. Warm vinegar was injected without doing any manifest harm.—Two drams of sugar dissolved in an ounce of water were injected into the jugular vein of a dog without any hurt.

These are the results of the experiments where saline substances were injected into the veins. Many acrids proved equally fatal. A decoction of two drams of white hellebore, injected into the jugular vein of a dog, killed him like a stroke of lightning. Another dog was killed in a moment by an injection of an ounce of rectified spirit of wine in which a dram of camphor was dissolved.—Ten drams of highly rectified spirit of wine, injected into the crural vein of a dog, killed him in a very short time: he died quietly, and licking his jaws with his tongue, as if with pleasure. In the vena cava and right ventricle of the heart the blood was coagulated into a great many little clots.—Three drams of rectified spirit of wine, injected into the crural vein of a small dog made him apoplectic, and as it were half dead. In a little time he recovered from the apoplexy, and became giddy; and when he endeavoured to go, reeled and fell down. Though his strength increased by degrees, yet his drunkenness continued. His eyes were red and fiery; and his sight so dull that he scarce seemed to take notice of any thing: and when he was beat, he would scarce move. However, in four hours he began to recover, and would eat bread when offered him; the next day he was out of danger.—Five ounces of strong white wine injected into the crural vein of a dog made him very drunk for a few hours, but did not produce any other consequences. An ounce of strong decoction of tobacco injected into a vein killed a dog in a very short time in terrible convulsions. Ten drops of oil of sage rubbed with half a dram of sugar, and thus dissolved in water, did no harm by being injected into the blood.

Mercury, though seemingly void of all acrimony, proves also fatal when injected into the blood. Soon after the injection of half an ounce of this mineral into the jugular vein of a dog, he was seized with a dry short cough which came by intervals. About two days after, he was troubled with a great difficulty of breathing, and made a noise like that of a broken-winded horse. There was no tumour about the root of the tongue or the parotid glands, nor any appearance of a salivation. In four days he died; having been for two days before so much troubled with an orthopnœa, that he could sleep only when he leaned his head against something. When opened, about a pint of bloody serum was found in the thorax, and the outside of the lungs in most places was blistered. Some of the blisters were larger and others smaller than a pea, but most of them contained mercurial globules. Several of them were broken; and upon being pressed a little, the mercury ran out with a mixture of a little sanies; but upon stronger pressure, a considerable quantity of sanies issued out. In the right ventricle of the heart some particles of quicksilver were found in the very middle of the coagulated blood lodged there, and the same thing also was observed in the pulmonary artery. Some blood also was found coagulated in a very strange and unusual manner between the columnæ of the right ventricle of the heart, and in this a greater quantity of quicksilver than anywhere else. In the left ventricle was found a very tenacious blood coagulated, and sticking to the great valve, including the tendons of it, and a little resembling a polypus. No mercury could be found in this ventricle by the most diligent search; whence it appears that the mercury had passed no farther than the extremities of the pulmonary artery, where it had stuck, and occasioned fatal obstructions.—In another dog, which had mercury injected into the jugular, it appears to have passed the pulmonary artery, as part of it was found in the cavity of the abdomen, and part also in some other cavities of the body. All the glandules were very turgid and full of liquor, especially in the ventricles of the brain, and all around there was a great quantity of serum.

In like manner, oil of olives proves certainly fatal when injected into the blood. Half an ounce of this injected into the crural vein of a dog, produced no effect in half a quarter of an hour: but after that, the animal barked, cried, looked dejected, and fell into a deep apoplexy; so that his limbs were deprived of all sense and motion, and were flexible any way at pleasure. His respiration continued very strong, with a snorting and wheezing, and a thick humour sometimes mixed with blood flowing out of his mouth. He lost all external sense: the eyes, though they continued open, were not sensible of any objects that were put to them; and even the cornea could be touched and rubbed, without his being the least sensible of it; his eyelids, however, had a convulsive motion. The hearing was quite lost; and in a short time the feeling became so dull, that his claws and ears could be bored with red-hot pincers without his expressing the least sense of pain.

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Sometimes he was seized with a convulsive motion of the diaphragm and muscles subservient to respiration; upon which he would bark strongly, as if he had been awake: but this waking was only in appearance; for all the time of this barking he continued as insensible as ever. In three hours he died; and on opening his body, the bronchiæ were filled with a thick froth.—An ounce of oil of olives injected into the jugular of another dog killed him in a moment; but a third lived an hour after it. He was seized with great sleepiness, snorting, and wheezing, but did not bark like the first. In all of them a great quantity of thick froth was found in the lungs.

We come now to speak of those poisons which prove mortal (B) when taken by the mouth. The principal of these are, arsenic, corrosive sublimate or muriate of mercury, glass of antimony, and lead. What the effects of these substances are when injected into the blood, cannot be related, as no experiments seem to have been made with them in that way, excepting antimony, whose effects have been already mentioned. The effects of opium, when injected into the veins, seem to be similar to its effects when taken by the mouth. Fifty grains of opium, dissolved in an ounce of water, were injected into the crural vein of a cat. Immediately after the operation she seemed much dejected, but did not cry; only made a low, interrupted, and complaining noise. This was succeeded by trembling of the limbs, convulsive motions of the eyes, ears, lips, and almost all parts of the body, with violent convulsions of the breast. Sometimes she would raise up her head, and seem to look about her; but her eyes were very dull, and looked dead. Though she was let loose, and had nothing tied about her neck, yet her mouth was so filled with froth, that she was almost strangled. At last, her convulsive motions continuing, and being seized with stretching of her limbs, she died in a quarter of an hour. Upon opening the body, the blood was found not to be much altered from its natural state.——A dram and a half of opium was dissolved in an ounce and a half of water, and then injected into the crural vein of a lusty strong dog. He struggled violently; made a loud noise, though his jaws were tied; had a great difficulty of breathing, and palpitation of the heart, with convulsive motions of almost all parts of his body. These symptoms were succeeded by a profound and apoplectic sleep. Having untied him, he lay upon the ground without moving or making any noise, though severely beaten. About half an hour after he began to recover some sense, and would move a little when beaten. The sleepiness still decreased; so that in an hour and a half he would make a noise, and walk a little when beat. However, he died in four days, after having voided a quantity of fetid excrements, in colour resembling the diluted opium he had swallowed.

The oil of tobacco has generally been reckoned a very violent poison when introduced into the blood; but from the abbé Fontana's experiments, it appears to be far inferior in strength to the poison of ticunas, or to the bite of a viper. A drop of oil of tobacco was put into a small incision in the right thigh of a pigeon, and in two minutes the animal could not stand on its right foot. The same experiment was repeated on another pigeon, and produced exactly the same effect. In another case, the oil was applied to a slight wound in the breast; three minutes after which, the animal could not stand on the left foot. This experiment was also repeated a second time, with the same success. A tooth-pick, steeped in oil of tobacco, and introduced into the muscles of the breast, made the animal fall down in a few seconds as if dead. Applied to two others, they threw up several times all the food they had eaten. Two others treated in the same manner, but with empty stomachs, made many efforts to vomit.—In general, the vomiting was found to be a constant effect of this poison: but the loss of motion in the part to which the poison is applied, was found to be only accidental. None of the animals died by the application of oil of tobacco. Dr Leake, however, asserts the contrary; saying, that this oil, which is used by the Indians in poisoning arrows, when infused into a fresh wound, besides sickness and vomiting, occasions convulsions and death. See *Practical Essay on Diseases of the Viscera*, p. 67.

The pernicious effects of laurel-water are taken notice of under the article MEDICINE, N° 261. The account is confirmed by the experiments of the Abbé Fontana; who tells us, that it not only kills in a short time, when taken by the mouth, but that, when given in small doses, the animal writhes so that the head joins the tail, and the vertebræ arch out in such a manner as to strike with horror every one who sees it. In order to ascertain the effects of this water when taken into the blood, our author opened the skin of the lower belly of a pretty large rabbit, and make a wound in it about an inch long; and having slightly wounded the muscles under it in many parts, applied two or three tea spoonfuls of laurel-water. The animal fell down convulsed in less than three minutes, and died soon after. The experiment was repeated with similar success in other animals: but was always found to act most powerfully, and in the shortest time, when taken by the mouth, or

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* See *Leake's Practical Treatise on Diseases of the Viscera.*

† See *Poison of Copper.*

(B) Of all poisons * those which may be called culinary are perhaps the most destructive, because they are generally the least suspected. All copper † vessels, therefore, and vessels of bell metal, which contains copper, should be laid aside. Even the common *earthen ware*, when they contain acids, as in pickling, become very pernicious, as they are glazed with lead, which in the smallest quantity, when dissolved, is very fatal; and even tin, the least exceptionable of the metals for culinary purposes except iron, is not always quite free of poisonous qualities, it having been found to contain a small portion of arsenic. Mushrooms and the common laurel are also very fatal. The bitter almond contains a poison and its antidote likewise. The cordial dram *ratafia*, much used in France, is a slow poison, its flavour being procured from the kernels of peach, black cherry stones, &c.—The spirit of *lauro-cerasus* is peculiarly fatal. The adulteration of bread, beer, wine, porter, &c. produces very fatal consequences, and merits exemplary punishment. Next to culinary poisons, the abuse of medicines deserves particular attention.

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injected by way of clyster. From these experiments, however, he concluded, that laurel-water would kill by being injected into the blood: but in this he was deceived; for two rabbits had each of them a large tea-spoonful injected into the jugular vein, without any inconvenience, either at the time of injection or afterwards. It proved innocent also when applied to the bare nerves, and even when introduced into the medullary substance.

We ought now to give some account of the proper antidotes for each kind of poison; but from what has been related concerning the extreme activity of some of them, it is evident that in many cases there can be but very little hope. People are most apt to be bit by serpents in the legs or hands; and as the poison, from the Abbé Fontana's experiments, appears to act only in consequence of being absorbed into the blood, it is plain, that to prevent this absorption is the chief indication of cure. We have recommended several methods for this purpose under the article MEDICINE, N° 408.; but the Abbé Fontana proposes another not mentioned there, namely, ligature. This, if properly applied between the wounded part and the heart, must certainly prevent the bad effects of the poison; but then it tends to produce a disease almost equally fatal; namely, a gangrene of the part; and our author gives instances of animals being thus destroyed after the effects of the poison were prevented; for which reason he prefers amputation. But the good effects of either of these methods, it is evident, must depend greatly on the nature of the part wounded, and the time when the ligature is applied, or the amputation performed. If the teeth of the serpent, or the poisoned arrow, happens to strike a large vein, the only possibility of escaping instant death is to compress the trunk of the vein above the wounded place, and to enlarge the wound, that the blood may flow freely, and in large quantity, in order to wash away the poison, and discharge the infected parts of the blood itself. If this be neglected, and the person falls into the agonies of death, perhaps strongly stimulating medicines given in large doses, and continued for a length of time, may enable nature to counteract the virulence of the poison. For this purpose volatile alkalies seem most proper, as acting soonest, (see MEDICINE); and perhaps a combination of them with ether might be advantageous, as by the volatility of that medicine the activity of the alkali would probably be increased. In the Philosophical Transactions, we have an account of the recovery of a dog seemingly by means of the volatile alkali, when probably he was in a dying condition. This dog indeed seems to have had a remarkable strength of constitution. The poor creature had first got two ounces of the juice of nightshade, which he bore without any inconvenience. An equal quantity of the juice of hemlock was then given him without effect. He then got a large dose of the root of wolfsbane with the same success. Two drams of white hellebore root were next given. These caused violent vomitings and purgings, but still he outlived the operation. He was then made to swallow five roots of the colchicum, or meadow-saffron, dug fresh out of the earth. The effect of these was similar to that of the white hellebore, but still he did not die. Lastly, he got two drams of opium; and he even outlived this dose. He was first cast into a deep sleep by it; but soon awaked, and was seized with violent vomitings and purgings, which carried off the effect of the opium. Seeing then that the animal had resisted the most violent poisons, it was resolved to try the effects of the bite of a viper; and he was accordingly bit three or four times on the belly a little below the navel by one enraged. The immediate consequence of this was an incipient gangrene in the parts adjoining to the wound, as appeared by the rising of little black bladders filled with a sanious matter, and a livid colour which propagated itself all around. The motion of the heart became very faint and irregular, and the animal lay without strength or sensation, as if he had been seized with a lethargy or apoplexy. In this condition his wound was cupped and scarified, and Venice treacle (a famous antidote) applied to it. In two hours after this all the symptoms were increased, and he seemed to be nearly dead; upon which half a dram of volatile salt of heartshorn mixed with a little broth was poured down his throat; and the consequence was, that in a short time he was able to stand on his feet and walk. Another dose entirely dispelled his lethargy, and the heart began to recover its strength. However, he continued very weak; and though he ate no solid meat for three days, yet at the end of that time his strength was evidently increased. The first day he drank water plentifully and greedily, and on the second day he drank some broth. On the third day he began to eat solid meat, and seemed out of danger; only some large and foul ulcers remained on that part of the belly which was bit, and before these were healed he was killed by another dog.

From comparing this with some other observations, indeed, it would seem that volatile alkali is the best antidote against all poisons which suddenly kill by a mixture with the blood, and even of some others. Indeed its effects in curing the bite of snakes seems to be put beyond all doubt, by a paper in the 2d volume of the Asiatic Researches, p. 323. "From the effect of a ligature applied between the bitten part and the heart (says Mr Williams, the author of the paper), it is evident that the poison diffuses itself over the body by the returning venous blood; destroying the irritability, and rendering the system paralytic. It is therefore probable, that the volatile caustic alkali, in resisting the disease of the poison, does not act so much as a specific in destroying its quality, as by counteracting the effect on the system, by stimulating the fibres, and preserving that irritability which it tends to destroy."

But whatever be the mode of its operation, the medicine is unquestionably powerful. Mr Williams used either the volatile caustic alkali or eau-de-luce; the former of which he seems to have preferred. Of it he gave 60 drops as a dose in water, and of the eau-de-luce he gave 40, at the same time applying some of the medicine to the part bitten, and repeating the dose as he found occasion. Of seven cases, some of which were apparently very desperate, only one died, and that appears to have been occasioned by bad treatment after the cure. Many of the patients were perfectly recovered in seven or eight minutes, and none of them required more than two hours: On the whole, Mr Williams says, that he "never knew an instance of the volatile caustic alkali failing in its effect, where the patient has been able to swallow it." Dr Mead asserts, that the alkali counteracts the deadly effects of laurel-water: we have seen its effects in curing the bite of a viper, and of snakes; and

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from Dr Wolfe's experiments on hydrophobous patients, it may even claim some merit there. Still, however, there is another method of attempting a cure in such deplorable cases; and that is, by injecting into the veins any thing which will not destroy life, but will destroy the effects of the poison. It is much to be regretted, that in those cruel experiments which we have already related, the intention seems almost always to have been to kill the animal at all events; whereas, it ought to have been to preserve him alive, and to ascertain what medicines could be safely injected into the blood, and what could not, with the effects which followed the injection of different quantities, none of which were sufficient to destroy life. But in the way they were managed, scarce any conclusion can be drawn from them. Indeed it appears that little good is to be expected from this mode; it is mere speculation, and future experiments must show whether it ever shall be used for the cure of poisons, or for any other purposes: its being now totally laid aside, seems to militate strongly against the efficacy of it; besides, the extreme cruelty of the operation will ever be a strong bar to its general introduction. See INJECTION.

There still remains another method of cure in desperate cases, when there is a certainty that the whole mass of blood is infected; and that is, by the bold attempt of changing the whole diseased fluid for the blood of a sound animal. Experiments of this kind have also been tried; and the method of making them, together with the consequences of such as are recorded in the Philosophical Transactions, we shall notice under the article TRANSFUSION.

Dr Mead, finding that many pretenders to philosophy have called the goodness of the Creator in question, for having created substances whose manifest and obvious qualities are noxious and destructive, remarks, by way of answer, that they have also salutary virtues. But, besides their physical effects, they are likewise food for animals which afford us good nourishment, goats and quails being fattened by hellebore, starlings by hemlock, and hogs innocently eating henbane; besides, some of those vegetables, which were formerly thought poisonous, are now used in medicine, and future discoveries may probably increase the number. The poison of many vegetables is their only defence against the ravages of animals; and by means of them we are often enabled to defend useful plants from the destroying insect; such as by sprinkling them with essential oil of turpentine; and by means of some substances poisonous to them, we are enabled to destroy those insects which infest the human body, and the bodies of domestic animals, &c.—As for poisonous minerals, arsenic for example, Dr Mead observes, that it is not a perfect mineral, but only an active substance, made use of by nature in preparing several metals in the earth, which are of great service to mankind; and, after confirming this by several instances, he concludes by saying, the case will be found much the same in all natural productions of this kind. As for poisonous animals, &c. their noxious qualities may easily be accounted for, by reflecting that it is their only mode of self-defence.

POISON of Copper. This metal, though when in an undissolved state it produces no sensible effects, becomes exceeding active when dissolved; and such is the facility with which the solution is effected, that it becomes a matter of some consequence to prevent the metal from being taken into the human body even in its proper form. It doth not, however, appear that the poison of copper is equally pernicious with those of arsenic or lead; much less with some others treated of in the last article. The reason of this is, that it excites vomiting so speedily as to be expelled, even though taken in considerable quantity, before it has time to corrode the stomach. Roman vitrol, which is a solution of copper in the vitriolic acid, has been used as a medicine in some diseases with great success. Verdigrise also, which is another very active preparation of the metal, has been by some physicians prescribed as an emetic, especially in cases where other poisons had been swallowed, in order to procure the most speedy evacuation of them by vomit. Where copper is not used with this view, it has been employed as a tonic and antispasmodic., with which it has been admitted into the Edinburgh Dispensatory under the title of *Cuprum Ammoniacale*. The effects of the metal, however, when taken in a pretty large quantity, and in a dissolved state, or when the stomach abounds with acid juices sufficient to dissolve it, are very disagreeable and even dangerous; as it occasions violent vomitings, pains in the stomach, faintings, and sometimes convulsions and death. The only cure for these symptoms is to expel the poison by vomiting as soon as possible, and to obtund its acrimony; for which purpose drinking warm milk will probably be found the most efficacious remedy. In order to prevent the entrance of the poison into the body, no copper vessels should be used in preparing food but such as are either well tinned or kept exceedingly clean. The practice of giving a fine blue or green colour to pickles, by preparing them in copper vessels, ought not to be tolerated; for Dr Falconer, in a treatise on this subject, assures us, that these are sometimes so strongly impregnated by this method of preparing them, that a small quantity of them will produce a slight nausea.—Mortars of brass or bell-metal ought for the same reason to be avoided, as by this means a considerable quantity of the pernicious metal may be mixed with our food, or with medicines. In other cases, an equal caution ought to be used. The custom of keeping pins in the mouth, of giving copper halfpence to children to play with, &c. ought to be avoided; as thus a quantity of the metal may be insensibly taken into the body, after which its effects must be uncertain.—It is proper to observe, however, that copper is much more easily dissolved when cold than when hot; and therefore the greatest care should be taken never to let any thing designed for food, even common water, remain long in copper vessels when cold; for it is observed, that though the confectioners can safely prepare the most acid syrups in clean copper vessels without their receiving any detriment whilst hot, yet if the same syrups are allowed to remain in the vessels till quite cold, they become impregnated with the pernicious qualities of the metal.

To what has now been said relative to the effects of mineral poisons, we shall add an account of some experiments, showing that a mineral poison may produce sudden and violent death, although the noxious matter cannot be detected by chemical tests in the contents of the stomach. As the subject of this investigation is of great importance in many points of view, we shall make no apology for laying the whole detail before our readers without

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without abridgement. The experiments were made by Dr Bostock of Liverpool, and the account of them is given by the author in a letter to the editor of the *Edinburgh Med. and Surg. Journal*, v. 14.

" In compliance with your request, I send you an account of some of the experiments which I made to illustrate the question, which was proposed to me at the late memorable trial at Lancaster, whether it was possible that a mineral poison might produce a sudden and violent death, and yet be afterwards incapable of detection in the contents of the stomach? You have already seen, in the pamphlet that was published by Drs Gerard and Rutter, Mr Hay, and myself, the effect which was produced upon dogs by corrosive sublimate. We there relate the result of two experiments, in which it was given to dogs in solution; vomiting, purging, and the symptoms of violent pain ensued, which after some hours were terminated by death. The contents of the stomach, it is there stated, were analysed by me, but none of the sublimate could be detected. In the first experiment, $1\frac{1}{2}$ grains of the salt were given, and in the second 4 grains; this latter being the larger quantity, and also the one in which the process was conducted with the most accuracy, I shall confine myself to relate the circumstances of this alone.

" When the stomach of the dog was opened, a small quantity of water was added to wash out its contents more completely, making the whole somewhat less than one ounce. It was deeply tinged with blood, and I let it remain at rest for 30 hours, in order that the colouring matter might subside from it. It had then acquired a very fœtid smell, and not being much clearer than at first, I added to it about an equal quantity of water, and passed it, first through a linen strain, and afterwards through a paper filter. It was now nearly transparent, but slightly tinged with blood.

" A solution of corrosive sublimate was prepared, containing $\frac{1}{2400}$ of its weight of the salt. Into a quantity of this solution the recently prepared muriate of tin was dropped, which produced an immediate and very copious precipitation. Caustic potash also threw down a precipitate, although in small quantity. The same tests were then added to the fluid taken from the stomach, but no effect was produced by the muriate of tin for some hours, when at length it became, in some degree, opake. The effect here, both as to time and the nature of the appearance, was quite different from the precipitate in the solution of corrosive sublimate, and I considered it as depending upon the action of the muriate of tin upon the mucus. In proof of this, when the stomach fluid had potash added to it, instead of having a precipitate thrown down, it was rendered more transparent than before the experiment. The solution of corrosive sublimate was subjected to the action of galvanism, by having a piece of gold placed in it, clasped by zinc wire; in an hour the gold was obviously whitened by the precipitation of the mercury upon it. The fluid taken from the stomach was submitted to the same process for three hours, but no effect was produced (c). The fluid from the stomach did not exhibit either acid or alkaline properties; it was copiously precipitated by the nitrate of silver, shewing that it contained muriatic acid.

" On the following day, a slight brown precipitate had subsided from the stomach fluid, and the whole had become very opake. The precipitate was dissolved by potash, at the same time that the fluid was rendered more transparent. It was become extremely putrid. The putridity increased: and, in two days more, a scum was formed on the surface, and the sides of the glass were also encrusted with a gray matter. The experiments were performed between the 17th and 22d of August.

" The following experiments were then made on the corrosive sublimate, with every possible attention to accuracy. Two grains of the salt were dissolved in 600 grains of distilled water. This I call solution N° 1. Ten grains of N° 1. were then added to 90 grains of water, forming solution N° 2. in which the fluid would contain $\frac{1}{10000}$ of its weight of the sublimate. Into 10 drops of N° 2. two drops of the muriate of tin were added, and caused a very obvious precipitate. Ten grains of N° 2. were added to 90 grains of distilled water, making the fluid to contain $\frac{1}{1000000}$ of its weight of the salt. Into 10 drops of this solution, two drops of the muriate of tin were added, and an immediate gray cloud was perceptible in the fluid, although no precipitate was thrown down. The galvanic process was repeated with the solution N° 3.; it remained six hours, and I thought I perceived a whiteness on one part of the gold; but it was not very distinctly visible.

" From these experiments, we may draw the following conclusions:—

" 1. The fluid taken from the dog's stomach contained muriatic acid, probably in the form of common salt, and animal matter, probably mucus, in considerable quantity.

" 2. The tests that were employed to discover the corrosive sublimate, were capable of detecting it in a fluid, when it composed only $\frac{1}{1000000}$ of its weight.

" 3. These tests did not detect any corrosive sublimate in the fluid taken from the dog's stomach; it may therefore be concluded,

" 4. That an animal may be suddenly killed by receiving a metallic poison into the stomach, and yet that the nicest tests may not be able to detect any portion of the poison after death, in the contents of the stomach.

" This conclusion appears incontrovertible; and though some analogous facts had occasionally been noticed*, it is so different from the generally received opinion upon the subject, that I think it must have considerable influence on all future judicial proceedings, in which the question of poisoning is agitated."

* *Hoffmanus de Veneni dati Accusatione.*

Poison of Lead. See Medicine, N° 303.

Poison-Tree. See Rhus, Botany *Index*.

Poison-Tree of Java, called in the Malayan language *bohun upas*, is a tree which has often been described by naturalists; but its existence has been very generally doubted, and the descriptions given of it, containing much of the marvellous, have been often treated as idle fictions. N. P. Foersch, however, in an account of it, written in Dutch, asserts that it does exist; and tells

(c) This experiment was performed at the suggestion of Dr Wollaston.

tells us, that he once doubted it as much as any person; but, determined not to trust general opinions, he made the most particular inquiries possible; the result of which was, that he found that it is situated in the island of Java, about 27 leagues from Batavia, 14 from Soura Charta, the emperor's seat, and about 19 from Tinkjoe, the residence of the sultan of Java. It is surrounded on all sides by hills and mountains, and the adjacent country for 12 miles round the tree is totally barren. Our author says he has gone all round the spot at about 18 miles from the centre, and on all sides he found the country equally dreary, which he ascribes to its noxious effluvia. The poison procured from it is a gum, issuing from between the bark and the tree; and it is brought by malefactors who have been condemned to death, but who are allowed by this alternative to have a chance for their life. An old ecclesiastic, our author informs us, dwelt on the outside of the surrounding hills, whose business it was to prepare the criminals for their fate, if death should be the consequence of their expedition. And indeed so fatal are its effluvia, that he acknowledged that scarcely two out of 20 returned from above 700 whom he had dismissed.

Mr Foersch farther tells us, that he had seen several of the criminals who had returned, and who told him, that the tree stands on the borders of a rivulet, is of a middling size, and that five or six young ones of the same kind stand close to it. They could not, however, see any other plant or shrub near it; and the ground was of brownish sand, full of stones and dead bodies, and difficult to pass. The Malayans think this tract was thus rendered noxious and uninhabitable by the judgement of God, at Mahomet's desire, on account of the sins of the inhabitants. No animal whatever is ever seen there; and such as get there by any means never return, but have been brought out dead by such of the criminals as have themselves escaped death.

Our author relates a circumstance which happened in the year 1775, to about 400 families (1600 souls), who refused to pay some duty to the emperor, and who were in consequence declared rebels and banished; they petitioned for leave to settle in the uncultivated parts round Upas: the consequence of which was, that in less than two months their number was reduced to about 300 souls, who begged to be reconciled to the emperor, and were again received under his protection. Many of these survivors Mr Foersch saw, and they had just the appearance of persons tainted with an infectious disorder.

With the juice of this tree arrows, lancets, and other offensive weapons, are poisoned. With lancets thus poisoned, Mr Foersch observes, that he saw 13 of the emperor's concubines executed for infidelity to his bed in February 1776. They were lanced in the middle of their breasts; in five minutes after which they were seized with a *tremor* and *subsultus tendinum*, and in 15 minutes they were dead. Their bodies were full of livid spots, like those of *petechiæ*, their faces swelled, colour blue, and eyes yellow, &c. Soon after he saw seven Malayans executed in the same way, and saw the same effects follow; on which he resolved to try it on other animals, and found the operation similar on three puppies, a cat, and a fowl, none of which survived more than 13 minutes. He also tried its effects internally on a dog seven months old; the animal became delirious, was seized with convulsions, and died in half an hour. From all which our author concludes, that it is the most violent of all vegetable poisons, and that it contributes greatly to the unhealthiness of the island in which it grows. By means of it many cruel and treacherous murders are perpetrated. He adds, that there exists a sort of cajoe-upas on the coast of Macassar, the poison of which, though not near so violent or malignant, operates nearly in the same manner.

Most of our readers will probably consider this whole account as highly incredible; but we have to add, that it has been directly controverted in all its parts in a memoir of Lambert Nolst, M. D. fellow of the Batavian Experimental Society at Rotterdam, (see *Gentleman's Mag.* May 1794, p. 433.). This memoir was procured from John Matthew à Rhyn, who had been 23 years, from 1763 to 1786, resident in the island, and therefore had every opportunity of informing himself on the spot. In this memoir we are told, that Foersch's account of the tree is extremely suspicious, from a variety of circumstances: 1. Though he had letters of introduction, he went to no considerable house, and afterwards privately withdrew among the English. 2. When the emperor was asked respecting Foersch, and the facts he relates, he answered, that he had never heard either of him or of the tree. 3. The distances given to mark the situation of the tree are not accurate. 4. The execution of criminals is different from what he represents. 5. The circumstance of several criminals returning when Foersch was there, has a suspicious appearance. 6. There exists no such tradition, as that the tree was placed there by Mahomet. 7. There were no such disturbances in 1775 as Foersch represents, the tract to which he alludes having submitted to the Dutch East India Company as early as 1756. 8. The island is not unhealthy, as Foersch asserts; nor are violent or premature deaths frequent. 9. The Javanese are a curious and intelligent people, and of course could not be so ignorant of this tree if it had any existence. 10. The assertions and pretended facts of Foersch have no collateral evidence; and every thing which we gather from the accounts of others, or from the history of the people, invalidates them. For these and other reasons, Dr Nolst concludes, that very little credit is due to the representations of Foersch, and that the island of Java produces no such tree, which, if it really grew there, would be the most remarkable of all trees.

We must notice also, that the account of this very remarkable tree has been still farther controverted by Sir George Staunton, who, during his stay at Batavia, made the most particular inquiries concerning it, and found, that the existence of such a tree had never been known there. (*Embassy to China*). The fabulous history of this tree, however, has produced a most beautiful description from the muse of Dr Darwin, whose harmonious verses on the subject we shall present to our readers.

Where seas of glass with gay reflections smile
Round the green coasts of Java's palmy isle,
A spacious plain extends its upland scene,
Rocks rise on rocks, and fountains gush between;

Soft

Soft zephyrs blow, eternal summers reign,
And showers prolific bless the soil,——in vain!
—No spicy nutmeg scents the vernal gales,
Nor towering plantain shades the mid-day vales;
No grassy mantle hides the sable hills,
No flowery chaplet crowns the trickling rills;
Nor tufted moss, nor leathery lichen creeps
In russet tapestry o'er the crumbling steeps.
—No step retreating, on the sand impress'd,
Invites the visit of a second guest;
No refluent fin the unpeopled stream divides,
No revolant pinion cleaves the airy tides;
Nor handed moles, nor beaked worms return,
That mining pass the irremeable bourn.—
Fierce in dread silence on the blasted heath
Fell UPAS sits, the HYDRA-TREE of death.
Lo! from one root, the envenom'd soil below,
A thousand vegetative serpents grow;
In shining rays the scaly monster spreads
O'er ten square leagues his far-diverging heads;
Or in one trunk entwists his tangled form,
Looks o'er the clouds, and hisses in the storm.
Steep'd in fell poison, as his sharp teeth part,
A thousand tongues in quick vibration dart;
Snatch the proud eagle towering o'er the heath,
Or pounce the lion, as he stalks beneath;
Or strew, as marshall'd hosts contend in vain,
With human skeletons the whiten'd plain.
—Chain'd at his root two scion-demons dwell,
Breathe the faint hiss, or try the shriller yell;
Rise fluttering in the air on callow wings,
And aim at insect-prey their little stings.

Loves of the Plants, canto iii.

POLACRE, a ship with three masts, usually navigated in the Levant and other parts of the Mediterranean. These vessels are generally furnished with square sails upon the mainmast, and *lateen* sails upon the foremast and mizenmast. Some of them, however, carry square sails upon all the three masts, particularly those of Provence in France. Each of their masts is commonly formed of one piece, so that they have neither topmast nor top-gallant mast; neither have they any *horses* to their yards, because the men stand upon the topsail-yard to loose or furl the top-gallant-sail, and on the lower yard to *reef*, to loose, or furl, the topsail, whose yard is lowered sufficiently down for that purpose.

POLAND, a country of Europe, in its largest extent bounded by Pomerania, Brandenburg, Silesia, and Moravia, to the west; and, towards the east, by part of Russia and the Lesser Tartary; on the north, it has the Baltic, Russia, the grand province of Livonia, and Samogitia; and on the south, it is bounded by Bessarabia, Transylvania, Moldavia, and Hungary. Geographers generally divide it into the provinces of Poland Proper, Lithuania, Samogitia, Courland, Prussia, Massovia, Polachia, Polesia, Little Russia, called likewise *Russia Rubra* or *Red Russia*, Podolia, and the Ukraine. The present kingdom of Poland, however, lately the duchy of Warsaw, occupies but a small part of these territories. For a map of Poland and Prussia, see Pl. CCCCXXXIV.

With regard to the history of Poland, we are not to gather the early part of it from any accounts transmitted to us by the natives. The early histories of all nations indeed are involved in fable; but the Poles never had even a fabulous history of their own nation. The reason of this is, that it was not the custom with that nation to entertain itinerant poets for the amusement of the great; for to the songs of these poets entertained among other nations we are obliged for the early part of their history; but this assistance being deficient in Poland, we must have recourse to what is recorded concerning it by the historians of other nations.

1 Polish sovereigns at first only styled dukes.

The sovereigns of Poland at first had the title of *duces*, dukes or generals, as if their office had been only to lead the armies into the field. The first of these is universally allowed to have been Lechus or Lecht; and to render him more illustrious, he is said to have been a lineal descendant from Japhet the son of Noah. According to some writers, he migrated at the head of a numerous body of the descendants of the ancient Sclavi from some of the neighbouring nations; and, to this day, Poland is called by the Tartars the kingdom of *Lechus*. Busching, however, gives a different account of the origin of the Poles. Sarmatia, he observes, was an extensive country, inhabited by a variety of nations of different names. He supposes the Poles to be the descendants of the ancient Lazi, a people who lived in Colchis near the Pontus Euxinus; whence the Poles are sometimes called *Polazi*. Crossing several rivers, they entered Posnania, and settled on the borders of the Warta, while their neighbours the Zechi settled on the Elbe, in the 550th year of Christ. As to the name of *Poland*, or *Polska*, as it is called by the natives, it comes from the Sclavonic word *Pole*, or *Poln*, which signifies a country adapted to hunting, because the whole country was formerly covered with vast forests, exceedingly proper for that employment.

2 Lechus the first duke.

3 Derivation of the different names of Poland.

Of the transactions of Lechus during the time that he enjoyed the sovereignty, we have no certain account. His successor was named *Viscimer*, who is generally supposed to have been the nephew of Lechus. He was a warlike and successful prince, subduing many provinces of Denmark, and building the city of Wismar, so called from the name of the sovereign. But the Danish historians take no notice of his wars with their country; nor do they even mention a prince of this name. However, he is said to have reigned for a long time with great glory; but to have left the people in great distress, on account of the disputes which arose about a successor.

4 Viscimer the second duke.

After the death of Viscimer, the nobility were on the point of electing a sovereign, when the people, harassed by the grievous burdens occasioned by the wars of Viscimer, unanimously demanded another form of government, that they might no longer be liable to suffer from ambition and tyranny. At first the nobility pretended to yield to this humour of the people with great reluctance; however, they afterwards determined on such a form of government as threw all the power into their own hands. Twelve palatines, or vaivodes, were chosen; and the Polish dominions divided into as many provinces. These palatines exercised a despotic authority within their several jurisdictions, and aggravated the misery of the people by perpetual wars among themselves; upon which the Poles, worn out with oppression, resolved to return to their old form of government. Many assemblies were held for this purpose; but, by reason of the opposition of the vaivodes, they

5 Form of government changed into an aristocracy.

 same

Poland.

came to nothing. At last, however, they cast their eyes upon Cracus, or Gracus, whose wealth and popularity had raised him to the highest honours among his countrymen. The Poles say that he was a native of Poland, and one of the 12 vaivodes; but the Bohemians affirm that he was a native of their country: however, both agree in maintaining, that he was descended from the ancient family of the Gracchi in Rome; who, they say, were banished to this country. He is said to have signalized himself against the Franks, whom he overthrew in some desperate engagements, and afterwards built the city of Cracow with their spoils. He did not enlarge his dominions, but made his subjects happy by many excellent regulations. At last, after a long and glorious reign, he expired, or, according to some, was assassinated by a nobleman who aspired to the crown.

6 The dukedom restored.

Cracus left three children; Cracus, Lechus, and a daughter named *Vanda*. The first succeeded to the dukedom in virtue of his birthright; but was soon after murdered by his brother Lechus. However, it seems the thoughts of the crime which he had committed so disturbed his conscience, that the secret could not be kept. When it was known that he had been the murderer of his late sovereign, he was deposed with all possible marks of ignominy and contempt, and his sister Vanda declared duchess. She was a most beautiful and accomplished lady; and soon after she had been raised to the sovereignty, one Rithogar, a Teutonic prince, sent an ambassador demanding her in marriage, and threatening war if his proposals were refused. Vanda marched in person against him at the head of a numerous army, and the event proved fatal both to Rithogar and herself. The troops of Rithogar abandoned him without striking a blow, upon which he killed himself in despair; and Vanda, having become enamoured of him, was so much concerned for his death, that she drowned herself in the river Vistula or Wessel. From this unfortunate lady the country of Vandalia takes its name.

7 Again abolished.

The family of Cracus having become extinct by the death of Vanda, the Poles were again left at liberty to choose a new sovereign or a new form of government. Through a natural levity, they changed the form of government, and restored the vaivodes notwithstanding all that they had formerly suffered from them. The consequences were the same as before: the vaivodes abused their power; the people were oppressed, and the state was distracted between foreign wars and civil contentions. At that time the Hungarians and Moravians had invaded Poland with a numerous army, and were opposed only by a handful of men almost ready to surrender at discretion, when one Premislaus, a private soldier, contrived a stratagem by which the numerous forces of the enemy were overthrown: and for his valour was rewarded with the dukedom. We are ignorant of the other transactions of his reign; but all historians inform us that he died deeply regretted, and without issue; so that the Poles had once more to choose a sovereign.

8 Restored a second time.

On the death of Premislaus several candidates appeared for the throne; and the Poles determined to prefer him who could overcome all his competitors in a horse-race. A stone pillar was erected near the capital, on which were laid all the ensigns of the ducal authority; and a herald proclaimed, that he who first arrived at that pillar from a river at some distance, named *Pouderic*, was to enjoy them. A Polish lord named *Lechus* was resolved to secure the victory to himself by a stratagem; for which purpose he caused iron spikes to be driven all over the course, reserving only a path for his own horse. The fraudulent design took effect in part, all the rest of the competitors being dismounted, and some severely hurt by their fall. Lechus, in consequence of this victory, was about to be proclaimed duke; when, unluckily for him, a peasant who had found out the artifice opposed the ceremony; and upon an examination of the fact, Lechus was torn in pieces, and the ducal authority conferred upon the peasant.

The name of the new monarch was also Lechus. He attained the sovereignty in the year 774, and conducted himself with great wisdom and moderation. Though he possessed the qualities of a great warrior, and extended his dominions on the side of Moravia and Bohemia, yet his chief delight was to make his subjects happy by peace. In the decline of life he was obliged to engage in a war with Charlemagne, and is said by some to have fallen in battle with that powerful monarch; though others assert that he died a natural death, having lived so long that the springs of life were quite worn out.

Lechus III. was succeeded by his son Lechus IV. who inherited all his father's virtues. He suppressed an insurrection in the Polish provinces, by which he acquired great reputation; after which he led his army against the Greek and Italian legions who had overrun Pannonia. He gained a complete victory over his enemies. Nor was his valour more conspicuous in the battle than his clemency to the vanquished: for he dismissed all his prisoners without ransom; demanding no other conditions than that they should never again disturb the peace of Poland, or the allies of that kingdom. This duke is said to have been endowed with many virtues, and is charged only with the vice of incontinence. He left 20 natural children, and only one legitimate son, named *Popiel*, to whom he left the sovereignty. Popiel was also a virtuous and pacific prince, who never had recourse to arms but through necessity. He removed the seat of government from Cracow to Gnesna, and was succeeded by his nephew Popiel II. a minor.

The young king behaved with propriety as long as he was under the tuition of others; but as soon as he had got the reins of government into his own hands the face of affairs was altered. Lechus III. who, as hath been already mentioned, had 20 illegitimate children, had promoted them to the government of different provinces; and they had discharged the duties of their offices in such a manner as showed that they were worthy of the confidence reposed in them. But as soon as Popiel came of age, being seduced by the advice of his wife, an artful and ambitious woman, he removed them from their posts, treated them with the utmost contempt, and at last found means to poison them all at once at an entertainment. A dreadful punishment, however, according to the historians of those times, attended his treachery and cruelty. The bodies of the unhappy governors were left unburied; and from them issued a swarm of rats, who pursued Popiel, his wife, and children, wherever they went, and at last devoured them. The nation now became a prey to civil discord at the same

Poland.

same time that it was harassed by a foreign enemy; and, in short, the state seemed to be on the verge of dissolution, when Piastus was proclaimed duke in 830, from whom the natives of ducal or regal dignity were called *Piastes*. See PIASTUS. This excellent monarch died in 861, and was succeeded by his son Ziemovitus, who was of a more warlike disposition than his father, and who first introduced regular discipline among the Polish troops. He maintained a respectable army, and took great pains to acquire a perfect knowledge in the art of war. The consequence of this was, that he was victorious in all his battles; and retook from the Germans and Hungarians not only all that they had gained, but enlarged his dominions beyond what they had been. After his death nothing remarkable happened in Poland till the time of Mieczslaus I. who attained the ducal authority in 964. He was born blind, and continued so for seven years: after which he recovered his sight without using any medicine; a circumstance so extraordinary, that in those times of ignorance and superstition it was accounted a miracle. In his reign the Christian religion was introduced into Poland. The most probable account of the manner in which Christianity was introduced is, that Mieczslaus having by ambassadors made his addresses to Daborwka daughter to the duke of Bohemia, the lady rejected his offer unless he would suffer himself to be baptized. To this the duke consented, and was baptized, after having been instructed in the principles of Christianity. He founded the archbishoprics of Gnesna and Cracow; and appointed St Adalbert, sent by the pontiff to propagate Christianity in Poland, primate of the whole kingdom. On the birth of his son Boleslaus he redoubled his zeal; founding several bishoprics and monasteries; ordering likewise that, when any part of the Gospel was read, the hearers should half draw their swords, in testimony of their readiness to defend the faith. But he was too superstitious to attend to the duties of a sovereign; and therefore suffered his dominions to be ravaged by his barbarous neighbour the duke of Russia. Yet, with all his devotion, he could not obtain the title of king from the pope, though he had warmly solicited it. That title was afterwards conferred on his son, who succeeded to all his dominions.

9 Why the sovereigns of Poland are called *Piastes*.

10 Christianity introduced by Mieczlaus I.

11 Boleslaus the first king of Poland.

Boleslaus I. the first king of Poland, surnamed *Chrobry*, succeeded to the sovereignty in 999. He also professed and cherished Christianity, and was a man of great valour and prudence. However, the first transaction of his reign savoured very much of the ridiculous piety of those times. He removed from Prague to Gnesna the remains of a saint which he had purchased at a considerable price. The emperor Otho III. made a pilgrimage, on account of a vow, to the tomb of this saint. He was hospitably received by Boleslaus, whom, in return, he invested with the regal dignity; an act which was confirmed by the pope. This new dignity added nothing to the power of Boleslaus, though it increased his consequence with his own subjects. He now affected more state than before: his body-guards were considerably augmented; and he was constantly attended by a numerous and splendid retinue whenever he stirred out of his palace. Thus he inspired his people with an idea of his greatness, and consequently of their own importance; which no doubt was necessary for the accomplishment of a design he had formed, namely, an offensive war with Russia: but when he was upon the point of setting out on this expedition, he was prevented by the breaking out of a war with the Bohemians. The elevation of Boleslaus to the regal dignity had excited the envy of the duke of Bohemia, who had solicited the same honour for himself, and had been refused. His jealousy was further excited by the connection between Boleslaus and the emperor, the former having married Rixa the emperor's niece. Without any provocation, therefore, or without giving the least intimation of his design, the duke of Bohemia entered Poland at the head of a numerous army, committing everywhere dreadful ravages. Boleslaus immediately marched against him, and the Bohemians retired with precipitation. Scarcity of provisions, and the inclemency of the season, prevented Boleslaus at that time from pursuing; but as soon as these obstacles were removed, he entered Bohemia at the head of a formidable army, with a full resolution of taking ample revenge. The Bohemians were altogether unable to resist; neither indeed had they courage to venture a battle, though Boleslaus did all in his power to force them to it. So great indeed was the cowardice of the duke or his army, that they suffered Prague, the capital of the duchy, to be taken after a siege of two years; having never, during all that time, ventured to relieve it by fighting the Polish army. The taking of this city was quickly followed by the reduction of all the places of inferior note: but though Boleslaus was in possession of almost all the fortified places in Bohemia, he could not believe his conquests to be complete until he became master of the duke's person. This unfortunate prince had shut himself up with his son in his only remaining fortress of Wissogrod, where he imagined that he should be able to foil all the attempts of the Polish monarch. In this, however, he found himself disappointed. Boleslaus invested the place, and made his approaches with such rapidity, that the garrison, dreading a general assault, resolved to capitulate, and persisted in their resolution notwithstanding all the entreaties and promises of the duke. The consequence was, that the unhappy prince fell into the hands of his enemies, and had his eyes put out by Boleslaus; after which, his son Jaremir was put into perpetual and close confinement.

12 He conquers Bohemia

13 and Moravia.

From Bohemia Boleslaus marched towards Moravia; and no sooner did he arrive on the frontier than the whole province submitted without a blow. He then resumed his intention of invading Russia; for which he had now a very fair opportunity, by reason of a civil war which raged with violence among the children of Duke Volodomir. The chief competitors were Jarislaus and Suantepolk. The latter, having been defeated by his brother, was obliged to take refuge in Poland, where he used all the arguments in his power with King Boleslaus in order to induce him to revenge his cause. Boleslaus having already an intention of invading that country, needed but little intreaty; and therefore moved towards Russia at the head of a very numerous army: giving out, that he had no other design than to revenge the injustice done to Suantepolk. He was met on the banks of the river Bog by Jarislaus at the head of an army much superior in number to his own; and for some days the Polish army was kept at bay by the Russians. At last Boleslaus, growing impatient, resolved to pass the river at all events; and therefore forming his cavalry in the best manner for breaking the torrent, he exposed

14 Gains a great victory over the Russians.

exposed his own person to the utmost of its force. Encouraged by his example, the Poles advanced breast-high in the water to the opposite shore; from whence the enemy gave them all the annoyance in their power. In spite of all opposition, however, the Poles reached the bank, and soon gained a complete victory, Jarislaus being obliged to fly to Kiovia. This city was immediately invested; but Jarislaus retired farther into the country in order to recruit his army, leaving the city to its fate. The garrison made a brave defence, but were at last compelled to surrender at discretion. A vast treasure was found in the place; great part of which was distributed by Boleslaus among the soldiers.

15
Places Suantepolk on the throne of Russia,

Though the king of Poland had now become master of the greatest part of Russia, he knew that the only possible means of keeping the country in subjection was by placing a natural sovereign over the inhabitants. For this reason he reinstated Suantepolk, though his pretensions were still disputed by Jarislaus. The latter had formed a flying camp, and meditated a scheme of surprising and carrying off his rival brother; but having failed in his attempt, he retired to Novogorod, where the attachment of the inhabitants enabled him to make some resistance, till at last he was attacked and defeated by Boleslaus, which seemed to give the finishing stroke to his affairs.

16
who attempts to cut him off with his whole army, but is defeated.

The king of Poland, however, now met with a more dangerous enemy in the perfidious and ungrateful Suantepolk than he had experienced in Jarislaus. The Russian prince, imagining himself a dependent on Boleslaus, formed a conspiracy against him; by which he projected nothing less than the destruction of him and his whole army. The massacre was already begun when Boleslaus received intelligence. The urgency of the case admitted of no delay: the king therefore mounted his horse; and having with the utmost haste assembled part of his army, fell upon the traitors with such fury, that they were obliged to betake themselves to flight, and Boleslaus got safe into Poland.

17
A dreadful battle between the Russians

But in the mean time Jarislaus having assembled fresh forces, pursued the Polish army; and having come up with them just as one half had crossed the river Boristhenes, attacked them with the utmost fury. Boleslaus defended himself with the greatest resolution; but, by reason of his forces being divided, victory was dubious for a long time. At last, when the army had wholly crossed, the Russians were entirely put to the rout, and a terrible carnage ensued. The victory, however, though complete, was not decisive; for which reason Boleslaus thought proper to continue his retreat, without attempting to conquer a country too extensive for him ever to keep in subjection.

18
Saxony conquered by Boleslaus,

Still, however, his martial inclination continued, and he led his army into Saxony. The inhabitants of this country had hitherto resisted all attempts that had been made on their freedom, and still made a violent struggle for liberty; though, in spite of their utmost efforts, they were obliged at last to submit to the yoke. On his withdrawing the troops from Saxony, however, the king thought proper to leave the people to their liberty, contenting himself with a rich booty. The boundaries of his empire he now fixed at the river Elbe; where he erected two iron columns, in order to transmit the memory of his conquest to posterity.

Boleslaus, still unsated with victory, now meditated the conquest of Prussia and Pomerania; the latter of which provinces had, in the former civil wars, been dismembered from Poland.

19
with Prussia and Pomerania.

His arms were attended with equal success against both: indeed the very terror of his name seemed to answer all the purposes of a formidable army. These, however, he seems to have designed to be the last of his warlike enterprises; for he now applied himself wholly to the enacting of wholesome laws for the benefit of his people. But in the midst of this tranquillity Jarislaus assembled the most numerous army that had ever been heard of in Russia, with which he appeared on the frontiers of Poland.

20
Gains another great victory over the Russians, on which the whole country submits.

Boleslaus, though now advanced in years, marched out against his adversaries, and met them on the banks of the Boristhenes, rendered famous by the victory he had lately gained there. The Poles crossed the river by swimming; and attacked the enemy before they had time to draw up in order of battle with such impetuosity, that a total rout soon ensued. The Russians were seized with a panic, and Jarislaus was hurried away, and almost trampled to death by the fugitives. Many thousand prisoners were taken, but Boleslaus released them upon very easy conditions; contenting himself with an inconsiderable tribute, and endeavouring to engage the affections of the people by his kindness. This well-timed clemency produced such a happy effect, that the Russians voluntarily submitted to his jurisdiction, and again became his subjects.

21
Boleslaus dies.

Soon after this he died in the year 1025, after having greatly extended his dominions, and rendered his subjects happy.

Boleslaus was succeeded by his son Mieczlaus II. but he possessed none of the great qualities of his father, being indolent and debauched in his behaviour. In the very beginning of his reign, the Russians, Bohemians, and Moravians, revolted. However, as the spirit and discipline introduced by Boleslaus still remained in the Polish army, Mieczslaus found no great difficulty in reducing them again to obedience: after which, devoting himself entirely to voluptuousness, he was seized with a frenzy, which put an end to his life in the year 1034.

22
Rixa, a tyrannical regent, driven out with her son Casimir.

The bad qualities of this prince proved very detrimental to the interest of his son Casimir; though the latter had received an excellent education, and was possessed of many virtues. Instead of electing him king, they chose Rixa his mother queen-regent. She proved tyrannical, and so partial to her countrymen the Germans, that a rebellion ensued, and she was forced to fly to Germany; where she obtained the protection of the emperor by means of the immense treasures of Boleslaus, which she had caused to be transported thither before her. Her bad behaviour and expulsion proved still more fatal to the affairs of Casimir than even that of his father. He was immediately driven out of the kingdom;

23
Poland distressed by foreign and domestic wars.

and a civil war taking place, a great many pretenders to the crown appeared at once. To the miseries occasioned by this were added those of a foreign war; for the Bohemians and Russians invaded the kingdom in different places, committing the most dreadful ravages. The consequence of these accumulated distresses was, that the nobility came at last to the resolution of recalling Casimir, and electing him sovereign. However, before they took this measure, it was thought proper to send to Rome to complain of the behaviour of the duke of Bohemia. The deputies were at first received favourably:

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but the influence of the duke's gold prevailing, no redress was obtained; so that at last, without farther struggle, it was resolved to recal Casimir.

24 Casimir recalled and elected king.

The only difficulty was where to find the fugitive prince; for he had been gone five years from the kingdom, and nobody knew the place of his retreat. At last, by sending an embassy to his mother, it was found out that he had retired into France, where he applied closely to study at the university of Paris. Afterwards he went to Italy; where, for the sake of subsistence, he took upon him the monastic habit. At that time he had returned to France, and obtained some preferment in the abbey of Clugni. Nothing now obstructed the prince's return but the sacred function with which he was invested. However, a dispensation was obtained from the pope, by which he was released from his ecclesiastical engagements, on condition that he and all the kingdom should become subject to the capitation tax called *Peter-pence*. Some other conditions of less consequence were added; such as, that the Poles should shave their heads and beards, and wear a white linen robe at festivals, like other professors of the Catholic religion. Great preparations were made for the reception of the young prince: and he was met on the frontier by the nobility, clergy, and forces of the nation; by whom he was conducted to Gnesna, and crowned by the primate with more than usual solemnity. He proved a virtuous and pacific prince, as indeed the distracted situation of the kingdom would not admit of the carrying on of wars. However, Casimir proved his courage in subduing the banditti by which the country was overrun; and by marrying the princess Mary, sister to the duke of Russia, all quarrels with that nation were for the present extinguished. Upon the whole, the kingdom flourished during his reign; and became more respectable from the wisdom and stability of the administration than it could have been by many victories. After a happy reign of 16 years, he died beloved and regretted by all his subjects.

25 Poland subjected to the tax called *Peter-pence*.

26 Boleslaus II. a valiant and successful prince.

By the happy administration of Casimir the kingdom recovered sufficient strength to carry on successful wars against its foreign enemies. Boleslaus II. the son of Casimir, an enterprising and valiant prince, succeeded to the throne; and soon made himself so famous, that three unfortunate princes all took refuge at his court at once, having been expelled from their own dominions by their rebellious subjects. These were, Jacomir, son of Briteslaus duke of Bohemia; Bela, brother to the king of Hungary; and Zaslaus duke of Kiovia, eldest son to Jarislaus duke of Russia, and cousin to the king of Poland. Boleslaus determined to redress all their grievances; but while he deliberated upon the most proper means for so doing, the duke of Bohemia, dreading the consequences of Jacomir's escape, assembled an army, and, without any declaration of war, marched through the Hercynian forest, desolated Silesia, and laid waste the frontiers of Poland with fire and sword. Boleslaus marched against him with a force greatly inferior; and, by mere dint of superior capacity, cooped up his adversary in a wood, where he reduced him to the greatest distress. In this extremity the duke sent proposals for accommodation; but they were rejected with disdain by Boleslaus; upon which the former, ordering fires to be kindled in his camp, as if he designed to continue there, removed with the utmost silence in the night-time; and marching through narrow defiles, had advanced several leagues before Boleslaus received advice of his retreat. The king pursued him, but in vain; for which reason he returned, after having ravaged the frontiers of Moravia. The next year he entered Bohemia with a numerous army; but the duke, being unwilling to encounter such a formidable adversary, submitted to such terms as Boleslaus thought proper to impose. In these the king of Poland stipulated for certain conditions in favour of Jacomir, which he took care to see punctually executed; after which he determined to march towards Hungary, to assist the fugitive prince Bela.

27 Entertains three unfortunate princes.

28 Affords effectual succour to Jacomir prince of Bohemia.

29 and to Bela prince of Hungary.

This prince had been for some time solicited by a party of disaffected nobility to return, as his brother, the reigning king, had alienated the hearts of his subjects by his tyrannical behaviour: as soon therefore as Boleslaus had finished the war in Bohemia, he was solicited by Bela to embrace so favourable an opportunity, and put him in possession of the kingdom of Hungary. This the king readily complied with, as being agreeable to his own inclination; and both princes entered Hungary by different routes, each at the head of a numerous body. The king of that country, however, was not disconcerted by such a formidable invasion; and being largely assisted by the emperor, advanced against his antagonists with a vast army; among whom was a numerous body of Bohemians, who had come to his assistance, though in direct violation of the treaty subsisting between the duke and the king of Poland. At last a decisive battle was fought, in which the Germans behaved with the greatest valour, but were entirely defeated through the treachery of the Hungarians, who in the heat of the battle deserted and went over to Bela. Almost all the foreign auxiliaries were killed on the spot; the king himself was seized, and treated with such insolence by his perfidious subjects, that he died in a short time of a broken heart; so that Bela was placed on the throne without further opposition, except from a revolt of the peasants, which was soon quelled by the Polish army.

30 He projects the conquest of Russia.

Boleslaus, having succeeded so happily in these two enterprises, began to look upon himself as invincible; and, instead of designing only to assist Zaslaus, as he had first intended, now projected no less than the subjection of the whole country. He had indeed a claim to the sovereignty by virtue of his descent from Mary, queen of Poland, sister to Jarislaus; and this he endeavoured to strengthen by marrying a Russian princess himself. Having therefore assembled a very numerous and well-disciplined army, he entered the duchy of Kiovia, where he was opposed by Wisseslaus, who had usurped the sovereignty, with a vast multitude of forces. Boleslaus, however, continued to advance; and the Russian prince being intimidated by the number and good order of his enemies, deserted his own troops, and fled away privately with a slender retinue; upon which his force dispersed themselves for want of a leader. The inhabitants of the city of Kiovia now called to their assistance Suantoslaus and Wszevold two brothers of Wisseslaus; but these princes acting the part of mediators, procured pardon for the inhabitants from Zaslaus their natural sovereign. With the same facility the two princes recovered all the other dominions belonging to Zaslaus; only one city venturing to stand a siege, and that was soon reduced. But in the mean time the king

31 Meets with surprising success.

of

of Hungary dying, a revolt ensued, and the two sons of Bela were on the point of being deprived of their paternal dominions. This Boleslaus no sooner heard of than he marched directly into Hungary; where by the terror of his name only, he re-established tranquillity, and confirmed the princes in the enjoyment of their kingdom. In the time that this was doing, Zaslaus was again driven from his territories, all the conquests that had been formerly made were lost, and Suantoslaus and Wszevold more powerful than ever. The king's vigour, however, soon disconcerted all their measures. He ravaged all those territories which composed the palatinates of Lusac and Chelm, reduced the strong city of Wolyn, and transported the booty to Poland. The campaign was finished by a battle with Wszevold; which proved so bloody, that though Boleslaus was victorious, his army was weakened in such a manner that he could not pursue his conquests. In the winter he made numerous levies; and returning in the spring to Kiovia, reduced it, after several desperate attacks, by famine. On this occasion, instead of treating the inhabitants with cruelty, he commended their valour, and strictly prohibited his troops from pillaging or insulting them; distributing provisions among them with the utmost liberality.

32 Reduces Kiovia, but enervates himself there.

This clemency procured the highest honour to the king of Poland; but his stay here produced a most terrible disaster. Kiovia was the most dissolute, as well as the richest city, in the north; the king and all his soldiers gave themselves up to the pleasures of the place. Boleslaus himself affected all the imperious state of an eastern monarch, and contracted an inclination for the grossest debaucheries. The consequence had almost proved fatal to Poland. The Hungarian and Russian wars had continued for seven years, during all which time the king had never been at home excepting once for the short space of three months. In the mean time the Polish women, exasperated at hearing that their husbands had neglected them and connected themselves with the women of Kiovia, raised their slaves to the beds of their masters; and in short the whole sex conspired in one general scheme of prostitution, in order to be revenged of the infidelity of their husbands, excepting one single woman, namely, *Margaret*, the wife of Count Nicholas of Demboisin, who preserved her fidelity in spite of all solicitation. Advice of this strange revolution was soon received at Kiovia, where it excited terrible commotions. The soldiers blamed the king for their dishonour; forgetting how much they had to accuse their own conduct in giving their wives such extreme provocation. The effect of these discontents was a general desertion, and Boleslaus saw himself suddenly left almost alone in the heart of Russia; the soldiers having unanimously resolved to return home to take vengeance of their wives and their gallants.

33 Universal defection of the Polish women.

34 A terrible civil war ensues.

A dreadful kind of war now ensued. The women knew that they were to expect no mercy from their enraged husbands, and therefore persuaded their lovers to take arms in their defence. They themselves fought by the side of their gallants with the utmost fury, and sought out their husbands in the heat of battle, in order to secure themselves from all danger of punishment by their death. They were, however, on the point of being subdued, when Boleslaus arrived with the few remaining Poles, but assisted by a vast army of Russians, with whom he intended to take equal vengeance on the women, their gallants, and his own soldiers who had deserted him. This produced a carnage more dreadful than ever. The soldiers united with their former wives and their gallants against the common enemy, and fought against Boleslaus and the Russians with the fury of lions. At last, however, the fortune of the king prevailed; the rebels were totally subdued, and the few who escaped the sword were tortured to death, or died in prison.

35 Religious contentions.

To add to the calamities of this unhappy kingdom, the schisms which for some time had prevailed in the church of Rome found their way also into Poland; and the animosity of parties became aggravated in proportion to the frivolousness of their differences. By perverse accident the matter came at last to be a contention for wealth and power between the king and clergy. This soon gave occasion to bloodshed; and the bishop of Cracow was massacred in the cathedral while he was performing the duties of his office. This and some other enormous crimes in a short time brought on the most signal vengeance of the clergy. Gregory VII. the pope at that time, thundered out the most dreadful anathemas against the king, released his subjects from their allegiance, deprived him of the titles of sovereignty, and laid the kingdom under a general interdict, which the archbishop of Gnesna saw punctually enforced. To this terrible sentence Boleslaus in vain opposed his authority, and recalled the spirit which had formerly rendered him so formidable to the neighbouring states. The minds of the people were blinded by superstition, so that they deemed it a less heinous crime to rise in rebellion against their sovereign than to oppose the tyranny of the holy see. Conspiracies were daily formed against the person and government of Boleslaus. The whole kingdom became a scene of confusion, so that the king could no longer continue with safety in his own dominions. He fled therefore with his son Mieczslaus, and took refuge in Hungary; but here also the holy vengeance of the clergy pursued him, nor did they cease persecuting him till he was brought to a miserable end. Authors differ widely with respect to the manner of his death. Some say that he was murdered by the clergy as he was hunting; others, that he killed himself in a fit of despair; and one author tells us, that he wandered about in the woods of Hungary, lived like a savage upon wild beasts, and was at last killed and devoured by dogs. The greatest number, however, tell us, that being driven from place to place by the persecutions of the clergy, he was at last obliged to become a cook in a monastery at Carinthia, in which mean occupation he ended his days.

36 Boleslaus deposed by the pope, and the whole kingdom put under an interdict.

37 The king's extreme distress and death.

38 The interdict removed at the expence of grievous impositions.

The destruction of Boleslaus was not sufficient to allay the papal resentment. It extended to the whole kingdom of Poland. Mieczlaus, the son of Boleslaus, was not suffered to ascend the throne; and the kingdom continued under the most severe interdict, which could be removed only by the force of gold, and the most abject concessions. Besides the tax called *Peter-pence*, new impositions were added of the most oppressive nature; till at length the pontiff, having satiated his avarice, and impoverished the country, consented that the brother of the deceased monarch should be raised to the sovereignty, but only with the title of duke. This prince, named *Uladislaus*, being of a meek disposition, with little ambition, thought it his duty to acquiesce implicitly

Poland.

39 Uladislaus becomes sovereign, but is allowed only the title of duke.

implicitly in the will of the pope; and therefore accepted the terms offered, sending at the same time an embassy to Rome, earnestly intreating the removal of the interdict. The request was granted; but all his endeavours to recover the regal dignity proved fruitless, the pope having in conjunction with the emperor of Germany, conferred that honour on the duke of Bohemia. This was extremely mortifying to Uladislaus, but it was absorbed in considerations of the utmost consequence to himself and his dominions. Russia took the opportunity of the late civil disturbances to throw off the yoke; and this revolt drew after it the revolt of Prussia, Pomerania, and other provinces. The smaller provinces, however, were soon reduced; but the duke had no sooner returned to Poland, than they again rebelled, and hid their families in impenetrable forests. Uladislaus marched against them with a considerable army; but was entirely defeated, and obliged to return back with disgrace. Next year, however, he had better fortune; and, having led against them a more numerous army than before, they were content to submit and deliver up the ringleaders of the revolt to be punished as the duke thought proper.

No sooner were the Pomeranians reduced, than civil dissensions took place. Sbigneus, the son of Uladislaus by a concubine, was placed at the head of an army by the discontented nobility, in order to subvert his father's government, and dispute the title of Boleslaus, the legitimate son of Uladislaus to the succession. The war was terminated by the defeat and captivity of Sbigneus; who was at first confined, but afterwards released on condition that he should join his father in punishing the palatine of Cracow. But before this could be done, the palatine found means to effect a reconciliation with the duke; with which the young princes being displeased, a war took place between them and their father. The end of all was, that the palatine of Cracow was banished, and the princes submitted; after which, Uladislaus, having chastised the Prussians and Pomeranians who had again revolted, died in the year 1103, the 59th of his age.

40 Boleslaus III. divides his dominions betwixt Sbigneus his illegitimate brother and himself.

Uladislaus was succeeded by his son Boleslaus III. who divided his dominions equally betwixt his brother Sbigneus and himself. The former being dissatisfied with his share, raised cabals against his brother. A civil war was for some time prevented by the good offices of the primate: but at last Sbigneus, having privately stirred up the Bohemians, Saxons, and Moravians, against his brother, made such formidable preparations as threatened the conquest of all Poland. Boleslaus, being unprovided with forces to oppose such a formidable power, had recourse to the Russians and Hungarians; who readily embraced his cause, in expectation of turning it to their own advantage. The event was, that Sbigneus was entirely defeated; and might easily have been obliged to surrender himself at discretion, had not Boleslaus generously left him in quiet possession of the duchy of Mazovia, in order to maintain himself suitably to the dignity of his birth. This kindness the ungrateful Sbigneus repaid by entering into another conspiracy; but the plot being discovered, he was seized, banished, and declared a traitor if ever he set foot again in Poland. Even this severity did not produce the desired effect: Sbigneus persuaded the Pomeranians to arm in his behalf; but he was defeated, taken prisoner, and again banished. Almost all the nobility solicited the king to put such an ungrateful traitor to death; however, that generous prince could

41 A civil war.

42 Generosity of Boleslaus, and ingratitude of Sbigneus.

not think of polluting his hands with the death of his brother, notwithstanding all he had yet done. Nay, he even took him back to Poland, and appointed him a maintenance suitable to his rank: but he soon had reason to repent of his kindness; for his unnatural brother in a short time began to raise fresh disturbances, in consequence of which he soon met with the death which he deserved.

43 who is at last put to death.

Boleslaus was scarcely freed from the intrigues of his brother, when he found himself in greater danger than ever from the ambition of the emperor Henry IV. The emperor had attacked the king of Hungary, with whom Boleslaus was in close alliance, and from whom he had received assistance when in great distress himself. The king of Poland determined to assist his friend; and therefore made a powerful diversion in Bohemia, where he repeatedly defeated the Imperialists: upon which, the emperor collecting all his forces, ravaged Silesia, and even entered Poland, where he laid siege to the strong town of Lubusz; but was at last obliged to abandon the enterprise, after having sustained much loss. However, Henry was not discouraged, but penetrated still farther into Poland, and was laying waste all before him, when the superior skill of Boleslaus compelled him to retire, after having almost destroyed his army with fatigue and famine, without once coming to action. Enraged at this disappointment, Henry laid siege to Glogaw, in hopes of drawing the Poles to an engagement before he should be obliged to evacuate the country. The fortifications of the place were weak; but the spirit of the inhabitants supplied their deficiencies, and they gave the Imperialists a most unexpected and vigorous reception. At last, however, they were on the point of surrendering to superior force; and actually agreed to give up the place, provided they did not receive any succours during that time. Boleslaus determined, however, not to let such a brave garrison fall a sacrifice to their loyalty; and therefore prevailed on the besieged to break the capitulation rather than surrender when they were on the point of being delivered. All this was transacted with the utmost secrecy; so that the emperor advanced, without thoughts of meeting with any resistance, to take possession of the city; but, being received by a furious discharge of arrows and javelins, he was so incensed, that he resolved to storm the place, and give no quarter. On the approach of the army, the Imperialists were astonished to see not only the breaches filled up, but new walls, secured by a wet ditch, reared behind the old, and erected during the suspension of hostilities by the industry of the besieged. The attack, however, went on; but the inhabitants, animated by despair, defended themselves with incredible valour, and at last obliged the Imperialists to break up the siege with precipitation. Next day Boleslaus arrived, and pursued the emperor with such vigour, that he obliged him to fly with disgrace into his own country. This soon brought on a peace, which was confirmed by a marriage between Boleslaus and the emperor's sister.

44 War with the emperor Henry IV.

45 Who is worsted.

Hitherto the glory of Boleslaus had equalled, or even eclipsed, that of his namesake and predecessor Boleslaus the Great; but about the year 1135 he was brought into difficulties and disgrace by his own credulity. He was imposed upon by an artful story patched up by a certain Hungarian; who insinuated himself so far into his affections, that he gave him the government of Wi-

46 Boleslaus brought into difficulties by his own credulity and generosity.

Poland. slica, a strong town on the river Nida. But the traitor gave up the place to the Russians, who pillaged and burnt it; carrying the inhabitants at the same time into slavery. Boleslaus was incensed, and entered immediately upon a war with Russia, by which means he only heaped one calamity upon another. He received a deputation from the inhabitants of Halitz, to implore his assistance in favour of a young prince, who had been banished into Poland. Boleslaus marched to their relief with a choice body of troops; but as he was preparing to enter the town, he was attacked by the whole Russian army, and, after a most violent conflict, entirely defeated. By this disgrace the duke was so much afflicted, that he died in a short time, after having reigned 36 years.

47 Poland divided among the children of Boleslaus.

Boleslaus, by his will, left his dominions equally divided among his four sons. Uladislaus, the eldest, had the provinces of Cracow, Sirad, Lencici, Silesia, and Pomerania. Boleslaus, the second son, had for his share the palatinates of Culm and Cujavia, with the duchy of Mazovia. The palatinates of Kaleszh and Posnania fell to Mieczslaus the third son; and to Henry, the fourth son, were assigned those of Lublin and Sandomir. Casimir the youngest child, then an infant in the cradle, was entirely forgotten, and no provision made for him. There have been but very few instances where dominions were thus divided, that the princes remained satisfied with their respective shares; neither did the sons of Boleslaus long continue at peace with one another. By the will of the late duke, all the brothers were obliged to own the supremacy of Uladislaus, who was declared duke of all Poland: they were restrained from forming alliances, declaring war, or concluding peace, without his approbation: they were obliged to take the field with a certain number of troops, whenever the duke required it; and they were forbid to meddle with the guardianship of the infant prince Casimir, his education being left entirely to the sovereign. The harmony of the princes was first disturbed by the ambition of Christina, the wife of Uladislaus, who formed a scheme to get possession of all Poland, and deprive the younger children of the benefit of their father's will. Having obtained her husband's concurrence, she assembled the states of Poland, and made a long speech, showing the dangers which might arise from a partition of the ducal dominions among so many; and concluded with attempting to show the necessity of revoking the ratification of the late duke's will, in order to ensure the obedience of the princes and the tranquillity of the republic. Many of the nobility expressed their resentment against this speech, and fully refuted every article in it; but they were all afterwards gained over, or intimidated by Uladislaus; so that none appeared to take the part of the young princes except a noble Dane, who lost his life for so doing.

48 A civil war.

49 Uladislaus drives out all the rest.

Uladislaus now having got the nobility on his side, first drove Boleslaus out of his territories; next, he marched against Henry, and dispossessed him also, forcing both to take refuge with Mieczslaus in Posnania, where all the three brothers were besieged. Several of the nobility interposed, and used all their influence to effect a reconciliation, but in vain; for Uladislaus was as inexorable as if he had received an injury; and therefore insisted that the besieged princes should surrender at discretion, and submit to the will of the conqueror. Thus driven to despair, the brothers sallied out, and attacked the duke's army with such impetuosity, that they obtained a complete victory, and took all his baggage and valuable effects. The brothers improved their victory, and laid siege to Cracow. The Russians, who had assisted Uladislaus at first, now entirely abandoned him, and evacuated Poland, which obliged him to shut himself up in Cracow; but, finding the inhabitants little disposed to stand a siege, he retired into Germany in order to solicit assistance from his wife's friends. But here he found himself mistaken, and that these friends were attached to him only in his prosperity; while in the mean time the city of Cracow surrendered, the unfortunate Uladislaus was formally deposed, and his brother Boleslaus raised to the supreme authority. 50 and is deposed.

The new duke began his administration with an act of generosity to his brother Uladislaus, to whom he gave the duchy of Silesia, which thus was separated from Poland, and has never since been re-annexed to it. This had no other effect upon Uladislaus than the putting him in a condition to raise fresh disturbances; for he now found means to persuade the emperor Conrade to invade Poland: but Boleslaus so harassed and fatigued his army by perpetual marches, ambuscades, and skirmishes, that he was obliged in a short time to return to his own country; and for some years Poland enjoyed profound tranquillity.

During this interval Henry entered on a crusade; and, though he lost almost all his army in that enthusiastic undertaking, he is celebrated by the superstitious writers of that age, as the bulwark of the church, and one of the greatest Christian heroes: however, in all probability, the reason of this extraordinary fame is, that he made large donations to the knights of St John of Jerusalem. Soon after the return of Henry, Poland was invaded by the emperor Frederic Barbarossa, who was persuaded to this by the solicitations of Uladislaus and his wife Christina. The number of the Imperialists was so great, that Boleslaus and his brothers did not think proper to oppose them in the field; they contented themselves with cutting off the convoys, placing ambuscades, harassing them on their march, and keeping them in perpetual alarms by false attacks and skirmishes. With this view the three brothers divided their forces, desolated the country before the enemy, and burnt all the towns and cities which were in no condition to stand a siege. Thus the emperor, advancing into the heart of a desolated country where he could not subsist, was at last reduced to such a situation that he could neither go forward nor retreat, and was obliged to solicit a conference with Boleslaus. The latter was too prudent to irritate him by an unseasonable haughtiness, and therefore went to the German camp attended only by his brothers and a slight guard. This instance of confidence was so agreeable to the emperor, that a treaty was soon entered upon, which was confirmed by a marriage between Adelaide, niece to the emperor, and Mieczslaus duke of Posnania.

51 Poland invaded by the emperor Barbarossa,

52 who is obliged to sue for peace.

Boleslaus having thus happily escaped from so great a danger, took it into his head to attempt the conquest of Prussia, for no other reason but because the inhabitants were heathens. Having unexpectedly invaded the country with a very numerous army, he succeeded in his enterprise; great numbers of infidels were converted, and many churches set up: but no sooner was Boleslaus gone,

gone, than the inhabitants returned to their old religion. Upon this Boleslaus again came against them with a formidable power; but being betrayed by some Prussians whom he had taken into his service and raised to posts of honour, his army was led into defiles and almost entirely cut off, Duke Henry was killed, and Boleslaus and Mieczslaus escaped with great difficulty.

This misfortune was quickly followed by another; for now the children of Uladislaus laid claim to all the Polish dominions which had been possessed by their father, most of which had been bestowed upon young Casimir.

53
A civil war.

They were supported in their pretensions by a great number of discontented Poles, and a considerable body of German auxiliaries. Boleslaus, finding himself unable to withstand his enemies by force, had recourse to negotiation, by which means he gained time to recruit his army and repair his losses. An assembly of the states was held, before which the duke so fully refuted the claims of the children of Uladislaus, that it was almost unanimously voted that they had kindled an unjust war; and to take away every pretence for renewing the civil discords of Poland, they were a second time invested with the duchy of Silesia, which for the present put an end to all disputes. After this, Boleslaus applied himself to promote, by all means, the happiness of his subjects, till his death, which happened in the year 1174.

On the death of Boleslaus, the states raised his brother Mieczslaus to the ducal throne, on account of the great opinion they had of him. But the moment that Mieczslaus ceased to be a subject, he became a tyrant, and a slave to almost every kind of vice; the consequence of which was, that in a very short time he was deposed, and his brother Casimir elected in his stead.

54
Casimir, an excellent prince,

Casimir was a prince of the greatest justice and benevolence, insomuch that he scrupled to accept of the honour which the states had conferred upon him, lest it should be a trespass against the laws of equity. However, this scruple being soon got over, he set himself about securing peace and tranquillity in all parts of his dominions. He redressed all grievances, suppressed exorbitant imposts, and assembled a general diet, in which it was proposed to rescue the peasants from the tyranny of the nobility; an affair of such consequence, that the duke could not enter upon it by his own authority, even though supported by the clergy. Yet it proved less difficult than had been imagined, to persuade the nobility to relinquish certain privileges extremely detrimental to natural right. They were influenced by the example of their virtuous sovereign, and immediately granted all that he required; and to secure this declaration in favour of the peasants, the archbishop of Gnesna thundered out anathemas against those who should endeavour to regain the unjust privileges which they had now renounced; and to give still greater weight to this decision, the acts of the diet were transmitted to Rome, and were confirmed by the pope.

But though the nobility in general consented to have their power somewhat retrenched, it proved matter of discontent to some, who for this reason immediately became the partisans of the deposed Mieczslaus. This unfortunate prince was now reduced to such indigence, that he wrote an account of his situation to his brother Casimir; which so much affected him, that in an assembly of the diet he proposed to resign the sovereignty in favour of his brother. To this the states replied in the most peremptory manner: they desired him never more to mention the subject to them, lest they should be under the necessity of deposing him and excluding his brother, who, they were determined, should never more have the dominion of Poland. Casimir, however, was so much concerned at the account of his brother's misfortunes, that he tried every method to relieve him, and even connived at the arts practised by some discontented noblemen to restore him. By a very singular generosity, he facilitated the reduction of Gnesna and Lower Poland, where Mieczslaus might have lived in peace and splendour, had not his heart been so corrupted that it could not be subdued by kindness. The consequence was, that he used all his art to wrest from his brother the whole of his dominions, and actually conquered the provinces of Mazovia and Cujavia; but of these he was soon dispossessed, and only some places in Lower Poland were left him. After this he made another attempt, on occasion of a report that Casimir had been poisoned in an expedition into Russia. He surprised the city of Cracow; but the citadel refused to surrender, and his hopes were entirely blasted by the return of Casimir himself; who, with an unparalleled generosity and magnanimity, asked peace of his brother whom he had vanquished and had in a manner at his mercy.—The last action of this amiable prince was the conquest of Russia, which he effected rather by the reputation of his wisdom and generosity than by the force of his arms. Those barbarians voluntarily submitted to a prince so famed for his benevolence, justice, and humanity. Soon after his return, he died at Cracow, lamented as the best prince in every respect who had ever filled the throne of Poland.

55
conquers Russia.

Casimir left one son, named *Lechus*, an infant; and the states, dreading the consequences of a long minority, hesitated at appointing him sovereign, considering how many competitors he must necessarily have, and how dubious it must be whether he might be fit for the sovereignty after he had obtained it. At last, however, Lechus was nominated, chiefly through the interest he had obtained on account of the reputation of his father's virtues. The consequence of his nomination was precisely what might have been expected. Mieczslaus formed an alliance against him with the dukes of Oppelen, Pomerania, and Breslau; and having raised all the men in Lower Poland fit to bear arms, took the road to Cracow with a very numerous army. A bloody battle was fought on the banks of the river Mozgarva; in which both sides were so much weakened, that they were unable to keep the field, and consequently were forced to retire for some time in order to repair their forces. Mieczslaus was first ready for action, and therefore had the advantage: however, he thought proper to employ artifice rather than open force; and therefore having attempted in vain to corrupt the guardians of Lechus, he entered into a treaty with the duchess-dowager his mother. To her he represented in the strongest manner the miseries which would ensue from her refusal of the conditions he proposed. He stipulated to adopt Lechus and Conrade, her sons, for his own; to surrender the province of Cujavia for their present support; and to declare them heirs to all his dominions. The principal nobility opposed this accommodation, but it was accepted by the duchess in spite of all their remonstrances; and Mieczslaus was once more put in possession

56
Civil war between Lechus and the deposed Mieczslaus.

57
Mieczslaus restored.

Poland. session of the capital, after having taken a solemn oath to execute punctually every article of the treaty.

It is not to be supposed that a prince of such a perfidious disposition as Mieczslaus would pay much regard to the obligations of a simple contract. It was a maxim with him, that a sovereign is no longer obliged to keep his oath than while it is neither safe nor beneficial to break it. Having therefore got all the power into his hands, he behaved in the very same manner as if no treaty with the duchess had subsisted. The duchess, perceiving herself duped, formed a strong party, and excited a general insurrection. The rebellion could not be withstood: Mieczslaus was driven out of Cracow, and on the point of being reduced to his former circumstances, when he found means to produce a variance between the duchess and palatine of Cracow; and thus once more turned the scale in his favour. The forces of Mieczslaus now became superior, and he, in consequence, regained possession of Cracow, but did not long enjoy his prosperity, falling a victim to his intemperance; so that Lechus was restored to the sovereignty in the year 1206.

58
Poland ravaged by the Tartars.

The government of Lechus was the most unfortunate of any of the sovereigns of Poland. In his time the Tartars made an irruption, and committed everywhere the most cruel ravages. At last they came to an engagement with the Poles, assisted by the Russians; and after an obstinate and dreadful conflict, obtained a complete victory. This incursion, however, terminated as precipitately as it commenced; for without any apparent reason they retired, just as the whole kingdom was ready to submit; but the devastations they had committed produced a famine, which was soon followed by a plague that depopulated one of the most populous countries of the north. In this unhappy situation of affairs, death ended the misfortunes of Lechus, who was murdered by his own subjects as he was bathing. A civil war took place after his death; and the history for some time is so confused, that it is difficult to say with certainty who was his successor. During this unfortunate state of the country, the Tartars made a second irruption, laid all desolate before them, and were advancing to the capital, when they were attacked and defeated with great slaughter by the palatine of Cracow with only a handful of men. The power of the enemy, however, was not broken by this victory; for, next year, the Tartars returned, and committed such barbarities as can scarce be imagined. Whole provinces were defeated, and every one of the inhabitants massacred. They were returning, laden with spoil, when the palatine fell upon them a second time, but not with the same success as before: for, after an obstinate engagement, he was defeated, and thus all Poland was laid open to the ravages of the barbarians; the nobility fled into Hungary, and the peasants sought an asylum among rocks and impenetrable forests. Cracow, being left entirely defenceless, was soon taken, pillaged, and burnt; after which the barbarians, penetrating into Silesia and Moravia, desolated these countries, destroying Breslau and other cities. Nor did Hungary escape the fury of their barbarity: the king gave battle to the Tartars, but was defeated with vast slaughter, and had the mortification to see his capital laid in ashes, and above 100,000 of his subjects perish by fire and sword. The arms of the Tartars were invincible; nothing could withstand the prodigious number of forces which they brought into the field, and the fury with which they fought. They fixed their head-quarters on the frontiers of Hungary; and spread their devastations on every side with a celerity and success that threatened the destruction of the whole empire, as well as of the neighbouring kingdoms.

In this dreadful situation was Poland when Boleslaus, surnamed the *Chaste*, was raised to the sovereignty; but this, so far from putting an end to the troubles, only superadded a civil war to the rest of the calamities. Boleslaus was opposed by his uncle Conrade the brother of Lechus, who was provoked at becoming the subject of his own nephew. Having assembled a powerful army, he gained possession of Cracow; assumed the title of *duke of Poland;* and might possibly have kept possession of the sovereignty, had not his avarice and pride equally offended the nobility and peasants. In consequence of their discontents, they unanimously invited Boleslaus, who had fled into Hungary, to come and head the insurrection which now took place in every quarter. On his arrival, he was joyfully received into the capital: but Conrade still headed a powerful party; and it is reported that on this occasion the knights of the Teutonic order were first called into Poland, to dispute the pretensions of Boleslaus. All the endeavours of Conrade, however, proved unsuccessful: he was defeated in two pitched battles, and forced to live in a private situation; though he never ceased to harass his nephew, and make fresh attempts to recover the crown. However, of the reign of Boleslaus we have little account, except that he made a vow of perpetual continency, and imposed the same on his wife; that he founded near 40 monasteries; and that he died after a long reign in 1279, after having adopted Lechus duke of Cujavia, and procured a confirmation of his choice by the free election of the people.

59
Knights of the Teutonic order first called into Poland.

60
Poland overrun by the Russians, Tartars, and Lithuanians.

The reign of this last prince was one continued scene of foreign and domestic trouble. On his first accession he was attacked by the united forces of Russia and Lithuania assisted by the Tartars: whom, however, he had the good fortune to defeat in a pitched battle. By this victory the enemy were obliged to quit the kingdom: but Lechus was so much weakened, that civil dissensions took place immediately after. These increased to such a degree, that Lechus was obliged to fly to Hungary, the common resource of distressed Polish princes. The inhabitants of Cracow alone remained firm in their duty; and these brave citizens stood all the fatigue and danger of a tedious siege, till they were at last relieved by Lechus at the head of a Hungarian army, who defeated the rebels, and restored to his kingdom a legitimate government. He had scarce reascended the throne when the united forces of the Russians, Tartars, and Lithuanians, made a second irruption into Poland, and desolated the country with the most savage barbarity. Their forces were now rendered more terrible than ever by their having along with them a vast number of large dogs trained to the art of war. Lechus, however, with an army much inferior, obtained a complete victory; the Poles being animated by despair, as perceiving, that, if they were conquered, they must also be devoured. Soon after this, Lechus died with the reputation of a warlike, wise, but unfortunate prince. As he died without issue, his crown was contested, a civil war again ensued;

ensued; and the affairs of the state continued in a very declining way till the year 1296, when Premislaus, the duke at that time, resumed the title of *king*. However, they did not revive in any considerable degree till the year 1305, when Uladislaus Locticus, who had seized the throne in 1300, and afterwards been driven out, was

61 War with the Teutonic knights.

again restored to it. The first transaction of his reign was a war with the Teutonic knights, who had usurped the greater part of Pomerania during the late disturbances. They had been settled in the territory of Culm by Conrade duke of Mazovia; but soon extended their dominion over the neighbouring provinces, and had even got possession of the city of Dantzic, where they massacred a number of Pomeranian gentlemen in cold blood; which so much terrified the neighbouring towns, that they submitted without a stroke. The knights were commanded by the Pope himself to renounce their conquests; but they set at nought all his thunders, and even suffered themselves to be excommunicated rather than part with them. As soon as this happened, the king marched into the territories of the marquis of Brandenburg, because he had pretended to sell a right to the Teutonic knights to those countries, when he had none to them himself. Uladislaus next entered the territory of Culm, where he laid every thing waste with fire and sword; and being opposed by the joint forces of the marquis, the knights, and the duke of Mazovia, he obtained a complete victory after a desperate and bloody engagement. Without pursuing the blow, he returned to Poland, recruited his army, and being reinforced by a body of auxiliaries from Hungary and Lithuania, he dispersed the enemy's forces, and ravaged a second time all the dominions of the Teutonic order. Had he improved this advantage, he might easily have exterminated the whole order, or at least reduced them so low, that they could never have occasioned any more disturbances in the state; but he suffered himself to be soothed and cajoled by the promises which they made without any design of keeping them, and concluded a treaty under the mediation of the kings of Hungary and Bohemia. In a few months he was convinced of the perfidy of the knights; for they not only refused to evacuate Pomerania as had been stipulated in the treaty, but endeavoured to extend their usurpations, for which purpose they had assembled a very considerable army. Uladislaus, enraged at their treachery, took the field a third time, and gave them battle with such success, that 4000 knights were left dead on the spot, and 30,000 auxiliaries killed or taken prisoners. Yet, though the king had it once more in his power to destroy the whole Teutonic order, he satisfied himself with obtaining the territories which had occasioned the war; after which he spent the remainder of his life in peace and tranquillity.

62 Russia Nigra conquered by Casimir the Great.

Uladislaus was succeeded by his son Casimir III. surnamed the *Great*. He subdued the province called *Russia Nigra* in a single campaign. Next he turned his arms against Mazovia; and with the utmost rapidity overran the duchy, and annexed it as a province to the crown; after which he applied himself to domestic affairs, and was the first who introduced a written code of laws into Poland. He was the most impartial judge, the most rigid observer of justice, and the most submissive to the laws, of any potentate mentioned in the history of Europe. The only vice with which he is charged is that of incontinency; but even this the clergy declared to be a venial sin, and amply compensated by his other virtues, particularly the great liberality which he showed to the clerical order.

63 Unhappy reign of Louis.

Casimir was succeeded in 1370 by his nephew Louis king of Hungary; but, as the Poles looked upon him to be a foreign prince, they were not happy under his administration. Indeed a coldness between this monarch and his people took place even before he ascended the throne; for in the *pacta conventa*, to which the Polish monarchs were obliged to swear, a great number of unusual articles were inserted. This probably was the reason why he left Poland almost as soon as his coronation was over, carrying with him the crown, sceptre, globe, and sword of state, to prevent the Poles from electing another prince during his absence. He left the government in the hands of his mother Elizabeth; and she would have been agreeable to the people, had her capacity for government been equal to the task. At that time, however, the state of Poland was too much distracted to be governed by a woman. The country was overrun with bold robbers and gangs of villains, who committed the most horrid disorders; the kingdom was likewise invaded by the Lithuanians; the whole province of Russia Nigra revolted; and the kingdom was universally filled with dissension. The Poles could not bear to see their towns filled with Hungarian garrisons; and therefore sent a message to the king, telling him that they thought he had been sufficiently honoured in being elected king of Poland himself, without suffering the kingdom to be governed by a woman and his Hungarian subjects. On this Louis immediately raised a numerous army, with a design fully to conquer the spirit of his subjects. His first operations were directed against the Russians; whom he defeated, and again reduced to subjection. Then he turned his arms against the Lithuanians, drove them out of the kingdom, and re-established public tranquility. However, instead of being satisfied with this, and removing the Hungarian garrisons, he introduced many more, and raised Hungarians to all the chief posts of government. His credit and authority even went so far as to get a successor nominated who was disagreeable to the whole nation, namely *Sigismund* marquis of Brandenburg. After the death of Louis, however, this election was set aside; and Hedwiga, daughter of Casimir the Great, was proclaimed queen.

64 Hedwiga marries the duke of Lithuania, thereby uniting that duchy, together with Samogitia and Russia Nigra, to Poland.

This princess married Jagello duke of Lithuania, who was now converted to Christianity, and baptized by the name of *Uladislaus*. In consequence of this marriage, the duchy of Lithuania, as well as the vast provinces of Samogitia and Russia Nigra, become annexed to the crown of Poland. Such a formidable accession of power excited the jealousy of the Teutonic knights, who were sensible that Uladislaus was now bound to undertake the reduction of Pomerania, and revenge all the injuries which Poland had sustained from them for a great number of years. From his first accession, therefore, they considered this monarch as their greatest enemy, and endeavoured to prevent his designs against them by effecting a revolution in Lithuania in favour of his brother Andrew. The prospect of success was the greater here, as most of the nobility were discontented with the late alliance, and Uladislaus had proposed to effect a revolution in religion, which was highly disagreeable.

On

Poland. On a sudden, therefore, two armies marched towards the frontiers of the duchy, which they as suddenly penetrated, laying waste the whole country, and seizing upon some important fortresses, before the king of Poland had any notice of the matter. As soon as he received advice of these ravages, Uladislaus raised some forces with the utmost celerity, which he committed to the care of his brother Skirgello, who defeated the Teutonic knights, and soon obliged them to abandon all their conquests. In the mean time Uladislaus marched in person into the Higher Poland, which was subjected to a variety of petty tyrants, who oppressed the people, and governed with intolerable despotism. The palatine of Posnia, in particular, had distinguished himself by his rebellious practices; but he was completely defeated by Uladislaus, and the whole country reduced to obedience.

65 Troubles in Lithuania.

Having secured the tranquillity of Poland, Uladislaus visited Lithuania, attended by a great number of the clergy, in order convert his subjects. This he effected without great difficulty; but left the care of the duchy to his brother Skirgello, a man of a cruel, haughty, and debauched turn, and who immediately began to abuse his power. With him the king sent his cousin Vitowda, a prince of a generous, brave, and amiable disposition, to be a check upon his conduct; but the barbarity of Skirgello soon obliged this prince to take refuge among the Teutonic knights, who were now become the asylum of the oppressed and discontented. For some time, however, he did not assist the knights in their designs against his country; but having applied for protection to the king, and finding him remiss in affording the necessary assistance, he at last joined in the schemes formed by the knights for the destruction of Poland. Entering Lithuania at the head of a numerous army, he took the capital, burnt part of it, and destroyed 14,000 persons in the flames, besides a great number who were massacred in attempting to make their escape. The upper part of the city, however, was vigorously defended, so that the besiegers were at last obliged to abandon all thoughts of making themselves masters of it, and to content themselves with desolating the adjacent country. The next year Vitowda renewed his attempts upon this city, but with the same ill success; though he got possession of some places of less note. As soon, however, as an opportunity offered, he came to an accommodation with the king, who bestowed on him the government of Lithuania. During the first years of his government, he bestowed the most diligent attention upon domestic affairs, endeavouring to repair the calamities which the late wars had occasioned; but his impetuous valour had prompted him at last to engage in a war with Tamerlane the Great, after his victory over Bajazet the Turkish emperor. For some time before, Vitowda had been at war with the neighbouring Tartars, and had been constantly victorious, transporting whole hordes of that barbarous people into Poland and Lithuania, where to this day they form a colony distinct in manners and dress from the other inhabitants. Uladislaus, however, dissuaded him from attacking the whole strength of the nation under such a celebrated commander as Tamerlane: but Vitowda was

66 Terrible battle with the Tartars.

obstinate; he encountered an army of 400,000 Tartars under Ediga, Tamerlane's lieutenant with only a tenth part of their number. The battle continued for a whole day; but at last Vitowda was surrounded by the numbers of his enemy, and in the utmost danger of being cut in pieces. However, he broke his way through with prodigious slaughter on both sides; and came off at last without a total defeat, having killed a number of the enemy equal to the whole of his own army.

67 Wars with the Teutonic knights.

During the absence of Vitowda, the Teutonic knights had penetrated into Lithuania, committing every where the most dreadful ravages. On his return he attacked and defeated them, making an irruption into Livonia, to punish the inhabitants of that country for the assistance they had given to the Teutonic order. This was succeeded by a long series of wars between Poland and Prussia, in which it became necessary for Uladislaus himself to take the field. The knights had now one way or other got possession of Samogitia, Mazovia, Culm, Silesia, and Pomerania; so that Uladislaus resolved to punish them before they became too powerful. With this view he assembled an army composed of several different nations, with which he penetrated into Prussia, took several towns, and was advancing to Marienburg, the capital of Pomerania, when he was met by the army of the Prussian knights, who determined to hazard a battle. When the engagement began, the Poles were deserted by all their auxiliaries, and obliged to stand the brunt of the battle by themselves. But the courage and conduct of their king so animated them, that after a most desperate battle they obtained a complete victory; near 40,000 of the enemy being killed in the field, and 30,000 taken prisoners. This terrible overthrow, however, was less fatal to the affairs of the Prussian knights than might have been expected; as Uladislaus did not improve his victory, and a peace was concluded upon easier terms than his adversaries had any reason to expect.—Some infraction of the treaty occasioned a renewal of hostilities; and Uladislaus was so much elated with victory that he would hearken to no terms, by which means the enemy were driven to the desperate resolution of burying themselves in the ruins of their capital. The siege was accordingly commenced, and both sides behaved with the greatest vigour; but at last, through the good conduct and valour of the grand master of the knights, named *Plawen*, the Polish monarch found himself obliged to grant them an advantageous peace, at a time when it was universally expected that the whole order would have been exterminated.

Uladislaus V. died in 1435, and was succeeded by his son Uladislaus VI. at that time only nine years of age. He had scarce ascended the throne, when the kingdom was invaded by the Tartars, who defeated Buccarius the general of the Polish forces; and committing everywhere dreadful ravages, returned to their own country loaded with booty. A few years after, the nation was involved in a war with Amurath the emperor of the Turks, who threatened to break into Hungary; and it was thought by the diet to be good policy to assist the Hungarians at this juncture, because it was impossible to know where the storm might fall after Hungary was conquered. But before all things were prepared for the young king to take the field, a strong body of auxiliaries was dispatched under the celebrated John Hunniades vaivode of Transylvania, to oppose the Turks, and likewise to support the

the election of Uladislaus to the crown of Hungary. This detachment surprised the Turkish army near the river Morava, and defeated Amurath with the loss of 30,000 men; after which Hunniades retook all the places which had been conquered by Amurath, the proud sultan was forced to sue for peace, and Uladislaus was raised without opposition to the crown of Hungary. A treaty was concluded, by which the Turks promised to relinquish their designs upon Hungary, to acknowledge the king's right to that crown, and to give up all their conquests in Rascia and Servia. This treaty was sealed by mutual oaths: but Uladislaus broke it at the persuasion of the pope's legate; who insisted, that now was the time for humbling the power of the infidels; and produced a special commission from the pope, absolving him from the oath he had taken at the late treaty. The consequence of this perfidy was, that Uladislaus was entirely defeated and killed at Varna, and the greatest part of his army cut in pieces.

68 Uladislaus defeated and killed by the Turks.

69 Teutonic knights subdued.

Uladislaus VI. was succeeded by Casimir IV. in whose reign the Teutonic knight were subdued, and obliged to yield up the territories of Culm, Michlow, and the whole duchy of Pomerania, together with the towns of Elbing, Marienburg, Talkmith, Schut, and Christburgh, to the crown of Poland. On the other hand, the king restored to them all the other conquests he had made in Prussia, granted a seat in the Polish senate to the grand-master, and endowed him with other privileges, on condition that, six months after his accession, he should do homage for Prussia, and take an oath of fidelity to the king and republic.

This success raised the spirits of the Polish nation, which had drooped ever since the battle of Varna. The diet did not, however, think proper to renew the war against the Turks, but took under their protection the hospodar of Moldavia; as thinking that this province would make a convenient barrier to the Polish dominions on one side. The request of the prince who asked this protection was therefore readily granted, an oath of fidelity exacted from him and the inhabitants, and a tribute required; regular payment of which was made for a great number of years afterwards.

70 Crowns of Bohemia and Hungary united to Poland.

About this time also the crown of Bohemia becoming vacant, the people were extremely desirous of being governed by one of the princes of Poland; upon which the barons were induced to bestow the crown upon Uladislaus, eldest son of Casimir, in opposition to the intrigues of the king of Hungary. Not satisfied with this acquisition, Uladislaus took advantage of the dissensions in Hungary, in order to unite that crown to his own: and this he also effected; by which means his power was greatly augmented, though not the felicity of his people. So many foreign expeditions had exhausted the treasury, and oppressed the peasants with taxes; the gentry were greatly diminished by a number of bloody engagements; agriculture was neglected, and the country almost depopulated. Before a proper remedy could be applied for these evils, Casimir died in 1492; much more admired, than beloved or regretted, by his subjects. It is related by the historians of this period, that in the reign of Casimir IV. the deputies of the provinces first appeared at the diet, and assumed to themselves the legislative power; all laws before this time having been framed by the king in conjunction with the senate. It is observed also, that before Casimir's time, the Latin language was understood only by the clergy in Poland; in proof of which, it is alleged, that at an interview between this prince and the king of Sweden at Dantzic, his Polish majesty was forced to make use of the assistance of a monk to interpret between him and the Swedish monarch. Casimir, ashamed of the ignorance shown by himself and court, published an edict, enjoining the diligent study of the Latin, which in our days is spoken as vernacular by every Polish gentleman, though very unclassically.

During the succeeding reigns of John, Albert, and Alexander, the Polish affairs fell into decline; the kingdom being harassed by continual wars with the Turks and Tartars. However, they were retrieved by Sigismund I. who ascended the throne in 1507. This monarch, having reformed some internal abuses, next set about rendering the kingdom as formidable as it had formerly been. He first quelled a rebellion which broke out in Lithuania; after which, he drove the Walachians and Moldavians out of Russia Nigra, and defeated the Russians in a pitched battle, with the loss of 30,000 men. In this engagement he was obliged to cause his cavalry to swim across the Boristhenes in order to begin the attack, while a bridge was preparing for the infantry. These orders were executed with astonishing celerity, notwithstanding the rapidity of the stream, the steepness of the banks, and the enemy's opposition. The onset was led by the Lithuanians, who were directed to retreat gradually, with a view of drawing the enemy within reach of the cannon. This the Russians mistook for a real flight; and as they were pursuing with eagerness, Sigismund opened his line to the right and left, pouring in grape-shot from the artillery with dreadful success. The Russian general, and several noblemen of the first distinction, were taken prisoners, while the whole loss of the royal army did not amount to 300 men.

71 Exploits of Sigismund I.

After this complete victory, the king turned his arms against the Teutonic knights, who had elected the marquis of Brandenburg their grand-master; and this prince not only refused to acknowledge the sovereignty of the crown of Poland, but even invaded the Polish territories. Sigismund marched against him, and gained possession of several important places in Brandenburg; but as he was pursuing his conquests, the marquis was reinforced by 14,000 Germans, led by the duke of Schonenburg, who ventured to lay siege to Dantzic, after having ravaged all the neighbouring country. The Dantzickers, however, defended themselves with so much spirit, that the besiegers were soon obliged to relinquish their enterprise. In their retreat they were attacked by a strong detachment of Polish cavalry, who made prodigious havock among them, and compelled the wretched remains to take shelter in Pomerania, where they were inhumanly butchered by the peasants. Soon after this the marquis was obliged to submit to the clemency of the conqueror; from whom, however, he obtained better conditions than could have been expected, or indeed than he would have got, had he not abandoned the interest of the Teutonic order, and resigned the dignity of grand-master. In order to secure him in his interest, therefore, Sigismund granted him half the province of Prussia as a secular duke, and dependent on the crown of Poland; by by which means he entirely deprived that order of the best part of their dominions, and put it quite out of their power to disturb the tranquillity of Poland any more.

The power of Sigismund had now excited the jealousy of the House of Austria; for which reason they took every method in their power to stir up enemies against him. By their means, the Russians, Moldavians, and Tartars, were all excited to fall upon the Polish territories at once. The vaivode of Walachia, with 50,000 men, made an irruption into the small province of Pokatior, but was entirely defeated by Count Taro at the head of no more than 6000. This victory is wholly ascribed to the good conduct of the commander, who possessed himself of some eminences on the flanks of the enemy. On these he erected batteries, which played with such fury as soon put their ranks in disorder: upon which the Poles attacked them sword in hand, and entirely dispersed them with the loss of 10,000 killed or taken. The count having then augmented his army with a strong body of Lithuanians, attacked the Muscovites and Tartars, drove them entirely out of the duchy, pursued them into Russia, reduced several towns, and at last laid siege to the strong fortress of Straradub; in which the regent, together with some of the best troops of Russia, were inclosed. The garrison made a gallant defence; and the fortifications were composed of beams joined together, and supported by a bulwark of earth, upon which the cannon-shot made no impression: but the count contrived a method of setting the wood on fire; by which means the regent and nobility were obliged to surrender at discretion, and Taro carried off upwards of 60,000 prisoners, with an immense booty.

In the reign of Sigismund, we may look upon the kingdom of Poland to have been at its greatest pitch of glory. This monarch possessed, in his own person, the republic of Poland, the great duchies of Lithuania, Smolensko, and Saveria, besides vast territories lying beyond the Euxine and Baltic; while his nephew Louis possessed the kingdoms of Bohemia, Hungary, and Silesia. But this glory received a sudden check in 1548, by the defeat and death of Louis, who perished in a battle fought with Solyman the Great, emperor of the Turks. The daughter of this prince married Ferdinand of Austria; whereby the dominions of Hungary, Bohemia, and Silesia, became inseparably connected with the hereditary dominions of the Austrian family. This misfortune is thought to have hastened the death of Sigismund; though, being then in his 84th year, he could not have lived long by the ordinary course of nature. He did not, however, survive the news many months, but died of a lingering disorder, leaving behind him the character of the completest general, the ablest politician, the best prince, and the strongest man, in the north; of which last, indeed, some instances are related by historians that are almost incredible.

72
Sigismund Augustus, a wise and valiant prince.

Sigismund Augustus, who succeeded his father Sigismund I. proved also a very great and happy prince.

At that time the most violent and bloody wars were carrying on in Germany, and indeed through other parts of Europe, on account of religion; but Sigismund wisely avoided interfering in these disputes. He would not admit into his dominions any of those divines who were taxed with holding heterodox opinions, nor even allow his people the liberty of corresponding with them; yet he never persecuted, or employed any other means for the preservation of the state than those of a well conducted and regular policy. Instead of disputing with his subjects about speculative opinions, Sigismund applied himself diligently to the reforming of abuses, enforcing the laws, enriching the treasury, promoting industry, and redeeming the crown-lands where the titles of the possessors appeared illegal. Out of the revenue recovered in this manner he obtained a formidable standing army, without laying any additional tax upon the subjects; and though he preferred peace to war, he was always able to punish those that offered indignities to his crown or person. His knowledge in the art of war was soon tried in a contest with the Russians, who had made an irruption into Livonia, encouraged by the disputes which had subsisted between the Teutonic knights and the archbishop of Riga, cousin to Sigismund. The province was at that time divided between the knights and the prelate; and the Russians, under pretence of assisting the former, had seized great part of the dominions of the latter. The archbishop had recourse to his kinsman the king of Poland; who, after fruitless efforts to accommodate matters, marched towards the frontiers of Livonia with an army of 100,000 men. The knights were by no means able to resist such a formidable power; and therefore, deserting their late allies, put themselves under the protection of the king of Poland. The czar, John Basilides, though deserted by the knights, did not lose his courage; nay, he even insolently refused to return any answer to the proposals of peace made by Sigismund. His army consisted of 300,000 men, with whom he imagined himself able to reduce all Livonia, in spite of the utmost efforts of the king of Poland: however, having met with some checks on that quarter, he directly invaded Poland with his whole army. At first he carried every thing before him; but the Poles soon made a vigorous opposition. Yet the Russians, though everywhere defeated, still continued their incursions, which Sigismund at last revenged by invading Russia in his turn. These mutual desolations and ravages at last made both parties desirous of peace, and a truce for three years was agreed on; during the continuance of which the king of Poland died, and with him was extinguished the house of Jagellon, which had governed Poland for near 200 years.

73
War with Russia.

74
Extinction of the house of Jagellon.

On the death of Sigismund, Poland became a prey to intestine divisions; and a vast number of intrigues were set on foot at the courts of Vienna, France, Saxony, Sweden, and Brandenburg; each endeavouring to establish a prince of their own nation on the throne of Poland. The consequence of all this was, that the kingdom became one universal scene of corruption, faction, and confusion; the members of the diet consulted only their own interest, and were ready on every occasion to sell themselves to the best bidder. The Protestants had by this time got a considerable footing in the kingdom, and thus religious disputes were intermingled with political ones. One good effect, however, flowed from this confusion: for a law was passed, by which it was enacted, that no difference in religious opinions should make any contention among the subjects of the kingdom; and that all the Poles, without discrimination,

75
Distracted state of Poland.

 discrimination, should be capable of holding public offices and trusts under the government; and it was also resolved, that the future kings should swear expressly to cultivate the internal tranquillity of the realm, and cherish without distinction their subjects of all persuasions.

While the candidates for the throne were severally attempting to support their own interest in the best manner they could, John Crasoski, a Polish gentleman of great merit, but diminutive stature, had just returned from France, whither he had travelled for improvement. His humour, wit, and diverting size, had rendered him universally agreeable at the court of France, and in a particular manner engaged the esteem of Catharine de Medicis, which the little Pole had the address to make use of for his own advantage. He owed many obligations to the duke of Anjou; whom, out of gratitude, he represented in such favourable terms, that the Poles began to entertain thoughts of making him their king. These sentiments were confirmed and encouraged by Crasoski, who returned into France by order of several leading men in Poland, and acquainted the king and Queen Catharine, that nothing was wanting besides the formality of an embassy to procure the crown for the duke of Anjou, almost without opposition. Charles IX. king of France, at that time also promoted the scheme, being jealous of the duke of Anjou's popularity, and willing to have him removed to as great a distance as possible. Accordingly the parties came to an agreement; and it was stipulated that

76 Duke of Anjou chosen king of Poland.

the duke of Anjou should maintain the laws, liberties, and customs of the kingdom of Poland, and of the grand duchy of Lithuania; that he should transport all his effects and annual revenues in France into Poland: that the French monarch should pay the late king Sigismund's debts; that he should maintain 100 young Polish gentlemen at his court, and 50 in other places; that he should send a fleet to the Baltic, to assist Poland against the Russians; and lastly, that Henry should marry the princess Anne, sister to the late king Sigismund; but this article Henry would not ratify till his return to Poland.

Every thing being thus settled, the young king quitted France, attended by a splendid retinue, and was accompanied by the queen-mother as far as Lorrain. He was received by his subjects on the frontiers of Poland, and conducted to Cracow, where he was soon after crowned. The affections of the Poles were soon engaged by the youth and accomplishments of Henry; but scarce was he seated on the throne, when, by the death of Charles IX. he became heir to the crown of France. Of this he was informed by repeated messages from Queen Catharine; he repented his having accepted the crown of Poland, and resolved to leave it for that of France. But being sensible that the Poles

77 Runs away from his kingdom,

would oppose his departure, he kept his intentions secret, and watched an opportunity of stealing out of the palace in disguise in the night-time. The Poles, as might well have been expected, were irritated at being thus abandoned, from the mere motive of interest, by a prince whom they had loved and honoured so much. Parties were dispatched after him by different roads; and Zamoski, a nobleman who headed one of these parties, overtook him some leagues distant from Cracow. All the prayers and tears of that nobleman, however, could not prevail on Henry to return; he rode post to Vienna, and then passed into France by the way of Italy.

In the mean time, the Poles were so much exasperated against Henry and his whole nation, that all the French in Cracow would have been massacred if the magistrates had not placed guards in the streets. Henry, however, had foreseen the consequences of his flight, and therefore endeavoured to apologise for his behaviour. One Danzai undertook his cause in full senate; and with great eloquence explained the king's motives for his abrupt departure. Henry also wrote to the chief nobility and clergy with his own hand. But nothing could satisfy the Poles; who now acquainted their king, that if he did not immediately return, they would be obliged to divest him of the royal dignity, and to choose another sovereign. Henry began to excuse himself on account of the wars in which he was engaged, and promised to send men of unexceptionable integrity to govern Poland till he should return; but no excuses could be 78
accepted; and, on the 15th of July 1575, he was solemnly divested of the regal dignity in full diet, and the throne declared vacant. and is deposed.

After the deposition of Henry, commotions and factions again took place. However, the contending parties were now reduced to two; one who supported the interest of Maximilian emperor of Germany; the other, who were for electing the princess Anne, and marrying her to Stephen Batori prince of Transylvania. The latter prevailed through the courage of one 79 Stephen Batori chosen king.
gentleman, who, in imitation of the power assumed by the Roman tribunes, stood up in the full senate, and opposed the proclamation of Maximilian, declaring that his election was violent and illegal. In this situation of affairs, it was obvious that strength and celerity must determine which election was legitimate: both parties wrote to the princes whose cause they had espoused, intreating them to come with all possible expedition to take possession of the throne. Batori proved the more alert; for while Maximilian was disputing about certain conditions which the Poles required for the security of their privileges, he entered Poland, married the princess, and was crowned on the first of May 1576.

No opposition was made to the authority of Batori except by the inhabitants of Dantzic. These adhered to the interest of Maximilian even after he was dead, and had the presumption to demand from the king an oath acknowledging their absolute freedom and independence. Batori referred them to the senate, declaring that he had no right to give up the privileges of the republic; but admonished the citizens to avoid all occasion of a civil war, which must necessarily terminate in their disadvantage. But the obstinate citizens, construing the king's lenity into fear, shut the gates against the ambassador, seized upon the fortress of Grebin, and published a manifesto resembling a libel upon the king and the republic. The king, incensed at these proceedings, marched against Grebin, retook the castle, and ravaged certain territories belonging to the Dantzickers; who retaliated by burning to the ground a monastery named *Oliva*, to prevent the Poles from taking possession of so important a situation. 80 Dantzic revolts.

Notwithstanding these outrages, Batori renewed his overtures for an accommodation: but the Dantzickers were deaf to these salutary proposals; so that he was obliged to declare them rebels, and send against them a body of troops under one Zborowski. As the number of the Polish army, however, was not considerable, the Dantzickers marched out to give him battle. They were assisted by a corps of Germans, and a resolution was formed of attacking the Poles in their camp by surprise; but the project was disconcerted by a sudden storm, accompanied with dreadful thunder and lightning, which spread a panic through the army, as if it had been a judgment from heaven, and obliged the commander, John de Collen, to retire into the city. In a short time, however, they recovered their spirits, and came to an action with the Poles; but were defeated with the loss of 8000 men killed on the spot, a great many taken prisoners, and the loss of several pieces of cannon. But this check, instead of abating the courage of the Dantzickers, only animated them the more, and they resolved to hold out to the last extremity.

81 Poland invaded by the Russians.

In the mean time, the czar of Muscovy, thinking the present opportunity favourable for extending his dominions, laid siege to Revel; but, not being able to make himself master of that place, he was obliged to content himself with ravaging Livonia, which he did in a dreadful manner. This did not, however, hinder Batori from laying siege to Dantzic in person, and pursuing the operations with the utmost vigour. Collen made many vigorous sallies, in several of which he defeated the Poles; but, happening at last to be killed, nobody was found

82 Dantzic submits.

capable of supplying his place, and the citizens were at last obliged to surrender at discretion; though not till they had obtained a promise from the elector of Saxony and landgrave of Hesse of interposing as mediators in their behalf. The only terms which the king demanded of them were, that they should ask his pardon, dismiss their troops, and rebuild the monastery of Oliva which they had destroyed; while his majesty, on the other hand, confirmed all their privileges, and granted them full liberty of adhering to the confession of Augsburg, for which they had for some time been strenuous advocates.

83 Cruelty of the Russians.

The war with Dantzic was no sooner ended, than the king directed his whole strength against the czar of Muscovy, who had made himself master of several important cities in Livonia. The czar behaved everywhere with the greatest cruelty, slaughtering all without distinction who were able to bear arms, and abandoning the women and children to the shocking brutality of the Tartars who served in his army. Such was the horror inspired by the perfidy and cruelty of the czar's conduct, that the inhabitants of Wender chose rather to bury themselves in the ruins of their town than to submit to such an inhuman enemy. For a considerable time the Russians were allowed to proceed in this manner, till the whole province of Livonia, excepting Riga and Revel, had suffered the barbarities of this insulting conqueror; but at last, in 1578, a body of forces was dispatched into the province, the towns of Wender and Dunnenburg were surprised, and an army sent by the czar to surprise the former was defeated.

At this time the Muscovites were not the only enemies who opposed the king of Poland, and oppressed Livonia. That unhappy province was also invaded by the Swedes, who professed themselves to be enemies equally to both parties, and who were scarcely inferior in cruelty to the Russians themselves. The king, however, was not daunted by the number of his adversaries; but having made great preparations, and called to his assistance Christopher prince of Transylvania, with all the standing forces of that country, he took the field in person against the Muscovites, and laid siege to Polocz, a town of great importance situated on the river Dwina.

84 Siege of Polocz.

The Russians no sooner heard of the approach of the Polish army, than they resolved to put all the citizens to death, thinking by this means to strike terror into the enemy. When Batori came near the town, the most shocking spectacle presented itself; the river appeared dyed with blood, and a vast number of human bodies fastened to planks, and terribly mangled, were carried down its stream. This barbarity, instead of intimidating the Poles, irritated them to such a degree, that nothing could resist them. Finding that their cannon made little impression upon the walls of the city, which were constructed of wood, they advanced to the assault with burning torches in their hands; and would soon have reduced the fortifications to ashes, had not a violent storm of rain prevented them. The design, however, was put in execution as soon as the rain slackened; and the barbarous Russians were obliged to surrender at discretion. It reflects the highest honour on Batori, that, notwithstanding the dreadful instances of cruelty which he had before his eyes, he would not suffer his soldiers to retaliate. Indeed the cruelties committed by the Russians on this occasion, seem almost to have authorised any revenge that could possibly have been taken.

85 Monstrous barbarities committed by the Russians in that city.

A number of Germans were found in the city, some expiring under the most dreadful tortures, and others dead of pains which nature could no longer support. Several of the officers had been dipped in cauldrons of boiling oil, with a cord drawn under the skin of the umbilical region, which fastened their hands behind; in which situation their eyes had been torn out from their sockets, or burnt with red-hot irons, and their faces otherwise terribly mangled. The disfigured carcases, indeed, plainly showed the barbarous treatment they had met with; and the dreadful tale was confirmed by the testimony of the few who survived. The Polish soldiers were exasperated almost to madness; so that scarce all the authority of Batori could restrain them from cutting in pieces the wretches who had been the authors of such a dreadful tragedy.

86 Russia ravaged by Batori.

After the reduction of Polocz, Batori continued the war with great success. Two detachments from the army penetrated the enemy's country by different roads, wasted all before them to the gates of Smolensko, and returned with the spoils of 2000 villages which they had pillaged and destroyed. In the mean time the Swedes and Poles thought proper to come to an accommodation: and though John king of Sweden was at that time prevented from bearing his share of the war, yet Batori reduced such a number of cities, and committed such devastations in the Russian territories, that the czar was

87 The czar sues for peace.

obliged to sue for peace; which he obtained on condition of relinquishing Livonia, after having thrown away the lives of more than 400,000 of his subjects in attempting to conquer it.

Batori, being thus freed from a most destructive and cruel war, applied himself to the internal government of his kingdom. He regulated the Polish cavalry in such a manner as made them become formidable to the Turks and other neighbouring nations: and this is the military establishment to which the Poles have given the name of *quartienne;* because a fourth part of the revenue is employed in supporting them. Batori sent this body of cavalry towards the frontiers of Tartary, to check the incursions of those barbarians; by which means the Ukraine, a vast tract of desert country, was filled with flourishing towns and villages, and became a strong barrier against the Turks, Tartars, and Russians.

88 Batori civilizes the Cossacks.

The last memorable action of Batori was his attaching the Cossacks to Poland, civilizing and instructing them in the arts of war and peace. His first endeavour was to gain their affections by his liberality; for which purpose, he presented them with the city of Techtemeravia, situated on the Boristhenes, which they formed into a magazine, and made the residence of their chieftains. He gave them officers of all degrees, established discipline among them, altered their arms, and formed them into a regular militia, which afterwards performed eminent services to the state. All kinds of manufactures at that time known in Poland were likewise established among the Cossacks; the women were employed in spinning and weaving woollen cloths, while the men were taught agriculture, and other arts proper for their sex.

While Batori was employed in this manner, the Swedes broke the convention into which they had entered with Poland, and were on the point of getting possession of Riga. To this, indeed, Batori himself had given occasion, by attempting to impose the Romish religion upon the inhabitants, after having promised them entire liberty of conscience. This so irritated them, that they revolted, and were on the point of admitting a Swedish garrison into the city, when the king was informed of what was going forward. Upon this he resolved to take a most exemplary vengeance on the inhabitants of Riga; but before he could execute his intention, he died in the year 1586, the 54th of his age, and 10th of his reign.

89 His death.

The death of Batori involved Poland in fresh troubles. Four candidates appeared for the crown, viz. the princes Ernest and Maximilian of the house of Austria, Sigismund prince of Sweden, and Theodore czar of Muscovy. Each of these had a separate party; but Sigismund and Maximilian managed matters so well, that in 1587 both of them were elected. The consequence of this was a civil war; in which Maximilian was defeated and taken prisoner: and thus Sigismund III. surnamed *De Vasa*, became master of the throne of Poland without opposition. He waged a successful war with the Tartars, and was otherwise prosperous; but though he succeeded to the crown of Sweden, he found it impossible for him to retain both kingdoms, and he was formally deposed from the Swedish throne. In 1610, he conquered Russia, and placed his son on the throne; but the Polish conquests of that country have always been but for a short time. Accordingly the young prince was soon after deposed; and the Russians not only regained their liberty, but began to make encroachments on Poland itself.

90 War with Gustavus Adolphus.

A very unfortunate war also took place with Sweden, which was now governed by the great Gustavus Adolphus; the particulars of which, with the other exploits of that renowned warrior, are related under the article SWEDEN. At last Sigismund, worn out with cares and misfortunes, died in 1629.

After Sigismund's death the affairs of Poland seemed to revive a little under Uladislaus VII.; for he obliged the Russians to sue for peace, and Sweden to restore some of her conquests: but having attempted to abridge the liberty of the Cossacks, they revolted, and gave the Poles several terrible defeats. Nor was the war terminated in the lifetime of Uladislaus, who died in 1648. His successor, John Casimir, concluded a peace with these dangerous enemies: but the war was soon after renewed; and while the kingdom was distracted between these enemies and the discontents of its own inhabitants, the Russians took the opportunity of invading and pillaging Lithuania. In a little after the whole kingdom was subdued by Charles Gustavus, successor to Christina queen of Sweden.

91 Poland subdued by Charles Gustavus.

Happily for Poland, however, a rupture took place between the courts of Sweden and Copenhagen; by which means the Poles were enabled to drive out the Swedes in 1657. This was succeeded by civil wars and contests with Russia, which so much vexed the king, that he resigned the crown in 1668.

For two years after the resignation of Casimir, the kingdom was filled with confusion; but on the 17th of September 1760, one Michael Coribut Wiesnowiski, collaterally descended from the house of Jagello, but in a very mean situation at that time, was chosen king. His reign continued but for three years; during which time John Sobieski, a celebrated Polish general, gave the Turks a dreadful overthrow, though their army consisted of more than 300,000 men; and had this blow been pursued, the Cossacks would have been entirely subdued, and very advantageous terms might have been obtained from the sultan. Of that vast multitude of Turks no more than 15,000 made their escape, the rest being all either killed or taken: however, the Polish soldiers, being bound by the laws of their country only to stay a certain time in the field, they refused to pursue this signal victory, and suffered the king to make peace on any terms he could procure.

Wiesnowiski died before the news of this transaction reached Cracow; and after his death a new scene of confusion ensued, till at last the fortune of John Sobieski prevailed, and he was elected king of Poland in 1674.

92 John Sobieski retrieves the Polish affairs.

He was a most magnanimous and heroic prince; who, by his valour and good conduct, retrieved the affairs of Poland, and entirely checked the progress of the Turks westward. These barbarians were everywhere defeated, as is particularly related under the article TURKEY; but notwithstanding his great qualities, Poland was now so thoroughly corrupted, and pervaded by a spirit of disaffection, that the latter part of this monarch's reign was involved in troubles, through the ambition and contention of some powerful noblemen.

Sobieski died in 1696; and with him fell the glory of Poland. Most violent contests took place about the succession; the recital of which would far exceed our limits. At last Frederic Augustus, elector of Saxony, prevailed; but yet, as some of the most essential ceremonies were wanting in his coronation, because the primate, who was in an opposite interest, would not perform them, he found it extremely difficult to keep his subjects in proper obedience. To add to his misfortunes, having engaged in a league with Denmark and Russia against Sweden, he was attacked with irresistible fury by Charles XII. Though Augustus had not been betrayed,

Poland.

as indeed he almost always was, he was by no means a match for the ferocious Swede. The particulars of this war, however, as they make great part of the exploits of that northern hero, more properly fall to be related under the article SWEDEN. Here, therefore, we shall only observe, that Augustus was reduced to the humiliating necessity of renouncing the crown of Poland on oath, and even of congratulating his rival Stanislaus upon his accession to the throne: but when the power of Charles was broken by his defeat at Pultowa, the fortune of Augustus again prevailed; Stanislaus was driven out; and the former being absolved from his oath by the pope, resumed the throne of Poland.

93 Poland conquered by Charles XII.

94 Degeneracy of the Poles.

Since that time the Polish nation has never made any figure. Surrounded by great and ambitious powers, it has sunk under the degeneracy of its inhabitants; so that it now scarcely exists as a nation. This catastrophe took place in the following manner: On the 5th of October 1763, died Augustus III. elector of Saxony, and king of Poland. He was succeeded by Count Poniatowski, a Polish grandee, who was proclaimed Sept. 7th 1764, by the name of *Stanislaus Augustus*, and crowned on the 25th of November the same year.—During the interregnum which took place between the death of Augustus III. and the election of Stanislaus, a decree had been made by the convocation-diet of Poland, with regard to the *dissidents*, as they were called, or dissenters from the Polish religion. By this decree they were prohibited from the free exercise of their religion, much more than they had formerly been, and totally excluded from all posts and places under the government. On this several of the European powers interposed, at the application of the dissidents for their good offices. The courts of Russia, Prussia, Great Britain, and Denmark, made remonstrances to the diet; but notwithstanding these remonstrances, the decree was confirmed by the coronation-diet held after the king's election.

95 Elevation of Poniatowski, by the name of Stanislaus Augustus, to the throne.

96 Interference of foreign powers in behalf of the dissidents.

October 6. 1766, an ordinary diet was assembled. Here declarations from the courts above mentioned were presented to his Polish majesty, requiring the re-establishment of the dissidents in their civil rights and privileges, and the peaceable enjoyment of their modes of worship secured to them by the laws of the kingdom, which had been observed for two centuries. These privileges, it was alleged, had been confirmed by the treaty of Oliva, concluded by all the northern powers, which could not be altered but by the consent of all the contracting parties. The Popish party contended strongly for a confirmation of some decrees made against the dissidents in 1717, 1723, and 1736. The deputies from the foreign powers replied, that those decrees had passed in the midst of intestine troubles, and were contradicted by the formal protestations and express declarations of foreign powers. At last, after violent contests, the matter was referred to the bishops and senators for their opinion. Upon a report from them, the diet came to a resolution, That they would fully maintain the dissidents in all the rights and prerogatives to which they were entitled by the laws of their country, particularly by the constitutions of the year 1717, &c. and by treaties; and that as to their complaints with regard to the exercise of their religion, the college of archbishops and bishops, under the direction of the prince primate, would endeavour to remove those difficulties in a manner conformable to justice and neighbourly love.—By this time, however, the court of Russia seemed determined to make her remonstrances more effectual, and a small body of Russian troops marched to within two miles of the capital of Poland.

These resolutions of the diet were by no means agreeable to the dissidents. They dated the beginning of their sufferings from the year 1717. The referring their grievances to the archbishops and bishops was looked upon as a measure the most unreasonable that could be imagined, as that body of men had always been their opposers, and in fact the authors of all the evils which had befallen them.—Shortly after matters were considered in this view, an additional body of Russians, to the number of about 15,000, entered Poland.

97 Consequences of this.

The dissidents, being now pretty sure of the protection of foreign powers, entered, on the 20th of March 1767, into two confederacies, at Thorn and Sluck. One of them was signed by the dissidents of Great and Little Poland, and the other by those of the Great Duchy of Lithuania. The purpose of these confederacies was, an engagement to exert themselves in the defence of their ancient privileges, and the free exercise of their religion; professing at the same time, however, the utmost loyalty to the king, and resolving to send a deputation to him to implore his protection. They even invited those of the Catholic communion, and all true patriots, to unite with them in maintaining the fundamental laws of the kingdom, the peace of religion, and the right of each one jointly with themselves. They claimed, by virtue of public treaties, the protection of the powers who were guarantees of their rights and liberties; namely, the empress of Russia, and the kings of Sweden, Great Britain, Denmark, and Prussia. Lastly, they protested, that they had no intention of acting to the detriment of the Roman Catholic religion, which they duly respected: and only asked the liberty of their own, and the re-establishment of their ancient rights. The three cities of Thorn, Elbing, and Dantzic, acceded to the confederacy of Thorn on the 10th of April; as did the duke and nobles of Courland to that of Sluck on the 15th of May.

The empress of Russia and king of Prussia, in the mean time, continued to issue forth new declarations in favour of the dissidents; and the Russian troops in Poland were gradually augmented to 30,000 men. Great numbers of other confederacies were also formed in different parts of the kingdom. These at first took little part in the affairs of the dissidents: they complained only of the administration of public affairs, in which they alleged that innovations had been introduced, and were therefore for some time called *confederations of malcontents*. All these confederacies published manifestoes, in which they recommended to the inhabitants to quarter and treat the Russian troops as the defenders of the Polish liberties.

98 General confederacy.

The different confederacies of malcontents formed in the 24 districts of Lithuania united at Wilna on the 22d of June; and that general confederacy re-established Prince Radzivil, who had married the king's sister, in his liberty, estates, and honour, of which he had been deprived in 1764 by the states of that duchy. On the 23d of June Prince Radzivil was chosen grand marshal of the general confederacy of all Poland, which then began to be called the *national confederacy*, and was said to be composed of 72,000 noblemen and gentlemen.

The

The general confederacy took such measures as appeared most proper for strengthening their party. They sent to the several waywodes of the kingdom, requiring their compliance with the following articles: 1. That all the gentlemen who had not signed the confederacy should do it immediately; 2. That all the courts of justice should subsist as formerly, but not judge any of the confederates; 3. That the marshals of the crown should not pass any sentence without the participation of at least four of the confederates; and, 4. That the marshals of the crown and the treasurers should be immediately restored to the possession of their respective rights. The Catholic party in the mean time were not idle. The bishop of Cracow sent a very pathetic and zealous letter to the dietines assembled at Warsaw on the 13th of August, in which he exhorted them to arm their nuncios with courage, by giving them orthodox and patriotic instructions, that they might not grant the dissidents new advantages beyond those which were secured to them by the constitutions of the country, and treaties with foreign powers, &c. The pope also sent briefs to the king, the great chancellor, the noblesse, bishops of the kingdom, and to the prince primate, with such arguments and exhortations as were thought most proper to ward off the impending danger. Councils in the mean time were frequently held at the bishop of Cracow's palace, where all the prelates at Warsaw assembled.

On the 26th of September 1767 the confederacy of dissidents was united with the general confederacy of malcontents in the palace of Prince Radzivil, who on that occasion expressed great friendship for the dissidents. In a few days after, the Russian troops in the capital were reinforced, and a considerable body of them was posted at about five miles distance.

99
Tumults in the diet.

On the 5th of October an extraordinary diet was held: but the affair of the dissidents met with such opposition, that it was thought necessary to adjourn the meeting till the 12th; during which interval, every expedient was used to gain over those who opposed Prince Radzivil's plan. This was, to appoint a commission, furnished with full power to enter into conference with Prince Repnin, the Russian ambassador, concerning the affairs of the dissidents. Notwithstanding all the pains taken, however, the meeting of the 12th proved exceedingly tumultuous. The bishops of Cracow and Kiow, with some other prelates, and several magnats, declared, that they would never consent to the establishment of such a commission; and at the same time spoke with more vehemence than ever against the pretensions of the dissidents. Some of the deputies answered with great warmth; which occasioned such animosities, that the meeting was again adjourned till the 16th.

100
Violent proceedings of the Russians.

On the 13th the bishops of Cracow and Kiow, the palatine of Cracow, and the staroste of Domski, were carried off by Russian detachments. The crime alleged against them, in a declaration published next day by Prince Repnin, was, that they had been wanting in respect to the dignity of the empress of Russia, by attacking the purity of her intentions towards the republic; though she was resolved to continue her protection and assistance to the general confederacy united for preserving the liberties of Poland, and correcting all the abuses which had been introduced into the government, &c.

It was probably owing to this violent proceeding of the Russians, that Prince Radzivil's plan was at last adopted, and several new regulations were made in favour of the dissidents. These innovations, however, soon produced a civil war, which at last ended in the ruin of the kingdom. In the beginning of the year 1768, a new confederacy was formed in Podolia, a province bordering on Turkey, which was afterwards called the *confederacy of Bar*. The intention of it was, to abolish, by force of arms, the new constitutions, particularly those in favour of the dissidents. The members of the new confederacy likewise expressed great resentment against the carrying away the bishops of Cracow, &c. and still detaining them in custody. 101

Confederacy of Bar.

Podolia was reckoned the fittest place for the purpose of the confederates, as they imagined the Russians could not attack them there without giving umbrage to the Ottoman court. Similiar confederacies, however, were quickly entered into throughout the kingdom: the clergy excited all ranks of men to exert themselves in defence of their religion; and so much were their exhortations regarded, that even the king's troops could not be trusted to act against these confederates. The empress of Russia threatened the new confederates as disturbers of the public tranquillity, and declared that her troops would act against them if they persisted. It was, however, some time before the Russian troops were considerably reinforced: nor did they at first seem inclined to act with the vigour which they might have exerted. A good many skirmishes soon happened between these two contending parties, in which the confederates were generally defeated. In one of these the latter being worsted, and hardly pressed, a number of them passed the Niester, and took refuge in Moldavia. This province had formerly belonged to Poland, but was now subject to the Grand Signior: the Russians, however, pursued their enemies into Moldavia; but in order to prevent any offence being taken by the Porte, Prince Repnin wrote to the Russian resident at Constantinople, to intimate there, that the conduct of the Russian colonel who commanded the party was quite contrary to the orders of his court, and that therefore he would be turned out of his post.

Great cruelty in the mean time was exercised against the dissidents where there were no Russian troops to protect them. Towards the end of October 1769, Prince Martin Lubomirski, one of the southern confederates, who had been driven out of Poland, and had taken shelter with some of his adherents among the mountains of Hungary, got a manifesto posted up on several of the churches of Cracow, in which he invited the nation to a general revolt, and assuring them of the assistance of the Ottoman Porte, with whom he pretended to have concluded a treaty. This was the beginning of hostilities between the Turks and Russians, which were not terminated but by a vast effusion of blood on both sides. 102

War between this confederacy and the Russians.

The unhappy kingdom of Poland was the first scene of this war, and in a short time was reduced to the most deplorable situation. In the end of the year 1768, the peasants of the Greek religion in the Polish Ukraine, and province of Kiow, took up arms, and committed the greatest ravages, having, as they pretended, been threatened with death by the confederates unless they would turn Roman Catholics. Against these insurgents the Russians employed their arms, and made great numbers

of

Poland. of them prisoners. The rest took refuge among the Haidamacks; by whom they were soon joined, and in the beginning of 1769 entered the Ukraine in conjunction with them, committing every where the most horrid massacres. Here, however, they were at last defeated by the Polish troops, at the same time that several of the confederacies in Poland were severely chastised. Soon after, the chan of the Crim Tartars, having been repulsed with loss in an attempt on New Servia, entered the Polish territories, where he left frightful marks of his inhumanity upon some innocent and defenceless persons. This latter piece of conduct, with the cruelties exercised by the confederates, induced the Polish Cossacks of Braclau and Kiovia, amounting to near 30,000 effective men, to join the Russians, in order to defend their country against these destroyers. Matters continued much in the same way during the rest of the year 1769; and in 1770, skirmishes frequently happened between the Russians and confederates, in which the latter were almost always worsted; but they took care to revenge themselves by the most barbarous cruelties on the dissidents, wherever they could find them. In 1770, a considerable number of the confederates of Bar, who had joined the Turks, and been excessively ill used by them, came to an accommodation with the Russians, who took them under their protection on very moderate terms. —Agriculture in the mean time had been so much neglected, that the crop of 1770 was very deficient. This encouraged a number of desperadoes to associate under the denomination of *confederates*, who were guilty of still greater excesses than those who had been under some kind of regulation. Thus a great part of the country was at last reduced to a mere desert, the inhabitants being either exterminated, or carried off to stock the remote Russian plantations, from whence they never could return.

103 New confederacies. In the year 1771, the confederacies, which seemed to have been extinguished, sprang up afresh, and increased to a prodigious degree. This was occasioned by their having been secretly encouraged and supplied with money by France. A great number of French officers engaged as volunteers in their service; who having introduced discipline among their troops, they acted with much greater vigour than formerly, and sometimes proved too hard for their enemies. These gleams of success proved at last their total ruin. The Russians were reinforced and properly supported. The Austrian and Prussian troops entered the country, and advanced on different sides; and the confederates found themselves in a short time entirely surrounded by their enemies, who seemed to have nothing less in view than an absolute conquest of the country, and sharing it among themselves.

104 Attempt to assassinate the king. Before matters came to this crisis, however, the confederates formed a design of assassinating the king, on account of his supposed attachment to the dissidents. Of this singular occurrence we have the following account in the travels of Mr Coxe, communicated to the author by Mr Wraxall.—"A Polish nobleman, named *Pulaski*, a general in the army of the confederates, was the person who planned the atrocious enterprise; and the conspirators who carried it into execution were about 40 in uumber, and were headed by three chiefs, named *Lukawski*, *Strawenski*, and *Kosinski*. These three chiefs had been engaged and hired for that purpose by Pulaski, who in the town of Czetschokow in Great Poland obliged them to swear in the most solemn manner, by placing their hands between his, either to deliver the king alive into his hands, or, in case that was impossible, to put him to death. The three chiefs chose 37 persons to accompany them. On the second of November, about a month after they had quitted Czetschokow, they obtained admission into Warsaw, unsuspected or undiscovered, by the following stratagem. They disguised themselves as peasants who came to sell hay, and artfully concealed their saddles, arms, and clothes, under the loads of hay which they brought in waggons, the more effectually to escape detection.

"On Sunday night, the third of September 1771, a few of these conspirators remained in the skirts of the town; and the others repaired to the place of rendezvous, the street of the Capuchins, where his majesty was expected to pass by about his usual hour of returning to the palace. The king had been to visit his uncle Prince Czartoriski, grand chancellor of Lithuania, and was on his return from thence to the palace between nine and ten o'clock. He was in a coach, accompanied by at least 15 or 16 attendants, beside an aid-de-camp in the carriage: scarce was he at the distance of 200 paces from Prince Czartoriski's palace, when he was attacked by the conspirators, who commanded the coachman to stop on pain of instant death. They fired several shot into the carriage, one of which passed through the body of a heyduc, who endeavoured to defend his master from the violence of the assassins. Almost all the other persons who preceded and accompanied his majesty were dispersed; the aid-de-camp abandoned him, and attempted to conceal himself by flight. Meanwhile the king had opened the door of his carriage with the design of effecting his escape under shelter of the night, which was extremely dark. He had even alighted, when the assassins seized him by the hair, exclaiming in Polish, with horrible execrations, 'We have thee now; thy hour is come.' One of them discharged a pistol at him so very near, that he felt the beat of the flesh; while another cut him across the head with his sabre, which penetrated to the bone. They then laid hold of his majesty by the collar, and mounting on horseback, dragged him along the ground between their horses at full gallop for near 500 paces through the streets of Warsaw.

105 who is taken prisoner,

106 and wounded,

"Soon finding, however, that he was incapable of following them on foot, and that he had already almost lost his respiration from the violence with which they had dragged him, they set him on horseback; and then redoubled their speed for fear of being overtaken. When they came to the ditch which surrounds Warsaw, they obliged him to leap his horse over. In the attempt the horse fell twice, and at the second fall broke its leg. They then mounted his majesty upon another, all covered as he was with dirt.

107 and rifled.

"The conspirators had no sooner crossed the ditch, than they began to rifle the king, tearing off the order of the Black Eagle of Prussia which he wore round his neck, and the diamond cross hanging to it. He requested them to leave his handkerchief, which they consented to: his tablets escaped their rapacity. A great number of the assassins retired after having thus plundered him, probably with intent to notify to their respective leaders the

Poland. the success of their enterprise; and the king's arrival as a prisoner. Only seven remained with him, of whom Kosinski was the chief. The night was exceedingly dark; they were absolutely ignorant of the way; and, as the horses could not keep their legs, they obliged his majesty to follow them on foot, with only one shoe, the other being lost in the dirt.

"They continued to wander through the open meadows, without following any certain path, and without getting to any distance from Warsaw. They again mounted the king on horseback, two of them holding him on each side by the hand, and a third leading his horse by the bridle. In this manner they were proceeding, when his majesty, finding they had taken the road which led to a village called *Burakow*, warned them not to enter it, because there were some Russians stationed in that place who might probably attempt to rescue him (A). Finding himself, however, incapable of accompanying the assassins in the painful posture in which they held him kept down on the saddle, he requested them, since they were determined to oblige him to proceed, at least to give him another horse and a boot. This request they complied with; and continuing their progress through almost impassable lands, without any road, and ignorant of their way, they at length found themselves in the wood of Bielany, only a league distant from Warsaw. From the time they had passed the ditch they repeatedly demanded of Kosinski their chief, if it was not yet time to put the king to death; and these demands were reiterated in proportion to the obstacles and difficulties they encountered, till they were suddenly alarmed by a Russian patrole or detachment. Instantly holding council, four of them disappeared, leaving him with the other three, who compelled him to walk on. Scarce a quarter of an hour after, a second Russian guard challenged them anew. Two of the assassins then fled, and the king remained alone with Kosinski the chief, both on foot. His majesty, exhausted with all the fatigue which he had undergone, implored his conductor to stop, and suffer him to take a moment's repose. Kosinski refused it, menacing him with his naked sabre; and at the same time informed him, that beyond the wood they should find a carriage. They continued their walk, till they came to the door of the convent of Bielany. Kosinski appeared lost in thought, and so much agitated by his reflections, that the king perceiving his disorder, and observing that he wandered without knowing the road, said to him, 'I see you are at a loss which way to proceed. Let me enter the convent of Bielany, and do you provide for your own safety.' 'No (replied Kosinski) I have sworn.'

108 His presence of mind remarkable.

"They proceeded till they came to Mariemont, a small palace belonging to the house of Saxony, not above half a league from Warsaw: here Kosinski betrayed some satisfaction at finding where he was, and the king still demanding an instant's repose, he consented at length. They sat down together on the ground, and the king employed these moments in endeavouring to soften his conductor, and induce him to favour or permit his escape. His majesty represented the atrocity of the crime he had committed in attempting to murder his sovereign, and the invalidity of an oath taken to perpetrate so heinous an action: Kosinski lent attention to this discourse, and began to betray some marks of remorse. But (said he), if I should consent and reconduct you to Warsaw, what will be the consequence? I shall be taken and executed! I give you my word (answered his majesty), that you shall suffer no harm; but if you doubt my promise, escape while there is yet time. I can find my way to some place of security; and I will certainly direct your pursuers to take the contrary road to that which you have chosen. Kosinski could not any longer contain himself, but, throwing himself at the king's feet, implored forgiveness for the crime he had committed; and swore to protect him against every enemy, relying totally on his generosity for pardon and preservation. His majesty reiterated to him his assurances of safety. Judging, however, that is was prudent to gain some asylum without delay, and recollecting that there was a mill at some considerable distance, he immediately made towards it. Kosinski knocked, but in vain; no answer was given: he then broke a pane of glass in the window, and intreated for shelter to a nobleman who had been plundered by robbers. The millar refused, supposing them to be banditti, and continued for more than half an hour to persist in his denial. At length the king approached, and speaking through the broken pane, endeavoured to persuade him to admit them under his roof, adding, 'If we were robbers, as you suppose, it would be very easy for us to break the whole window, instead of one pane of glass.' This argument prevailed. They at length opened the door and admitted his majesty. He immediately wrote a note to General Coccei, colonel of the foot-guards, informing him of his danger and miraculous escape.

109 He gains over his conductor, effects his escape, and

"When the messenger arrived with the note, the astonishment and joy was incredible. Coccei instantly rode to the mill, followed by a detachment of the guards. He met Kosinski at the door with his sabre drawn, who admitted him as soon as he knew him. The king had sunk into a sleep, caused by his fatigue; and was stretched on the ground, covered with the millar's cloak. Coccei immediately threw himself at his majesty's feet, calling him his sovereign, and kissing his hand. It is not easy to paint or describe the astonishment of the miller and his family, who instantly imitated Coccei's example, by throwing themselves on their knees (B). The king returned to Warsaw in General Coccei's carriage,

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(A) "This intimation, which the king gave to his assassins, may at first sight appear extraordinary and unaccountable, but was really dictated by the greatest address and judgment. He apprehended with reason, that, on the sight of a Russian guard, they would instantly put him to death with their sabres, and fly; whereas by informing them of the danger they incurred, he in some measure gained their confidence: in effect, this behaviour of the king seemed to soften them a little, and made them believe he did not mean to escape from them."

(B) "I have been (says Mr Wraxall) at this mill, rendered memorable by so deplorable an event. It is a wretched

Poland. riage, and reached the palace about five in the morning. His wound was found not to be dangerous; and he soon recovered from the bruises and injuries which he had suffered during this memorable night. So extraordinary an escape is scarce to be paralleled in history, and affords ample matter of wonder and surprise.

"It is natural to inquire what is become of Kosinski, the man who saved his majesty's life, and the other conspirators. He was born in the palatinate of Cracow, and of mean extraction; having assumed the name of *Kosinski* (c), which is that of a noble family, to give himself credit. He had been created an officer in the troops of the confederates under Pulaski. It would seem as if Kosinski began to entertain the idea of preserving the king's life from the time when Luskawski and Strawenski abandoned him; yet he had great struggles with himself before he could resolve on this conduct, after the solemn engagements into which he had entered. Even after he had conducted the king back to Warsaw, he expressed more than once his doubts of the propriety of what he had done, and some remorse for having deceived his employers. He was detained under a very strict confinement, and obliged to give evidence against his two companions Lukawski and Strawenski, who were beheaded, his majesty having obtained for them from the diet a mitigation of the horrible punishment which the laws of Poland inflicts upon regicides. About a week after the execution of these conspirators, Kosinski was sent out of Poland, after the king had settled upon him an annual pension, which he enjoyed at Semigallia, in the papal territories."

110 Is received at Warsaw with demonstrations of joy.

Upon the king's return to Warsaw he was received with the utmost demonstrations of joy. Every one exclaimed with rapture, "The king is alive!" and all struggled to get near him, to kiss his hand, or even to touch his clothes. But neither the virtues nor the popularity of the sovereign could allay the factious spirit of the Poles, nor prevent the dismemberment of his kingdom.

111 Partition of Poland projected by the king of Prussia.

"The partition of Poland was first projected by the king of Prussia. Polish or Western Prussia had long been an object of his ambition: exclusive of its fertility, commerce, and population, its local situation rendered it highly valuable to that monarch; it lay between his German dominions and Eastern Prussia, and while possessed by the Poles, cut off at their will all communication between them." The period was now arrived when the situation of Poland seemed to promise the easy acquisition of this valuable province. Frederic pursued it, however, with all the caution of an able politician. On the commencement of the troubles, he showed no eagerness to interfere in the affairs of this country; and although he had concurred with the empress of Russia in raising Stanislaus Augustus to the throne of Poland, yet he declined taking any active part in his favour against the confederates. Afterwards, when the whole kingdom became convulsed throughout with civil commotions (1769), and desolated likewise by the plague, he, under pretence of forming lines to prevent the spreading of the infection, advanced his troops into Polish Prussia, and occupied that whole district.

112 who gains over the emperor and the empress to his measures.

Though now completely master of the country, and by no means apprehensive of any formidable resistance from the disunited and distracted Poles, yet, as he was well aware that the security of his new acquisition depended upon the acquiescence of Russia and Austria, he planned the partition of Poland. He communicated the project to the emperor, either upon their interview at Niess in Silesia in 1769, or in that of the following year at Newstadt in Austria; from whom the overture met with a ready concurrence. To induce the empress of Russia to acquiesce in the same project, he dispatched his brother Henry to Petersburg, who suggested to the empress that the house of Austria was forming an alliance with the Porte, with which she was then at war; that if such alliance took place, it would create a most formidable combination against her; that, nevertheless the friendship of that house was to be purchased by acceding to the partition; that, upon this condition, the emperor was willing to renounce his connection with the Grand Signior, and would suffer the Russians to prosecute the war without interruption. Catharine, anxious to push her conquest against the Turks, and dreading the interposition of the emperor in that quarter; perceiving likewise, from the intimate union between the courts of Vienna and Berlin, that it would not be in her power, at the present juncture, to prevent the intended partition—closed with the proposal, and selected no inconsiderable portion of the Polish territories for herself. The treaty was signed at Petersburg in the beginning of February 1772, by the Russian, Austrian, and Prussian plenipotentiaries. It would be tedious to enter into a detail of the pleas urged by the three powers in favour of their several demands; it would be no less uninteresting to lay before the reader the answers and remonstrances of the king and senate, as well as the appeals to the other states which had guaranteed the possessions of Poland. The courts of London, Paris, Stockholm, and Copenhagen, remonstrated against the usurpations; but remonstrances without assistance could be of no effect. Poland submitted to the dismemberment not without the most violent struggles; and now for the first time felt and lamented the fatal effects of faction and discord.

113 Poland dismembered.

A diet being demanded by the partitioning powers, in order to ratify the cession of the provinces, it met on the 19th of April 1773; and such was the spirit of the members, that, notwithstanding the deplorable situation of their country, the threats and bribes of the three powers, the partition-treaty was not carried through without much difficulty. For some time the majority of the nuncios appeared determined to oppose the dismemberment, and the king firmly persisted in the same resolution. The ambassadors of the three courts enforced their requisitions by the most alarming menaces, and threatened the king with deposition and imprisonment. They also gave out by their emissaries, that in case the diet continued refractory, Warsaw should be pillaged.

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wretched Polish hovel, at a distance from any house. The king rewarded the miller to the extent of his wishes, in building him a mill upon the Vistula, and allowing him a small pension."

(c) His real name was John Kutsma.

pillaged. This report was industriously circulated, and made a sensible impression upon the inhabitants. By menaces of this sort, by corrupting the marshal of the diet, who was accompanied with a Russian guard; in a word, by bribes, promises, and threats, the members of the diet were at length prevailed on to ratify the dismemberment.

The partitioning powers, however, did less injury to the republic by dismembering its fairest provinces, than in perpetuating the principles of anarchy and confusion, and establishing on a permanent footing that exorbitant liberty which is the parent of faction, and has proved the decline of the republic. Under pretence of amending the constitution, they confirmed all its defects, and took effectual precautions to render this unhappy country incapaple of emerging from its present deplorable state, as was seen in the failure of the most patriotic attempt that was perhaps ever made by a king to reform the constitution of his kingdom.

114 The kings of Poland originally hereditary,

The kings of Poland were anciently hereditary and absolute; but afterwards became elective and limited. In the reign of Louis, towards the end of the 14th century, several limitations were laid on the royal prerogative. In that of Casimir IV. who ascended the throne in 1446, representatives from the several palatinates were first called to the diet; the legislative power till then having been lodged in the states, and the executive in the king and senate. On the decease of Sigismund Augustus, it was enacted by law, "That the choice of a king for the future should perpetually remain free and open to all the nobles of the kingdom;" which law was accordingly observed to the great injury of the kingdom.

115 afterwards elective.

Universal History.

"As soon as the throne is vacant, all the courts of justice, and other ordinary springs of the machine of government, remain in a state of inaction, and all the authority is transferred to the primate, who, in quality of interrex, has in some respects more power than the king himself; and yet the republic takes no umbrage at it, because he has not time to make himself formidable. He notifies the vacancy of the throne to foreign princes, which is in effect proclaiming that a crown is to be disposed of; he issues the *universalia*, or circular letters for the election; gives orders to the starosts (a sort of military officers who have great authority, and whose proper business it is to levy the revenue) to keep a strict guard upon the fortified places, and to the grand-generals to do the same upon the frontiers, towards which the army marches.

116 Place and manner of the election.

"The place of election is the field of Wola, at the gates of Warsaw. All the nobles of the kingdom have a right of voting. The Poles encamp on the left side of the Vistula, and the Lithuanians on the right, each under the banners of their respective palatinates, which makes a sort of civil army; consisting of between a hundred and fifty and two hundred thousand men, assembled to exercise the highest act of freedom. Those who are not able to provide a horse and a sabre stand behind on foot, armed with scythes, and do not seem at all less proud than the rest, as they have the same right of voting.

"The field of election is surrounded by a ditch with three gates, in order to avoid confusion, one to the east for Great Poland, another to the south for Little Poland, and a third to the west for Lithuania. In the middle of the field, which is called *Kolau*, is erected a great building of wood, named the szopa or hall for the senate, at whose debates the deputies are present, and carry the result of them to the several palatinates. The part which the marshal acts upon this occasion is very important; for, being the mouth of the nobility, he has it in his power to do great service to the candidates; he is also to draw up the instrument of election, and the king elect must take it only from his hand.

"It is prohibited, upon pain of being declared a public enemy, to appear at the election with regular troops, in order to avoid all violence. But the nobles, who are always armed with pistols and sabres, commit violence against one another, at the time that they cry out 'liberty!'

"All who aspire openly to the crown are expressly excluded from the field of election, that their presence may not constrain the voters. The king must be elected *nemine contradicente*, by all the suffrages without exception. The law is founded upon this principle, that when a great family adopts a father, all the children have a right to be pleased. The idea is plausible in speculation; but if it was rigorously kept to, Poland could have no such thing as a lawful king. They therefore give up a real unanimity, and content themselves with the appearance of it; or rather, if the law, which prescribes it, cannot be fulfilled by means of money, they call in the assistance of the sabre.

"Before they come to this extremity, no election can possibly be carried on with more order, decency, and appearance of freedom. The primate in few words recapitulates to the nobles on horseback the respective merits of the candidates; he exhorts them to choose the most worthy, invokes heaven, gives his blessing to the assembly, and remains alone with the marshal of the diet, while the senators disperse themselves into the several palatinates, to promote an unanimity of sentiments. If they succeed, the primate goes himself to collect the votes, naming once more all the candidates. 'Szoda (answer the nobles), that is the man we choose;' and instantly the air resounded with his name, with cries of *vivat*, and the noise of pistols. If all the palatines agreed in their nominations, the primate got on horseback; and then the profoundest silence succeeding to the greatest noise, he asked three times if all were satisfied? and after a general approbation, three times proclaimed the king; and the grand-marshal of the crown repeated the proclamation three times at the three gates of the camp. How glorious a king this, if endued with royal qualities! and how incontestable his title in the suffrages of a whole people! But this sketch of a free and peaceable election is by no means a representation of what usually happened. The corruption of the great, the fury of the people, intrigues and factions, the gold and the arms of foreign powers, frequently filled the scene with violence and blood."

117 The pacta conventa.

Before the king was proclaimed, the *pacta conventa* was read aloud to him, which on his knees at the altar he swore to observe. As this contract, which was drawn up, methodized, and approved, by the senate and nobility, was deemed the great charter of Poland, we shall enumerate the principal articles of which it consisted. These are, that the king should not attempt to encroach on the liberty of the people, by rendering the crown hereditary in his family; but that he should preserve all the customs, laws, and ordonnances, respecting the

the freedom of election: that he should ratify all treaties subsisting with foreign powers which were approved by the diet: that it should be his chief study to cultivate peace, preserve the public tranquillity, and promote the interest of the realm: that he should not coin money except in the name of the republic, or appropriate to himself the advantages arising from coinage: that in declaring war, concluding peace, making levies, hiring auxiliaries, or admitting foreign troops upon any pretext within the Polish dominions, the consent of the diet and senate should be necessary: that all offices and preferments should be given to the natives of Poland and Lithuania; and that no pretence should excuse or palliate the crime of introducing foreigners into the king's council or the departments of the republic: that the officers of his majesty's guards should be Poles or Lithuanians; and that the colonel should absolutely be a native of Poland, and of the order of nobility: that all the officers should be subordinate to the authority of the mareschal: that no individual should be vested with more employments than the law allows: that the king should not marry without the approbation of the senate; and that the household of the queen should be determined and regulated by the republic: that the sovereign should never apply his private signet to acts and papers of a public nature: that the king should dispose of the offices both of the court and of the republic; and regulate with the senate the number of forces necessary for the defence of the kingdom: that he should administer justice by the advice of the senate and his council: that the expences of his civil list should be the same with those of his predecessors: that he should fill up all vacancies in the space of six weeks: that this should be his first business in the diet, obliging the chancellor to publish his appointments in due form: that the king should not diminish the treasure kept at Cracow; but, on the contrary, endeavour to augment that and the number of the crown-jewels: that he should borrow no money without the consent of the diet: that he should not equip a naval force without the consent and full approbation of the republic: that he should profess the Roman Catholic faith, promote, maintain, and defend it, through all the Polish dominions: and finally, that all their several liberties, rights, and privileges, should be preserved to the Polanders and Lithuanians in general, and to all the districts and provinces contained within each of these great divisions, without change, alteration, or the smallest violation, except by the consent of the republic. To these articles a variety of others were added, according to circumstances and the humour of the diet; but what we have recited formed the standing conditions, which were scarcely ever altered or omitted.

118 The diet of Poland, and

The diet of Poland was composed of the king, the senate, bishops, and the deputies of the nobility or gentry of every palatinate, called, in their collective capacity, *comitia togata*, that is, when the states assembled in the city without arms and horses; or *comitia paludata*, when they met in the fields armed, as during an interregnum, at the diet of election. It was a prerogative of the crown to assemble the diet at any particular place, except on occasion of a coronation, which the custom of the country required should be celebrated at the capital. For a number of years, indeed, the diet regularly assembled at Warsaw; but, on complaint made by the Lithuanians, it was agreed, that every third diet should be held at Grodno. "When it is proposed to hold a general diet, the king, or, in case of an interregnum, the primate, issued writs to the palatines of the several provinces, specifying the time and place of the meeting. A sketch likewise was sent of the business to be deliberated on by the assembly; the senate was consulted in this particular, and six weeks were allowed the members to prepare themselves for the intended session. It is remarkable, that the diet never sat more than six weeks in the most critical conjunctures and pressing emergencies: they have been known to break up in the middle of an important debate, and to leave the business to a future meeting. This custom has been justly esteemed one of the greatest defects of the Polish constitution, which probably owed its origin to convenience, but was afterwards superstitiously observed from whim and caprice. On receipt of the king's writ, the palatine communicated the meeting of the diet to all the castellans, starostas, and other inferior officers and gentry within his jurisdiction, requiring them to assemble on a certain day to elect deputies, and take into consideration the business specified in the royal summons. These meetings were called *petty diets*, *dietines*, or *lantage*, in the language of the country; every gentleman possessing three acres of land having a vote, and matters being determined by a majority; whereas in the general diet decrees were only valid when the whole body was unanimous. Every palatinate had three representatives, though the business devolved on one called a *nuncio*, who was elected for his ability and experience; and the other two were added only to give weight to this leading member, and do honour by their magnificent appearance to the palatinate they represented. As these deputies, since the reign of Casimir III. had seats in the diet, it naturally divided the general assembly into two bodies, the upper and lower; the one being composed of the senate, the superior clergy, and the great officers; the other of the representatives of the palatinates, who prepared all business for the superior body.

119 Dietines.

The first business of the assembly was to choose a mareschal; upon which occasion the debates and tumults ran so high, that the whole time for the session of the diet was often consumed in altercation and wrangling about the election of a speaker, who had now nothing farther to do than return quietly to his own home. After his election, he kissed the king's hand; and the chancellor, as the royal representative, reported the matters to be deliberated by the diet. Then the mareschal acquainted the king with the instructions of the deputies from their constituents, the grievances which they would have redressed, and the abuses they required to be remedied. He likewise requested of his majesty to fill up the vacant offices and benefices, according to law; and he was answered by a set speech from the chancellor, who reported the king's inclination to satisfy his people, as soon as he had consulted his faithful senate. There was something very peculiarly absurd in some of the customs observed by the Polish diet: one in particular merits attention. Not only an unanimity of voices was necessary to pass any bill, and constitute a decree of the diet, but every bill must likewise be assented to unanimously, or none can take effect. Thus, if out of twenty bills one happened to be opposed by a single voice, called *liberum veto*, all the rest were thrown out, and the diet met,

120 Absurd customs observed in the diet.

121 The liberum veto.

Poland. met, deliberated, and debated, for six weeks, to no purpose.

"To add to the other inconveniences that attended the constitution of the diet of Poland, a spirit of venality in the deputies, and a general corruption, had seized all ranks and degress in that assembly. There, as in some other countries, the cry of liberty was kept up for the sake of private interest. Deputies came with a full resolution of profiting by their patriotism, and not lowering their voice without a gratification. Determined to oppose the most salutary measures of the court, they either withdrew from the assembly, protested against all that should be transacted in their absence, or else excited such a clamour as rendered it necessary for the court to silence them by some lucrative pension, donation, or employment. Thus not only the business of the assembly was obstructed by its own members, but frequently by largesses from neighbouring powers, and sometimes by the liberality of an open enemy, who had the art of distributing his money with discretion.

122 The senate of Poland.

"Perhaps the most respectable department of the Polish government was the senate, composed of the bishops, palatines, castellans, and ten officers of state, who derived a right from their dignities of sitting in that assembly; in all amounting to 144 members, who were styled *senators of the kingdom* or *counsellors of the state*, and had the title of *excellency*, a dignity supported by no pension or emoluments necessarily annexed. The senate presided over the laws, was the guardian of liberty, the judge of right, and the protector of justice and equity. All the members, except the bishops, who were senators *ex officio*, were nominated by the king, and they took an oath to the republic before they were permitted to enter upon their functions. Their honours continued for life: at the general diet they sat on the right and left of the sovereign, according to their dignity, without regard to seniority. They were the mediators between the monarch and the subject, and, in conjunction with the king, ratified all the laws passed by the nobility. As a senator was bound by oath to maintain the liberties of the republic, it was thought no disrespect to majesty that they reminded the prince of his duty. They were his counsellors, and this freedom of speech was an inseparable prerogative of their office."

Such was the constitution of Poland before it was new-modelled by the partitioning powers. That it was a very bad constitution needs no proof; but those foreign reformers did not improve it. For two centuries at least, the Poles had with great propriety denominated their government a republic, because the king was so exceedingly limited in his prerogative, that he resembled more the chief of a commonwealth than the sovereign of a powerful monarchy. That prerogative, already too confined to afford protection to the peasants, groaning under the aristocratic tyranny of the nobles, was, after the partition treaty, still further restrained by the establishment of the *permanent counsel*, which was vested with the whole executive authority, leaving to the sovereign nothing but the name. The permanent council consisted of 36 persons, elected by the diet out of the different orders of nobility; and though the king, when present, presided in it, he could not exert a single act of power but with the consent of the majority of persons, who might well be called his *colleagues*.

123 The permanent council.

That the virtuous and accomplished Stanislaus should labour to extricate himself and the great body of the people from such unparalleled oppression, and that the more respectable part of the nation should wish to give to themselves and their posterity a better form of government, was surely very natural and very meritorious. The influence of the partitioning powers was indeed exerted to make the king contented with his situation. His revenues, which before did not exceed 100,000l. were now increased to three times that sum. The republic likewise agreed to pay his debts, amounting to upwards of 400,000l. It bestowed on him also, in hereditary possession, four starosties, or governments of castles, with the districts belonging to them; and reimbursed him of the money he had laid out for the state. It was also agreed, that the revenues of the republic should be enhanced to 33 millions of florins (near two millions sterling), and the army should consist of 30,000 men. Soon after the conclusion of the peace with Turkey, the empress of Russia also made the king a present of 250,000 rubles, as a compensation for that part of his dominions which fell into her hands.

124 A new constitution established in 1791.

These bribes, however, were not sufficient to blind the eyes of Stanislaus, or to cool the ardour of his patriotism. He laboured for posterity, and with such apparent success, that on the 3d of May 1791, a new constitution of the government of Poland was established by the king, together with the confederate states assembled in double number to represent the Polish nation. That this was a perfect constitution, we are far from thinking; but it was probably as perfect as the inveterate prejudices of the nobles would admit of. It deviated as little as possible from the old forms, and was drawn up in 11 articles, respecting the government of the republic; to which were added 21 sections, regulating the dietines or primary assemblies of Poland.

125 Substance of the first five articles of it.

Of this constitution, the first article established the Roman Catholic faith, with all its privileges and immunities, as the dominant national religion; granting to all other people, of whatever persuasion, peace in matters of faith, and the protection of government. The second article guaranteed to the nobility or the equestrian order, all the privileges which it enjoyed under the kings of the house of Jagellon. The third and fourth articles granted to the free royal towns internal jurisdictions of their own; and exempted the peasants from slavery, declaring every man free as soon as he set his foot on the territory of the republic. The fifth article, after declaring, that in civil society all power should be derived from the will of the people, enacted that the government of the Polish nation should be composed of three distinct powers, the *legislative*, in the states assembled; the *executive*, in the king and the council of inspection; and the *judicial* power, in the jurisdictions existing, or to be established. The sixth and seventh articles, as being of more importance, we shall give in the words of the constitution itself.

126 The diet to consist of two houses, viz. the house of nuncios,

VI. *The Diet*, or *the legislative power*, shall be divided into two houses, viz. the house of nuncios, or deputies, and the house of senate, where the king is to preside. The former being the representative and central point of supreme national authority, shall possess the pre-eminence in the legislature; therefore all bills are to be decided first in this house.

1. *All General Laws*, viz. constitutional, civil, criminal, and perpetual taxes; concerning which maters, the

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the king is to issue his propositions by the circular letters sent before the dietines to every palatinate and to every district for deliberation, which coming before the house with the opinion expressed in the instructions given to their representatives, shall be taken the first for decision.

2. *Particular Laws*, viz. temporal taxes; regulations of the mint; contracting public debts; creating nobles, and other casual recompenses; reparation of public expences, both ordinary and extraordinary; concerning war; peace; ratification of treaties, both political and commercial; all diplomatic acts and conventions relative to the laws of nations; examining and acquitting different executive departments, and similar subjects arising from the accidental exigencies and circumstances of the state; in which the propositions, coming directly from the throne into the house of nuncios, are to have preference in discussion before the private bills.

127 and the house of senate.

In regard to the house of senate, it is to consist of bishops, palatines, castellans, and ministers, under the presidency of the king, who shall have but one vote, and the casting voice in case of parity, which he may give either personally, or by a message to the house. Its power and duty shall be,

1. Every general law that passes formally through the house of nuncios, is to be sent immediately to this, which is either accepted, or suspended till further national deliberation, by a majority of votes, as prescribed by law. If accepted, it becomes a law in all its force; if suspended, it shall be resumed at the next diet; and if it is then agreed to again by the house of nuncios, the senate must submit to it.

2. Every particular law or statute of the diet in matters above-specified, as soon as it has been determined by the house of nuncios, and sent up to the senate, the votes of both houses shall be jointly computed, and the majority, as described by law, shall be considered as a decree and the will of the nation. Those senators and ministers who, from their share in executive power, are accountable to the republic, cannot have an active voice in the diet, but may be present, in order to give necessary explanations to the states.

These ordinary legislative diets shall have their uninterrupted existence, and be always ready to meet; renewable every two years. The length of sessions shall be determined by the law concerning diets. If convened out of ordinary session upon some urgent occasion, they shall only deliberate on the subject which occasioned such a call, or on circumstances which may arise out of it.

No law or statute enacted by such ordinary diet can be altered or annulled by the same. The complement of the diet shall be composed of the number of persons in both houses to be determined hereafter.

The law concerning the dietines or primary elections, as established by the present diet, shall be regarded as a most essential foundation of civil liberty.

128 The *liberum veto* abolished.

The majority of votes shall decide every thing, and everywhere; therefore we abolish, and utterly annihilate, *liberum veto*, all sorts of confederacies and confederate diets, as contrary to the spirit of the present constitution, as undermining the government, and as being ruinous to society.

Willing to prevent, on one hand, violent and frequent changes in the national constitution, yet, considering on the other, the necessity of perfecting it, after experiencing its effects on public prosperity, we determine the period of every 25 years for an extraordinary constitutional diet, to be held purposely for the revision and such alterations of the constitution as may be found requisite: which diet shall be circumscribed by a separate law hereafter. 129 Extraordinary diet for revising the constitution.

VII. The most perfect government cannot exist or last without an effectual executive power. The happiness of the nation depends on just laws, but the good effects of laws flow only from their execution. Experience has taught us, that the neglecting this essential part of government has overwhelmed Poland with disasters.

Having, therefore, secured to the free Polish nation the right of enacting laws for themselves, the supreme inspection over the executive power, and the choice of their magistrates, we entrust to the king and his council the highest power of executing the laws. This council shall be called *straz*, or the council of inspection. 130 Powers of the king and council of inspection.

The duty of such executive power shall be to watch over the laws, and to see them strictly executed according to their import, even by the means of public force, should it be necessary. All departments and magistracies are bound to obey its directions. To this power we leave the right of controlling such as are refractory, or of punishing such as are negligent in the execution of their respective offices.

This executive power cannot assume the right of making laws, or of their interpretation. It is expressly forbidden to contract public debts; to alter the repartition of the national income, as fixed by the diet; to declare war; to conclude definitively any treaty, or any diplomatic act; it is only allowed to carry on negociations with foreign courts, and facilitate temporary occurrences, always with reference to the diet.

The crown of Poland we declare to be elective in regard to families, and it is settled so for ever. 131 Crown elective in regard to families;

Having experienced the fatal effects of interregna, periodically subverting government, and being desirous of preventing for ever all foreign influence, as well as of insuring to every citizen a perfect tranquillity, we have, from prudent motives, resolved to adopt hereditary succession to our throne: therefore we enact and declare, that, after the expiration of our life, according to the gracious will of the Almighty, the present elector of Saxony shall reign over Poland, and in his person shall the dynasty of future kings of Poland begin. We reserve to the nation, however, the right of electing to the throne any other house or family, after the extinction of the first. 132 but hereditary in each family till its extinction.

Every king, on his accession to the throne, shall take a solemn oath to God and the nation, to support the present constitution, to fulfil the *pacta conventa*, which will be settled with the present elector of Saxony, as appointed to the crown, and which shall bind him in the same manner as former ones. 133 Coronation oath.

The king's person is sacred and inviolable; as no act can proceed immediately from him, he cannot be in any manner responsible to the nation; he is not an absolute monarch, but the father and the head of the people; his revenues, as fixed by the *pacta conventa*, shall be sacredly 134 King's person sacred;

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ly preserved. All public acts, the acts of magistracies, and the coin of the kingdom, shall bear his name.

135 His particular powers.

The king, who ought to possess every power of doing good, shall have the right of pardoning those that are condemned to death, except the crimes be against the state. In time of war, he shall have the supreme command of the national forces: he may appoint the commanders of the army, however, by the will of the states. It shall be his province to patentee officers in the army, and other dignitaries, consonant to the regulations hereafter to be expressed, to appoint bishops, senators, and ministers, as members of the executive power.

136 Members of the council of inspection.

The king's council of inspection is to consist, 1. Of the primate, as the head of the clergy, and the president of the commission of education, or the first bishop in ordine. 2. Of five ministers, viz. the minister of police, minister of justice, minister of war, minister of finances, and minister for the foreign affairs. 3. Of two secretaries to keep the protocols, one for the council, another for the foreign department; both, however, without decisive vote. The hereditary prince coming of age, and having taken the oath to preserve the constitution, may assist at all sessions of the council, but shall have no vote therein. The marshal of the diet, being chosen for two years, has also a right to sit in this council, without taking any share in its resolves; for the end only to call together the diet, always existing, in the following case: should he deem, from the emergencies hereunder specified, the convocation of the diet absolutely necessary, and the king refusing to do it, the marshal is bound to issue his circular letters to all nuncios and senators, adducing real motives for such meeting.

137 Powers of the marshal.

The cases demanding such convocation of the diet are the following: 1. In a pressing necessity concerning the law of nations, and particularly in case of a neighbouring war. 2. In case of an internal commotion, menacing with the revolution of the country, or of a collision between magistrates. 3. In an evident danger of general famine. 4. In the orphan state of the country, by demise of the king, or in case of the king's dangerous illness. All the resolutions of the council of inspection are to be examined by the rules above mentioned. The king's opinion, after that of every member in the council has been heard, shall decisively prevail. Every resolution of this council shall be issued under the king's signature, countersigned by one of the ministers sitting therein; and thus signed, shall be obeyed by all executive departments, except in cases expressly exempted by the present constitution.

Should all the members refuse their countersign to any resolution, the king is obliged to forego his opinion; but if he should persist in it, the marshal of the diet may demand the convocation of the diet; and if the king will not, the marshal himself shall send his circular letters as above. Ministers composing this council cannot be employed at the same time in any other commission or department.

If it should happen that two-thirds of secret votes in both houses demand the changing of any person, either in the council, or any executive department, the king is bound to nominate another. Willing that the council of inspection should be responsible to the nation for their actions, we decree, that when these ministers are denounced and accused before the diet (by the special committee appointed for examining their proceedings) of any transgression of positive law, they are answerable with their persons and fortunes. Such impeachments being determined by a simple majority of votes, collected jointly from both houses, shall be tried immediately by the comitial tribunal, where the accused are to receive their final judgment and punishment, if found guilty; or to be honourably acquitted on sufficient proof of innocence.

138 Commissions of education, police, &c.

In order to form a necessary organization of the executive power, we establish hereby separate commissions, connected with the above council, and subjected to obey its ordinations. These commissions are, 1. Of education; 2. Of police; 3. Of war; 4. Of treasury. It is through the medium of these four departments that all the particular orderly commissions, as established by the present diet, in every palatinate and district, shall depend on, and receive all orders from, the council of inspection, in their respective duties and occurrences.

139 Administration of justice.

The eighth article regulates the administration of justice, beginning with a very sensible declaration, that the judicial power is incompatible with the legislative, and that it cannot be administered by the king. It therefore constitutes primary courts of justice for each palatinate or district, composed of judges chosen at the dietine; and appoints higher tribunals, erected one in each of the three provinces into which the kingdom is divided, with which appeals may be lodged from the primary courts. It appoints likewise for the trial of persons accused of crimes against the state, one supreme general tribunal for all classes, called a *comitiul tribunal* or court, composed of persons chosen at the opening of every diet. The ninth article provides a regency during the king's minority, in case of his settled alienation of reason, or upon the emergency of his being made a prisoner of war. This regency was to be composed of the council of inspection, with the queen at their head, or, in her absence, the primate of the kingdom. The tenth article enjoins, that the education of the king's sons shall be entrusted to the king with the council, and a tutor appointed by the states; and the eleventh regulates the army in such a manner, as to prevent it from being employed to overturn the constitution.

140 Regency on certain occasions.

The regulation of the dietines contains nothing that can be interesting to a British reader, except what relates to the election and duties of nuncios or representatives to the general diet. And here it is enacted, that persons having a right to vote are all nobles of the equestrian order; i. e. 1. All hereditary proprietors of landed property, or possessed of estates by adjudication for a debt, paying territorial tax to government: sons also of such proprietors during the life of their parents, before the ex-division of patrimony. 2. Brothers inheriting estates before they have shared their succession. 3. All mortgages who pay 100 florins (50 shillings) of territorial tax per year from their possessions. 4. All life-holders of lands paying territorial tax to the same amount. 5. All nobles in the army possessed of such qualifying estates have a vote in their respective districts in time of peace, and properly furloughed by their commanders. 6. Legal possession is understood to be qualifying when it has been formerly acquired and actually enjoyed for twelve calendar months previously.

141 The election and duties of nuncios.

Persons who have no right to vote are, 1. Those of the equestrian order that are not actually possessed of a property

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property, as described in the foregoing article. 2. Such as hold royal, ecclesiastical, or noble lands, even with right of inheritance, but on condition of some duty or payment to their principals, consequently dependent thereon. 3. Gentry possessing estates on feudal tenure, called *ordynackie*, as being bound to certain personal service thereby. 4. All renters of estates that have no other qualifying property. 5. Those that have not accomplished 18 years of age. 6. *Crimine notati*, and those that are under a decree passed in default, even in the first instance, for having disobeyed any judicial court.

142 Persons eligible and not eligible.

Every person of the equestrian order that pays territorial tax to government for his freehold, let it be ever so small, is eligible to all elective offices in his respective district.

Gentlemen actually serving in the army, even possessed of landed hereditary estate, must have served six complete years before they are eligible to the office of a nuncio only. But this condition is dispensed with in favour of those that have filled before some public function.

Whoever is not personally present at the dietine; whoever has not completed 23 years of age; whoever has not been in any public function, nor passed the biennial office of a commissary in the orderly commission; those that are not exempted by law from obligations of *scarta bellatus*, which subjects all newly-nobilitated persons to certain civil restrictions until the next generation; and, lastly, all those against whom may be objected a decree *in contumaciam* in a civil cause; are not eligible.

During the business of election, the president who opened the meeting, with the rest of the committee, except those who are assessors, shall prepare instructions for procedure; and in regard to the propositions sent by the king and the council of inspection, these instructions shall be worded thus: "Our nuncios shall vote *affirmative* to the article *N*;" or, "Our nuncios shall vote *negative* to the article *N*," in case it is found contrary to the opinion of the dietine: and should any amendment or addition be deemed necessary and agreed on, it may be inserted in the instructions at the end of the relative proposition.

143 Instructions to the nuncios,

144 who are accountable to their constituents.

At the meeting of the dietines, after the diet has sat, the nuncios are bound to appear before their constituents, and to bring their report of the whole proceedings of that assembly; first, respecting the acts of legislature; next, with respect to the particular projects of their palatinate or district recommended to them by the instructions.

It is at these dietines that nuncios, after they have rendered to their constituents a clear account of their proceedings and of the diet, may be either confirmed or changed, and new ones elected in their stead till the general election for the following ordinary diet.

New nuncios are chosen, 1. In the room of the deceased. 2. In the room of those that are become senators or ministers of state. 3. In case of resignation. 4. In the room of such as are disqualified by the diet. 5. When any of the assembly desires a new election, to substitute another nuncio in the room of one expressly pointed out; which request must be made in writing, signed by 12 members besides, and be delivered to the marshal of the dietine. In this last case, the marshal is to read the name of the nuncio objected to, and to make the following proposition: "Shall the nuncio *N* be confirmed in his function? or, shall there be a new election made in his stead?" The opinion of the meeting being taken by a division, the majority shall decide the question, and be declared by the marshal. If the majority approves the conduct of the nuncio, the marshal and the assessors shall certify this confirmation on the diploma; and in case of disapprobation, the marshal shall declare the vacancy, and begin the form of a new election.

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145 This constitution though superior to the former, protested against by some corrupt nobles,

Such are the outlines of the Polish constitution established by the king and the confederates in 1791. It will not bear a comparison with that under which Britons have the happiness to live; but it is surely infinitely superior to that motley form of government which, for a century past, rendered Poland a perpetual scene of war, tumult, tyranny, and rebellion. Many of the corrupt nobles, however, perceiving that it would curb their ambition, deprive them of the base means which they had long enjoyed of gratifying their avarice by setting the crown to sale, and render it impossible for them to continue with impunity their tyrannical oppression of the peasants, protested against it, and withdrew from the confederates. This was nothing more than what might have been expected, or than what the king and his friends undoubtedly did expect. But the malcontents were not satisfied with a simple protest; they preferred their complaints to the empress of Russia, who, ready on all occasions, and on the slightest pretence, to invade Poland, poured her armies into the republic, and surrounding the king and the diet with ferocious soldiers, compelled them, by the most furious and indecent menaces, to undo their glorious labour of love, and to restore the constitution as settled after the partition treaty.

146 and opposed by the Russians.

Of the progress of the Russians in this work of darkness, our readers will be pleased with the following manly and indignant narrative, taken from a periodical work * of acknowledged merit.

* New Annual Register, 1792.

"It was on the 21st of April 1792, that the diet received the first notification from the king, of the inimical and unjust intentions of Russia. He informed them that, without the shadow of pretence, this avowed enemy of the rights of mankind had determined to invade the territory of the republic with an army of 60,000 men. This formidable banditti, commanded by generals Soltikow, Michelson, and Kosakowski, was afterwards to be supported by a corps of 20,000, and by the troops then acting in Moldavia, amounting to 70,000. The king, however, professed that he was not discouraged, and declared his readiness to put himself at the head of the national troops, and to terminate his existence in a glorious contest for the liberties of his country. Then, and not before, the diet decreed the organization of the army, and its augmentation to 100,000. The king and the council of inspection were invested with unlimited authority in every thing that regarded the defence of the kingdom. Magazines were ordered to be constructed when it was too late, and quarters to be provided for the army.

147 The nation rises to maintain its independence.

"The diet and the nation rose as one man to maintain their independence. All private animosities were obliterated, all private interests were sacrificed; the greatest encouragements were held forth to volunteers to

Poland. to enroll themselves under the national standard, and it was unanimously decreed by the diet, that all private losses should be compensated out of the public treasury.

"On the 18th of May, the Russian ambassador delivered a declaration, which was worthy of such a cause. It was a tissue of falsehood and hypocrisy. It asserted, that this wanton invasion, which was evidently against the sense of almost every individual Polander, was meant entirely for the *good* of the republic. It censured the precipitancy with which the new constitution was adopted, and ascribed the ready consent of the diet to the influence of the Warsaw mob. It represented the constitution as a violation of the principles on which the Polish republic was founded—complained of the licentiousness with which the *sacred name of the empress* was treated in some speeches of the members; and concluded by professing, that on these accounts, and in behalf of the emigrant Poles, her imperial majesty had ordered her troops to enter the territories of the republic.

"At the moment this declaration was delivered to the diet, the Russian troops, accompanied by Counts Potocki, Rzewuski, Branicki, and a few Polish apostates, appeared upon the frontiers, and entered the territories of the republic in several columns, before the close of

148 Spirit of the nobles. the month. The spirit manifested by the nobility was truly honourable. Some of them delivered in their plate to the mint. Prince Radzvil engaged voluntarily to furnish 10,000 stand of arms, and another a train of artillery. The courage of the new and hastily embodied soldiers corresponded with the patriotism of their nobles. Prince Poniatowski, nephew to the king, was appointed commander in chief; and though his force was greatly inferior to the enemy, it must be confessed that he made a noble stand. On the 24th of May, the enemy's Cossacks were repulsed, and pursued by the patroles of the republic to the very entrenchments. On the 26th, about one o'clock, the piquets of the republic discovered a large body of Don Cossacks approaching the outposts; and a squadron of cavalry, commanded by Lieutenant Kwasniewski, supported by Lieutenant Golejowski with two squadrons more, in all about 300, marched out to meet them. They attacked the Cossacks with success, but pursued them with more valour than prudence to the side of a wood, where they found themselves drawn into an ambuscade, and surrounded by 2000 horse, two battalions of chasseurs, and six pieces of cannon. The intrepid Poles bravely fought their way through the Russian line, and killed upwards of 200 of the enemy. The Poles in this engagement lost 100 men and two officers; one of whom, Lieutenant Kwasniewski, was wounded and made prisoner. The remainder of the detachment reached their quarters in safety.

149 Conduct of the court of Berlin. "Perhaps the history of man can scarcely furnish an instance of perfidy, meanness, and duplicity, equal to that which was manifested by Prussia on this occasion. By the treaty of defensive alliance, solemnly contracted between the republic of Poland and the king of Prussia, and ratified on the 23d of April 1790, it is expressly stipulated, 'That the contracting parties shall do all in their power to guarantee and preserve to each other reciprocally the whole of the territories which they respectively possess: That, in case of menace or invasion from any foreign power, they shall assist each other with *their whole force*, if necessary:—and by the sixth article, it is further stipulated, 'that if any foreign power whatever shall presume to interfere in the internal affairs of Poland, his Prussian majesty shall consider this as a case falling within the meaning of the alliance, and shall assist the republic according to the tenor of the fourth article," that is, with his *whole force*. What then is the pretext for abandoning this treaty? It is, that the *empress of Russia has shown a decided opposition to the order of things established in Poland on the third of May* 1791, *and is provoked by Poland presuming to put herself into a posture to defend it.*—It is known, however, by the most authentic documents, that nothing was effected on the 3d of May 1791, to which Prussia had not previously assented, and which she did not afterwards sanction; and that Prussia, according to the assertion of her own king, did not intimate a single doubt respecting the revolution till one month (and according to the Prussian minister till six months) after it had taken place; in short, to use the monarch's own words as fully explanatory of his double politics, 'not till the *general tranquillity of Europe* permitted him to explain himself.'—Instead, therefore, of assisting Poland, Prussia insultingly recommended to Poland to retrace her steps; in which case, she said that she would be ready to *attempt an accommodation* in her favour. This attempt was never made, and probably never intended; for the empress pursued her measures.

The duchy of Lithuania was the great scene of action in the beginning of the war; but the Russians had made little progress before the middle of the month of June. 150 War with Russia. On the 10th of that month, General Judycki, who commanded a detachment of the Polish troops, between Mire and Swierzna, was attacked by the Russians; but, after a combat of some hours, he obliged them to retire with the loss of 500 men dead on the field.—The general was desirous of profiting by this advantage, by pursuing the enemy, but was prevented by a most violent fall of rain. On the succeeding day, the Russians rallied again to the attack; and it then too fatally appeared, that the Poles were too young and undisciplined to contend with an inferior force against experienced troops and able generals. By a masterly manœuvre, the Russians contrived to surround their antagonists, at a moment when the Polish general supposed that he had obliged the enemy to retreat; and though the field was contested with the utmost valour by the troops of the republic, they were at length compelled to give way, and to retire towards Nieswiesz.

On the 14th another engagement took place near Lubar, on the banks of the river Sluez, between a detachment of the Russian grand army and a party of Polish cavalry dispatched by Prince Joseph Poniatowski, to intercept the enemy. The patriotic bravery of the Poles was victorious in this contest; but upon reconnoitring the force of the enemy, the prince found himself incapable of making a successful stand against such superior numbers. He therefore gave orders to strike the camp at Lubar, and commenced a precipitate retreat. During their march, the Polish rear was harassed by a body of 4000 Russians, till arriving at Boruskowee, the wooden bridge unfortunately gave

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Poland. way, under the weight of the cavalry. The enemy, in the mean time, brought their artillery to play upon the rear of the fugitives, who lost upwards of 250 men. The Polish army next directed its course towards Zielime, where meeting, on the 17th, with a reinforcement from Zaslow, it halted to give battle to the enemy. The Russians were upwards of 17,000 strong, with 24 pieces of cannon, and the force of the republic much inferior. After a furious contest from seven in the morning till five in the afternoon, the Russians were at length obliged to retreat, and leave the field of battle in possession of the patriots. The Russians were computed to have lost 4000 men in this engagement, and the Poles about 1100.

Notwithstanding these exertions, the Poles were obliged gradually to retire before their numerous and disciplined enemies. Nieswez, Wilna, Minsk, and several other places of less consequence, fell into their hands one after another. On a truce being proposed to the Russian general Kochowski, the proposal was haughtily rejected; while the desertion of Vice-brigadier Rudnicki and some others, who preferred dishonour to personal danger, proclaimed a tottering cause. The progress of the armies of Catharine was marked with devastation and cruelty, while, such was the aversion of the people both to the cause and the manner of conducting it, that, as they approached, the country all around became a wilderness, and scarcely a human being was to be seen.

In the mean time, a series of little defeats, to which the inexperience of the commanders, and the intemperate valour of new raised troops appear to have greatly contributed, served at once to distress and to dispirit these defenders of their country. Prince Poniatowski continued to retreat, and on the 17th of July, his rear being attacked by a very superior force, it suffered a considerable loss, though the skill and courage of General Kosciusko enabled him to make a most respectable defence. On the 18th, a general engagement took place between the two armies. The Russian line extended opposite Dubienka, along the river Bog, as far as Opalin. The principal column, consisting of 14,000 men, was chiefly directed against the division of General Kosciusko, which consisted of 5000 men only. After a most vigorous resistance, in which the Russians lost upwards of 4000 men, and the troops of the republic only some hundreds, the latter was compelled to give way before the superior numbers of the enemy, and to retire further into the country.

151 The king proposes submission.

This unequal contest was at last prematurely terminated. The king, whose benevolent intentions were, perhaps, overpowered by his mental imbecility, and whose age and infirmities, probably, rendered him unequal to the difficulties and dangers which must attend a protracted war, instead of putting himself, according to his resolve, at the head of his army, determined at once to surrender at discretion. On the 23d of July, he summoned a council of all the deputies at that moment in Warsaw. He laid before them the last dispatches from the empress, which insisted upon total and unreserved submission. He pointed out the danger of a dismemberment of the republic, should they delay to throw themselves upon the clemency of the empress, and to entreat her protection. He mentioned the fatal union of Austria and Prussia with Russia; and the disgraceful supineness manifested by every other court in Europe. Poland.

Four citizens, the intrepid and patriotic Malachowski, the princes Sapieha, Radzvil, and Soltan, vehemently protested against these dastardly proceedings; and the following evening a company of gentlemen from the different provinces attended for the same purpose. The assembly waited immediately on these four distinguished patriots, and returned them their acknowledgements for the spirit and firmness with which they had resisted the usurpations of despotism. The submission of the king to the designs of Russia was no sooner made known, than Poland was bereft of all her best and most respectable citizens. Malachowski as marshal of the diet, and Prince Sapieha, grand marshal of Lithuania, entered strong protests on the journals of the diet against these hostile proceedings, and declared solemnly that the diet legally assembled in 1788 was not dissolved.

152 Confederation at Warsaw governed by Russia, restores the former constitution.

On the second of August a confederation was formed at Warsaw, of which the grand apostate, Potocki, was chosen marshal. The acts of this confederation were evidently the despotic dictates of Russia, and were calculated only to restore the ancient abuses, and to place the country under the aggravated oppression of a foreign yoke.

It is remarkable, that at the very moment when Poland was surrendering its liberties to its despotic invaders, the generous sympathy of Great Britain was evinced by a liberal subscription, supported by all the most respectable characters in the nation, of every party and of every sect, for the purpose of assisting the king and the republic to maintain their independence. Though the benevolent design was frustrated, the fact remains on record as a noble testimony of the spirit of Britons in the cause of freedom, of the indignation which fills every British heart at the commission of injustice, and of the liberality with which they are disposed to assist those who suffer from the oppression of tyrants.

153 The empress seizes upon part of the Polish territory.

Not satisfied with restoring the old wretched constitution, the empress of Russia seized upon part of the territory which, at the last partition, she and her coadjutors had left to the republic; and her ambassador entering into the diet with a crowd of armed ruffians, compelled the king and that assembly to grant the form of legality to her usurpations. The nation, however, did not submit.

In Februrary 1794 General Kosciusko appeared in the neighbourhood of Cracow with a small force of armed peasants. He beat some detachments of Russians and Prussians, compelled them to evacuate Cracow, and proclaimed there the constitution of 1791. Every where the people and the nobles flew to arms. The Russians, who occupied Warsaw with 15,000 men, began to seize suspected persons, and demanded possession of the arsenal. But at that moment the news arrived of a defeat sustained by a corps of 6000 Russians, with the loss of 1000 killed, and their general Woronzow made prisoner. Encouraged by this event, the people rose on the garrison, and after 48 hours hard fighting, drove them out, with the loss of 6000 killed, 3000 prisoners, and 50 pieces of cannon. The whole country was now in arms. Russia and Prussia, however, sent 110,000 men into Poland. Kosciusko, pressed by superior forces, made an able retreat upon Warsaw. The king of Prussia, after besieging this city during three months,


PRUSSIA.
English Miles.
Neufchatel and Valangin
RUSSIA
NORTH SEA
BALTIC OR EAST SEA
DENMARK
HANOVER
SAXONY
AUSTRIA
BAVARIA
FRANCE
BADEN
NASSAU
EAST PRUSSIA
WEST PRUSSIA
POMERANIA
NETZ DISTRICT
SOUTH PRUSSIA
SILESIA
NEW MARK
MIDDLE MARK
UCKER MARK
PRIGNITZ
OLD MARK
MAGDEBURG
THURINGIA
LUSATIA
MARK
MINDEN
CLEVE
GRD. DUTCHY OF THE LOWR. RHINE
NEW EAST PRUSSIA
CEDED TO RUSSIA
Copenhagen
Bornholm
Rugen I.
Koenigsberg
Dantzig
Hamburg
Lubek
Bremen
Berlin
Stettin
Thorn
Posen
Kalisz
Warsaw
Cracow
Breslau
Dresden
Prague
Leipzig
Magdeburg
Frankfurth
Glogau
Cassel
Coblentz
Munster
Aurich
Oldenburg
Hanover
Minden
Potsdam
Brandenburg
Elbing
Memel
Polangen
Kauen
Bialystok
Tilsit
Pillau
Danzig
Treves
Worms
Sarre Louis
Vistula R.
Elbe R.
Weser R.
Oder R.
Eger R.
Moldau R.
Main R.
Rhine R.
Moselle R.
Ems R.
Vecht R.
Niemen R.
Warta R.
Bug R.
Pilica R.
Aller R.
Werra R.
Lahn R.
Sarre R.
Issel R.
Maese R.

months, was compelled to retire towards his own territories, with the loss of 20,000. Here he was harassed for some time by Madalinsky with a small corps of cavalry. Kosciusko, relieved from the Prussians, marched against the new Russian armies, which, during the siege of Warsaw, had reconquered Lithuania and Volhynia. But the battle of Noezylac, on the 10th October 1794, in which the Poles fought with heroic resolution against overpowering numbers, proved fatal to that unhappy country. Kosciusko was made prisoner, and carried to Petersburgh, where he remained confined in a dungeon till the death of Catherine. The Russians, after this event, united their forces and marched upon Warsaw, where the Poles had named Wawrzecky general in chief. Though he had only 10,000 men to oppose 50,000, an obstinate resistance was made. At length the suburb named Prague was taken by assault, and the city surrendered. Nine thousand Poles fell in the fight; 30,000 persons of all ages and either sex were destroyed in cold blood; and 30,000 more, who still refused to submit, were suffered to leave the place, and afterwards hunted down by the soldiery on every side. The most distinguished chiefs were carried away to distant provinces; the wretched king was sent to Russia, where he soon after died, not without suspicious circumstances. The two powers were proceeding to divide between them the remaining provinces, when Austria interfered, and declared that she could not permit the destruction of Poland unless she received a share. At that moment it was not thought prudent to raise up a new enemy; and Austria obtained a considerable addition of territory without having struck a blow or expended a florin. The negociations continued till 1795, when the definitive treaty of partition was signed, which closed a series of transactions unparalleled, for perfidy, cruelty, and infamy, in the annals of Europe. The total acquisitions of each power, from the first dismemberment in 1772 to the final partition in 1795, were as follows:—(Mentelle et Malte Brun, Geog. iv. 402.)

	Sq. miles.	Inhabitants.
Poland when entire contained,	290,000	12,000,000
Russia obtained - -	176,000	5,764,400
Prussia obtained - -	51,000	2,596,400
Austria obtained - -	63,000	3,600,000

At the peace of Tilsit in 1807, Prussia lost three-fourths of her Polish conquests, which were erected into a principality, under the name of the Duchy of Warsaw. The sovereignty of this duchy was given to the king of Saxony. At the peace of Presburg in 1809, Austria was also compelled to cede a portion of her acquisitions to the duchy of Warsaw. After the peace of Paris in 1814, Prussia recovered a part of what she had lost; and, at the congress of Vienna in 1815, the duchy was raised to the rank of a kingdom, under the name of the kingdom of Poland, the crown of which was annexed to that of Russia. No part of the original acquisitions of Russia is included in this kingdom, which consists entirely of the parts ceded by Prussia and Austria. It contained in 1815 about 47,000 square English miles, and 2,793,000 inhabitants. In 1818 the kingdom of Poland received from the emperor Alexander a representative constitution, founded on principles similar to those of the constitution of 1791.

155 Air, climate, &c. of Poland.

The air of this country is cold in the north, but temperate in the other parts both in summer and winter, and the weather in both more settled than in many other countries. The face of the country is for the most part level, and the hills are but few. The Crapack or Carpathian mountains separate it from Hungary on the south. The soil is very fruitful both in corn and pasturage, hemp and flax. Such is the luxuriance of the pastures in Podolia, that it is said one can hardly see the cattle that are grazing in the meadows. Vast quantities of corn are yearly sent down the Vistula to Dantzic, from all parts of Poland, and bought up chiefly by the Dutch. The eastern part of the country is full of woods, forests, lakes, marshes, and rivers; of the last of which, the most considerable in Poland are the Vistula, Nieper, Niester, Duna, Bog, Warta, and Memel. The metals found in this country are iron and lead, with some tin, gold, and silver; but there are no mines of the two last wrought at present. The other products of Poland are most sorts of precious stones, ochre of all kinds, fine rock-crystal, Muscovy glass, talc, alum, saltpetre, amber, pitcoal, quicksilver, spar, sal-gem, lapis calaminaris, and vitriol. In Lesser Poland are salt mines, which are the chief riches of the country, and bring most money into the exchequer. In the woods, which consist mostly of oak, beech, pine, and fir-trees, besides the more common wild beasts, are elks, wild asses, wild oxen or uri, lynxes, wild horses, wild sheep with one horn, bisons, hyænas, wild goats, and buffaloes. In the meadows and fenny ground is gathered a kind of manna; and the kermes-berries produced in this country are used both in dyeing and medicine.

156 Different classes of inhabitants.

The inhabitants consist of nobles, citizens, and peasants. The first possess great privileges, which they enjoy partly by the indulgence of their kings, and partly by ancient custom and prescription. Some of them have the title of *prince*, *count*, or *baron*; but no superiority or pre-eminence on that account over the rest, which is only to be obtained by some public post or dignity. Formerly they had the power of life and death over their vassals; paid no taxes; were subject to none but the king; had a right to all mines and salt-works on their estates; to all offices and employments, civil, military, and ecclesiastic; could not be cited or tried out of the kingdom; might choose whom they will for their king, and lay him under what restraints they please by the Pacta Conventa; and none but they and the burghers of some particular towns can purchase lands.

157 Language.

The Polish tongue is a dialect of the Sclavonic: (see PHILOLOGY, N° 222.). It is neither copious nor harmonious. Many of the words, as they are written, have not a single vowel in them; but the High Dutch and Latin are understood, and spoken pretty commonly, though incorrectly. The language in Lithuania differs much from that of the other provinces. True learning, and the study of the arts and sciences, have been little attended to in Poland, till of late they began to be regarded with a more favourable eye, and to be not only patronized, but cultivated, by several of the nobles and others, both laymen and ecclesiastics.

158 Manufactures.

There are few or no manufactures in the kingdom, if we except some linen and woollen cloths and hardwares; and the whole trade is confined to the city of Dantzic, and other towns on the Vistula or Baltic.

159 Revenue.

Before the troubles, the king's revenue was all clear to himself, for he paid no troops, not even his own guards;

guards; but all the forces, as well as the officers of state were paid by the republic. The public revenues arose chiefly from the crown-lands, the salt-mines in the palatinate of Cracow, from the rents of Marienburg, Dirshau, and Regenhus, from the government of Cracow,
160 Order of knighthood. and district of Niepolomiez, and from ancient tolls and customs, particularly those of Elbing and Dantzic.

The order of the White Eagle was instituted by Augustus II. in the year 1705. Its ensign is a cross of
161 Forces. gold enamelled with red, and appendant to a blue ribbon. The motto, *Pro fide, rege, et lege.*

The standing forces of Poland were divided into the crown-army, and that of Lithuania, consisting of horse and foot, and amounting to between 20,000 and 30,000 men. These troops were mostly cantoned on the crown-lands, and in Poland were paid by a capitation or poll-tax; but in Lithuania other taxes were levied for this purpose. Most of the foot were Germans. On any sudden and imminent danger, the whole body of the nobility, with their vassals, was obliged to appear in the field on horseback; and the cities and towns furnished a certain number of foot-soldiers, with carriages, and military stores: but for want of proper arms, provisions, subordination, and discipline, and by being at liberty after a few weeks to return home, this body proved but of little advantage to the republic. Dantzic is the only place in the Polish dominions that deserves the name of a fortress, and it fell to the possession of Prussia. Foreign auxiliaries were not to be brought into the kingdom, nor the national troops to march out of it, without the consent of the states. Such was the
162 Character of the people. military establishment of Poland before the partition treaty.

The Poles are personable men, and have good complexions. They are esteemed a brave, honest people, without dissimulation, and exceedingly hospitable. They clothe themselves in furs in winter, and over all they throw a short cloak. No people keep grander equipages than the gentry. They look upon themselves as so many sovereign princes; and have their guards, bands of music, and keep open houses: but the lower sort of people are poor abject wretches, in the lowest state of slavery. The exercises of the gentry are hunting, riding, dancing, vaulting, &c. They reside mostly upon their estates in the country; and maintain themselves and families by agriculture, breeding of bees, and grazing.

POLAR, in general, something relating to the poles of the world, or the poles of artificial globes.

Polar Regions, those parts of the world which lie near the north and south poles. See the article Pole.

POLARITY, the quality of a thing considered as having poles, or a tendency to turn itself into one certain position; but chiefly used in speaking of the magnet.

POLE, Reginald, cardinal, and archbishop of Canterbury, a younger son of Sir Rich. Pole, Lord Montague, was born at Stoverton castle, in Staffordshire, in the year 1500. At seven years of age he was sent to a Carthusian monastery at Shene, near Richmond in Surry; and thence, when he was about 12 years old, removed to Magdalen college in Oxford, where, by the instructions of the celebrated Linacre and Latimer, he made considerable progress in learning. In 1515 he took the degree of bachelor of arts, and was admitted to deacon's orders some time after: in 1517, he was made prebendary of Salisbury, and in 1519 dean of Wimborne and dean of Exeter. We are not surprised at this young nobleman's early preferments, when we consider him as the kinsman of Henry VIII. and that he was bred to the church by the king's special command.

Being now about the age of 19, he was sent, according to the fashion of the times, to finish his studies at Padua in Italy, where he resided some time in great splendour, having a handsome pension from the king. He returned to England in 1525, where he was most graciously received at court, and universally admired for his talents and address; but preferring study and sequestration to the pleasures of a court, he retired to the Carthusian convent at Shene, where he had continued about two years, when the pious king began to divulge his scruples of conscience concerning his marriage with Catharine of Spain. Pole foresaw that this affair would necessarily involve him in difficulties; he therefore determined to quit the kingdom, and accordingly obtained leave to visit Paris. Having thus avoided the storm for the present, he returned once more to his convent at Shene; but his tranquillity was again interrupted by the king's resolution to shake off the pope's supremacy, of which Pole's approbation was thought indispensably necessary. How he managed in this affair, is not very clear. However, he obtained leave to revisit Italy, and his pension was continued for some time.

The king, having now divorced Queen Catharine, married Anne Boleyn, and being resolved to throw off the papal yoke, ordered Dr Richard Sampson to write a book in justification of his proceedings, which he sent to Pole for his opinion. To this Pole, secure in the pope's protection, wrote a scurrilous answer, entitled *Pro Unitate Ecclesiastica*, and sent it to the king; who was so offended with the contents, that he withdrew his pension, stripped him of all his preferments, and procured an act of attainder to be passed against him. In the mean time, Pole was created a cardinal, and sent nuncio to different parts of Europe. King Henry made several attempts to have him secured and brought to England, but without effect. At length the pope fixed him as legate at Viterbo, where he continued till the year 1543, when he was appointed legate at the council of Trent, and was afterwards employed by the pope as his chief counsellor.

Pope Paul III. dying in 1540, Pole was twice elected his successor, and, we are told, twice refused the papal dignity: first, because the election was made in too great haste; and the second time, because it was done in the night. This delicacy in a cardinal is truly wonderful: but the intrigues of the French party seem to have been the real cause of his miscarriage; they started many objections to Pole, and by that means gained time to procure a majority against him. Cardinal Maria de Monte obtained the triple crown; and Pole, having kissed his slipper, retired to the convent of Magazune near Verona, where he continued till the death of Edward VI. in the year 1553. On the accession of Queen Mary, Pole was sent legate to England, where he was received by her majesty with great veneration, and conducted to the archbishop's palace at Lambeth, poor Cranmer being at that time prisoner in the Tower. He immediately appeared in the House of Lords, where he made a long speech; which being reported to the commons by their speaker, both these obsequious houses concurred in an humble supplication to be reconciled to the

Pole.

the see of Rome. They presented it on their knees to her majesty, who interceded with the cardinal, and he graciously condescended to give them absolution. This business being over, the legate made his public entry into London, and immediately set about the extirpation of heresy. The day after the execution of Cranmer, which he is said, though we believe falsely, to have advised, he was consecrated archbishop of Canterbury. In the same year, 1556, he was elected chancellor of the university of Oxford, and soon after of Cambridge; both which he visited, by his commissioners. He died of a double quartan ague in the year 1558, about 16 hours after the death of the queen; and was buried in the cathedral of Canterbury.

As to his character, the Romish writers ascribe to him every virtue under heaven: even Bishop Burnet is extremely lavish in his praise, and attributes the cruelties of Mary's reign to the advice of Gardiner. In this Mr Hume agrees with the bishop, and represents Pole as the advocate of toleration. By every impartial account, he seems to have been a man of mild manners, and of real worth, though undoubtedly a zealous member of the church of Rome.—He wrote, *Pro unitate ecclesiastica*, *De ejusdem potestate*, A treatise on Justification, and various other tracts.

Mr Philips published a very well written, though a very partial account, of Pole's life, to which Glocester Ridley replied. This last work, which is entitled a *Review of Mr Philips's Life of Reginald Pole*, was published in 1766. It is a complete confutation of the former, and is a very learned and temperate vindication of the doctrines of the Reformation.

POLE, in *Astronomy*, that point in the heavens round which the whole sphere seems to turn. It is also used for a point directly perpendicular to the centre of any circle's plane, and distant from it by the length of a radius.

POLE, in *Geography*, one of the points on which the terraqueous globe turns; each of them being 90 degrees distant from the equator, and, in consequence of their situation, the inclination of the earth's axis, and its parallelism during the annual motion of our globe round the sun, having only one day and one night throughout the year.

1
...e poles
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...ht;

It is remarkable, that though the *north* in Hebrew, Greek, Latin, and French, derives its name from gloom, obscurity, and darkness, the poles enjoy more light than any other part of the world. The ancients believed the north to be covered with thick darkness; Strabo tells us, that Homer, by the word ζοφος, which properly signifies *obscurity* or *darkness*, meant the *north;* and thus Tibullus, speaking of the north, says,

Illic et densa tellus absconditur umbra,
Paneg. ad Missel.

The Arabians call the northern ocean the *dark sea;* the Latins gave the name of *Aquilo* to the north wind, because *aquilus* signifies *black;* and the French call it *la bise*, from *bis*, "black." According to the ancients, the Cimmerians lived in darkness, because they were placed near the north. But all this is mere prejudice; for there are no places in the world that enjoy light longer than the arctic and antarctic poles; and this is accounted for by considering the nature of twilight. In the torrid zone, and under the line, night immediately follows

2
...why.

the setting of the sun, without any sensible twilight; whereas the twilight begins and continues increasing in proportion as places are distant from the equator, or approach the pole. To this long twilight we must add the *aurora borealis*, which appears in the northern regions, Greenland, &c. in clear nights, at the beginning of the new moon, casting a light equal to that of full moon. See Gassendi, in the *Life of Peyresc*, book iii. and La Perere in his *Account of Greenland*. There is also long moonlight at the poles during winter. See ASTRONOMY. But though there is really more light in the polar regions than elsewhere, yet owing to the obliquity with which the rays of the sun fall upon them, and the great length of winter night, the cold is so intense, that those parts of the globe which lie near the poles have never been fully explored, though the attempt has been repeatedly made by the most celebrated navigators. Indeed their attempts have chiefly been confined to the northern regions; for with regard to the south pole, there is not the same incitement to attempt it. The great object for which navigators have ventured themselves in these frozen seas, was to find out a more quick and more ready passage to the East Indies*; and this hath been attempted three several ways: one by coasting along the northern parts of Europe and Asia, called the *north-east passage;* another, by sailing round the northern part of the American continent, called the *north-west passage;* and the third, by sailing directly over the pole itself.

* See *Cook*, life of.

We have already given a short account of several unsuccessful attempts which have been made from England to discover the first two of these. *See* NORTH-*West Passage, and* NORTH-*East Passage.* But before we proceed to the third, we shall make a few further observations on them, and mention the attempts of some other nations.

3
Attempts to find out north-east passage.

During the last century, various navigators, Dutchmen particularly, attempted to find out the *north-east passage*, with great fortitude and perseverance. They always found it impossible, however, to surmount the obstacles which nature had thrown in the way. Subsequent attempts are thought by many to have demonstrated the impossibility of ever sailing eastward along the northern coast of Asia; and this impossibility is accounted for by the increase of cold in proportion to the extent of land. See AMERICA, N° 3—5. This is indeed the case in temperate climates; but much more so in those frozen regions where the influence of the sun, even in summer, is but small. Hence, as the continent of Asia extends a vast way from west to east, and has besides the continent of Europe joined to it on the west, it follows, that about the middle part of that tract of land the cold should be greater than anywhere else. Experience has determined this to be fact; and it now appears that about the middle part of the northern coast of Asia the ice never thaws; neither have even the hardy Russians and Siberians themselves been able to overcome the difficulties they met with in that part of their voyage. In order to make this the more plain, and the following accounts more intelligible, we shall observe, that from the north-western extremity of Europe, called the *North Cape*, to the north-eastern extremity of Asia, called the *Promontory of the Tschutski**, is a space including about 160 degrees of longitude, *viz.* from 40 to 200 east from Ferro: the port of Archan-

4
Why it is impossible to sail along the north-east coast of Asia.

* See Cook's *Discoveries*, n° 109 and 118.

Pole.

gel lies in about 57 degrees east longitude, Nova Zembla between 70 and 95, which last is also the situation of the mouth of the great river Oby. Still farther eastward are the mouths of the rivers Jenisey in 100°; Piasida in 105°; Chatanga in 124°; Lena, which has many mouths, between 134° and 142°: Indigirka in 162°; and the Kovyma in 175°. The coldest place in all this tract, therefore, ought to be that between the mouths of the Jenisey and the Chatanga; and indeed here the unsurmountable difficulty has always been, as will appear from the following accounts of the voyages made by the Russians with a view to discover the north-east passage.

5 Voyage of Morzovieff, &c.

In 1734, Lieutenant Morzovieff sailed from Archangel towards the river Oby, but could scarce advance 20 degrees of longitude during that season. The next summer he passed through the straits of Wyegatz into the sea of Kara; but he did not double the promontory which separates the sea of Kara from the bay or mouth of Oby. In 1738, the lieutenants Malygin and Shurakoff doubled that promontory with great difficulty, and entered the bay of Oby. Several unsuccessful attempts were made to pass from the bay of Oby to the Jenisey; which was at last effected, in 1738, by two vessels commanded by lieutenants Offzin and Koskeleff. The same year the pilot Feodor Menin sailed eastward from the Jenisey to the mouth of the Piasida: but here he was stopped by the ice; and finding it impossible to force a passage, he returned to the Jenisey.

6 Of Prontshistcheff.

In July 1735, Lieutenant Prontshistcheff sailed down the river Lena, in order to pass by sea to the mouth of the Jenisey. The western mouths of the Lena were so choked up with ice, that he was obliged to pass through the most easterly one; and was prevented by contrary winds from getting out till the 13th of August. Having steered north-west along the islands which lie scattered before the mouths of the Lena, he found himself in lat. 70. 4.; yet even here he saw pieces of ice from 24 to 60 feet in height, and in no place was there a free channel left of greater breadth than 100 or 200 yards. His vessel being much damaged, he entered the mouth of the Olenek, a small river near the western mouth of the Lena; and here he continued till the ensuing season, when he got out in the beginning of August. But before he could reach the mouth of the Chatanga, he was so entirely surrounded and hemmed in with ice, that it was with the utmost difficulty he could get loose. Observing then a large field of ice stretching into the sea, he was obliged to sail up the Chatanga. Getting free once more, he proceeded northward, doubled the cape called *Taimura*, and reached the bay of that name, lying in about 115° east from Ferro; from thence he attempted to proceed westward along the coast. Near the shore were several small islands, between which and the shore the ice was immoveably fixed. He then directed his course towards the sea, in order to pass round the chain of islands. At first he found the sea more free to the north of these islands, but observed much ice lying between them. At last he arrived at what he took to be the last of the islands lying in lat. 77. 25. Between this island and the shore, as well as on the other side of the island which lay most to the north, the ice was firm and immoveable. He attempted, however, to steer still more to the north; and having advanced about six miles, he was prevented by a thick fog from proceeding: this fog being dispersed, he saw nothing everywhere but ice, which at last drove him eastward, and with much danger and difficulty he got to the mouth of the Olenek on the 29th of August.

7 Of Chariton Laptieff.

Another attempt to pass by sea from the Lena to the Jenisey was made in 1739 by Chariton Laptieff, but with no better success than that just mentioned. This voyager relates, that between the river Piasida and Taimura, a promontory stretches into the sea, which he could not double, the sea being entirely frozen up before he could pass round.

8 Mr Coxe's observations.

Besides the Russians, it is certain that some English and Dutch vessels have passed the island of Nova Zembla into the sea of Kara: "But (says Mr Coxe in his Account of the Russian voyages) no vessel of any nation has ever passed round that cape which extends to the north of the Piasida, and is laid down in the Russian charts in about 78° lat. We have already seen that no Russian vessel has ever got from the Piasida to the Chatanga, or from the Chatanga to the Piasida; and yet some authors have positively asserted that this promontory has been sailed round. In order therefore to elude the Russian accounts, which clearly assert the contrary, it is pretended that Gmelin and Muller have purposely concealed some part of the Russian journals, and have imposed on the world by a misrepresentation of facts. But without entering into any dispute upon this head, I can venture to affirm, that no sufficient proof has been as yet advanced in support of this assertion; and therefore, until some positive information shall be produced, we cannot deny plain facts, or give the preference to hearsay evidence over circumstantial and well attested accounts."

9 Of the navigation from the Lena to Kamtschatka.

The other part of this north-east passage, viz. from the Lena to Kamtschatka, though sufficiently difficult and dangerous, is yet practicable; as having been once performed, if we may believe the accounts of the Russians. According to some others indeed, says Mr Coxe, this navigation has been open a century and a half; and several vessels at different times have passed round the north-eastern extremity of Asia. But if we consult the Russian accounts, we shall find that frequent expeditions have been unquestionably made from the Lena to the Kovyma, but that the voyage from the Kovyma round Tschutskoi Noss into the Eastern ocean has been performed but once. According to Mr Muller, this formidable cape was doubled in the year 1648. The material incidents of this remarkable voyage are as follow.

10 Voyage of Deshneff, Ankudinoff, &c.

"In 1648 seven kotches, or vessels, sailed from the mouth of the river Kovyma, in order to penetrate into the Eastern ocean. Of these, four were never more heard of: the remaining three were commanded by Simon Deshneff, Gerasim Ankudinoff, and Fedot Alexeeff. Deshneff and Ankudinoff quarrelled before their departure concerning the division of profits and honours to be acquired by their voyage; which, however, was not so easily accomplished as they had imagined. Yet Deshneff in his memorials makes no mention of obstructions from the ice, nor probably did he meet with any; for he takes notice that the sea is not every year so free from ice as it was at that time. The vessels sailed from the Kovyma on the 20th of June, and in September they reached the promontory of the Tschutski, where Ankudinoff's

Ankudinoff's vessel was wrecked, and the crew distributed among the other two. Soon after this the two vessels lost sight of each other, and never joined again. Deshneff was driven about by tempestuous winds till October, when he was shipwrecked considerably to the south of the Anadyr. Having at last reached that river, he formed a scheme of returning by the same way that he had come, but never made the attempt. As for Alexeeff, after being also shipwrecked, he had died of the scurvy, together with Ankudinoff; part of the crew were killed by the savages, and a few escaped to Kamtschatka, where they settled.

From Captain * Cook's voyage twards the north-eastern part of Asia, it appears that it is possible to double the promontory of Tschutski without any great difficulty; and it now appears, that the continents of Asia and America are separated from one another but by a narrow strait, which is free from ice; but, to the northwards, that experienced navigator was everywhere stopped by the ice in the month of August, so that he could neither trace the American continent farther than to the latitude of 70°, nor reach the mouth of the river Kovyma on the Asiatic continent; though it is probable that this might have been done at another time, when the situation of the ice was altered either by winds or currents.

* See Cook's *Discoveries*, N° 95—100.

11
Insurmountable obstacles in the north-east passage.

On the whole, therefore, it appears that the insurmountable obstacle in the north-east passage lies between the rivers Piasida and Chatanga; and unless there be in that space a connection between the Asiatic and American continents, there is not in any other part. Ice, however, is as effectual an obstruction as land: and though the voyage were to be made by accident for once, it never could be esteemed a passage calculated for the purposes of trade, or any other beneficial purpose whatever.

12
Of the north-west passage.

With regard to the north-west passage, the same difficulties occur as in the other. Captain Cook's voyage has now assured us, that if there is any strait which divides the continent of America into two, it must lie in a higher latitude than 70°, and consequently be perpetually frozen up. If a north-west passage can be found then, it must be by sailing round the whole American continent, instead of seeking a passage through it, which some have supposed to exist at the bottom of Baffin's bay. But the extent of the American continent to the northward is yet unknown; and there is a possibility of its being joined to that part of Asia between the Piasida and Chatanga, which has never yet been circumnavigated*. It remains therefore to consider, whether there is any possibility of attaining the wished-for passage by sailing directly north, between the eastern and western continents.

* See Cook's *Discoveries*. N° 11.

13
Barrington's arguments in favour of a possibility of reaching the pole.

Of the practicability of this method, the Honourable Daines Barrington is very confident, as appears by several tracts which he published in the years 1775 and 1776, in consequence of the unsuccessful attempts made by Captain Phipps, afterwards Lord Mulgrave. See *North-East Passage*.—In the tracts now alluded to he instances a great number of navigators who have reached very high northern latitudes; nay, some who have been at the pole itself, or gone beyond it.—These instances are 1., One Captain Thomas Robertson assured our author, that he had been in latitude 82½, that the sea was open, and he was certain that he could have reached the latitude of 83°.—2. From the testimony of Captain Cheyne, who gave answers to certain queries drawn up by Mr Dalrymple concerning the polar seas, it appears that he had been in the latitude of 82°.—3. One Mr Watt informed our author, that when he was 17 years of age, at that time making his first voyage with Captain M'Callam, a bold and skilful navigator, who commanded a Scotch whale-fishing ship, as during the time that the whales are supposed to copulate no fishing can be carried on, the captain resolved to employ that interval in attempting to reach the north pole. He accordingly proceeded without the least obstruction to 83½, when the sea was not only open to the northward, but they had seen no ice for the last three degrees; but while he still advanced, the mate complained that the compass was not steady, and the captain was obliged with reluctance to give over his attempt.—4. Dr Campbell, the continuator of Harris's voyages, informed Mr Barrington, that Dr Dallie, a native of Holland, being in his youth on board a Dutch ship of war which at that time was usually sent to superintend the Greenland fishery, the captain determined, like the Scotchman above mentioned, to make an attempt to reach the pole during the interval between the first and second fisheries. He penetrated, according to the best of Dr Campbell's recollection, as far as 88°; when the weather was warm, the sea free from ice, and rolling like the bay of Biscay. Dallie now pressed the captain to proceed: but he answered, that he had already gone too far, and should be blamed in Holland for neglecting his station; upon which account he would suffer no journal to be kept, but returned as soon as possible to Spitsbergen.—5. In the year 1662-3, Mr Oldenburg, then secretary of the Royal Society, was ordered to register a paper, entitled "Several Inquiries concerning Greenland, answered by Mr Gray, who had visited these parts." The 19th of these queries is the following: How near hath any one been known to approach the pole?—The answer is, "I once met upon the coast of Greenland a Hollander that swore he had been half a degree from the pole, showing me his journal, which was also attested by his mate; where they had seen no ice or land, but all water."—6. In Captain Wood's account of a voyage in quest of the north-east passage, we have the following account of a Dutch ship which reached the latitude of 89°. "Captain Goulden, who had made above 30 voyages to Greenland, did relate to his majesty, that being at Greenland some 20 years before, he was in company with two Hollanders to the eastward of Edge's island; and that the whales not appearing on the shore, the Hollanders were determined to go farther northward; and in a fortnight's time returned, and gave it out that they had sailed into the latitude 89°, and that they did not meet with any ice, but a free and open sea, and that there run a very hollow *grown* sea like that of the bay of Biscay. Mr Goulden being not satisfied with the bare relation, they produced him four journals out of the two ships, which testified the same, and that they all agreed within four minutes."—7. In the Philosophical Transactions for 1675 we have the following passage: "For it is well known to all that sail northward, that most of the northern coasts are frozen up for many leagues, though in the open sea it is not so, *no nor under the pole itself*, unless by accident." In which passage the having reached the

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pole is alluded to as a known fact, and as such stated to the Royal Society.—8. Mr Miller, in his Gardener's Dictionary, mentions the voyage of one Captain Johnson, who reached 88 degrees of latitude. Mr Barrington was at pains to find a full account of this voyage; but met only with the following passage in Buffon's Natural History, which he takes to be a confirmation of it. "I have been assured by persons of credit, that an English captain, whose name was Monson, instead of seeking a passage to China between the northern countries, had directed his course to the pole, and had approached it within two degrees, where there was an open sea, without any ice." Here he thinks that M. Buffon has mistaken Johnson for Monson.—9. A map of the northern hemisphere, published at Berlin (under the direction of the academy of Sciences and Belles Lettres), places a ship at the pole, as having arrived there according to the Dutch accounts.—10. Moxon, hydrographer to Charles II. gives an account of a Dutch ship having been two degrees beyond the pole, which was much relied on by Wood. This vessel found the weather as warm there as at Amsterdam.

Besides these, there are a great number of other testimonies of ships which have reached the latitude of 81, 82, 83, 84 (A), &c.; from all which our author concludes, that if the voyage is attempted at a proper time of the year, there would not be any great difficulty of reaching the pole. Those vast pieces of ice which commonly obstruct the navigators, he thinks, proceed from the mouths of the great Asiatic rivers which run northward into the frozen ocean, and are driven eastward and westward by the currents. But though we should suppose them to come directly from the pole, still our author thinks that this affords an undeniable proof that the pole itself is free from ice; because, when the pieces leave it, and come to the southward, it is impossible that they can at the same time accumulate at the pole.

14 Why we, cannot suppose the sea all round the pole to be frozen.

The extreme cold of the winter air on the continents of Asia and America has afforded room for suspicion, that at the pole itself, and for several degrees to the southward of it, the sea must be frozen to a vast depth in one solid cake of ice; but this Mr Barrington refutes from several considerations. In the first place, he says, that on such a supposition, by the continual intensity of the cold, and the accumulation of snow and frozen vapour, this cake of ice must have been increasing in thickness since the creation, or at least since the deluge; so that now it must be equal in height to the highest mountains in the world, and be visible at a great distance. Besides, the pieces broken off from the sides of such an immense mountain must be much thicker than any ice that is met with in the northern ocean; none of which is above two yards in height above the surface of the water, those immense pieces called *ice mountains* being always formed on land.

Again, the system of nature is so formed, that all parts of the earth are exposed for the same length of time, or nearly so, throughout the year to the rays of the sun. But, by reason of the spheroidal figure of the terraqueous globe, the poles and polar regions enjoy the sun somewhat longer than others; and hence the Dutch who wintered in Nova Zembla in 1672 saw the sun a fortnight sooner than they ought to have done by astronomical calculations. By reason of this flatness about the poles, too, the sun not only shines for a greater space of time on these inhospitable regions, but with less obliquity in the summer-time, and hence the effect of his rays must be the greater. Now Mr Barrington considers it as an absurd supposition, that this glorious luminary should shine for six months on a cake of barren ice where there is neither animal nor vegetable. He says that the polar seas are assigned by nature as the habitation of the whales, the largest animals in the creation; but if the greatest part of the polar seas are for ever covered with an impenetrable cake of ice, these huge animals will be confined within very narrow bounds; for they cannot subsist without frequently coming to the top of the water to breathe.

15 Quantity of ice formed is not always in proportion to the degree of cold.

Lastly, the quantity of water frozen by different degrees of cold is by no means directly in proportion to the intensity of the cold, but likewise to the duration of it. Thus, large bodies of water are never frozen in any temperature of short duration, though shallow bodies often are. Our author observes, that as much of a given mass of water was frozen in five hours of a temperature 12° below the freezing point, as was frozen in one

(A) See *M. Bauche's Observations on the North or Ice Sea*, where he gives an account of various attempts made to reach the pole, from which he is convinced that the sea is there open, and that the thing is practicable. M. de Pages, in his *Travels*, vol. iii. informs us, that he wished to take a voyage to the north seas, for the purpose of bringing under one view the various obstacles from the ice, which have impeded the researches of navigators in those seas; and for this purpose he was prepared to continue his voyage to as high a latitude as possible, and that he might be able to say whether any land actually exists north from the coast of Greenland. He sailed without any encouragement from his court (France) on the 16th of April 1776 from the Texel, in a Dutch vessel bound to Spitsbergen. On the 16th of May she was a little way north of 81°, the highest latitude she reached.

"Being now (says the author) less than 180 leagues from the pole, the idea of so small a distance served effectually to awaken my curiosity. Had I been able to inspire my fellow-voyagers with sentiments similar to my own, the winds and currents which at this moment carried us fast towards the pole, a region hitherto deemed inaccessible to the eye of mortals, would have been saluted with acclamations of joy. This quarter, however, is not the most eligible for such an enterprise: here the sea lying in the vicinity of those banks of ice, so frequent a little farther to the west, is much too confined. Nevertheless, when I consider the very changeable nature of the shoals under whatever form, even in their most crowded and compact state; their constant changes and concussions which break and detach them from one another, and the various expedients that may be employed for freeing the ship from confinement, as well as for obviating impending danger—I am far from viewing a voyage to the pole as a chimerical idea."

one hour of the temperature 50° below it; and that long duration of the temperature between 20 and 32 is, with regard to the congelation of water, equivalent to intensity of cold such as is marked 0 and below 0 in Fahrenheit, but of short duration. See COLD and CONGELATION.

16
Mr Forster's arguments against the possibility of reaching the pole.

On the other hand, Mr Forster, in his Observations, takes the contrary side of the question with no little vehemence. "I know (says he) that M. de Buffon, Lomonosof, and Crantz, were of opinion, that the ice found in the ocean is formed near the lands only, from the fresh water and ice carried down into the sea by the many rivers in Siberia, Hudson's bay, &c.; and therefore, when we fell in with such quantities of ice in December 1772, I expected we should soon meet with the land from whence these ice masses had been detached. But being disappointed in the discovery of this land, though we penetrated beyond the 67° twice, and once beyond 71°, south latitude, and having besides some other doubts concerning the existence of the pretended southern continent, I thought it necessary to inquire what reasons chiefly induced the above authors to form the opinion that the ice floating in the ocean must be formed near land, or that an austral land is absolutely requisite for that purpose: and having looked for their arguments, I find they amount chiefly to this: 'That the ice floating in the ocean is all fresh: that salt water does not freeze at all; or if it does, it contains briny particles. They infer from thence, that the ice in the ocean cannot be formed in the sea far from any land: there must therefore exist austral lands; because, in order to form an idea of the original of the great ice masses agreeably to what is observed in the northern hemisphere, they find that the first point for fixing the high ice-islands is the land; and, secondly, that the great quantity of flat ice is brought down the rivers.' I have impartially and carefully considered and examined these arguments, and compared every circumstance with what we saw in the high southern latitude, and with other known facts; and will here insert the result of all my inquiries on this subject.

"First, they observe the ice floating in the ocean to yield, by melting, fresh water: which I believe to be true. However, hitherto it has by no means been generally allowed to be fresh: for Crantz says expressly, that 'the flat pieces (forming what they call the *ice-fields*) are salt, because they were congealed from sea-water.' The ice taken up by us for watering the ship was of all kinds, and nevertheless we found it constantly fresh: Which proves, either that the principle of analogy cannot be applied indiscriminately in both hemispheres; and that one thing may be true in the northern hemisphere which is quite otherwise in the southern, from reasons not yet known or discovered by us; or we must think that Crantz and others are mistaken, who suppose the ice floating in the ocean to be salt.

"The next remark is, That salt water does not freeze at all; or if it does, it contains briny particles. M. de Buffon tells us, 'that the sea between Nova Zembla and Spitzbergen, under the 79° north latitude, does not freeze, as it is there considerably broad: and that it is not to be apprehended to find the sea frozen not even under the pole itself; for indeed there is no example of having ever found a sea wholly frozen over, and at a considerable distance from the shores; that the only instance of a sea entirely frozen is that of the Black sea, which is narrow and not very salt, and receives a great many rivers coming from northern regions, and bringing down ice: that this sea therefore sometimes freezes to such a degree, that its whole surface is congealed to a considerable thickness; and, if the historians are to be credited, was frozen, in the reign of the emperor Constantine Copronymus, 30 ells thick, not including 20 ells of snow which was lying on the ice. This fact, continues M. de Buffon, seems to be exaggerated: but it is true, however, that it freezes almost every winter; whilst the high seas which are 1000 leagues nearer towards the pole do not freeze; which can have no other cause than the difference in saltness, and the little quantity of ice carried out by rivers, if compared to the enormous quantity of ice which the rivers convey into the Black sea.' M. de Buffon is not mistaken when he mentions that the Black sea frequently freezes. Strabo informs us, that the people near the Bosphorus Cimmerius pass this sea in carts from Panticapæum to Phanagorea; and that Neoptolemus, a general of Mithridates Eupator, won a battle with his cavalry on the ice on the very spot where he gained a naval victory in the summer. Marcellinus Comes relates, that under the consulship of Vincentius and Fravita, in the year 401 after Christ, the whole surface of the Pontus was covered with ice, and that the ice in spring was carried through the Propontis, during 30 days, like mountains. Zonaras mentions the sea between Constantinople and Scutari frozen to such a degree in the reign of Constantine Copronymus, that even loaded carts passed over it. The prince Demetrius Cantemir observes, that in the year 1620-1 there happened so intense a frost, that the people walked over the ice from Constantinople to Iskodar. All these instances confirm M. de Buffon's assertion. But as this great natural historian says that the Black sea is the only instance of a sea being entirely frozen (B), I must beg leave to dissent from him; for it is equally well attested that the Baltic is sometimes entirely frozen, according to Caspar Schutz's account. In the year 1426, the winter was so severe, that people travelled over the ice across the Baltic from Dantzic to Lubeck; and the sea was likewise passable from Denmark to Mecklenburg: and in the year 1459 the whole Baltic was entirely frozen, so that persons travelled both on foot and on horseback, over ice, from Denmark to the Venedick Hans-towns, called *Lubeck*, *Wismar*, *Rostock*, and *Stralsund*, which had never happened before; people likewise travelled across the Baltic over ice

(B) In the year 860 the Mediterranean was covered with ice, so that people travelled in carts and horses across the Ionian sea to Venice; (*Hermænnus Contractus ap. Pistor. Script.* tom. ii. p. 236.). And in 1234 the Mediterranean was again thus frozen, that the Venetian merchants travelled over the ice with their merchandise to what place they chose; *Matt. Paris*, p. 78.

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ice from Revel in Estland to Denmark and to Sweden, and back again, without the least danger (c). But, according to Sæmund Frode, even the great German ocean between Denmark and Norway was frozen in the year 1040, so that the wolves frequently ran over the ice from one country to the other. The great northern ocean is likewise most certainly sometimes frozen to a great distance from any land: for Muller relates, that in the year 1715 a Cossack called *Markoff*, with some other persons, was sent by the Russian government to explore the north sea; but finding it next to impossible to make any progress during summer on account of the vast quantities of ice commonly filling this ocean, he at last determined to try the experiment during winter. He therefore took several sledges drawn according to the custom of the country by dogs, which commonly go about 80 or 100 versts per day, 105 of which make a degree; and on March the 15th, old style, with this caravan of nine persons, he left the shores of Siberia at the mouth of the river Yana, under the 71° of north latitude, and proceeded for seven days together northward, so that he had reached at least the 77° or 78° north latitude, when he was stopped by the ice, which there began to appear in the shape of prodigious mountains. He climbed up to the top of some of these ice-mountains: but seeing from thence no land, nor any thing except ice as far as the eye could reach, and having besides no more food for his dogs left, he thought it very necessary to return; which he with great difficulty performed on April the 3d, as several of the dogs, which had perished for want, were employed to support those that remained alive. These facts, I believe, will convince the unprejudiced reader, that there are other seas besides the Black sea which really do freeze in winter, and that the ice carried down the rivers could not at least freeze the German ocean between Norway and Denmark, because the rivers there are so small, and bear a very inconsiderable proportion to the immense ocean, which, according to experiments made by Mr Wilkie, is very salt, though near the land, in the Swedish harbour of Landscrona.

"Now, if six or seven degrees of latitude, containing from 360 to 420 sea-miles, are not to be reckoned a great distance from the land, I do not know in what manner to argue, because no distance whatsoever will be reckoned far from any land. Nay, if the Cossack Markoff, being mounted on one of the highest ice-mountains may be allowed to see at least to the distance of 20 leagues, the extent alluded to above must then be increased to 480 English sea-miles; which certainly is very considerable, and makes it more than probable that the ocean is frozen in winter, in high northern latitudes, even as far as the pole. Besides, it invalidates the argument which these gentlemen wish to infer from thence, *that the ocean does not freeze in high latitudes, especially where there is a considerably broad sea;* for we have shown instances to the contrary.

"But M. de Buffon speaks of ice carried down the rivers into the northern ocean, and forming there these immense quantities of ice. "And in case, says he, we would suppose, against all probability, that at the pole it could be so cold as to congeal the surface of the sea, it would remain equally incomprehensible how these enormous floating ice-masses could be formed, if they had not land for a point to fix on, and from whence they are severed by the heat of the sun. The two ships which the India Company sent in 1739 upon the discovery of the austral lands, found ice in 47° or 48° south latitude, but at no great distance from land; which they discovered, without being able to approach it. This ice, therefore, must have come from the interior parts of the lands near the south pole; and we must conjecture, that it follows the course of several large rivers, washing these unknown lands, in the same manner as the rivers Oby, the Yenisea, and the other great rivers which fall into the northern sea, carry the ice-masses, which stop up the straits of Waigats for the greater part of the year, and render the Tartarian sea inaccessible upon this course.' Before we can allow the analogy between the rivers Oby, Yenisea, and the rest which fall into the northern ocean, and those coming from the interior parts of the austral lands, let us compare the situation of both countries, supposing the austral lands really to exist. The Oby, Yenisea, and the rest of the Siberian rivers,

(c) In 1296 the Baltic was frozen from Gothland to Sweden. *Incerti auctoris Annales Denor. in Westphalii monument. Cimbr.* tom. i. p. 1392.

In 1306 the Baltic was, during fourteen weeks, covered with ice between all the Danish and Swedish islands. (*Ludwig. reliquiæ, MSS* tom. ix. p. 170.).

In 1323 there was a road for foot passengers and horsemen over the ice on the Baltic during six weeks. (*id. ibid.*)

In 1349 people walked over the ice from Stralsund to Denmark. (*Incerti auct. cit. ap. Ludwig.* tom. ix. p. 181.

In 1408 the whole sea between Gothland and Oeland, and likewise between Rostock and Gezoer, was frozen. (*Id. ibid.*)

In 1423 the ice bore riding from Prussia to Lubec. (*Crantzii Vandal.* lib. x. c. 40.). The whole sea was covered with ice from Mecklenburg to Denmark. (*Incert. auct. cit. ap. Ludwig.* tom. ix. p. 125.).

In 1461 (says *Nicol. Marschallus in Annal. Herul. ap. Westphal.* tom. i. p. 261.), "tanta erat hyems, ut concreto gelu oceano, plaustris millia passuum supra CCC merces ad ultimam Thylen (*Iceland*) et Orcades veherentur *e Germania* tota pene bruma."

In 1545 the sea between Rostock and Denmark, and likewise between Fionia and Sealand, was thus frozen, that the people travelled over the ice on foot, with sledges to which horses and oxen were put. (*Anonym. ap. Ludwig.* tom. ix. p. 176.).

In 1294 the Cattegat or sea between Norway and Denmark was frozen; that from Oxslo in Norway, they could travel on it to Jutland. (*Strelow Chron. Juthiland*, p. 148.).

rivers, falling down into the northern ocean, have their sources in 48° and 50° north latitude, where the climate is mild and capable of producing corn of all kinds. All the rivers of this great continent increasing these great rivers have likewise their sources in mild and temperate climates, and the main direction of their course is from south to north; and the coast of the northern ocean, not reckoning its sinuosities, runs in general west and east. The small rivers which are formed in high latitudes have, properly speaking, no sources, no springs, but carry off only the waters generated by the melting of snow in spring, and by the fall of rain in the short summer, and are for the greatest part dry in autumn. And the reason of this phenomenon is obvious, after considering the constitution of the earth in those high northern climates. At Yakutsk, in about 62° north latitude, the soil is eternally frozen, even in the height of summer, at the depth of three feet from the surface. In the years 1685 and 1686, an attempt was made to dig a well; and a man, by great and indefatigable labour, continued during two summer seasons, and succeeded so far in this laborious task, that he at last reached the depth of 91 feet; but the whole earth at this depth was frozen, and he met with no water; which forced him to desist from so fruitless an attempt. And it is easy to infer from hence how impossible it is that springs should be formed in the womb of an eternally frozen soil.

17 the ...ezing salt-...ter.

"The argument, therefore, is now reduced to this, *That salt water does not freeze at all; or, if it does, the ice contains briny particles.* But we have already produced numberless instances, that the sea does freeze; nay, Crantz allows, *that the flat pieces of ice are salt, because they were congealed from sea-water.* We beg leave to add a few decisive facts relative to the freezing of the sea. Barentz observes in the year 1596, September the 16th, the sea froze two fingers thick, and next night the ice was as thick again. This happened in the middle of September; what effect then must the intense frost of a night in January not produce? When Captain James wintered in Charleton's isle, the sea froze in the middle of December 1631. It remains, therefore, only to examine, whether the ice formed in the sea must necessarily contain briny particles. And here I find myself in a very disagreeable dilemma; for during the intense frost of the winter in 1776, two sets of experiments were made on the freezing of sea-water, and published, contradicting one another almost in every material point. The one by Mr Edward Nairne, F. R. S. an ingenious and accurate observer; the other by Dr Higgins, who reads lectures on chemistry and natural philosophy, and consequently must be supposed to be well acquainted with the subject. I will therefore still venture to consider the question as undecided by these experiments, and content myself with making a few observations on them: but previously I beg leave to make this general remark, that those who are well acquainted with mechanics, chemistry, natural philosophy, and the various arts which require a nice observation of minute circumstances, need not be informed, that an experiment or machine succeeds often very well when made upon a smaller scale, but will not answer if undertaken at large; and, *vice versa*, machines and experiments executed upon a small scale will not produce the effect which they certainly have when made in a more enlarged manner. A few years ago an experiment made on the dyeing of scarlet, did not succeed when undertaken on a small scale, whereas it produced the desired effect when tried at a dyer's house with the large apparatus; and it evidently confirms the above assertion, which I think I have a right to apply to the freezing of salt water. It is therefore probable, that the ice formed in the ocean at large, in a higher latitude, and in a more intense degree of cold, whereof we have no idea here, may become solid, and free from any briny particles, though a few experiments made by Dr Higgins, in his house, on the freezing of salt water, produced only a loose spongy ice filled with briny particles. 18

Result of Mr Nairne's experiments on this subject.

"The ice formed of sea-water by Mr Nairne was very hard, three inches and a half long, and two inches in diameter: it follows from thence, that the washing the outside of this ice in fresh water, could not affect the inside of a hard piece of ice. This ice when melted yielded fresh water, which was specifically lighter than water which was a mixture of rain and snow water, and next in lightness to distilled water. Had the ice thus obtained not been fresh, the residuum of the sea-water, after this ice had been taken out, could not have been specifically heavier than sea-water, which, however, was the case in Mr Nairne's experiment. It seems, therefore, in my opinion, evident from hence, that salt water does freeze, and has no other briny particles than what adhere to its outside. All this perfectly agrees with the curious fact related by Mr Adanson (D), who had brought to France two bottles of sea water, taken up in different parts of the ocean, in order to examine it, and to compare its saltness, when more at leisure; but both the bottles containing the salt water were burst by being frozen, and the water produced from melting the ice proved perfectly fresh. This fact is so fairly stated, and so very natural, that I cannot conceive it is necessary to suppose, without the least foundation for it, *that the bottles were changed, or that Mr Adanson does not mention the circumstance by which the sea water was thus altered upon its being dissolved:* for as he expressly observes the bottles to have been burst, it is obvious that the concentrated briny parts ran out, and were entirely drained from the ice, which was formed of the fresh water only.

"The ice formed by Dr Higgins from sea water, *consisted of thin laminæ, adhering to each other weakly.* Dr Higgins took out the frozen ice from the vessels wherein he exposed the sea water, and continued to do so till the remaining concentrated sea water began to form crystals of sea salt. Both these experiments, therefore, by no means prove what the Doctor intended to infer from thence; for it was wrong to take out such ice, which only *consisted of thin laminæ, adhering to each other weakly.* Had he waited with patience, he would have obtained a hard ice as well as Mr Nairne, which, by a more perfect congelation, would have excluded the briny particles intercepted between the *thin laminæ, adhering to each other weakly;* and would have connected the laminæ,

(D) Second Supplement to the Probability of reaching the North Pole, p. 119.

minæ, by others formed by fresh water. The Doctor found afterwards, it is true, thicker and somewhat more solid ice: but the sea water had already been so much concentrated by repeated congelations, that it is no wonder the ice formed in it became at last brackish: it should seem, then, that no conclusive arguments can be drawn from these experiments.

"There are two other objections against the formation of the ice in the great ocean. The *first* is taken from the immense bulk and size of the ice masses formed in the ocean, which is *the deepest mass of water we know of*. But it has been experimentally proved, that in the midst of summer, in the latitudes of 55°, 55° 26′, and 64° south, at 100 fathoms depth, the thermometer stood at 34°, $34\frac{1}{2}$°, and 32°; and that in all instances, the difference between the temperature at top and 100 fathoms depth never exceeded four degrees of Fahrenheit's thermometer, or that the temperature of the air did not differ five degrees from that of the ocean at 100 fathoms deep. If we now add to this, that beyond the 71° south the temperature of the air and ocean must be still colder, and that the rigours of an antarctic winter are certainly more than sufficient to cool the ocean to $28\frac{1}{2}$°, which is requisite for congealing the aqueous particles in it; if we moreover consider, that these severe frosts are continued during six or eight months of the year, we may easily conceive that there is time enough to congeal large and extensive masses of ice. But it is likewise certain, that there is more than one way by which those immense ice masses are formed. We suppose very justly, that the ocean does freeze, having produced so many instances of it; we allow likewise, that the ice thus formed in a calm, perhaps does not exceed three or four yards in thickness; a storm probably often breaks such an ice-field, which Crantz allows to be 200 leagues one way and 80 the other; the pressure of the broken fragments against one another frequently sets one upon the other piece, and they freeze in that manner together; several such double pieces, thrown by another pressure upon one another, form at last large masses of miles extent, and of 20, 40, 60, and more fathoms thickness, or of a great bulk or height. Martens, in his description of Spitzbergen, remarks, that the pieces of ice cause so great a noise by their shock, that the navigators in those regions can only with difficulty hear the words of those that speak; and as the ice-pieces are thrown one upon another, ice-mountains are formed by it. And I observed very frequently, in the years 1772 and 1773, when we were among the ice, masses which had the most evident marks of such a formation, being composed of strata of some feet in thickness. This is in some measure confirmed by the state in which the Cossack Markoff found the ice at the distance of 420 miles north from the Siberian coasts. The high masses were not found formed, as is suspected in the *Second supplement to the probability of reaching the north pole*, p. 143 145, near the land, under the high cliffs, but far out at sea; and when these ice mountains were climbed by Markoff, nothing but ice, and no vestiges of land, appeared as far as the eye could reach. The high climates near the poles are likewise subject to heavy falls of snow, of several yards in thickness, which grow more and more compact, and by thaws and rain are formed into solid ice, which increase the stupendous size of the floating ice mountains.

"The *second* objection against the freezing of the ocean into such ice as is found floating in it, is taken from the *opacity* of ice formed in salt water; because the largest masses are commonly transparent like crystal, with a fine blue tint, caused by the reflection of the sea. This argument is very specious, and might be deemed unanswerable by those who are not used to cold winters and their effects. But whosoever has spent several winters in countries which are subject to intense frosts, will find nothing extraordinary or difficult in this argument: for it is a well-known fact in cold countries, that the ice which covers their lakes and rivers is often opaque, especially when the frost sets in accompanied by a fall of snow; for, in those instances, the ice looks, before it hardens, like a dough or paste, and when congealed it is opaque and white; however, in spring, a rain and the thaw, followed by frosty nights, change the opacity and colour of the ice, and make it quite transparent and colourless like a crystal: but, in case the thaw continues, and it ceases entirely to freeze, the same transparent ice becomes soft and porous, and turns again entirely opaque. This I believe may be applicable to the ice seen by us in the ocean. The field-ice was commonly opaque; some of the large masses, probably drenched by rain, and frozen again, were transparent and pellucid; but the small fragments of loose ice, formed by the decay of the large masses, and soaked by long-continued rains, we found to be porous, soft, and opaque.

"It is likewise urged as an argument against the formation of ice in the ocean, that it always requires land, in order to have a point upon which it may be fixed. First, I observe, that in Mr Nairne's experiments, the ice was generated on the surface, and was seen shooting crystals downwards: which evidently evinces, in my opinion, that ice is there formed or generated where the intensest cold is; as the air sooner cools the surface than the depth of the ocean, the ice shoots naturally downwards, and cools the ocean more and more, by which it is prepared for further congelation. I suppose, however, that this happens always during calms, which are not uncommon in high latitudes, as we experienced in the late expedition. Nor does land seem absolutely necessary in order to fix the ice; for this may be done with as much ease and propriety to the large ice mountains which remain undissolved floating in the ocean in high latitudes; or it may, perhaps, not be improper to suppose, that the whole polar region, from 80° and upwards, in the southern hemisphere, remains a solid ice for several years together, to which yearly a new circle of ice is added, and of which, however, part is broken off by the winds and the return of the mild season. Wherever the ice floats in large masses, and sometimes in compact bodies formed of an infinite number of small pieces, there it is by no means difficult to freeze the whole into one piece; for amongst the ice the wind has not a power of raising high and great waves. This circumstance was not entirely unknown to the ancients; and it is probable they acquired this information from the natives of ancient Gaul, and from the Britons and other northern nations, who sometimes undertook long voyages.

The

Pole. The northern ocean was called by the ancients the *frozen*, the *dead*, the *lazy*, and *immoveable sea*: sometimes they give it the name *mare cronium*, the concrete sea, and *morimorusum* *, the dead sea. And, what is very remarkable, in all the northern cold countries the frost sometimes is so intense, that all the waters become suddenly coagulated into a kind of paste or dough, and thus at once congeal."

So called the Cimbri.

10 Observations on Mr Forster's reasoning.

On this reasoning of Mr Forster's, however, we must observe, that it cannot possibly invalidate any fact which Mr Barrington has advanced. The best concerted and most plausible theory in the world must yield to experience; for this is in fact what must judge all theories. Now, from what we have already related, it is demonstrated, that in the space between the mouths of the rivers Piasida and Chatanga more ice must be formed, and more intense colds generated, than in any other part of the world; consequently, for a considerable space both on the east and west side of that, the sea must be more full of ice than anywhere else. Now, between these two rivers there is the promontory of Taimura, which runs out to the latitude of 78°, or near it, and which of necessity must obstruct the dispersion of the ice; and that it actually does so is in some degree probable, because in one of the Russian voyages above mentioned the eastern mouth of the Lena was quite free, when the western ones were entirely choked up with ice. Now the mouth of the Yana lies several degrees to the eastward of the Lena: consequently, when the ice comes eastward from the cape of Taimura, it must necessarily fill all that sea to the latitude of 78° and upwards; but the Cossack Markoff, if he proceeded directly north, could not be farther than the promontory of Taimura, and consequently still enveloped among the ice. Besides, we are certain, that the sea in 78° is not at all frozen into a solid cake in some places, since Lord Mulgrave, in 1773, reached 81°. Mr Forster's argument, therefore, either proves nothing, or it proves too much. If it proves, that about the middle of the eastern continent the cold is so intense that a sufficient quantity of ice is formed to obstruct the navigation for several hundred miles round, this proves nothing; because we knew before that this must be the case: But if it proves, that the sea must be unnavigable by reason of ice all round the globe at 78° north latitude, this is too much; because we certainly know, that in 1773 Lord Mulgrave reached the latitude of 81°. However, though it should be allowed that the sea is quite clear all the way to the pole, it must be a very great uncertainty whether any ship could by that way reach the East Indies; because we know that it must sail down between the continents of Asia and America, through that strait whose mouth must often be blocked up with ice driving eastward along the continent of Asia.

The south pole is still more inaccessible than the north pole; for the ice is found in much lower southern than northern latitudes. This superior degree of cold has by many been supposed to proceed from a greater quantity of land about the south than the north pole *; and the notion of a vast continent in these regions prevailed almost universally, insomuch that many have sought for it, but hitherto in vain. See the articles *Cook's Discoveries*, N° 38—49, and N° 68, and 69; *South Sea*, and *Terra Australis*. A new attempt was made in 1818 to penetrate into the polar seas. Two expeditions were fitted out at Deptford, the one under Captain Ross, for Baffin's bay, the other under Captain Buchan for the polar seas beyond Spitzbergen. They sailed in April. Captain Buchan returned in October, having been unable to penetrate beyond the latitude of 80° 30′ on account of the ice. Captain Ross also failed in his attempt to find a passage out of Baffin's bay to the westward, and returned in November. The result of Captain Ross's investigation seems not to have been considered decisive, as a new expedition has since been fitted out for the same object.

* See America, 3—5. Cook's Discoveries, 38, &c.

Magnetic Pole. See Magnetism.

North Pole. See Pole.

Pole-Axe, a sort of hatchet nearly resembling a battle-axe, having an handle about 15 inches in length, and being furnished with a sharp point or claw, bending downwards from the back of its head; the blade whereof is formed like that of any other hatchet. It is principally employed in sea-fights to cut away and destroy the rigging of any adversary who endeavours to board.

Pole-axes are also said to have been successfully used on some occasions in boarding an enemy, whose sides were above those of the boarder. This is executed by detaching several gangs to enter at different parts of the ship's length, at which time the pole-axes are forcibly driven into her side, one above another, so as to form a sort of scaling-ladders.

Pole Cat. See Mustela, Mammalia *Index*.

Pole Star. See Astronomy, N° 3, 17, and 39.

POLEIN, in English antiquity, is a sort of shoe, sharp or piked at the point. This fashion took its rise in the time of King William Rufus; and the pikes were so long, that they were tied up to the knees with silver or golden chains. They were forbidden by stat. an. 4. Edw. IV. cap. 7. *Tunc fluxus crinium, tunc luxus vestium, tunc usus calceorum cum arcuatis aculeis inventus est.* Malmesb. in Will. ii.

POLEMARCHUS was a magistrate at Athens, who had under his care all the strangers and sojourners in the city, over whom he had the same authority that the archon had over the citizens. It was his duty to offer a solemn sacrifice to Enyalus (said to be the same with Mars, though others will have it that he was only one of his attendants), and another to Diana, surnamed Αγροτερα, in honour of the famous patriot Harmodius. It was also his business to take care that the children of those that had lost their lives in the service of their country should be provided for out of the public treasury.

Potter's Grecian Antiquities.

POLEMICAL, in matters of literature, an appellation given to books of controversy, especially those in divinity.

POLEMO, who succeeded Xenocrates in the direction of the academy, was an Athenian of distinguished birth, and in the earlier part of his life a man of loose morals. The manner in which he was reclaimed from the pursuit of infamous pleasures, and brought under the discipline of philosophy, affords a memorable example of the power of eloquence employed in the cause of virtue. His history is thus related by Dr Enfield: "As he was, one morning about the rising of the sun, returning home from the revels of the night, clad in a loose robe, crowned with garlands, strongly perfumed, and intoxicated

cated with wine, he passed by the school of Xenocrates, and saw him surrounded with his disciples. Unable to resist so fortunate an opportunity of indulging his sportive humour, he rushed without ceremony into the school, and took his place among the philosophers. The whole assembly was astonished at this rude and indecent intrusion, and all but Xenocrates discovered signs of resentment. Xenocrates, however, preserved the perfect command of his countenance; and with great presence of mind turned his discourse from the subject on which he was treating to the topics of temperance and modesty, which he recommended with such strength of argument, and energy of language, that Polemo was constrained to yield to the force of conviction. Instead of turning the philosopher and his doctrine to ridicule, as he at first intended, he became sensible of the folly of his former conduct; was heartily ashamed of the contemptible figure which he had made in so respectable an assembly; took his garland from his head; concealed his naked arm under his cloak; assumed a sedate and thoughtful aspect; and, in short, resolved from that hour to relinquish his licentious pleasures, and devote himself to the pursuit of wisdom. Thus was this young man, by the powerful energy of truth and eloquence, in an instant converted from an infamous libertine to a respectable philosopher. In such a sudden change of character it is difficult to avoid passing from one extreme to another. Polemo, after his reformation, in order to brace up his mind to the tone of rigid virtue, constantly practised the severest austerity and most hardy fortitude. From the thirtieth year of his age to his death, he drank nothing but water. When he suffered violent pain, he showed no external sign of anguish. In order to preserve his mind undisturbed by passion, he habituated himself to speak in an uniform tone of voice, without elevation or depression. The austerity of his manners was, however, tempered with urbanity and generosity. He was fond of solitude, and passed much of his time in a garden near his school. He died, at an advanced age, of a consumption. Of his tenets little is said by the ancients, because he strictly adhered to the doctrine of Plato."

POLEMONIUM, Greek Valerian, or *Jacob's Ladder*; a genus of plants belonging to the pentandria class; and in the natural method ranking under the 29th order, *Campanaceæ*. See Botany *Index*.

POLEMOSCOPE, in *Optics*, the same with Opera-glass. See Dioptrics.

POLENBURG, Cornelius, an excellent painter of small landscapes and figures, was born at Utrecht in 1586, and educated under Blomaert, whom he soon quitted to travel into Italy; and studied for a long time in Rome and Florence, where he formed a style entirely new, which, though preferable to the Flemish, is unlike any Italian, except in his having adorned his landscapes with ruins. There is a varnished smoothness and finishing in his pictures, that render them always pleasing, though simple and too nearly resembling one another. The Roman cardinals were charmed with the neatness of his works, as was also the great duke; but could not retain him. He returned to Utrecht, and pleased Rubens, who had several of his performances. King Charles I. invited him to London, where he generally painted the figures in Steenwyck's perspectives: but the king could not prevail on him to fix here; for after staying only four years, and being handsomely rewarded by his majesty for several pieces which he performed for him, he returned to Utrecht, and died there at the age of 74. His works are very scarce and valuable.

POLERON, one of the Banda or Nutmeg islands in the East Indies. This was one of those spice islands which put themselves under the protection of the English, and voluntarily acknowledged James I. king of England for their sovereign; for which reason the natives of this and the rest of the islands were murdered or driven thence by the Dutch, together with the English.

POLESIA, a province of Poland, bounded by Polachia and Proper Lithuania on the north, and by Volhinia on the south. It is one of the palatinates of Lithuania, and is commonly called *Brescia*, and its capital is of this name. It is full of forests and lakes.

POLESINO de-Rovigo, a province of Italy, in the republic of Venice, lying to the north of the river Po; and bounded on that side by the Paduan, on the south by the Ferrarese, on the east by Degado, and on the west by the Veronese. It is 45 miles in length, and 17 in breadth, and is a fertile country. Rovigo is the capital.

POLETÆ were ten magistrates of Athens, who, with three that had the management of money allowed for public shows, were empowered to let out the tribute-money and other public revenues, and to sell confiscated estates; all which bargains were ratified by their president, or in his name. They were by their office also bound to convict such as had not paid the tribute called *Μετοικιον*, and sell them in the market by auction. The market where these wretches were sold was called *πωλητηριον τε μετοικιε*.

POLIANTHES, the Tuberose; a genus of plants belonging to the hexandria class; and in the natural method ranking under the 10th order, *Coronariæ*. See Botany *Index*. The varieties are the common tuberose with single flowers,—double-flowered,—dwarf-stalked,—variegated leaved. They all flower here in June, July, and August.

All the varieties being exotics from warm countries, although they are made to flower in great perfection in our gardens by assistance of hot-beds, they will not prosper in the open ground, and do not increase freely in England; so that a supply of the roots is imported hither annually from Genoa, and other parts of Italy, by most of the eminent nursery and seedsmen, and the Italian warehouse-keepers; generally arriving in February or March, time enough for the ensuing summer's bloom; and are sold commonly at the rate of twelve or fifteen shillings per hundred, being careful always to procure as large roots as possible, for on this depends the success of having a complete blow. Requiring artificial heat to blow them in this country, they are planted in pots, and plunged in a hot-bed, under a deep frame furnished with glass lights; or placed in a hot-house, where they may be blowed to great perfection with little trouble. The principal season for planting them is March and April: observing, however, that in order to continue a long succession of the bloom, it is proper to make two or three different plantings, at about a month interval; one in March, another in April, and a third the beginning of May, whereby the blow may be continued from June until September; observing, as above mentioned, they may be flowered either by aid of a common dung or bark hot-bed, or in a hot-house.

With respect to the propagation of these plants, it is principally by offsets of the roots. The blowing roots that are brought annually from abroad for sale are often furnished with offsets, which ought to be separated previous to planting. Those also that are planted here in our gardens frequently furnish offsets fit for separation in autumn when the leaves decay: they must then be preserved in sand all winter in a dry sheltered place; and in the beginning of March, plant them either in a bed of light dry earth in the full ground; or, to forward them as much as possible, allow them a moderate hot-bed: and in either method indulge them with a shelter in cold weather, either of a frame and lights, or arched with hoops and occasionally matted; but let them enjoy the full air in all mild weather, giving also plenty of water in dry weather during the season of their growth in spring and summer. Thus let them grow till their leaves again decay in autumn: then take them up, clean them from earth, and lay them in sand till spring; at which time such roots as are large enough to blow may be planted and managed as already directed, and the small roots planted again in a nursery-bed, to have another year's growth; afterwards plant them for flowering. The Egyptians put the flowers of tuberose into sweet oil; and by this means give it a most excellent flavour, scarce inferior to oil of jasmine.

POLICANDRO, a small island in the Archipelago, seated between Milo and Morgo. It has no harbour, but has a town about three miles from the shore near a huge rock. It is a rugged stony island, but yields as much corn as is sufficient for the inhabitants, who consist of about 120 Greek families, all Christians. The only commodity is cotton: of which they make napkins, a dozen of which are sold for a crown. E. Long. 35. 25. N. Lat. 36. 36.

POLICASTRO, an episcopal town of Italy, in the kingdom of Naples, and in the Hither Principato; but now almost in ruins, for which reason the bishop resides in another town. E. Long. 15. 46. N. Lat. 40. 26.

POLICY, or POLITY, in matters of government. See POLITY.

POLICY of Insurance, or *Assurance*, of ships, is a contract or convention, whereby a person takes upon himself the risks of a sea-voyage; obliging himself to make good the losses and damages that may befal the vessel, its equipage, tackle, victualling, lading, &c. either from tempests, shipwrecks, pirates, fire, war, reprisals, in part or in whole; in consideration of a certain sum of seven, or eight, or ten *per cent.* more or less according to the risk run; which sum is paid down to the assurer by the assuree upon his signing the policy. See INSURANCE.

POLIDORO DA CARAVAGGIO, an eminent painter, born at Caravaggio in the Milanese in 1492. He went young to Rome, where he worked as a labourer in preparing stucco for the painters; and was so animated by seeing them at work in the Vatican, that he solicited some of them to teach him the rules of designing. He attached himself particularly to Maturino, a young Florentine; and a similarity in talents and taste producing a disinterested affection, they associated like brothers, laboured together, and lived on one common purse, until the death of Maturino. He understood and practised the chiaro-scuro in a degree superior to any in the Roman school: and finished an incredible number of pictures both in fresco and in oil, few of the public buildings at Rome being without some of his paintings. Being obliged to fly from Rome when it was stormed and pillaged, he retired to Messina, where he obtained a large sum of money with great reputation, by painting the triumphal arches for the reception of Charles V. after his victory at Tunis: and when he was preparing to return to Rome, he was murdered, for the sake of his riches, by his Sicilian valet with other assassins, in the year 1543.

POLIFOLIA. See ANDROMEDA, BOTANY *Index*.

POLIGNA, MELCHIER DE, an excellent French genius and a cardinal, was born of an ancient and noble family at Puy, the capital of Velay, in 1662. He was sent by Louis XIV. ambassador extraordinary to Poland, where, on the death of Sobieski, he formed a project of procuring the election of the prince of Conti. But failing, he returned home under some disgrace; but when restored to favour, he was sent to Rome as auditor of the Rota. He was plenipotentiary during the congress at Utrecht, at which time Clement I. created him a cardinal; and upon the accession of Louis XV. he was appointed to reside at Rome as minister of France. He remained there till the year 1732, and died in the year 1741. He left behind him a MS. poem entitled *Anti-Lucretius, seu De Deo et Natura;* the plan of which he is said to have formed in Holland in a conversation with Mr Bayle. This celebrated poem was first published in the year 1749, and has since been several times printed in other countries besides France. He had been received into the French Academy in 1704, into the Academy of Sciences in 1715, into that of the Belles Lettres in 1717: and he would have been an ornament to any society, having all the accomplishments of a man of parts and learning.

POLISHER, or BURNISHER, among mechanics, an instrument for polishing and burnishing things proper to take a polish. The gilders use an iron-polisher to prepare their metals before gilding, and the blood-stone to give them the bright polish after gilding.

The polishers, among cutlers, are a kind of wooden wheels made of walnut-tree, about an inch thick, and of a diameter at pleasure, which are turned round by a great wheel; upon these they smooth and polish their work with emery and putty.

The polishers for glass consist of two pieces of wood; the one flat, covered with old hat; the other long and half-round, fastened on the former, whose edge it exceeds on both sides by some inches, which serves the workmen to take hold of, and to work backwards and forwards by.

The polishers used by spectacle-makers are pieces of wood a foot long, seven or eight inches broad, and an inch and a half thick, covered with old beaver hat, whereon they polish the shell and horn frames their spectacle-glasses are to be set in.

POLISHING, in general, the operation of giving a gloss or lustre to certain substances, as metals, glass, marble, &c.

Polishing. Politeness.

The operation of polishing optic-glasses, after being properly ground, is one of the most difficult points of the whole process. See TELESCOPE.

POLITENESS means elegance of manners or good breeding: Lord Chesterfield calls it the art of pleasing. It has also been called an artificial good nature; and indeed good nature is the foundation of true politeness; without which art will make but a very indifferent figure, and will generally defeat its own ends. "Where compliance and assent, caution and candour, says an elegant essayist *, arise from a natural tenderness of disposition and softness of nature, as they sometimes do, they are almost amiable and certainly excusable; but as the effects of artifice, they must be despised. The persons who possess them are, indeed, often, themselves dupes of their own deceit, when they imagine others are deluded by it. For excessive art always betrays itself; and many, who do not openly take notice of the deceiver, from motives of delicacy and tenderness for his character, secretly deride and warmly resent his ineffectual subtilty."

* Dr Knox.

"True politeness (says another author †) is that continual attention which humanity inspires us with, both to please others, and to avoid giving them offence. The surly plain-dealer exclaims loudly against this virtue, and prefers his own shocking bluntness and Gothic freedom. The courtier and fawning flatterer, on the contrary, substitute in its place insipid compliments, cringings, and a jargon of unmeaning sentences. The one blames politeness, because he takes it for a vice; and the other is the occasion of this, because that which he practices is really so."

† Beauties of History.

Both these characters act from motives equally absurd, though not equally criminal. The conduct of the artful flatterer is guided by self-love, while that of the plain-dealer is the effect of ignorance: for nothing is more certain, than that the desire of pleasing is founded on the mutual wants and the mutual wishes of mankind; on the pleasure which we wish to derive from society, and the character which we wish to acquire. Men having discovered that it was necessary and agreeable to unite for their common interests, they have made laws to repress the wicked, they have settled the duties of social life, and connected the idea of respectability with the practice of those duties; and after having prescribed the regulations necessary to their common safety, they have endeavoured to render their commerce with one another agreeable, by establishing the rules of politeness and good breeding. "Indeed," as an elegant author already quoted remarks, "the philosopher who in the austerity of his virtue, should condemn the art of pleasing as unworthy cultivation, would deserve little attention from mankind, and might be dismissed to his solitary tub, like his brother Diogenes. It is the dictate of humanity, that we should endeavour to render ourselves agreeable to those in whose company we are destined to travel in the journey of life. It is our interest, it is the source of perpetual satisfaction; it is one of our most important duties as men, and particularly required in the professor of Christianity."

It is needless to particularize the motives which have induced men to practise the agreeable virtues; for, from whatever source the desire of pleasing proceeds, it has always increased in proportion to the general civilization of mankind. In a rude state of society, pleasure is limited in its sources and its operation. When the wants of mankind, and the means of attaining them, are few, personal application is necessary to gratify them, and it is generally sufficient; by which means an individual becomes more independent than can possibly be the case in civilized life, and of course less disposed to give or receive assistance. Confined to the solitary wish of furnishing means for his own happiness, he is little intent on the pleasures of conversation and society. His desire of communication is equal to the extent of his knowledge. But as soon as the natural wants of life are filled up, we find unoccupied time, and we labour hard to make it pass in an agreeable manner. It is then we perceive the advantage of possessing a rational nature, and the delights of mutual intercourse. When we consider society in that state of perfection which enables a great part of the members of it to pursue at leisure the pleasures of conversation, we should expect, both from the ease of acquitting ourselves to the satisfaction of our associates, and from the advantages arising from this conduct, that the art of pleasing might be reduced to a few plain and simple rules, and that these might be derived from a slight attention to general manners.

The art of pleasing, in our intercourse with mankind, is indeed so simple, that it requires nothing more than the constant desire to please in all our words and actions; and the practice of it can neither wound a man's self-love, nor be prejudicial to his interest in any possible situation.

But though this be certain, it is doubtless less attended to than in reason it ought to be. Each particular man is so zealous to promote his own ends or his own pleasure, as to forget that his neighbour has claims equal to his own; that every man that enters into company gives up for the time a great many of his peculiar rights; and that he then forms part of an association, met together not for the particular gratification of any one, but for the purpose of general satisfaction. See BREEDING, CONVERSATION, and *Good MANNERS*.

The qualities essential in the art of pleasing, are *virtue*, *knowledge*, and *manners*. All the virtues which form a good and respectable character in a moral sense are essential to the art of pleasing. This must be an established principle, because it depends on the wants and mutual relations of society. In all affairs of common business, we delight in transacting with men in whom we can place confidence, and in whom we find integrity; but truth is so naturally pleasing, and the common affairs of life are so interwoven with social intercourse, that we derive abundantly more satisfaction from an honest character than from specious manners. "Should you be suspected (says Chesterfield) of injustice, malignity, perfidy, lying, &c. all the parts and knowledge of the world will never procure you esteem, friendship, and respect."

The first of virtues in our commerce with the world, and the chief in giving pleasure to those with whom we associate, is inviolable sincerity of heart. We can never be too punctual in the most scrupulous tenderness to our moral character in this respect, nor too nicely affected in preserving our integrity.

The peculiar modes, even of the fashionable world, which are founded in dissimulation, and which on this account have induced several to recommend the practice, would not prevent a man of the highest integrity from

Politeness. from being acceptable in the very best company. Acknowledged sincerity gives the same ornament to character that modesty does to manners. It would abundantly atone for the want of ridiculous ceremony, or false and unmeaning professions; and it would in no respect diminish the lustre of a noble air, or the perfection of an elegant address.

If integrity be the foundation of that character which is most generally acceptable, or which, in other words, possesses the power of pleasing in the highest degree, humanity and modesty are its highest ornaments.

The whole art of pleasing, as far as the virtues are concerned, may be derived from the one or other of these sources. Humanity comprehends the display of every thing amiable to others; modesty removes or suppresses every thing offensive in ourselves.

This modesty, however, is not inconsistent with firmness and dignity of character; it arises rather from the knowledge of our imperfection compared with a certain standard, than from conscious ignorance of what we ought to know. We must therefore distinguish between this modesty and what the French call *mauvaise honte*. The one is the unaffected and unassuming principle which leads us to give preference to the merit of others, the other is the awkward struggling of nature over her own infirmities. The first gives an additional lustre to every good quality; while some people, from feeling the pain and inconveniency of the *mauvaise honte*, have rushed into the other extreme, and turned impudent, as cowards sometimes grow desperate from excess of danger. The medium between these two extremes marks out the well-bred man; he feels himself firm and easy in all companies, is modest without being bashful, and steady without being impudent.

A man possessing the amiable virtues is still farther prepared to please, by having in his own mind a perpetual fund of satisfaction and entertainment. He is put to no trouble in concealing thoughts which it would be disgraceful to avow, and he is not anxious to display virtues which his daily conversation and his constant looks render visible.

The next ingredient in the art of pleasing, is to possess a correct and enlightened understanding, and a fund of rational knowledge. With virtue and modesty, we must be able to entertain and instruct those with whom we associate.

The faculty of communicating ideas is peculiar to man, and the pleasure which he derives from the interchange alone is one of the most important of his blessings. Mankind are formed with numberless wants, and with a mutual power of assisting each other. It is a beautiful and happy part of the same perfect plan, that they are likewise formed to delight in each other's company, and in the mutual interchange of their thoughts. The different species of communication, in a highly polished age, are as numerous as the different ranks, employments, and occupations of men; and indeed the knowledge which men wish to communicate, takes its tinge from their peculiar profession or occupation.

Thus commercial men delight to talk of their trade, and of the nature of public business; men of pleasure, who wish merely to vary or quicken their amusements, are in conversation light, trifling, and insincere; and the literati delight to dwell on new books, learned men, and important discoveries in science or in arts. But as the different classes of men will frequently meet together, Politeness. all parties must so contrive matters, as to combine the useful and agreeable together, so as to give the greatest delight at the time, and the greatest pleasure on reflection. An attention to these principles would make the man of pleasure and the man of learning meet together on equal terms, and derive mutual advantage from their different qualifications. With due attention to such ideas, we proceed to mention the kinds of knowledge which are most fitted for conversation. Those who wish to please should particularly endeavour to be informed in those points which most generally occur. An accurate or extensive knowledge on learned subjects is by no means sufficient: we must also have an accurate and extensive knowledge of the common occurrences of life.

It is the knowledge of mankind, of governments, of history, of public characters, and of the springs which put the great and the little actions of the world in motion, which give real pleasure, and rational instruction. The knowledge which we communicate must in some shape be interesting to those to whom we communicate it; of that nature, that the desire of receiving it may overbalance every kind of disgust, excited too often on the score of envy and self-love, against those who happen to possess superior endowments, and at the same time of that importance, as to elevate the thoughts somewhat above the actions and the faults of the narrow circle formed in our own immediate neighbourhood. On this account it is recommended by an author who fully knew mankind, as a maxim of great importance in the art of pleasing, to be acquainted with the private character of those men who, from their station or their actions, are making a figure in the world. We naturally wish to see such men in their retired and undisguised moments; and he who can gratify us is highly acceptable. History of all kinds, fitly introduced, and occasionally embellished with pleasing anecdotes, is a chief part of our entertainment in the intercourse of life. This is receiving instruction, without exciting much envy; it depends on memory, and memory is one of those talents the possession of which we least grudge to our neighbour. Our knowledge of history, at the same time, must not appear in long and tedious details; but in apt and well chosen allusions, calculated to illustrate the particular subject of conversation. But the knowledge most necessary is that of the human heart. This is acquired by constant observation on the manners and maxims of the world, connected with that which passes in our own minds. This leads us from the common details of conduct, from slander and defamation, to the sources and principles of action, and enables us to enter into what may be called the philosophy of conversation. We may see both the practicability of this kind of discourse, and the nature of it, in the following lines of Horace:

> Sermo oritur, non de villis domibusve alienis;
> Nec male necne Lepos saltet: sed quod magis ad nos
> Pertinet, & nescire malum est, agitamus: utrumne
> Divitiis homines, an sint virtute beati?
> Quidve ad amicitias, usus rectumne, trahat nos?
> Et quæ sit natura boni, summumque quid ejus? &c.

By this means constant materials are supplied for free, easy, and spirited communication. The restraints which

are

are imposed on mankind, either from what their own character may suffer, or from the apprehension of giving offence to others, are entirely taken off, and they have a sufficient quantity of current coin for all the common purposes of life.

In addition to virtue and knowledge, which are the chief ingredients in the art of pleasing, we have to consider graceful and easy manners. Lord Chesterfield indeed considers these as the most essential and important part; as if the diamond received its whole value from the polish. But though he is unquestionably mistaken, there is yet a certain sweetness of manners which is particularly engaging in our commerce with the world. It is that which constitutes the character which the French, under the appellation of *l'aimable*, so much talk of, and so justly value. This is not so easily described as felt. It is the compound result of different things; as complaisance, a flexibility but not a servility of manners, an air of softness in the countenance, gesture, and expression, equally whether you concur or differ with the person you converse with. This is particularly to be studied when we are obliged to refuse a favour asked of us, or to say what in itself cannot be very agreeable to the person to whom we say it. It is then the necessary gilding of a disagreeable pill. But this, which may be called the *suaviter in modo*, would degenerate and sink into a mean and timid complaisance and passiveness, if not supported by firmness and dignity of character. Hence the Latin sentence, *suaviter in modo, fortiter in re*, becomes a useful and important maxim in life.

Genuine easy manners result from a constant attention to the relations of persons, things, time, and places. Were we to converse with one greatly our superior, we are to be as easy and unembarrassed as with our equals; but yet every look, word, and action, should imply, without any kind of servile flattery, the greatest respect. In mixed companies, with our equals, greater ease and liberty are allowed: but they too have their proper limits. There is a social respect necessary. Our words, gestures, and attitudes, have a greater degree of latitude, though not an unbounded one. That easiness of carriage and behaviour which is exceedingly engaging, widely differs from negligence and inattention, and by no means implies that one may do whatever he pleases; it only means, that one is not to be stiff, formal, and embarrassed, disconcerted and ashamed; but it requires great attention to, and a scrupulous observation of, what the French call *les bienseances;* a word which implies "decorum, good-breeding, and propriety." Whatever we ought to do, is to be done with ease and unconcern; whatever is improper, must not be done at all. In mixed companies, also, different ages and sexes are to be differently addressed. Although we are to be equally easy with all, old age particularly requires to be treated with a degree of deference and regard. It is a good general rule, to accustom ourselves to have a kind feeling to every thing connected with man, and when this is the case, we shall seldom err in the application. Another important point in the *bienseances* is, not to run our own present humour and disposition indiscriminately against every body, but to observe and adopt theirs. And if we cannot command our present humour and disposition, it is necessary to single out those to converse with who happen to be in the humour the nearest to our own. Peremptoriness and decision, especially in young people, is contrary to the *bienseances:* they should seldom seem to dissent, and always use some softening mitigating expression.

There is a *bienseance* also with regard to people of the lowest degree; a gentleman observes it with his footman, and even indeed with the beggar in the street. He considers them as objects of compassion, not of insult; he speaks to neither in a harsh tone, but corrects the one coolly, and refuses the other with humanity.

The following observations perhaps contain the sum of the art of pleasing:

1. A fixed and habitual resolution of endeavouring to please, is a circumstance which will seldom fail of effect, and its effect will every day become more visible as this habit increases in strength.

2. This resolution must be regulated by a very considerable degree of good sense.

3. It is a maxim of almost general application, that what pleases us in another will also please others in us.

4. A constant and habitual attention to the different dispositions of mankind, to their ruling passions, and to their peculiar or occasional humours, is absolutely necessary.

5. A man who would please, must possess a firm, equal, and steady temper. And,

6. An easy and graceful manner, as distant from bashfulness on the one hand as from impudence on the other. "He who thinks himself sure of pleasing (says Lord Chesterfield), and he who despairs of it, are equally sure to fail." And he is undoubtedly in the right. The one, by his assuming vanity, is inattentive to the means of pleasing; and the other from fear, is rendered incapable of employing them.

A variety of excellent rules for acquiring politeness, with strictures on particular kinds of impoliteness, may be found in the *Spectator*, *Rambler*, *Idler*, *Lounger*, *Mirror*, and other periodical works of that kind; in *Knox's Essays*, and among *Swift's Works;* see GOOD MANNERS, *Chesterfield's Art of Pleasing*, and his *Letters*, are also worthy of perusal, provided the reader be on his guard against the insincerity and other vices which those books are calculated to infuse, and provided he always bear in mind, what we have endeavoured to show in this article, that true politeness does not consist in specious manners and a dissimulating address, but that it must always be founded on real worth and intrinsic virtue.

POLITIAN, ANGELO, was born at Monte Pulciano in Tuscany in 1454. He learned the Greek tongue, of which he became a complete master, under Andronicus of Thessalonica. He is said to have written verses both in Greek and Latin when he was not more than 12 years of age. He studied also the Platonic philosophy under Marsilius Ficinus, and that of Aristotle under Argyropylus. He was one of the most learned and polite writers of his time. The first work which gained him a reputation was a poem on the tournament of Julian de Medicis. The account he wrote some time after of the conspiracy of the Pazzi's was very much esteemed. He wrote many other pieces which have merited approbation; and had he lived longer, he would have enriched the republic of letters with many excellent works; but he died at the age of 40 years. His morals answered the homeliness of his face rather than the beauty of his genius; for Paul Jovius informs us, that "he was a man of awkward and perverse manners, of a a countenance by no means open and liberal, a nose remarkably large, and squinting eyes. He was crafty, satirical, and full of inward malice: for his constant way was, to sneer and ridicule the productions of other men, and never to allow any criticism, however just, upon his own."

He was, nevertheless, as all acknowledged, a man of most consummate erudition; and not only so, but a very polite and elegant writer. Erasmus, in his *Ciceronianus*, calls him a rare miracle of nature, on account of his excelling in every kind of writing; his words are remarkable: "*Fateor Angelum prorsus angelica fuisse mente, rarum naturæ miraculum, ad quodcunque scripti genus applicaret animum.* Some of his poems were so much admired, that several learned men have made it their business to comment on them. It has been often reported that he spoke of the Bible with great contempt; and that, having read it but once, he complained he had never spent his time so ill. But this is not probable, for it must be remembered that he was a priest and canon of Florence; and we learn from one of his Epistles that he preached a whole Lent. It does not indeed follow hence, that he did not think contemptuously of the Bible, because many of his church, especially among the better sort, have not been very good believers, and he might be one of them: but it is not likely he would speak out so freely. "I could (as Bayle says) much more easily believe the judgment he is said to have made on the Psalms of David and the Odes of Pindar: he did not deny that there are many good and fine things in the Psalms; but he pretended that the same things appear in Pindar with more brightness and sweetness. The two Scaligers have spoken highly of Politian: the elder has preferred a consolatory elegy of his to that which Ovid sent to Livia upon the death of Drusus, and says, he had rather have been the author of it: the younger calls him an excellent poet, but thinks the style of his epistles too elate and declamatory.

His works have been printed at various times, and in various places: his epistles have probably been most read, because these are things which the generality of people are best pleased with.

POLITICAL, from πολις, "a city," signifies any thing that relates to policy or civil government.

Political Arithmetic, is the art of reasoning by figures upon matters relating to government, such as the revenues, number of people, extent and value of land, taxes, trade, &c. in any nation.

These calculations are generally made with a view to ascertain the comparative strength, prosperity, &c. of any two or more nations. With this view, Sir William Petty, in his *Political Arithmetic*, p. 74, &c. computes the land of Holland and Zealand to be about 1,000,000 acres, and that of France to be 8,000,000; and yet the former is one-third part as rich and strong as the latter. The shipping of Europe he computes to be about 2,000,000: of which Britain has 500,000; Holland 900,000; France 100,000; Hamburgh, Denmark, Sweden, and Dantzic 250,000; and Spain, Portugal, Italy, &c. the rest. The exports of France he computes at 5,000,000l. of which one-fourth came to Britain; of Holland 18,000,000l. of which 300,000l. came to Britain. The money raised yearly by the king of France was about 6,500,000l. Sterling; that of all the Dutch provinces 3,000,000l. of which 2,100,000 was raised in Holland and Zealand. The number of people in England he computed to be six millions, and their expences, at 7l. *per annum* a head, 42,000,000l.; the rent of land 8,000,000l. and the interests, &c. of personal estates as much; the rents of houses 4,000,000l. and the profits of labour 26,000,000l. The people of Ireland he reckoned 1,200,000. The corn spent in England, at 5s. a bushel for wheat, and 2s. 6d. for barley, amounts to 10,000,000l. a-year. The navy of England then required 36,000 men to man it, and other trade and shipping 48,000. In France, to manage the whole shipping trade, there were then required only 1500 men. The whole people of France were 13,500,000; and those of England, Scotland, and Ireland, about 9,500,000. In the three kingdoms are about 20,000 churchmen, and in France more than 270,000. In the dominions of England were above 40,000 seamen, and in France not more than 10,000. In England, Scotland, and Ireland, and all their dependencies, there was then about 60,000 ton of shipping, worth about 4,500,000l. in money. The sea line round England, Scotland, and Ireland, and the adjacent isles, is about 3800 miles. In the whole world he reckoned about 350,000,000 of people; and those with whom the English and Dutch have any commerce, not more than eighty millions; and the value of commodities annually traded for in the whole not above 45,000,000l. That the manufactures exported from England amounted to about 5,000,000l. *per annum*; lead, tin, and coals, to 500,000l. *per annum*. The value of the French commodities then brought into England did not exceed 1,200,000l. *per annum*; and the whole cash of England in current money was then about 6,000,000l. Sterling.

With these calculations Dr Davenant was dissatisfied; and therefore, from the observations of Mr Greg. King, he advanced others of his own. He reckons the land of England 39 millions of acres: the number of people 5 millions and a half, increasing 9000 a-year, making allowance for wars, plagues, and other accidents. He reckons the inhabitants of London 530,000: of other cities and market-towns in England 870,000; and those of villages, &c. 4,100,000. The yearly rent of land he reckons 10,000,000l.; of houses, &c. 2,000,000l.; the produce of all kinds of grain in a tolerable year 9,075,000l.; the annual rent of corn lands 2,200,000l. and the net produce 9,000,000l.; the rent of pasture, meadows, woods, forests, commons, heaths, &c. 7,000,000l.; the annual produce by cattle in butter, cheese, and milk, about 2,500,000l.; the value of the wool yearly shorn about 2,000,000l.; of horses yearly bred about 250,000l.; of the flesh yearly spent as food about 3,350,000l.; of the tallow and hides about 600,000l.; of the hay yearly consumed by horses about 1,300,000l.; of the hay consumed by other cattle 1,000,000l.; of the timber yearly felled for building 500,000l.; and of the timber yearly felled for firing, &c. about 500,000l. The proportion of the land of England to its inhabitants is now about $7\frac{1}{4}$ acres per head; the value of the wheat, rye, and barley, necessary for the sustenance of England, amounts to at least 6,000,000l. Sterling *per annum*; of the woollen manufacture about 8,000,000l. *per annum*; and exports of all kinds of the woollen manufacture amount to above 2,000,000l. *per annum*; the annual income of England, on which the whole people subsist, and out of which all taxes

taxes are paid, is reckoned to be about 43,000,000l. that of France 81,000,000l. and of Holland 18,250,000l. See Davenant's *Essay on Trade*, in vol. vi. of his works. For calculations respecting mortality, see Major Grant's *Observations on the Bills of Mortality*, and our article *Bills of Mortality*.

In vol. xlix. of the Philosophical Transactions we have an estimate of the number of people in England by Dr Brakenridge, from considering the number of houses and quantity of bread consumed. On the former principle he computes the number of people to be 6,257,418 of all ages, counting in England and Wales 911,310 houses, and allowing six persons to a house. From a survey of the window-lights after the year 1750, the number of houses charged in England and Wales was 690,000, besides 200,000 cottages that pay nothing; the whole number therefore was 890,000, and the number of people, allowing six to a house, 5,340,000. On the latter principle, he estimates the number of quarters of wheat consumed at home to be 2,026,100; and allowing a quarter for three persons in a year, or seven ounces a day for each person, he concludes the number of people to be 6,078,300. Of this number, according to Dr Halley's rule, he supposes about 1,500,000 men able to carry arms. The country he supposes capable of supporting one half more inhabitants, or 9,000,000; for, according to Mr Templeman's survey, England contains 49,450 square miles, that is, 31,648,000 acres, of which 23,000,000 acres are proper to be cultivated; and allowing three acres, well manured, for the maintenance of one person, there will be maintenance in England for 8,430,000 people; to which add the produce of fishing, and it will enable the country to support 9,000,000. In Ireland, Mr Templeman reckons 17,536,000 acres, of which Dr Brakenridge thinks 12,000,000 are capable of cultivation; and allowing four acres to each person, and the number of inhabitants to be only 1,000,000, Ireland could maintain 2,000,000 more people than it has now. In Scotland, containing 1,500,000 people, and 17,728,000 acres of land, of which there are 11,000,000 good acres, allowing five for each person, he supposes there may be provision for 2,200,000 people, or for 700,000 more than there are at present. Hence he infers, that were both the British isles properly cultivated, there is a provision for 6,000,000 inhabitants beyond the present number. Extending his survey to the whole globe, he supposes the whole surface to be to the quantity of land as 8 to 3, *i. e.* as 197,819,550 to 74,182,331 square miles; out of which deducting one-third for waste-ground, there will be 49,454,887 square miles, or 31,651,127,680 good acres. And stating the whole number of inhabitants on the globe to be 400,000,000, there will be 79 good acres to each person. See Dr Halley's *Calculations* on the same subject, and *Dr Price's* (for a list of whose works see his life at the word Price), and King *on the National Debt*.

POLITICAL ECONOMY

May be defined the science which relates to the production, multiplication and distribution of Wealth.

HISTORY.

The acquisition of wealth must at all times have been an object of interest and attention to mankind. Yet it was not for a long time reduced into a science, but was left merely to the industry and practical observation of men engaged in the different branches of industry. We find little or nothing in the ancient writers which can be considered as belonging to this department of science. Among them agriculture appears to have been more honoured and attended to, than either trade or manufactures. The latter especially were considered as unworthy of freemen, and were abandoned entirely to slaves. Yet the ancient world had its commercial states; and perhaps had the monuments of Phenician or Carthaginian literature come down to us, they might in some measure have supplied this blank.

During the middle ages, the reign of disorder and violence checked the practical, and still more the theoretical pursuit of these important objects. The feudal system, in which the lordly baron ruled with licentious sway over his little territory, and carried on almost perpetual war with his neighbours, was hostile to all improved agriculture, and absolutely precluded any progress in manufactures and commerce. These took refuge in the large maritime towns, where fortifications secured the inhabitants from lawless inroads, and a regular police placed person and property in safety. The gradual growth of these cities constituted the grand cause which induced the civilization of modern Europe. The models of beautiful workmanship which were produced, and the various means which ingenuity discovered for multiplying the accommodations of life, gradually brought about a complete change in the habits of landed proprietors. Power, not wealth, had formerly been their object; and to promote this power, they spent almost all their revenues in maintaining a crowd of idle retainers. But when, by the improvement of arts, they had got a taste for luxury, the gratification of which required an augmentation of wealth, their object came to be, how to turn their estates to the best account. This could only be done by granting the farmer a longer lease, which, enabling him to make improvements, led to a better system of agriculture. The same tastes drew them to large cities, and thus led them into extravagant habits, which often brought their estates to market, and placed them in the hands of the commercial and industrious. Thus the improvement of modern Europe, contrary to the natural course of things, began with the manufacturing and commercial classes, and was from them reflected to the agricultural part of the community. The consequence was, that commerce and manufactures were long looked upon as the grand source of wealth, and were the objects of peculiar favour to the legislator. Hence arose the mercantile system, which, till about the middle of the last century, was completely predominant in Europe. A sketch of its leading principles will be introduced in the course of the

History.

the present treatise, and they are fully detailed and supported in the writings of Davenant, Petty, Child, and other writers by whom its tenets were adopted.

This system had a powerful influence on the legislation of the different European nations, England not excepted. But in France, above all, it reigned with absolute sway. Colbert, the celebrated minister of Lewis XIV. in his zeal for the promotion of trade and manufactures, not only neglected, but even depressed agriculture, by laying absurd restraints on the exportation of corn. One extreme leads to another. Thinking men in France, observing the pernicious consequences of this system, were led to the adoption of one directly opposite. According to them, agriculture formed the only real source of wealth. This opinion was first advanced by M. Quesnay, a physician of Paris; he was followed by a multitude of philosophers, who espoused his opinion with all the union and zeal of a sect. Accordingly they went under the name of *Economists*, and the Economical Sect. The *Encyclopedie* of Diderot and D'Alembert was conducted entirely upon their principles, and tended to give them a wide circulation. Turgot, in the reforms which he undertook during his short administration, was chiefly guided by the principles of the Economists.

Soon after this, Scotland had the honour of producing a system, which has obtained the general approbation of thinking men, and has gradually superseded all others. Adam Smith, being professor in the first commercial city of Scotland, had his attention naturally drawn to these subjects. In his class he had already begun to illustrate the true principles of political economy. Travelling afterwards in France, he became acquainted with the leading members of the Economical school. On his return he spent nine years in maturing his ideas, and preparing his great work "On the Wealth of Nations," which was published in 1776. Here, like the Economists, he shewed the errors of the mercantile system, but in a much more solid and satisfactory manner. He shewed also their own principles to be in many respects erroneous; and he investigated the effects of the division of labour, and various other circumstances which had not occurred to any former writer.

Although the system of Smith gave general satisfaction to all who were able to investigate the subject, and though it was even adopted by Mr Pitt as the basis of his financial and commercial arrangements, yet it did not for a long time acquire a very general currency with the public. It was adopted by the learned only, and not always by them (A). In this respect, the publication of the Edinburgh Review may be considered as forming an era in the history of this science. This celebrated journal, by illustrating in a popular manner the leading subjects of political economy, and by beating down, with its keen powers of ridicule, the opinions of those who still adhered to the obsolete system, has done more towards *diffusing* the true principles of the science, than any former publication. Lord Lauderdale also has recently published a work, in which, with some paradoxes, he has made also some important additions and corrections to the doctrine of Smith.

Nature of Wealth, &c.

In the following sketch, considering Smith as the father of political economy, we shall closely follow his steps, adopting however a somewhat different arrangement, and including such improvements as the science has received since his time.

The subject, it appears to us, may be treated with advantage under the following heads:

I. The nature and different species of wealth.

II. The sources of wealth.

III. The manner in which wealth is produced and distributed.

IV. Views of the mercantile and economical systems.

V. Public revenue.

These topics will form the subjects of the following chapters.

Chap. I. *On the Nature and different Species of Wealth.*

Sect. I. *Of the Definition of Wealth; and of Price.*

Wealth has been defined to consist of every thing which can be exchanged for another. Lord Lauderdale gives a more general definition, and considers it as consisting of every thing which is useful or agreeable to man*. We conceive, however, that this must be limited to objects of external accommodation; for knowledge and mental qualifications of every kind, though most useful and agreeable, cannot be said to constitute wealth, nor to form the subject of political economy. Again, external accommodations, which are in complete and universal abundance, the air we breath, the light of heaven, are not wealth. To constitute this, the article must exist in some degree of scarcity. It is then only that it can possess an exchangeable value, that its possessor can procure other commodities in return for it. Thus there are two circumstances to be considered in any commodity; its *value in use*, and its *value in exchange*. Water, air, &c. are of the greatest use; but from their great abundance, nothing can be got in exchange for them. Diamonds, on the contrary, are of very little use, but from their great rarity, their exchangeable value, or *price*, is beyond that of any other substance.

* *Lauderdale on Wealth*, ch. i. *Edinburgh Review*, N° viii art. 8.

The *price* of an article depends entirely upon two circumstances. 1. The *demand*, or the number of persons who desire to possess it, and have something to give in exchange. 2. The supply, or the quantity brought to market. The price is directly as the demand, and inversely as the supply; the former raises, the latter sinks it. Where there are many bidders, and where the quantity is small, the competition must be increased, each must seek to outbid the other, and the price of the commodity must rise. On the contrary, if the bidders are few, and the commodity in great abundance, the possessor, in order to dispose of it, will be under the necessity of offering it at a low price.

O 2 Sect

(A) In the scarcity of 1799 or 1800, the university of Cambridge was announced in the newspapers as having subscribed 50l. to be employed in the apprehension of *regraters and forestallers!!*

Nature of Wealth, &c.

Sect. II. *Of Capital.*

Every man's wealth is of two kinds; the one which he lays aside for immediate consumption; the other which he reserves for the supply of future wants, or employs in such a manner as to make it produce new wealth. The former is called his *income*, the latter his *capital*. In proportion as he devotes his property to the former of these purposes, his wealth is diminished; in proportion as he devotes it to the latter, it is increased. This evidently takes place in the case of an individual; and Smith seems to consider it as taking place equally in the case of a nation *. Later inquirers, however, seem to have proved, that there is here a difference. Extreme parsimony throughout a nation, by preventing the production of all articles but those of the first necessity, would induce general poverty †. Still, however, it is essential to the prosperity of a people, that their annual produce should not be all consumed, but that a considerable portion should be set aside and converted into capital.

* Book ii. ch. iii.

† *Lauderdale on Wealth.*

Capital is divided into *fixed* and *circulating*. Fixed capital consists of all those articles, which, without being themselves calculated for exchange or consumption, tend to increase the production of those articles which are so. Such are all kinds of machinery, farming stock, erections for the purpose of mining or manufacture, ships, &c. These form a most valuable part of the property of the nation, and make its revenue much greater than it would otherwise be. At the same time, as they are of no use in themselves, provided the same effects can be produced without them, or by cheaper instruments, their disuse, by saving expence, forms a real addition to the national wealth.

Circulating capital consists of all those commodities which are produced or purchased for the purpose of being wrought upon, or transported elsewhere, and again sold. It comprises almost all the wealth not included under fixed capital. The seed corn of the farmer, the materials of the manufacturer, the goods purchased by the merchant, come all under this description. Lands, mines, and fisheries, are the sources from which circulating capital originally proceeds; whence, after passing through various hands, it arrives at length, and is lost, in those of the consumer.

Sect. III. *Of Money* ‡.

‡ *Smith*, book i. ch. iv. ii. Book ii. ch. ii.

Barter, or the exchange of one thing for another of equal value, is essential to the supply of the varied wants of man, and is the grand principle on which commerce depends. Thus it is that men, while merely consulting their own interests, minister to each others necessities. It is attended, however, with an obvious inconvenience. A man may have goods to exchange, which do not suit his neighbour. The farmer has a sheep, and is in want of cloth; but the cloth merchant may not be in want of mutton, or at least may not wish so large a quantity. Hence the necessity of finding some commodity which may at all times be in demand, and which every one may be ready to receive in exchange for every other article. This commodity ought evidently to possess some quality which may render it an object of universal estimation; it ought also to possess great value in a small compass, so as to be portable, and not to encumber its possessor; it ought to be divisible into the smallest portions; and it ought to be durable, so as to be capable of being treasured up till wanted. All these qualities are united in the precious metals. Their beauty, their durability, their very scarcity, render them better fitted than any other commodity for being the standard of value and the medium of exchange. All nations, accordingly, after a trial of some ruder expedients, have finally had recourse to them for this purpose.

Money is in one view a fixed, and in another a circulating capital. To the individual it stands in the latter capacity, for no one receives money unless for the purpose of sooner or latter exchanging it for something else. To the nation, however, it is a fixed capital; being not destined for consumption, but merely an instrument for transacting business with greater facility and advantage.

As the facility of exchanging the precious metals for every other commodity, renders the *demand* for them constant and universal, their price depends almost wholly on the *supply*. This, too, is more uniform than that of most other commodities. A great revolution, however, took place at the beginning of the 16th century, in consequence of the discovery of America. For some time before, the value of silver seems rather to have been rising. But the immense mines of Mexico and Peru furnished such a copious supply, as soon reduced it to about one-third of its former value. Smith is of opinion, that since that time there has been rather a rise in the value of these metals. The East Indies, where they still continue scarcer than in Europe, forms a constant drain. The mines, in the course of working, approach nearer to an exhaustion; accordingly, the king of Spain, who originally levied a tax amounting to half the produce of silver, has found it necessary to reduce it successively to one-third, one-fifth, and at last, to one-tenth. The tax on gold is reduced to one-twentieth. The annual importation of gold and silver into Spain is estimated at about six millions.

It has been a frequent practice with sovereigns to reduce the quantity of bullion in any given denomination of coin, and thus to pay their debts with a smaller amount of gold and silver. To such an extent has this practice been carried, that in England the pound sterling is not quite a third of the real pound of silver, and in France the depreciation is far greater. This practice is completely fraudulent and dishonourable. No power of the sovereign can really make this debased coin pass for as much as it formerly did; the consequence is, an immediate rise in the nominal or money price of every commodity. All those, however, who are in the pay of government, suffer, and so do all creditors both public and private; for though the law cannot compel the nation to set the same value on the new coin as on the old, it can compel the creditor to accept it in payment of the sums which he has previously advanced in good coin.

All states reserve to themselves the privilege of coining money. Some, as England, perform this office gratis; while others, as France, impose a small seignorage at the mint. The latter mode seems rather preferable: for when the circulating coin, as frequently happens, is reduced by long use and attrition, beneath its real

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real value in bullion, the issuing of new coin which possesses that value affords a temptation to melt it down and recoin it.

Sect. IV. *Of Paper Money* *.

* Smith, book ii. ch. ii.

Money, we have had occasion to observe, considered in a national point of view, is fixed capital. Like other fixed capitals, therefore, although its functions be most essential to the maintenance of trade, yet if any less costly substitute can be found, by which the same functions may be equally well performed, the public is decidedly a gainer. Such a substitute is paper money. By employing it, a nation saves the expence of gold and silver, and at the same time derives all the commercial advantages which money can afford. It is even in some respects more convenient, as being more easily transported, and less liable to accident.

There are, however, extraordinary dangers attending the excessive and incautious use of this instrument, and no cause perhaps has been productive of more signal commercial disasters. The apparent facility of thus creating wealth, as it were, tempts banks and other public bodies to an excessive issue of it. The circulation of the country, however, can absorb only a certain quantity; and as soon as more is thrown in, it immediately returns upon the issuer, in a quantity for which he is probably unprepared. As soon as he shows any hesitation in discharging the demand, the whole rushes in, and bankruptcy and ruin ensue. Where the paper indeed has been issued by the government, payment may be refused; but in this case an immediate depreciation takes place in the value of the notes, and a deep injury is sustained by all who are possessed of them. From this cause it was that the French assignats fell so far below their original value; and for the same reason the American currency is considerably beneath its nominal value. Where, however, peculiar circumstances have produced an accidental scarcity of money, a temporary suspension of payment may become necessary, and with due caution may be productive of no serious bad consequences; such has been lately the case of the bank of England †.

† Edinburgh Review, N° i. art. 25.

Banks can with no propriety advance to merchants the whole capital on which they trade, but only that part of it which they would otherwise be obliged to keep by them for the purpose of answering occasional demands. This they do in two ways. 1. By discounting bills. 2. By granting cash accounts. The former only of these is practised in England. The latter is peculiar to Scotland. It is managed thus. Two persons of respectable, commonly of landed, property, becoming caution to the extent of a certain sum, the merchant is allowed to draw to the extent of that sum. Merchants, however, do not always content themselves with the degree of assistance above pointed out. They endeavour to carry on extensive speculations merely on paper money. For this purpose they draw fictitious bills for the mere purpose of having them discounted; and by drawing a second before the first becomes due, they delay still farther the repayment of the original advance. Banks ought always, if possible, to avoid the discounting of fictitious bills; and should take care, in cash accounts, that the advances and repayments nearly keep pace with each other. In this case there is little danger of an over issue of notes.

It does not appear eligible, however, that gold and silver should be entirely supplanted by paper money. In all transactions with foreign nations, the former becomes necessary; and even domestic inconveniences would arise from its absolute exclusion. For the prevention of this, it is adviseable not to isue notes below a certain value. In England, this, till of late was fixed at five or ten pounds; though in a recent scarcity, notes for twenty shillings began to be issued. In Scotland these have long been in circulation; and notes even for five shillings were some time ago introduced, though these, as soon as the pressure of necessity admitted, have been discontinued.

Sect. V. *Of the Variations in the Prices of Commodities.*

The price of commodities fundamentally depends on the capacity which they possess, of ministering to the use and pleasure of man. Great variations, however, are seen to take place; and in this country particularly, in consequence of national prosperity, a great rise has occurred in a variety of articles. This is vulgarly ascribed to the greater plenty of *money;* an assertion every way vague, and which has no foundation in fact. Had the increase taken place in consequence of any remarkable increase in the supply of gold and silver, through the discovery of new mines, the assertion would have been just. No such general increase, however, has taken place, at least to any very sensible degree. The increase in this particular country has been owing to the augmentation in the number and value of all other commodities, for the circulation of which a greater quantity of this instrument of exchange becomes necessary. The relation, however, between it and other commodities, continues unaltered; and the quantity of any particular commodity, for which a certain quantity of it can be exchanged, remains the same. Indeed the augmentation has taken place, not so much in gold and silver, as in paper money, the substitute of those metals. The same arguments would hold against a rise occasioned by the use of this instrument, which can happen only where it is depreciated, as in some government paper, by the refusal of payment on demand. This case, however, would be indicated by a difference between its value and that of gold and silver; a difference which has no place in this country.

Smith has illustrated *, in a most able and satisfactory manner, the source of those variations of price, which take place in consequence of advancing cultivation. He divides commodities into three kinds, which are as follows:

* Book i. chap. xi.

The first consists of those productions of nature which human efforts have no power of multiplying. Such are a variety of rare birds and fishes, most kinds of game, and particularly birds of passage. The growth of wealth and population has a natural tendency to increase the demand for these articles; and as the supply cannot be made to meet this demand, the price must consequently rise. Accordingly, in a highly opulent state of society, it becomes, in some instances, enormous. The Roman epicures are said sometimes to have given 60l. or 80l. for a single bird.

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The second sort is of those which human industry can multiply in proportion to the demand. Where the commodity, as corn, is such as cannot be produced but by human industry, the price is more uniform than in almost any other case. The increasing scarcity and consequently value of land, tends indeed to raise it; but this is counteracted by the invention of machinery, and improved methods of labour. The opposite agency of these two causes has a constant tendency to preserve uniformity in the value of grain; though we cannot, with Smith, consider this uniformity as likely to be so complete, as to render the price of grain a sure standard for the value of silver.

There are other commodities, however, which nature produces in abundance, or which, where land is plentiful, can be multiplied with little or no cultivation. Of these the principal is butcher meat. Lands can be covered with cattle or sheep by the labour of few hands, and sometimes without any labour at all. Hence, in rude times, butcher meat is always cheaper than corn; in improved periods, the reverse is the case. For a long time the price continues constantly to rise, as we have seen it do throughout Great Britain, the pasture lands being more and more converted into arable. At last, however, it becomes so high as to make it an object for the farmer to stall his cattle, and to cultivate ground for the purpose of feeding them. After this era, the price is likely to experience a certain diminution, from the improved modes of feeding and rearing, which, in consequence of this new attention, are likely to be discovered and adopted.

There are certain animals, as hogs, poultry, &c. which are fed on mere offals, and in a rude state, therefore, are still cheaper than butcher meat. In an improved state they are dearer; for they have not as yet, at least in this country, become an object of separate cultivation.

The third sort consists of those, in the multiplication of which the power of man is either limited or uncertain. In these the rule is various. Some commodities are not cultivated on their own account, but are appendages to others; as wool and hides to the carcase of the ox or sheep Both these commodities are much more portable, and more easily preserved, than the flesh of the animals from which they are taken; the market for them is thus much more extensive, and the demand more equal at all times. Hence, in rude periods, when the flesh of animals, from its abundance, is of small value, these appendages equal or surpass it in price. At Buenos Ayres frequently, and sometimes even in Spain, an ox is killed for the sake of the hide and tallow. In an improved state of society, on the contrary, the hide and fleece become considerably inferior in value to the carcase.

Fish is an article, the supply of which is considerably limited, as man has no power of production in respect to it, though, by the exertion of industry, he can collect a greater quantity. Shoals of fish are generally copious, but uncertain.

Metals and minerals are articles, the supply of which is not precisely limited, but extremely uncertain. The discovery of new mines, or the continuance of fertility in the old, are equally beyond the reach of calculation.

Source of Wealth

Chap. II. *Of the Sources of Wealth.*

All wealth arises from three sources; it is either produced by the spontaneous bounty of nature, or it is the fruit of human industry, or it is generated by the judicious employment of a quantity of wealth previously accumulated. To these three heads then of *land*, *labour*, and *capital*, all national wealth may be referred.

Smith has treated of the revenue derived from these three sources as forming the constituent parts of the price of commodities; and with regard to labour in particular, repeatedly considers it as the only source of wealth *. According to the view, however, given above, the price of all commodities depends entirely on the proportion between the demand and the supply. Labour, therefore, (and the same may be said of land and capital), is only a means of furnishing or increasing a supply of those articles for which there already exists a demand, and unless it be successful in so doing, the most severe labours will meet with no remuneration whatever. We shall therefore proceed to consider the revenue which arises from these different sources, and the circumstances by which it is increased or diminished.

* Book ch. v. v. ...

Sect. I. *Land.*

All land which is not naturally barren, and is cultivated with any ease, affords something more than is necessary to pay the expence of labouring it. This surplus goes as a rent to the landlord, who, in consideration of receiving it without risk or trouble, relinquishes to the farmer the profits of cultivation.

The proportion of the produce of a field which is to go for rent, varies with different circumstances. The chief of these is the fertility of the soil, the extent of the market, which enables the produce to be disposed of to greater advantage, the prosperity or poverty of the country, which causes a greater or less demand for that produce, and the average skill and activity of the farmers, which will enable them to turn the fertility of the ground to better account. It is almost needless to observe, were it not for the vague language often made use of upon this subject, that the rate at which farms let, must, like all other commodities, depend altogether upon the demand and the supply. If much is to be made by farming, many will bid for farms, and the rent will be raised by their competition, and *vice versa*. The idea that all the landlords of an extensive country may combine to raise their rents, is altogether chimerical. Even could it take place, it could be accomplished only by a certain number of them allowing their lands to lie waste, which diminishing the supply, would doubtless raise the rent of the cultivated lands. But we need not fear that any landlord should leave his lands in this condition, from a culpable scheme of aggrandizing the rest of his body at his own expence, as well as that of the public.

Land which produces food for man will at all times afford rent to the landlord, in proportion to its fertility, and the other circumstances mentioned above. Men multiply in proportion to the means of subsistence; they have even a constant tendency to multiply beyond these means; hence there is always a full demand for this species

species of produce. The rent, therefore, afforded by the ground which is employed in cultivating whatever is the staple food of the community, regulates the rent of all other ground. No one, unless forced to it by peculiarities of soil, would cultivate any article which afforded less rent than this. There may be soils indeed which are only fit for the production of an inferior article, and there are others which are fitted for the production of those of higher value. In vine countries, the rent of an ordinary vineyard seems to be nearly on a level with that of corn. But there are others, whose wines being regarded as superior, make them yield a much higher rent. The West India islands, before the late depreciation of their produce, seem to have been nearly in the same predicament.

These observations, however, apply chiefly to that produce of land which is the result of human labour. In regard to the spontaneous produce of land, it depends upon circumstances, whether or not it yields any rent at all. In a rude state of society, above all, the demand is often so slender, that, unless through the intervention of foreign commerce, this produce will bear scarcely any value. Such countries are often covered with immense natural woods, the cutting down of which is a burden instead of an advantage. In an improved country this wood would afford a large revenue. Most of the materials of clothing and lodging are of this nature. In the infancy of society, the great object is food; and provided men can procure that, they are satisfied with very moderate accommodations in other respects. The hides and furs of their cattle, and of the wild animals whom they kill in hunting, are more than sufficient to supply them with coverings. But as society becomes opulent, and luxury is introduced, clothes are among the favourite objects on which this luxury is vented. A great increase therefore takes place in the demand for its materials. The same may be said of those of lodging and furniture.

Mines, in political economy, may be considered in the same light as land. Like it, they yield a rent, which, however, from the difficulty of working, is generally less than that of land. Coal, an important article, is kept down both by its great bulk, which narrows the market, and by its relation to the price of wood, which price it cannot exceed, otherwise wood would be preferred as fuel. A fifth of the whole produce is reckoned a great rent for a coal mine; a tenth is the most common. Metals, even the coarse, and still more the fine, will bear very extensive carriage. In general, however, their rent is not very high. The tin mines of Cornwall, said to be the richest in the world, yield on an average only a sixth part of their gross produce. The king of Spain's tax of a fifth on the silver mines in America, formed indeed the rent of those mines; but this tax he was obliged to reduce to one tenth. It is said to be ill paid *.

* *Smith*, book i. ch. i.

Fisheries form another source of wealth similar to land and mines. The sea, however, has never yet been appropriated, nor a rent exacted for its use. The right of fishing, however, in some seas of peculiar fertility, has been claimed as national property. River fisheries let frequently at a very high rent.

Sect. II. *Labour.*

The great source of exchangeable commodities, is the labour of man. Even those powers of nature for which rent is paid, rarely afford any thing valuable unless aided by human efforts. Capital, however powerful an instrument, consists merely of accumulated labour. Originally the fruit of every man's industry would belong entirely to himself. Soon, however, the proprietor of the land from which he drew food, would claim a share. As the structure of society became more complicated, and markets more remote, something more would be found requisite. It would be necessary to have subsistence while the article was producing and carrying to market, to be able to purchase materials on which to work, and to command machinery or fixed capital in order to render labour more productive. For all these purposes, capital would become necessary; and the person who had accumulated a portion of it would be able to command the services of several others, to whom he would advance subsistence and the materials of working, and would receive in return the fruits of their labour. As capitals accumulate, this becomes almost universally the case; in a commercial state, few independent workmen are to be found.

The price of labour or wages is regulated, like every thing else, by the demand and the supply. If there are many who want and can employ workmen, and if few can be found, the competition of the masters will raise the wages, until the whole capital, not otherwise employed, is distributed among that small number. In the opposite circumstance, workmen, glad to work for any thing rather than starve, will bid against each other till all are employed, at however small a recompense. The combinations among workmen, so much complained of, can never have any permanent effect, unless accompanied by those circumstances which necessarily lead to a rise. The combination of masters, though less heard of, is more to be feared. Their numbers are smaller, and from their greater command of property, they can hold out for a longer time. From the above causes, however, there is no reason whatever to dread any serious or lasting consequences from such a measure.

The supply of labour, or the population, has a natural tendency to suit itself to the demand. High wages, by encouraging early marriage, and enabling the labourer to take better care of his children, soon cause an addition to the numbers of a state, which, in its turn, brings down the wages. Hence uncommonly high wages take place chiefly in an advancing state of society, when a number of employments are open, for which a sufficiency of labourers cannot be found. When the wealth of a country is stationary, the wages will be moderate, sufficient to admit of the rearing of such a number of children, as may keep up the population, but not such as to admit of any increase. When the country is in a declining state, the wages will fall even below this. They will scarcely enable the labourer to subsist; comparatively few will be able to rear families, and population will decline †.

† *Smith*, book i. ch viii.

From what has been said above, there will appear no reason to suppose, that the price of subsistence has any immediate influence on the wages of labour; an idea which even Smith seems strangely to have entertained ‡. The demand for labour, the funds by which it is paid, and the number of labourers continuing the same, no alteration in its price can take place. For masters to give higher wages on account of scarcity, is, we suspect, a very injudicious benevolence. The funds for the maintenance

‡ *Ib.* book iii.

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tenance of labour, far from being increased by a dearth, are rather diminished; so that the giving a greater proportion of them than before to some, must be the means of throwing others altogether out of employment; and to this cause we suspect that the want of work usually complained of at these periods, is very much to be ascribed. Where the rise of provisions is permanent, however, that of labour though not immediate, takes place ultimately, in consequence of a diminution of the supply. The difficulty of subsistence prevents labourers from rearing such numerous families; population is thinned; and the diminished competition causes a rise in the price of wages.

Wages in general are nearly the same over a country; for if they are higher in any one place, this proves a natural attraction to those of other districts, who soon reduce the rate to its proper level. This free circulation of labour, however, may be prevented by artificial restraints, as was the case, till of late, in England, by means of the poor laws. These authorized the parish officers to prevent any one who was ever likely to become a burden on the parish from settling in it. The most obnoxious part of these laws, however, has been done away, chiefly through the exertions of Mr Rose.

Wages are generally higher in cities than in the country. The capitals there are greater. The country too is more prolific, while few towns keep up their own numbers. Many indeed migrate from the former to the latter; but the predilection for their native spot, and to more wholesome and cheerful occupations, prevents this migration from being so great as completely to equalize the rate. Another cause arises, in modern Europe, from the corporation system which has generally prevailed. Almost every trade has some regulations to limit the number of its members, and thus by restraining competition, to increase their wages. The principal of these regulations are those regarding the duration of apprenticeship. By the fifth of Elizabeth, no trade can be exercised in England, till after an apprenticeship of seven years; and the only freedom from this statute is in the case of those trades which were at that time unknown. In Scotland, apprenticeships are in general much shorter.

Wages, however, vary not only from local causes, but from others connected with the nature of the trades by which they are earned. There seem to be five circumstances which tend to raise the wages of any class of men above the ordinary level.

First, When any employment is of an unwholesome and disagreeable nature. Thus miners, blacksmiths, butchers, and innkeepers, earn higher wages than those whose occupation is not liable to the same objections. On the other hand, hunting and fishing, being naturally agreeable, and pursued by many for mere amusement, are by no means profitable.

Secondly, Where a profession is difficult to learn, as in the fine arts and liberal professions, which require many years study before a man is qualified to exercise them.

Thirdly, Where employment is precarious. Thus masons whose employment depends on the weather, and all workmen who are liable to be called upon and dismissed at a moment's warning, receive higher wages to compensate for this uncertainty in the means of their subsistence.

Fourthly, Where great trust is reposed in the workman. On this ground, goldsmiths and physicians are entitled to higher gains than others, in order that such important trusts may be reposed in persons who have something to lose.

Fifthly, Where there is any peculiar risk, either of failure, or of other disasters. Thus in the case of physicians, and still more of lawyers, it is only a few of those who apply to the profession to whom it ever yields a subsistence. Those who rise to eminence, therefore, have gained prizes in a lottery, which ought to be high in proportion to the number of blanks. The effect of this circumstance, however, is diminished by the natural confidence which every one has in his talents and good fortune, and by the brilliant reputation which accompanies success in these departments. The same remark applies to those professions which present a life of danger and adventure, as the naval and military service. Fortunately for the public, notwithstanding the danger, the hardship, and the slender emolument with which these professions are accompanied, no want is found of persons who are ready to engage in them.

Lastly, There are some circumstances, to which all trades are occasionally liable. In a new trade, the wages are generally higher. The success, and consequently the duration, of such must be more or less uncertain; and men will not be inclined, without some extraordinary temptation, to quit their old and established occupations, in order to engage in it. An extraordinary demand too sometimes arises for the commodities furnished by some particular trade; more labourers than usual will consequently be wanted; and these must be allured by the offer of higher wages. Sometimes, on the other hand, work is done cheaper than usual, from being taken up as a bye-employment, by those who derive their subsistence from a different source; as, for instance, stockings in the north of Scotland. This takes place, however, only where the demand for labour is slender, as otherwise the whole of a man's time may be advantageously employed.

In considering the effects of labour in the production of wealth, Smith divides it into two kinds, which he calls productive and unproductive. Productive labourers are those whose industry produces a commodity which remains and can be exchanged for another. Thus the farmer produces corn, the manufacturer cloth or hardware. The unproductive, on the contrary, are those whose services perish in the moment of performance, and never produce any commodity to which value can be attached. These include a variety of professions both the most respectable and the least so. It includes, on one hand, all those employed in the executive government, officers of the army and navy, officers of justice, public teachers of every description; on the other, menial servants, players, musicians, &c. The more a man maintains of the former kind of labourers, the richer he becomes; the more he maintains of the latter, he becomes the poorer.

The most eminent writers on this subject, in the present age, seem disposed to treat this distinction as nugatory. They urge, that wealth consists merely in the abundance of conveniences and pleasures of life; and that whoever contributes to augment these is a productive labourer, although he may not present us with any tangible commodity. The professor who gives me a lecture, and the musician who gives me a tune, give something subservient

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vient to use or pleasure, and for which other articles may be had in exchange. We are rather disposed, however, to adhere to the doctrine of Smith, and to doubt how far these perishing and immaterial commodities, however valuable they may be, can, strictly speaking, be considered as wealth *.

* Smith, book iii. chap. 3. *Lauderdale*; *Edin. Review*, N° viii. art. 8. *Fay, Elemens d' Economie Politique*, book i. ch. 42.

Sect. III. *Of Capital.*

Capital or stock, as already hinted, is merely the produce of land and labour accumulated, and employed in such a manner as to cause an augmentation of the wealth of the community. It acts, however, too important a part, not to deserve separate consideration. We have already, considering it as one of the divisions of wealth, explained, at some length, its nature and office. We shall now consider it in the relation which it bears to revenue, which, when arising from this source, is usually called the *profits of stock*.

It is difficult to obtain direct information with regard to the rate of profit in any particular country; but it may be inferred with considerable certainty from the rate of interest, which always bears a certain relation to these profits. The more advantageously a man can employ stock, the more will he be inclined to pay for the use of it. Profit is generally supposed to be about double of the interest.

In poor but advancing communities profits are high. There is a great demand for stock, and little to be had; hence men are glad to pay a high premium for the use of it. In North America interest is from six to eight per cent. New colonies afford almost the only instances in which both profit and wages are high at the same time. The employment is so ample as to demand at once more men, and more stock, than can be supplied to it. As the country advances in wealth, stock becomes more abundant, and the competition of different stocks lowers the profit of each. Hence, in a rich country, profits are low. In England the current rate of interest is (or at least was, before the immense loans of the present war) from four to four and a half per cent. In Holland, the richest country perhaps in the world, interest is two or three per cent. and the Dutch are observed to trade on lower profits than any other people. But when a country is in a state of decline, in consequence of its property being plundered or destroyed, stock, from its scarcity, acquires often an enormous value. In Bengal money is said to be lent to the farmer at forty per cent. and upwards. We must observe, however, that even in opulent countries the opening of new channels of employment, by increasing the demand, tends to raise the profits of stock, while the shutting of former channels has the contrary effect.

Profit does not vary nearly so much as labour, according to the different modes in which it is employed. Scarcely any of the five circumstances mentioned under that head, except the last, affect it at all. Smith seems indeed to consider the first, viz. the agreeableness or disagreeableness of the employment, as somewhat affecting it; but this it appears to us to do, only from the labour with which it is accompanied. It is by the drudgery and inconvenience of constant attendance on his guests that the employment of an inn-keeper is rendered disagreeable.

The safety or risk, however, attendant on the different modes of employing a capital, is a most serious consideration. A man will not, without some temptation of extraordinary profit, embark in a concern where a part or the whole of his capital may be lost. We are disposed, indeed, to consider this as the only circumstance which raises the profits of stock above the market rate of interest. In almost all modes of employing capital, there is some risk; and it may be supposed, that where that risk is greatest, the profit should be greatest also. Yet employments attended with very great risk, provided that risk be compensated by the chance of very great gains, are the most crowded. Such is the sanguine and adventurous spirit of men, that speculation, as it is called in trade, as well as such uncertain trades as that of the corn-merchant or the smuggler, are always overstocked; and though productive of occasional gains, prove commonly ruinous in the end.

In some of the Asiatic countries, where property is remarkably insecure, the accumulation of capital is thereby so much discouraged as to render it scarce, even where the annual produce of the land and labour is considerable. Even the quantity which is accumulated, instead of being employed in trade, is concealed or buried in the earth. The same was the case anciently in European kingdoms, before the establishment of law and order; accordingly, at that time, treasure-trove formed an important part of the revenue of the sovereign.

It may be observed, that what goes under the denomination of profit is often merely wages. A merchant or shopkeeper who conducts his own business, besides the profit of his stock, must receive some remuneration for the portion of time and attention he devotes to the employment. Thus, especially in a country town, a grocer or apothecary will, on a small stock, make 50 or 100 per cent.; but this may be no more than sufficient to repay him for that skill and knowledge which are equally necessary for conducting these employments on a small as on a great scale.

Although, however, the variations in the profits of stock occasioned by the nature of the employment be not considerable, it is otherwise with those which have been occasioned by the policy of modern Europe. As the improvements introduced into it have been chiefly by cities, and by the mercantile part of the community, that part has been extravagantly favoured. The interest of the agriculturist and of the consumer has, till of late, been uniformly sacrificed to theirs. The regulations prompted by this system have not indeed been of any real service to trade; but, by narrowing the competition, they have secured to some commercial bodies a certain monopoly of the articles in which they dealt, and thereby enabled them to raise their profits above the natural level. This they do sometimes directly, by vesting the privilege of conducting certain trades altogether in the hands of an exclusive company, who can set their own price on commodities which are produced or imported by them alone. At other times, they impose prohibitions or high duties on the importation of certain articles from abroad. Bounties are given for the encouragement of certain favourite branches of agriculture, or manufactures. These regulations form what is called the mercantile system, which we shall have occasion hereafter to consider at large, and to show its entire fallacy. The exclusive privileges of corporations operate to raise the profits of stock, as well as the wages of labour.

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bour. They exclude all such as have not certain qualifications from employing their stock within the corporation. Those, therefore, who possess these qualifications enjoy some degree of monopoly against the rest of the society. From all these causes the profits derived from manufactures and commerce have been on the whole greater than those of agriculture. The instances of great fortunes raised out of nothing in the former lines are frequent; in the latter, they are rare. We may observe, however, that since the general diffusion of the writings of Smith and of the economists, this system has, in a great degree, ceased to influence the legislatures of Europe; and what remains of it arises rather from the force of habit than from design. Perhaps there is now a tendency to the opposite error; to undervalue trade too much, and to grant to agriculture those exclusive privileges which were formerly lavished on manufactures and commerce.

The profits of stock are equally, with the wages of labour, liable to be affected by the introduction of new trades, and by alterations in the demand. These variations, however, like the causes which produced them, will be only of a temporary nature.

Sect. IV. *The Interest of Money.*

It may often happen, that persons are possessed of stock who want inclination or talents for engaging in trade. On the other hand, some may possess this inclination and capacity, who have no stock. In this case a natural arrangement takes place. The person possessed of the stock, which he does not employ, lends it to the other who is in want of it, and who, in consideration of the profit he derives from its use, is willing to give an annual premium to the lender. This is called the interest of money; for money, being the common exchangeable medium, is the form in which stock generally appears, when it is collected by its possessor for the purposes either of hoarding or lending.

In order to prevent the ignorant or necessitous from being imposed upon, governments have generally fixed a certain rate, which the interest of money should not be allowed to exceed. This rate ought always to be regulated by the market rate. An attempt to keep down the interest below that rate, tends only to raise it higher. The consideration given for the use of money must still be regulated, like every such transaction, by the supply and the demand: and the borrower must give a compensation to the lender, not only for the use of his money, but also for the risk which he incurs by the violation of the law. The regulated rate, however, ought to be somewhat above the market rate; though, were it too much so, its operation would become nugatory.

Chap. III. *Of the manner in which Wealth is produced and distributed.*

Among the three sources of wealth above enumerated, labour is pre-eminent, not only as the most abundant, but as necessary in order to give efficacy to the rest; neither land nor stock, unless in some rare instances, being of any value, unless labour be added. The result, however, of rude and unassisted labour is exceedingly small, when compared with what it becomes by means of certain artificial aids, which it gradually receives in an opulent and improved society. These aids are chiefly the *division of labour*, and *machinery*.

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Sect. I. *The division of Labour.*

The division of labour, by which one employment, or one branch of that employment, forms the sole occupation of one man, produces the most wonderful effects in augmenting the productive powers of labour. The oftener that a man performs any operation, the greater power he acquires of performing it skilfully and rapidly: and when his whole life is spent in the performance of any single process, this power becomes almost incredible. Thus, too, he saves the time which is spent in passing from one work to another. He saves more indeed than the mere time, for at first beginning the new one, he commonly saunters and trifles a little, and does not at first go on heartily and vigorously.

A striking instance of the effects of division of labour is afforded in the manufacture of *pin-making*. The important occupation of making a pin affords employment to eighteen persons; one man draws out the wire, another straights it, a third cuts it, a fourth points it, a fifth grinds it at the top to receive the head, which two or three are employed in making. To put it on, to whiten the pin, to put it into the paper, form all distinct occupations. Smith saw a manufactory where only ten were employed, and where some consequently performed two or three operations, yet they made forty-eight thousand pins a day, or four thousand eight hundred each; whereas a single man, performing the whole process by himself, would not probably make twenty. These effects would be equally perceptible in manufactures of greater consequence, were all their processes capable of being brought as close to each other as in this small one.

The division of labour is capable of being carried farther in manufactures than in agriculture. In the latter, a change of employment is dictated by the change of seasons; the same man must successively sow, reap, and thrash out the grain. Although, therefore, an improved society excels a rude one in agriculture, it does not, in general, excel so much as in manufactures, where man, making all the arrangements himself, can carry the division of labour as far as the extent of his undertaking will admit of.

Sect. II. *Machinery.*

As improvement advances, and the invention of man exerts itself in every direction, the labour of man is more and more seconded by the aid of machinery. This source of improvement is classed by Smith under the head of the division of labour, to which he conceives it to be indebted for its origin. We rather incline, however, to agree with Lord Lauderdale, in judging it worthy of ranking as a separate and independent principle. Some rude machinery for domestic and agricultural purposes must have been invented prior to any considerable division of labour; while those wonderful machines which have excited the admiration of the present age, the cotton mill, the steam engine, &c. are the

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the invention of ingenious men, not the casual discovery of workmen; though they may have received some improvement from the latter source.

Machinery is, in many instances, not less powerful than the division of labour, in multiplying the productions of human industry. It has besides this advantage, that there are many operations to which it is essential, and which, without it, cannot, in any degree, be performed. Without the plough or spade, the saw, the flour-mill, or some instruments corresponding to these, the unassisted efforts of man would be of no avail to effect the purposes for which they are intended.

When any machine is first introduced, the immediate consequence is, that a number of labourers are thrown out of employment; hence, according to the idea of the vulgar, which has been hastily adopted by some philosophers, such innovations are pernicious, tending to distress the poor, and to check population. There seems no good reason for this complaint. The population of a country must always depend upon the abundance of the means of subsistence; while, therefore, improved machinery has no tendency to diminish these, it cannot be injurious to population. The manufacturer, being enabled to produce the same quantity of goods, with only part of the stock before employed, will employ the other part in extending his concerns, either in the same or in other branches of industry; and even the part of his stock which is spent in the purchase of machinery, will give employment to workmen in framing that machinery. The only effect, therefore, will be that of adding, in proportion to the power of this machinery, to the comforts and conveniences of the society. A certain degree of inconvenience may no doubt be experienced by those workmen who have been accustomed to this species of employment, and are less qualified for any other. But this is merely a temporary disadvantage, such as may be expected to accompany all changes, however beneficial.

Machinery, like the division of labour, can be introduced to a much greater extent in manufactures than in agriculture. Nothing on a great scale, seems hitherto to have been introduced into the latter, except the threshing machine.

Sect. III. *Of the different Employments of Labour and Stock.*

All these seem to be included under four heads: agriculture, including mines and fisheries; manufactures; trade by wholesale; and trade by retail. Each of these will present some objects for our consideration.

Sect. IV. *Agriculture.*

Of all modes of employing labour and stock, this is the most productive. It is not here, as in other employments where every thing is to be done by man. Nature labours along with him. His object is to direct rather than to augment those powers of vegetation which the earth already possesses and exercises. No other employment yields that surplus produce obtained without labour or effort, which is called *rent*. Wherever, therefore, things are allowed to take their natural course, agriculture is the first object to which the labour of the society is directed. Till it has made considerable advances, manufactures are either rudely executed as a by-work, or, where opportunity offers, are imported from abroad, in exchange for the rude produce of land. This last, where practicable, appears evidently to be the most advantageous system. The adoption of it has been one great cause of the rapid progress of the North American colonies.

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Agriculture gives employment to a greater number of men than any other species of industry. These men also, are likely to be the most sound, healthy, uncorrupted part of the population; and from its local nature, they must all reside within the society, and form a constituent part of it.

Sect. V. *Manufactures.*

Manufactures do not actually produce any new commodity; but they modify in such a manner the produce of land or mines, as to increase its exchangeable value. Few things, especially in a highly cultivated state of society, are fit for use as they come out of the hands of nature, till they have been operated upon by human art. Even corn, the staple produce of land, must pass through the hands of the miller and the baker, before it can be used as food. Some manufactures add comparatively little to the value of the original article; while, in others, the latter becomes little or nothing when compared with the additional value stamped on it by the manufacture. Thus half a crown's worth of flax, when wrought into the finest cambric, will be raised perhaps to the value of twenty pounds.

Manufactures employ fewer men than agriculture, but more than any other species of industry. These men, too, must evidently reside in the country where the manufacture is carried on; though that may be different from the country where the rude material is produced, as well as from that where the finished manufacture is consumed. The cotton of America and the West Indies is imported into Britain, and after being there wrought into cloth, is re-exported to those countries.

Manufactures, as already observed, give scope beyond any other employment to the productive powers arising from machinery and the division of labour. They can be collected into the smallest space, and the instruments are completely under the controul of man. A poor nation may rival, or even surpass a rich one, in the cheapness and abundance of its corn; but in manufactures it is always inferior.

It is a general rule, that the manufactures in which a country excels, are those which are suited to the wants of her inhabitants. These she comes to produce, not only better, but cheaper, than other countries, to whom therefore those articles become, for her, the most advantageous subject of export. In France, before the revolution, the consumers were chiefly persons of very large fortune, to whom the finest manufactures and articles of ornament were alone suited. In England, on the other hand, the greater proportion of the consumers are persons of moderate fortune, and in the middling rank. Substantial articles, of moderate price, are, therefore, chiefly demanded in this country. The effect of these different habits appeared clearly in the discussions respecting the commercial treaty concluded by Mr Pitt. It appeared, that millinery, jewellery, fine manufac-

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ture of all kinds, were made both better and cheaper in France; but in hardware, cloth, common articles of every sort, she was completely undersold by England. Although woollens be the staple of England, yet in the finest woollen cloth she was surpassed by France; and though silks be the staple of France, yet common silks were sold cheaper by England. Several other curious instances are given by Lord Lauderdale, in the concluding chapter of his work on public wealth.

Sect. VI. *Commerce.*

Commerce is the grand source of all improvement in the productive powers of industry. It is founded on the principle of barter. The butcher has a quantity of beef, and the baker of bread, more than either can consume himself; but each is in want of the other's commodity. And exchange therefore being made, both the beef and the bread acquire a value which they did not possess before. Thus it is that commerce, consisting in the exchange of two articles, raises the value of both.

It is only by means of extensive commerce, that both the division of labour and machinery can be carried to any great extent. A manufactory, established for the supply of a small neighbourhood, can never be conducted on that great scale which is requisite for these improvements. The division of labour must depend on the numbers employed; and an extensive sale is necessary to repay the expence of complicated and powerful machinery. Land carriage would probably be the first employed; but as soon as navigation was invented, the cheapness and facility of water carriage would give it a decided preference. In the infancy of the art, the inland navigation of rivers would experience a preference; and it is still possessed of peculiar advantages. All the earliest improved countries have been those which possessed an extensive inland navigation; Egypt, by the Nile, Indostan, by the Ganges, and China, by several great rivers which perforate it. Africa, an unbroken mass of continent, is still barbarous; the only part which affords any exception to this remark, is that situated along the Senegal and Niger. Hence the great advantage which a country derives from good roads, and still more from navigable canals, which facilitate the communication between its different parts, and extend the market of the farmer and manufacturer.

Commerce is of three kinds; the home trade, the foreign trade, and the carrying trade *.

The home trade is of all others the most advantageous. In the exchange which takes place here, both the commodities, whose value is raised, belong to the same country, and consequently a double benefit accrues to the society. The returns, also, of such a commerce are much more quick. With the same capital, therefore, a much greater number of transactions will take place in a given time. Smith calculates that the foreign trade of Great Britain does not exceed a fortieth of its home trade. The grand branch of internal trade is that between the country and the town, in which the farmer supplies provisions and raw materials, and receives in return manufactured produce.

When all the channels of domestic trade are filled, a nation naturally turns to a foreign market. Here, however, it does not trade with equal advantage. Of the two commodities whose value is raised, one only belongs to it; and consequently it reaps only half the benefit which it reaped from the home trade. Nor is this all. The market being more distant, the returns are slower. With the same capital, twelve operations may frequently be performed in the one, in the same time that a single one was performing in the other. In this case, the former will be twenty-four times more advantageous to the country. It does not follow, however, that foreign trade is not really and greatly advantageous, when the capital is sufficient to carry it on, in addition to the home trade.

The foreign trade is sometimes modified as follows. A country exports to another some commodity, and then, with the commodity which it receives in return, purchases some article of a third country. Thus, England sends to Virginia woollens, and having received in return tobacco, exports it to the Baltic to exchange for naval stores. This roundabout trade differs from a common foreign trade in no respect, except that its returns are likely to be slower, and consequently its effects still less beneficial to the community.

When all other branches are filled, the only resource of overflowing capital is in the carrying trade. Here the merchant merely exports the produce of one foreign country to another foreign country. The country to which he belongs gains nothing but the mere profits of the trade. It receives no encouragement to its agriculture or its manufactures. Neither of the goods whose value is raised belong to it. The carrying trade is the least advantageous of all modes of employing the national capital. It is the *symptom*, however, of a great and almost overgrown commercial prosperity; for it is not till capital is extremely abundant, that it turns into this direction. Seeing the carrying trade, therefore, the accompaniment of great national prosperity, legislators have mistaken it as a cause, and have held out peculiar encouragements with the view of forcing part of the national capital prematurely into this direction; which, from the view now given, must be evidently hurtful.

Commerce employs fewer men than either manufactures or agriculture; it employs merely the merchant, who transacts the business, and the sailors and carriers who transport the goods. These, too, may belong indifferently either to one country or the other, or even to a different one from either; and this, from the smallness of their number, is a matter of little consequence.

Sect. VII. *The Retail Trade.*

The last species of industry is the retail trade. The convenience, and indeed necessity of this, is obvious. It would be extremely troublesome if a man were obliged to purchase a whole ox or sheep at a time; if he were obliged to lay in at once six or eight months provision of every different article. Part of his stock would thus constantly lie dead, and the commodities besides would often perish in his hands. Hence the use of shop-keepers, from whom we may purchase any article in as small a quantity as suits us. Some persons have apprehended bad consequences from the multiplication of retailers, but with no good reason; for the greater the competition, on the better terms will the public

* Smith, book ii. chap. v.

public be served, each being anxious to undersell his rivals. Their multiplication might ruin themselves, which, in general, we may be sure of their guarding against; but it must be for the benefit of their customers.

Sect. VIII. *On the Coincidence between Public and Private Interest.*

As the wealth of a society consists merely of the aggregate wealth of its members, every thing which tends to increase the property of an individual, without injuring that of others, that is, every species of lawful industry, tends to augment also the riches of the society. Those branches also which are most productive to the society, will be equally so to the individual who conducts them. Such branches have, besides, peculiar recommendations, which will lead men, upon equal profits, to prefer them to others of a nature less generally beneficial.

The improvement and cultivation of land is the mode in which the greatest produce may be raised with the least capital: it has, besides, other recommendations. It is the way in which a man's property is most completely under his own eye, and most secure from accident. The pleasures of a country life, the independence by which it is generally accompanied, the healthful and animating nature of its occupations, secure it a certain preference over most other employments.

Manufactures, again, possess many advantages above commerce, at least in that early state of improvement where capitals are moderate. The capital employed in it is more secure, and more under the inspection of its owner, than that which is sent to a distance, and committed to the winds and the waves. Some trade indeed must always exist for the exchange of the surplus produce, which even the rudest society possesses. But, in the earlier period of society, it is more advantageous to allow foreigners to carry on this trade, and even to supply all the finer manufactures. The opportunities of this kind possessed by the North American colonies, have been one great cause of their rapid prosperity.

It is evident, that, in commerce, both domestic and foreign, the merchant, with equal profits, will prefer the shorter voyage, which places the business more under his own superintendance, yields him quicker returns, and subjects him to less risk. Above all, the carrying trade, the whole of which must be transacted abroad, will have little attraction for him, unless strong temptation be presented.

Thus we see, that in all instances, the private interest of the individual leads him to adopt that species of employment which is most conducive to the interest of the public. In leaving him, therefore, to find out and choose the most advantageous employment for his own industry and stock, we are certainly doing that which is also best for the general good. This principle ought to be the polar star to guide the steps of the legislator in political economy. His object should be, to secure to every individual the fruit of his industry, and then to leave him at liberty to exert it in any manner he may judge advantageous. All regulations of an opposite nature, are as contrary to the interests of the society, as they are injurious to the individual.

Chap. IV. *Of the Mercantile and Economical Systems.*

Sect. I. *General View of the Mercantile System.*

The fundamental principle of the mercantile system, and that which its supporters are accustomed to treat as a self-evident axiom, is, that wealth consists in *money*, or in gold and silver. The facility of exchanging these metals for any other commodity, the habit thence derived, of calculating, according to their standard, the wealth belonging to each individual, has made this a natural and general error. Having laid down this principle, the next question comes to be, how the money of any nation was to be increased? Where it was possessed of gold and silver mines, the obvious policy was, to lock up the whole produce of these within itself, and to prohibit its exportation under the severest penalties. Where the nation possessed no mines of its own, gold and silver could be obtained only by giving other commodities in exchange. Suppose a nation to export to the value of a million, while it imported only to the value of half a million, the other half, it was conceived, must be paid in money, and must go to increase the wealth of the nation. To export much, and to import little, were therefore conceived to be the great means of enriching the nation. The difference between the exports and imports was called the *balance of trade*, and considered as the grand criterion of commercial prosperity. If the exports exceeded the imports, it was called a favourable balance; if the contrary, an unfavourable balance. It so happened, to the great consolation of our mercantile politicians, that the former of these cases always took place. A certain annual supply of gold and silver was actually imported for the maintenance of the current coin, and for some ornamental manufactures; and, besides, as duties are rarely levied on articles exported, the vanity or convenience of merchants led them often to enter more than they actually shipped. But though this was the case in general, it was otherwise with regard to some particular countries. If, in the case of Spain, America and the West Indies, the result was as favourable as could be desired, many a rueful look was cast upon the statements of the German, Baltic, and East India commerce; in all which the balance, as it is called, was decidedly against this country. To check this great evil, every expedient was employed which might diminish importation and encourage exportation in general, and particularly in regard to those countries with whom our balance was unfavourable. What the nature and effects of these measures really are, we shall presently have occasion to consider. We shall now make some remarks on the general principle on which they are founded.

1. Restrictions upon the intercourse with a particular country, which is supposed to have a balance against us, are unreasonable, even supposing the general principle to be sound. For if we get commodities cheaper from that nation, and sell ours to it with greater advantage, the balance will, on the whole, be more in our favour, than if we carried on the same transactions with any other nation. If we can get wine cheaper from France than from Portugal, the annual value of our imports for wine

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wine will be diminished, by dealing with the former country. Besides, what is imported may often be so, only for the purpose of re-exportation to some other country.

2. The whole idea of the balance of trade is quite fanciful and chimerical. By every exchange which takes place with a foreign country, the nation gains as well as the individual; nor does it make any difference whether goods or money be received in return. If indeed the legislature could succeed in forcing a greater importation of gold and silver than would naturally take place, it would do the country a serious injury. These metals, when converted into money, form, as above observed, a part of the fixed capital of the society, a most useful and necessary part, but still one which is merely instrumental, and does not make any direct addition to the wealth of the society. If we could have the same functions performed without it, the society would gain the whole of what it has been accustomed to pay for it. On the contrary, when a government forces upon the nation more than is requisite for the purposes of circulation, it makes it incur an expence which would otherwise have been saved. It does not appear, in the case of nations which have no mines, that any of the boasted regulations respecting import and export, will have the least effect in enlarging the importation of gold and silver. But where a people have mines within themselves, a strict prohibition, such as is usually imposed, against the export of these metals, though it will be far from absolutely preventing that export, will yet keep within the country a somewhat greater quantity than would otherwise have remained. This appears to be (or at least to have been) actually the case with Spain and Portugal, occasioning a considerable loss to both these countries.

As the principle of the mercantile system naturally leads to the supposition, that whatever is gained by one nation, is lost to another, it generally leads to violent commercial jealousies between neighbouring countries. The nearer they are to each other, the more are restrictions and prohibitions multiplied. This is altogether unreasonable. The nearer a country, the more advantageous is its trade. It approaches the more nearly to the home trade, in the quickness of its returns, and can be carried on with a smaller capital. The plan, therefore, of making our neighbours as poor as possible, is completely unwise. The richer they are, they will be the better customers for our commodities, and the greater will be the benefit which we derive from their trade.

Having thus proved, that the regulations of the mercantile system are altogether unfitted for attaining their end, and that the end, were it attainable, is useless, and even pernicious, we shall now consider what is the real effect of these regulations. With this view they may be classed under two heads, *restraints upon importation*, and *encouragements to exportation*.

Sect. II. *Restraints upon Importation.*

These are either high duties or prohibitions.

It has been an universal principle of modern taxation, that duties are to be levied only on articles imported, and not on those which are exported. This principle is sound. The taxes imposed by any community ought to fall upon its own members, not upon those of other communities. To attempt acting otherwise, would be not only unjust, but impolitic. These articles of produce and manufacture, on which the export duty was imposed, would not, in the general market of the world, keep their ground against the same commodities from other nations, which imposed no such duty. The mercantile system, however, goes much farther. With the view of encouraging internal industry, and preventing importation, it lays higher duties upon certain articles imported, than upon the same when manufactured within the country; thus securing to the latter, a certain advantage in the home market, independent of any superiority of skill. It thus turns to certain branches of industry a greater proportion of the national industry and capital than would naturally have gone to them. Now, we have proved, that in all cases, the direction which individual interest spontaneously gives to the national industry, is the best and most useful direction. Every thing, therefore, which tends to disturb it, to turn industry into channels into which it would not naturally have gone, is injurious to the public, and tends to render that industry less productive. Such is precisely the operation of the duties in question, which, therefore, though they may augment the productive industry of the nation in some particular branches, tend to diminish its whole amount. Thus, in an agricultural nation, if duties are imposed upon the importation of manufactured goods, a part of the national capital which was employed in the more profitable employment of agriculture, will be forced into the less advantageous one of manufactures. The misfortune is, that in the mercantile system, from a very natural prejudice of those with whom it originates, the less advantageous branch is always rated higher than the more advantageous; manufactures than agricultural, commerce than manufactures, and foreign trade than domestic. Its operations are pernicious, not only in their general principle, but still more in their particular application.

In regard to prohibitions their effect is the same as high duties, only greater in degree. They are seldom completely effectual, unless in the case of very bulky goods; but their operation must always be equal to the highest duty, and must therefore be equally injurious, without bringing any advantage to the revenue.

Sect. III. *Encouragements to Exportation.*

The expedients which the mercantile system employs to encourage exportation are *drawbacks* and *bounties*.

As to drawbacks, they are extremely reasonable. No government we observed, can properly, or without imprudence, attempt to tax the consumption of other nations. When, therefore, it has imposed a duty on any article produced within itself, it is quite expedient that this should be repaid on exportation; otherwise the articles, when carried to a foreign market, could not meet the competition of others, which had paid no such duty. In the same manner, when an article has paid a duty at importation, it is perfectly fair that the duty should be repaid, in the case of the article being re-exported; otherwise a severe check would be put both upon the carrying trade, and the foreign trade of consumption. Still, indeed, the merchant has the disadvantage of having advanced the tax, and consequently been deprived,

for

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for a certain time, of the use of that portion of his capital. In some instances, a plan has been adopted, which obviates this inconvenience. The goods are placed in a warehouse, under the joint lock and key of the merchant and the officer of government. No duty is then paid upon them, unless they are taken out for the purpose of home consumption.

Bounties are expedients of a different nature. They are given upon the production and exportation of certain articles, which, it is conceived, would not otherwise pay the expence. Their tendency is, therefore, to force capital and industry into the channels which, it is admitted, are disadvantageous to the individual, and which according to the principles above explained, must be equally so to the society. Their effect, therefore, is nearly the same as that produced by restraints upon importation. Premiums are not liable to the same objections: Being only given to one or two specimens of peculiar merit, they merely stimulate to excellence in any branch of industry, without having much tendency to turn towards it a disproportionate share of the national capital.

The bounty on corn is the most important of those granted in Great Britain; and as the whole system of corn laws is not only of the utmost importance, but closely connected with the views of the mercantile system, it may not be unseasonable to introduce our sketch of them in this place.

Sect. IV. *Of the Corn Laws.*

To render the necessaries of life cheap, is a grand object of the mercantile system, since it thus expects to lower the wages of labour, and thereby lessen the expence of manufacturing. The expedients it adopts, however, are by no means judicious. The object of the legislator, on this subject, has been to prevent as much as possible all trade in corn; to urge the farmer to bring it to market as soon as possible, and to discourage to the utmost its passing through any intermediate hands between him and the consumer. All such intermediate persons are stigmatized by the opprobrious names of *regraters* and *forestallers*, and the severest penalties are enacted against them. Let us consider on what grounds these proceedings can be justified.

The great evil in the price of grain is the variations to which it is liable, which at one time produce superfluous plenty, and at another threaten the community with absolute want. The production of it being only once a year, there is a constant danger, that before next harvest, the supply may run out. Crops too vary, and sometimes fail to a distressing degree. It is most desirable, therefore, that the superabundance of one period should, if possible, be made to supply the defficiency of another. The grand interest of the public, in regard to grain, is to distribute, as equally as possible, over different years, and over different parts of the same year, the supply of grain, so that the plenty of one period may relieve the want of another, and the general price be kept as equal as possible. This is precisely what the merchant does. He buys when it is cheap, and sells again when it is dear. If he buys it even when it bears a high price, it is only from the expectation of its rising still higher, that is, of the scarcity becoming still greater; and unless this expectation be well grounded, he loses instead of gaining by the transaction. He may miscalculate indeed; but in this case, he suffers severely for his mistake; and he has the constant stimulus of private interest to guard him against it.

It follows, therefore, that the freer we leave the trade in corn, the better will the public be guarded against the evils of famine, and that the vulgar outcry upon this subject has no real foundation.

With regard to the bounty, it has been defended as being an artificial mode of obviating that irregularity of price, to which grain is liable. The increased quantity which the bounty tends to produce, may, it is alleged, be employed in a year of scarcity, to alleviate the evils of dearth *. See this subject treated at length in the article Corn Laws, Supplement.

* *Anderson on National Industry.*

Sect. V. *Of Exclusive Companies.*

At the first introduction of commercial enterprise in Europe, it was frequently the practice of governments to vest particular trades, supposed to be of a peculiarly arduous nature, in the hands of an exclusive company. Such a measure is almost always hurtful to the public. The interest of all traders is to buy cheap and sell dear, and is thereby hostile to the interest, both of the producers and consumers. But an exclusive company, having no competition to dread, can carry this system into effect to a much greater extent than the private trader. It is even found that the selling a small quantity at a high price, is more profitable than the selling a large quantity at a moderate price. The Dutch East India Company are said to have destroyed a number of their plantations in the Spice islands, with the view of diminishing the supply, and thereby raising the price.

It is supposed that some very extensive branches of trade could not be carried on by individuals with safety; but in this case, either the capital of the country is not yet sufficient for such undertakings, or a company will be formed to carry them on, without the necessity of any exclusive privilege. It may be observed, that such companies, from the waste and negligence attending a large concern, managed often by persons who have no deep interest in it, and not stimulated by the dread of competitors, prove generally as ruinous to those concerned in it, as to the public. Almost all the exclusive companies, established in this and the neighbouring countries, have ended in bankruptcy.

Sect. VI. *Of Colonial Policy.*

As countries increase in populousness, and as cultivation is carried to a greater extent, the means of subsistence become continually more and more difficult. The evil most felt is a scarcity of land, of that grand source from which all revenue must originally flow. But while there are other countries comparatively unimproved, an obvious remedy presents itself. A certain portion of the inhabitants of the cultivated country removes into that which is still uncultivated, where they find land cheap, and the means of subsistence easy. Of all societies, these generally make the most rapid strides towards improvement. To the abundance and cheapness of land, which is peculiar to uncultivated countries, they join the arts and industrious habits of cultivated society. They are thus enabled to make a much more rapid progress than either. All the Grecian colonies, in Asia Minor, Italy, and

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and Sicily, enjoyed an unexampled degree of prosperity. The North American colonies doubled their numbers every twenty years; and in South America, notwithstanding the injudicious restraints with which its commerce was fettered, the increase has not been much less considerable.

In spite of the temptation thus held out to colonize, men are in general not easily induced to leave their native country, till they are driven by some compulsory motive. In the ancient republics, colonies were formed by men who had been driven from their homes by civil war and faction. The North American states were peopled by refugees, criminals, and other refuse of the mother country. The case was somewhat different in the southern part of the continent, where a false but glittering lure was thrown out by the immense mines of gold and silver which it contained.

In pursuance of the monopolizing and trafficking spirit of modern Europe, each country has reserved to itself the exclusive trade of its colonies. This restriction evidently tends to cramp the improvement of the latter, and to divert the trade of the former into a less natural and advantageous channel. To Britain, and to the British colonies, however, the restriction has been little injurious. The former was in a state to carry on, and to need, the whole of this commerce; while the latter, from their infant state, could confine themselves with much more advantage to agriculture. The French colonies have probably suffered something from the restriction; but to the Spanish and Portuguese it has been very ruinous, as their mother countries were wholly unfit for carrying on so extensive a commerce *. See COLONY, SUPPLEMENT.

* *Smith*, book iv. ch. viii. *Brougham on Colonial Policy*.

SECT. VIII. *Of the Economical System*.

We have already noticed, in our historical introduction, the circumstances in which, and the persons from whom, this system originated. According to it, agriculture is the only real source of wealth, and the persons employed in it are alone to be honoured with the appellation of productive labourers. The capital spent by the landlord in improvements, and that employed by the farmer in cultivation, are in like manner represented as the only capitals which are productive of wealth. In support of this position they argue, that manufactures merely repay what has been spent upon them; the expence of materials, and the subsistence of the labourers. The only part which is gain to the nation is the profit of the manufacturer, and the portion of their wages (probably a very small portion), which the labourers save, and convert into capital. It does not follow, however, that traders and manufacturers, though under this system they receive the name of unproductive labourers, are useless to the society. They are valuable servants to the proprietors and cultivators of lands. They save them the trouble of performing a variety of operations, which would distract their attention, and which they could not do equally well. By giving a greater quantity of manufactured commodities in exchange for the produce of land, they raise the value of that produce. Still, however, they act altogether a subordinate part to the agricultural portion of the community, by whom they are fed and supported †.

† *Smith*, book iii. ch. 9. *Condorcet's Life of Turgot*; *Spence, Britain independent of Commerce, with Mill's Answer*.

A very little consideration will shew us the fallacy of this system. The wealth of a nation, as we observed above, consists in the total amount of external conveniences and comforts which are produced and enjoyed in it. Now every commodity, with every increase in its value, which is produced by manufactures and commerce, is so much added to national convenience and comfort, that is, to national wealth. It is of no consequence, that, while the labourer is producing it, he is also consuming a certain portion of corn and other necessaries of life. These were produced for the purpose of being consumed, and if they have perished, they have not done so without having performed their office, without having ministered to the benefit of the society, and enlarged the amount of its comforts. The whole, therefore, of what the manufacturer produces in any given time, is clear gain to the public. To be convinced of this, we have only to suppose, that in this time, he had consumed the same quantity of goods, without working at all.

Economical System.

We admit indeed, and have already observed, that agriculture is more productive than any other species of industry, and alone, besides paying the labour and capital employed in it, affords a surplus as rent to the landlord. It does not follow, however, because the one employment is more productive, that the other is not productive at all. Besides manufactures, over and above the labour and circulating capital employed in them, pay often a very large fixed capital. Now land, we conceive, is merely to be considered as a great fixed capital provided by nature, and rent as a consideration given for the use of that fixed capital.

The Economists conceive the rent of land to be the fund on which all taxes must ultimately fall. They therefore recommend a land tax to be substituted instead of all others. The propriety of this system will come to be considered in the course of the following chapter. See ECONOMISTS, SUPPLEMENT.

CHAP. V. *Of Public Revenue*.

As the whole society derives from government their protection against evils internal and external, the regular administration of justice, and a variety of other benefits, without which they could not subsist, it is perfectly equitable that each, in proportion to his means, should contribute to the extent which is necessary for fulfilling these different objects. Regular government is even indispensable to the production of public wealth, as it alone affords that security of property which is the life of industry. In this view, the officers of government cannot, even upon Smith's principle, be considered as unproductive labourers. They might more properly be considered as a part of the fixed capital of the society.

SECT. I. *Of Taxes in general*.

In the composition of taxes there are four circumstances, which ought, as far as possible, to be constantly kept in view, and the observance of which forms the criterion of the propriety or impropriety of each particular tax.

1. They ought to fall as equally as possible on every member of the society, in proportion to his means of contribution. As all derive equal benefits from the establishment

Of Public Revenue.

blishment of regular government, all ought to contribute equally for its support. The rich, however, ought to contribute not only more, but in a greater proportion, than the poor. As by far the greater part of their expenditure is on luxuries, they can retrench a part of it much better than those who, to pay the tax, must deprive themselves of the necessaries or first comforts of life.

2. The sum paid by each person ought to be fixed, and not left to the arbitrary appointment of the collecting officers. In this last case, the security of property is in a great measure done away, and room is left for the most grievous oppression. This is a still greater evil than inequality.

3. A tax ought to be payable at the time when a man can best afford it.

4. In proportion to what it brings into the treasury, it ought to take as little as possible from the people; that is, the expence of collection ought to be as moderate as possible. There ought also to be care taken to avoid trouble and inconvenience to the people, in the way of domiciliary visits, fines, &c.

Some persons have fancied, that taxes were beneficial. They allege, that the merchant derives a profit, not only for his advance upon the article, but also for his advance upon the tax. In this way, doubtless, *he* is no loser: but neither is he a gainer; for, in consequence of the increased price, the public must retrench in their use of the article, and consequently the extent of his dealings in it be diminished. Even should they not retrench in this, they must in some other article, which will fall heavy on some other class of merchants. But it is the interest, not of the merchant, but of the consumer, which ought to be the grand object in political economy; and this interest infallibly suffers. The consumers of the article taxed must inevitably have their comforts, that is, their wealth, abridged.

We admit, indeed, that taxes, where they are not so heavy as to intrench on the capital of the country, do not essentially encroach on its wealth. They merely transfer income out of the pockets of one class of men into those of another. The money which a man of fortune would spend in maintaining menial servants and other instruments of luxury, when placed in the hands of government, is employed in maintaining soldiers and sailors. The amount of national income is not diminished. They have the disadvantage, however, that the money is taken out of the hands of those by whom it was earned, and put into the hands of those who contributed nothing to its production. If taxes come to fall upon capital, or to diminish its accumulation, they are then ruinous.

Sect. II. *Taxes upon Rent.*

The rent of land has always been considered as a proper object of taxation. In most of the eastern empires, the whole land belongs to the sovereign, who draws the rent of every farm throughout his dominions *. In most of the European kingdoms, a certain portion of land belongs to the sovereign, under the name of crown lands. These, however, are seldom managed in that economical manner, which would be necessary to render them productive. The only lands which a government ought to possess, are lands for the purpose of pleasure and magnificence.

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The rent of land is a very proper subject of taxation. It comes to the possessors without care or trouble, and it depends, more than any other source of income, on the protection of government. The chief difficulty arises from its being so variable. Thus the English land-tax was imposed in the reign of King William. Since that time, the value of all the lands in England has risen, but that of some much more than others; so that the tax, even had it been equal at first, must now have become very unequal The only remedies are by making a survey at certain intervals, or by keeping a register of leases. To this it is objected, that it would discourage the landlord from laying out money on improvements; but the objection might be obviated by making liberal deductions on that account.

The rent of houses is of a very different nature from the rent of land. It is a commodity produced by art; and as the builder must have his profit, the rent will be raised in consequence of the tax. The rise, however, does not take place immediately. Houses are so durable an article, that for some time there will be no diminution of the supply; the rent will continue the same; and the loss will fall on the proprietor. As a certain number of houses, however, fall to ruin, undertakers will not build new ones without adequate profits; and the rents will rise to their proper level. It is singular that this should have been overlooked by Smith †.

† Book v. ch. ii.

Taxes are sometimes imposed, not on the rent, but on the produce of land. Such is that levied for the support of the church, both in England and Ireland Such taxes are pernicious. They discourage industry. The farmer feels that the more he raises, the more will be taken from him. It would be of great advantage, therefore, to the country, if tithes were commuted for a fixed annual sum. It would then completely be the interest of the cultivator to raise as much produce as possible. The difficulty, no doubt, lies in making such an arrangement as would enable the clergy to benefit by the improvement of agriculture; but expedients might doubtless be found out, similar to those which were proposed above, in the case of land tax.

The economists, as above observed, contend that all taxes fall finally on the rent of land; and therefore recommend that they should be laid directly upon that subject. The only argument which they allege in support of this opinion is, that taxes cannot fall either upon the profit of stock, or the wages of labour. Now we shall, in treating of these subjects, endeavour to prove, that taxes may most readily fall upon both.

Sect. III. *Of Taxes on the Profit of Stock.*

What are usually called the *profits* of stock, may be divided into three parts. The first is equal to the market rate of interest, and constitutes what any one is willing to give for the mere use of the stock; the second is a compensation for the risk incurred; the third is a compensation for the trouble of carrying on the business. Of these, the last appears to us to belong more properly to the wages of labour, and will be considered under that head. The second evidently is not taxable, because a man would rather not employ his stock at all, than

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than not receive a full compensation for the risk he runs in so doing. But the first (which perhaps ought alone to be considered, strictly speaking, as the profits of stock), is, to almost its whole extent, completely taxable. Although, out of *five* per cent. government should take *four*, it would still remain the interest of the capitalist, to lend, or to employ his stock, rather than lose the remaining *one*. The profits of stock, however, are a less proper subject of taxation, than the rent of land. They are not so easily ascertained; the capital from which they are derived has been accumulated by industry and frugality; and it is the interest of the public to encourage this accumulation. There would be a danger of driving the capitalists into other countries where they would be liable to no such imposition, to the great detriment of the country which they left.

A tax is sometimes imposed upon the profit of particular employments. Such a tax can never fall finally upon these profits. The persons engaged in this employment must have the usual profits for their stock, otherwise they will carry it into some other. Where these taxes, however, are unequal, they may favour certain classes of traders. Thus all licences, being the same whether the trader deals to a greater or less extent, fall heavier on the small than on the great dealer.

Taxes on the tranference of property, stamp duties, duties of registration, &c. have been carried to a considerable extent in modern financial systems. The facility of raising a revenue by this method, has encouraged its adoption. Such taxes are unequal; for the frequency of transference has no connection with the value of property. We may conceive an estate coming so often to market, that these duties may absorb the whole of it; while another of the same value, from remaining long in the same hand, may pay nothing whatever. These taxes, too, fall chiefly upon the national capital, the fund by which its industry is supported. In many cases, they may prove a bar to the frequency and facility of mercantile exchange. Upon the whole, therefore, it is to be regretted, that they should prevail to so great an extent.

Sect. IV. *Taxes on the Wages of Labour.*

Dr Smith is of opinion, that no tax can fall upon the wages of labour; that wages, in consequence of such taxes, must immediately rise; and that the only effect will be a rise in the price of every species of produce. But how this effect can follow, we confess we do not see. A tax on the wages of labour has no tendency to increase the funds for the maintenance of labour; so far as it has any effect, it tends to diminish them. The supply and the demand will still remain the same. The only way in which such taxes can raise the price of labour, is by diminishing the supply of it, that is, the population; which, in process of time, they are very likely to do. The same funds being then distributed among a smaller number, the wages of labourers will be higher; after paying the tax, they will still subsist as well as formerly; but still a portion will remain to go into the pockets of government. It is to be fully admitted, however, that such taxes are oppressive, and by all means to be avoided. When they diminish, too, the population and raise wages, they produce all the bad effects which Smith imputes to them, in raising the price of every manufactured commodity.

Sect. V. *Of Capitation Taxes.*

The taxes already noticed, are destined to fall on some particular source of revenue; this, and the rest of which we are now to treat, fall indifferently on all.

Capitation taxes are obviously unequal. The same sum is paid by the richest and the poorest. They must fall chiefly, too, on the labouring classes; and what may be most oppressive to them will be scarcely felt by the more opulent. They are not arbitrary, however; they are easily levied; and in absolute governments, where the comfort of the people is little considered, they are pretty frequent. A capitation on slaves must be paid by the masters, and forms a tax on his farming or manufacturing stock.

Sect. VI. *Of Income Tax.*

A well regulated income tax is, in many respects, the most equal which can be imposed. It falls upon every one according to his ability, and it affords no one an opportunity of exempting himself from bearing a share in the public burdens. The expence of collection is small, and it takes as little as possible out of the pockets of the people, in proportion to what it places in those of the government. At the same time, it is liable to serious objections. It demands a disclosure of private circumstances, which must often be a hardship. It affords considerable room for evasion. The payment of a large sum at once is felt much more grievously than the same would be, if paid gradually and insensibly, by taxes on commodities. These causes have hitherto prevented its adoption, unless in a few rare instances, where reliance, it was supposed, could be placed on the good faith of the contributors. This seems to have happened only in some small republics, where the connection between public and private interest was very evident. By this means, however, under the present exigency, a very large sum is now raised in this country, more easily perhaps than it could be raised by any other method. To render it an equal tax, however, some further modification would still be necessary. One broad distinction is that of income which perishes with its owner, and income arising from land or capital. The last is evidently of considerably greater value, yet, under the present system, it is taxed equally. Land, indeed, pays the land tax. We observed above, that the larger a man's income, the greater proportion of it can he afford to pay, since he spends the more on superfluities. In regard to the lower ranks, this is sufficiently provided for by the present income tax; but by levying 10 per cent. on all who have 150l. a-year and upwards, it falls heavy on the middling ranks.

Sect. VII. *Of Taxes on Consumable Commodities.*

Of all taxes these are the least felt. Being directly paid by the merchant, they are felt by the consumers only.

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only in the increased price of the goods. They are thus paid gradually and piecemeal, and every one has the power of paying or not as he chooses. These advantages, especially in countries where the comfort of the subject is much attended to, lead to the very extensive adoption of such taxes. They are attended, however, with very serious drawbacks. No taxes take so much out of the pocket of individuals, in proportion to what they put into that of government. The tax being advanced by the merchant, he expects not only to have it repaid to him in the price of his goods, but to have it repaid with a profit. The commodity will therefore be raised, not merely by the amount of the tax, but by somewhat more than that amount. These taxes also require an host of collecting officers, whose salaries considerably diminish their amount. The visits which these officers must be allowed to make into the warehouse, workshop, and even private house of the merchant and manufacturer, form also a very serious grievance.

Such taxes may be either on necessaries or luxuries. The former are avoided as much as possible, by all wise legislators, as oppressive, falling chiefly on the poor, and having at least an ultimate tendency to raise the wages of labour. In Great Britain, the only taxes on necessaries are those on salt, soap, leather, and candles.

It is of the utmost importance that these duties should be levied in such a manner as not to impede the free transference of commodities from one place to another. In France, before the Revolution, and in other European countries, duties were to be paid almost constantly in passing from one province to another. The alcavala of Spain, the most ruinous of all taxes, levied ten, though afterwards only six per cent. every time a commodity was sold; which amounted almost to an absolute prohibition of all trade.

Sect. VIII. *Of Public Debts.*

Governments are seldom economical; and besides the large expence which is regularly incurred in supporting their establishment, they are liable to great occasional demands, which their ordinary revenue is quite unable to answer. Of these demands the most frequent and pressing is war, whether offensive or defensive; nor is there any cause which so frequently deranges the finances of a nation.

In rude times, when no great capitals are accumulated, and when, from the unsettled state of things, those who have, would be unwilling to lend them, the only resource is in amassing a treasure. This was the policy of the sovereigns and great barons in the middle ages; and it still is that of most of the Asiatic princes. In a commercial state of society, however, sovereigns find ample means and temptation to spend the whole of their ordinary revenue in the luxuries which abound; while, at the same time, the great accumulation of capital enables the merchants easily to advance very large sums to government. In this transaction, they of course receive advantageous terms, and by selling their share of the public debt (thus converting it into a species of commodity, called *stock*), they are enabled to replace their capitals, and carry on their business as before.

Loans made by the government have this disadvantage, that whereas taxes are drawn from the income of the nation, these are drawn from its capital; from the fund by which its industry is supported. They have also the disadvantage, that from the facility with which money may be borrowed, they are apt to increase to an enormous and ruinous amount. To the credit of a private person, there are limits in the extent of his fortune; but these limits do not exist in the case of a government, which possesses an unlimited, or at least indefinite, power of augmenting its means. The interest of the present funded debt of Great Britain would be nearly sufficient for carrying on the most expensive war. In such a case the only remedy is by a sinking fund. A certain annual sum is appropriated to the purpose of paying off the national debt; and the interest which consequently falls in, is added to the original sum, which thus accumulating at compound interest, will increase, after a certain period, with immense rapidity. Before the time of Mr Pitt, there was always, during peace, something in the shape of a sinking fund in Great Britain. It was frequently devoted, however, to other purposes, and never paid off any considerable portion of the debt of the preceding war. He was the first who steadily set aside, in peace and war, a million for this purpose, and allowed it to accumulate at compound interest. Whenever a new loan was raised, he laid on one per cent. as a sinking fund. In consequence of a steady perseverance in this system, there is now a fair prospect of the country being gradually relieved from the burden which pressed upon it. See the Articles COMMERCE, CORN LAWS, POLITICAL ECONOMY, SUPPLEMENT.

Politics, Polity.

POLITICS, the first part of economy or ethics, consisting in the well governing and regulating the affairs of a state for the maintenance of the public safety, order, tranquillity, and morals.

Lord Bacon divides politics into three parts, viz. the *preservation* of the state, its *happiness* and *flourishing*, and its *enlargement*. Of the first two he informs us, various authors have treated, but the last has never been handled; and he has given a specimen of an essay to supply the want.

POLITY, or POLICY, denotes the peculiar form and constitution of the government of any state or nation; or the laws, orders, and regulations, relating thereto *. ——Polity differs only from politics, as the theory from the practice of any art.

* See *Government.*

Of the nature of our social duties, both private and political, we have already spoken at some length (see *MORAL Philosophy*, Part II. chap. iii. and particularly sect. vii.); and we shall have occasion to take a view of the origin and nature of the several political establishments of Europe, &c. hereafter. (See *Civil SOCIETY*). We shall only further remark in this place upon the necessity

cessity of always joining politics and morality together. This view of the subject is indeed antiquated and neglected; but the connection has always been externally respected, even by those who have separated them the most widely. Politics and morality, far from standing in opposition to each other, have the most intimate connection, and exhibit the relation which the *part* bears to the *whole;* that is to say, that politics are only a part or a branch of morality. No truth can be more evident than this; for as morality is the guide of human life, the principle of order, and the universal source of real improvement and genuine happiness to all mankind, every thing relative to the direction of individuals, or the government of nations, must be comprehended within its sphere, and must be subservient to its laws. All the schemes and projects of pretended political wisdom, that deviate from or violate the rules of this master-science, turn out in the issue often to the detriment of their contrivers, always to that of the nation; and it is a palpable and absurd error to think of advancing the happiness of one country at the expence of the general good of mankind. The experience of ages, and the history of the world, confirm these assertions; from which, and from daily observation, we obtain a convincing proof of the wisdom of the good old maxim, both in its application to individuals and to nations, that "honesty is the best policy." See Baron Dahlberg's *Considerations on the Connection between Morality and Politics*, read by himself to the Academy of Sciences at Erfurt.

POLL, a word used in ancient writings for the head: hence to poll, is either to vote, or to enter down the names of those persons who give their votes at an election.

Poll-Evil, a troublesome ulcer on the back of the horse's neck, usually the consequence of external injury. See FARRIERY, N° 395.

Poll Money, or *Capitation*, a tax imposed by authority of parliament on the person or head; either on all indifferently, or according to some known mark or distinction, as quality, calling, &c.

Thus, by the statute 18 Car. II. every subject in the kingdom was assessed by the head, or poll, according to his degree; every duke 100l. marquis 80l. baronet 30l. knight 20l. esquire 10l. &c. and every single private person 12d.

This was no new tax, as appears by former acts of parliament.

POLLACHIUS, or POLLACK. See GADUS, ICHTHYOLOGY *Index*.

POLLARD, or CROCARD, the name of a sort of base money current in Ireland in the time of Edward I. See *Simon's History of Irish Coins*, p. 15.

POLLARDS, a kind of coarse flour. When wheat is ground to meal, and divided into three kinds, according to the degree of fineness, the third or coarsest kind comes under the denomination of pollards.

POLLEN, the fecundating or fertilizing dust contained within the antheræ or tops of the stamina, and dispersed upon the female organ when ripe for the purposes of impregnation. See BOTANY.

This dust, corresponding to the seminal fluid in animals, is commonly of a yellow colour; and is very conspicuous in the summits of some flowers, as the tulip and lily. Its particles are very minute, and of extreme hardness. Examined by the microscope, they are generally found to assume some determinate form, which often predominates, not only through all the species of a particular genus, but also through the genera of a natural family or order. The powder in question being triturated, and otherwise prepared in the stomach of bees, by whom great quantities are collected in the hairy brushes with which their legs are covered, is supposed by some authors to produce the substance known by the name of *wax;* a species of vegetable oil, rendered concrete by the presence of an acid, which must be removed before the substance can be rendered fluid.

POLLENTIA, a town or colony of Roman citizens in the Balearis Major. It is now said to be Alcudia, situated on the north-east side of the island Majorca. There was another *Pollentia* of the Picenum, likewise a colony. It is thought to be either the same with or near to the Urbs Salvia, but is now extinct. There was a third of Liguria, situated at the confluence of the Stura and Tanarus. Suetonius calls it a municipium, and the people *Polentina Plebs.* It was famous for its abundance of black fleeces; but was afterwards, under Arcadius, stained with a defeat rather of the Romans under Stilico than of the Goths under Alaricus, though palliated by Claudian the poet; after which Rome was taken and set on fire. It is now called *Solenza*, a small town of Piedmont, not far from Asti.

POLLEX, in *Anatomy*, denotes either the thumb or great toe, according as *manus* or *pedis* is added to it.

POLLICHIA, a genus of plants belonging to the monandria class, and in the natural method ranking with those that are doubtful. See BOTANY *Index*.

POLLICIS PRESSIO, and POLLICIS VERSIO, were used at the combats of gladiators as signals of life or death to the vanquished combatant; or to the victor to spare or take the life of his antagonist. The *pollicis pressio*, by which the people granted life to the prostrate gladiator, was no more than a clenching of the fingers of both hands together, and so holding the two thumbs upright close together. The *pollicis versio*, which authorised the victor to kill the other as a coward, was the bending back of the thumbs. Such is Dacier's opinion; but others say the *pollicis pressio* was when the people held up one hand with the thumb bent, and the *pollicis versio* when they showed the hand with the thumb raised. Authors, however, are not perfectly agreed, though the phrases *pollicem premere*, and *pollicem vertere*, frequently occur in the Latin classics as indications of the people's will that a gladiator should live or die.

POLLIO, CAIUS ASINIUS, a celebrated Latin poet and orator, was of consular dignity, and composed some tragedies which were esteemed, but are now lost. He was the first who opened at Rome a library for the use of the public. He was the friend of Mark Antony; which prevented his complying with the solicitations of Augustus, who pressed him to embrace his party. At length Augustus having wrote some verses against Pollio, he was urged to answer them: on which he said, "I shall take care of writing against a man who has the power of proscribing us. He is praised by Virgil and Horace, whose patron he was,

There was another *Pollio*, a friend of Augustus, who used to feed his fishes with human flesh. This cruelty was discovered when one of his servants broke a glass in the

the presence of Augustus, who had been invited to a feast. The master ordered the servant to be seized, but he threw himself at the feet of the emperor, and begged him to interfere, and not to suffer him to be devoured by fishes. Upon this the causes of his apprehension were examined; and Augustus, astonished at the barbarity of his favourite, caused the servant to be dismissed, all the fish ponds to be filled up, and the crystal glasses of Pollio to be broken to pieces.

POLLUTION, in general signifies defilement, or the rendering a person or place unclean or unholy. For the Jewish pollutions, see the article IMPURITY.

The Romanists hold a church to be polluted by the effusion of blood or of seed therein: and that it must be consecrated anew. And the Indians are so superstitious on this head, that they break all the vessels which those of another religion have drank out of, or even only touched; and drain all the water out of a pond in which a stranger has bathed.

POLLUTION, in *Medicine*, a disease which consists in an involuntary emission of the seed in time of sleep. This, in different persons, is very different in degree; some being affected with it only once in a week, a fortnight, three weeks, or a month, and others being subject to it almost every night. The persons most subject to it, are young men of a sanguineous temperament, who feed high and lead a sedentary life. When this happens to a person but once in a fortnight or a month, it is of no great consequence; but when it happens almost every night, it greatly injures the health; the patient looks pale and sickly; in some the eyes become weak and inflamed, are sometimes affected with violent defluxions, and are usually at last encircled with a livid appearance of the skin. This distemper is to be cured rather by a change of life than by medicines. When it has taken its rise from a high diet and a sedentary life, a coarser food and the use of exercise will generally cure it. Persons subject to this disease should never take any stimulating purges, and must avoid as much as possible all violent passions of the mind; and though exercise is recommended in moderation, yet if this be too violent, it will rather increase the disorder than contribute to its cure.

Self-POLLUTION. See ONANISM.

POLLUX, JULIUS, a Greek writer of antiquity, flourished in the reign of the emperor Commodus, and was born at Naucrates, a town in Egypt. He was educated under the sophists, and made great progress in grammatical and critical learning. He taught rhetoric at Athens, and became so famous that he was made preceptor of the emperor Commodus. He drew up for his use, and inscribed to him, while his father Marcus Antoninus was living, an *Onomasticon* or Greek vocabulary, divided into ten books. It is extant, and contains a vast variety of synonymous words and phrases, agreeable to the copiousness of the Greek tongue, ranged under the general classes of things. It was intended to facilitate the knowledge of the Greek language to the young prince; and it is still very useful to all who have a mind to be perfect in it. The first edition of it was printed at Venice by Aldus in 1502, and a Latin version was afterwards made and published with it: but there was no correct and handsome edition of it till that of Amsterdam, 1706, in folio, by Lederlinus and Hemsterhusius. Lederlinus went through the first seven books, corrected the text and version, and subjoining his own, with the notes of Salmasius, Is. Vossius, Valesius, and of Kuhnius, whose scholar he had been, and whom he succeeded in the professorship of the oriental languages in the university of Strasburg. Hemsterhusius continued the same method through the three last books: this learned man has since distinguished himself by an excellent edition of Lucian, and other monuments of solid and profound literature.

Pollux wrote many other things, none of which remain. He lived to the age of 58. Philostratus and Lucian have treated him with much contempt and ridicule. *Philostrat. de vit. Sophist.* lib. ii. and *Lucian in Rhetorum præceptore.*

POLLUX. See CASTOR and POLLUX.

POLLUX, in *Astronomy*, a fixed star of the second magnitude, in the constellation Gemini, or the Twins. See CASTOR.

POLLUX and Castor, a fiery meteor. See *CASTOR and Pollux.*

POLOCSKI, a palatinate in the duchy of Lithuania, partly in Poland, and partly in Russia, and under the government of Russia since 1773; bounded on the north by the palatinate of Weytepski, on the south by the Dwina, on the north by Muscovy, and on the west by Livonia. It is a desert country, full of wood, and had formerly its own dukes.

POLOCSKI, a town of Lithuania, and capital of a palatinate of the same name, with two castles to defend it. It was taken by the Muscovites in 1563, and retaken the same year. It is seated on the river Dwina, 50 miles south-west of Weytepski, and 80 east of Breslaw. E. Long. 29. 0. N. Lat. 56. 4.

POLTROON, or POLTRON, a coward or dastard, wanting courage to perform any thing great or noble. The word is borrowed from the French, who according to Salmasius, derived it *à pollice truncato;* because anciently those who would avoid going to the wars cut off their thumb. But Menage, with more probability, derives it from the Italian *poltrone* and that from *poltro* a "bed;" because timorous, pusillanimous people take pleasure in lying a-bed. Others derive the word from the Italian *poltro*, a "colt;" because of that creature's readiness to run away.

POLVERINE, the calcined ashes of a plant; of a similar nature with our pot-ashes or pearl-ashes. It is brought from the Levant and Syria; and in the glass-trade it is always to be preferred to any other ashes. The barilla, or pot-ashes of Spain, yield more pure salt than the polverine of the Levant, but the glass made with it has always some blue tinge: that made with the polverine is perfectly white, which ought always to be used for the finest crystal.

POLYADELPHIA (from πολυς, *many*, and αδελφια, *brotherhood*), many brotherhoods; the name of the 18th class of Linnæus's sexual system, consisting of plants with hermaphrodite flowers, in which several stamina or male organs are united by their filaments into three or more distinct bundles. See CLASSIFICATION under BOTANY.

POLYÆNUS, the name of many famous men recorded in ancient writers. Among them was Julius Polyænus, of whom we have some Greek epigrams extant

tant in the first book of the *Anthologia*. The Polyænus whom it most concerns us to know about, is the author of the eight books of the Stratagems of Illustrious Commanders in War. He was probably a Macedonian, and perhaps a soldier in the early part of his life; but of this there is no certainty. He was undoubtedly a rhetorician and a pleader of causes; and appears, from the dedication of his work to the emperors Antoninus and Verus, to have lived towards the latter part of the second century. The *Stratagemata* were published in Greek by Isaac Casaubon, with notes, in 1589, 12mo; but no good edition of them appeared till that of Leyden, 1690, in 8vo. The title page runs thus: *Polyæni Stratagematum libri octo, Justo Vulteio interprete, Pancratius Maasvicius recensuit, Isaaci Casauboni nec non suas notas adjecit.*

We have in this work the various stratagems of above 300 captains and generals of armies, chiefly Greeks and barbarians; for the Romans seldom used such finesses; and Polyænus has shown further, that he was not well versed in Roman affairs. A great number of these stratagems appear to us to be ridiculous or impracticable; and neither the generals, or even common soldiers of our days, would be found simple enough to be caught by them. Few of this order are capable of reading *Polyænus's Stratagems*; and if they were, they would reap little benefit from it. The book is useful to such as study the Greek language and antiquity; for many things will be found in it, illustrating the customs and opinions of ancient times. The sixth and seventh books are imperfect.

Polyænus composed other works besides the *Stratagemata*. Stobœus has produced some passages out of a book *De Republica Macedonum*; and Suidas mentions a piece concerning the Thebans, and three books of Tacitus. If death had not prevented, he would have written *Memorabilia of the Emperors Antoninus and Verus*: for he makes a promise of this in the preface to his sixth book of *Stratagems*. Casaubon, in the dedication of Polyænus to Mornæus, calls him *an elegant, acute, and learned writer*.

POLYANDRIA (from πολυς, *many*, and ανηρ, a *man*, or *husband*), many husbands. The name of the 13th class in Linnæus's sexual method, consisting of plants with hermaphrodite flowers, which are furnished with several stamina, that are inserted into the common receptacle of the flower. See *Classification* under BOTANY.

POLYANTHEA, a collection of common-places in alphabetical order, for the use of orators, preachers, &c. The word is formed from the Greek πολυς, *much*, and ανθος, *flower*: and has much the same meaning with *anthology* or *florilege*. The first author of the polyanthea was Dominic Nanni de Mirabellio, whose labour has been improved on by Barth. Amantius, and Franc. Torsius; and since these, by Jos. Langius, under the title of *Polyanthea nova*, 1613.

POLYANTHUS. See PRIMULA, BOTANY *Index*; and for the cultivation of this early ornament of the flower-garden, see GARDENING.

POLYBIUS, a famous Greek historian, was born at Megalopolis, a city of Arcadia, 205 years before Christ, and was the son of Lycortas, chief of the republic of the Achæans. He was trained to arms under the celebrated Philopœmen, and is described by Plutarch carrying the urn of that great but unfortunate general in his funeral procession. He arose to considerable honours in his own country, but was compelled to visit Rome with other principal Achæans, who were detained there as pledges for the submission of their state. From hence he became intimate with the second Scipio Africanus, and was present with him at the demolition of Carthage. He saw Corinth also plundered by Mummius, and thence passing through the cities of Achaia, reconciled them to Rome. He extended his travels into Egypt, France, and Spain, that he might avoid such geographical errors as he has censured in others.

It was in Rome that he composed his excellent history, for the sake of which his travels were undertaken. This history was divided into 40 books; but there only remain the five first, with extracts of some parts of the others. It has had several editions in Greek and Latin; and there is an English translation by Mr Hampton. He died at the age of 82.

POLYCARP, one of the most ancient fathers of the Christian church, was born towards the end of the reign of Nero, probably at Smyrna; where he was educated at the expence of Calista, a noble matron distinguished by her piety and charity. He was unquestionably a disciple of St John the Evangelist, and conversed familiarly with other of the apostles. When of a proper age, Bucolus ordained him a deacon and catechist of his church; and upon his death he succeeded him in the bishopric, to which he is said to have been consecrated by St John, who also directed his Apocalypse, among others, to him, under the title of *the angel of the church of Smyrna*. At length the controversy about the observation of Easter beginning to grow high between the eastern and western churches, he went to Rome to discourse with those who were of the opposite party. The see was then possessed by Anicetus, with whom he had many conferences, that were carried on in the most peaceable and amicable manner; and though neither of them could bring the other to embrace his opinion, they both retained their own sentiments without violating that charity which is the great law of their religion.

Whilst at Rome he particularly opposed the heresies of Marcian and Valentinus. His conduct on this occasion is related by Irenæus; who informs us, that when Polycarp passed Marcian in the street without speaking, Marcian said, "Polycarp, own us!" To which he replied with indignation, "I own thee to be the first-born of Satan." Irenæus adds, that when any heretical doctrines were spoken in his presence, he would stop his ears and say, "Good God! to what times hast thou reserved me, that I should hear such things!" and immediately left the place. He was wont to tell, that St John, going into a bath at Ephesus, and finding Cerinthus the heretic in it, immediately started back without bathing, crying out, "Let us run away, lest the bath should fall upon us while Cerinthus the enemy of truth is in it." Polycarp governed the church of Smyrna with apostolic purity, till he suffered martyrdom in the 7th year of Marcus Aurelius; the manner of which is thus related.

The persecution waxing hot at Smyrna, and many having sealed their faith with their blood, the general cry was, "Away with the impious; let Polycarp be sought for." Upon which he privately withdrew into a neighbouring village, where he continued for some time praying night and day for the peace of the church. He was thus employed, when one night he fell into a trance, and dreamed that his pillow took fire, and was burnt to ashes; which, when he awoke, he told his friends was a presage that he should be burnt alive for the cause of Christ. Three days afterwards, in order to escape the incessant search for him, he retired into another village: his enemies, however, were at hand, who seized upon two youths (one of whom they forced by stripes to a confession), by whom they were conducted to his lodging. He might have saved himself by getting into another house; but he submitted, saying, "The will of the Lord be done." He therefore came down from his bed-chamber, and saluting his persecutors with a serene and cheerful countenance, he ordered a table to be set with provisions, invited them to partake of them, and only requested for himself, one hour for prayer; after which he was set upon an ass, and conducted towards Smyrna. On the road he met Herod an irenarch or justice of the province, and his father, who were the principal instigators of the persecution. Herod took him up into his chariot, and strenuously endeavoured to undermine his constancy; but having failed in the attempt, he thrust him out of the chariot with so much violence and indignation that he bruised his thigh with the fall. When at the place of execution, there came, as is said, a voice from heaven, saying, "Polycarp, be strong, and quit thyself like a man." Before the tribunal he was urged to swear by the genius of Cæsar. "Repent (says the proconsul), and say with us, take away the impious." Whereupon the martyr looking round at the crowd with a severe and angry countenance, beckoned with his hand, and looking up to heaven, said with a sigh, in a very different tone from what they meant, "Take away the impious." At last, confessing himself to be a Christian, the crier thrice proclaimed his confession, and the people shouted, "This is the great doctor of Asia, and the father of the Christians; this is the destroyer of our gods, that teaches men not to do sacrifice, or worship the deities." When the fire was prepared, Polycarp requested not to be nailed, as usual, but only tied to the stake; and after a short prayer, which he pronounced with a clear and audible voice, the executioner blew up the fire, which increasing to a mighty flame, "Behold a wonder seen (says my author) by us who were purposely reserved, that we might declare it to others; the flames disposing themselves into the resemblance of an arch, like the sails of a ship swelled with the wind, gently encircled the body of the martyr, who stood all the while in the midst, not like roasted flesh, but like the gold or silver purified in the furnace, his body sending forth a delightful fragrancy, which like frankincense or some other costly spices, presented itself to our senses. The infidels, exasperated by the miracle, commanded a spearman to run him through with a sword: which he had no sooner done, but such a vast quantity of blood flowed from the wound as extinguished the fire; when a dove was seen to fly from the wound, which some suppose to have been his soul, clothed in a visible shape at the time of its departure (A)." The Christians endeavoured to carry off his body entire, but were not allowed by the irenarch, who commanded it to be burnt to ashes. The bones, however, were gathered up, and decently interred by the Christians.

Thus died St Polycarp, the 7th of the kalends of May, A. C. 167. The amphitheatre on which he suffered was mostly remaining not many years ago; and his tomb, which is in a little chapel in the side of a mountain, on the south-east of the city, was solemnly visited by the Greeks on the festival day; and for the maintenance and repairing of it, travellers were wont to throw a few aspers into an earthen pot that stands there for the purpose. He wrote some homilies and epistles, which are now lost, except that to the Philippians, which is a truly pious and Christian piece, containing short and useful precepts and rules of life, which St Jerome informs us was even in his time read in the public assemblies of the Asiatic churches. It is singularly useful in proving the authenticity of the books of the New Testament; for he has several passages and expressions from Matthew, Luke, the Acts, St Paul's Epistles to the Philippians, Ephesians, Galatians, Corinthians, Romans, Thessalonians, Colossians, 1st Timothy, 1st Epistle of St John, and 1st of Peter; and makes particular mention of St Paul's Epistle to the Ephesians. Indeed his whole Epistle consists of phrases and sentiments taken from the New Testament (B).

POLYCARPON, a genus of plants, belonging to the triandria class; and in the natural method ranking under the 22d order, *Caryophyllei*. See BOTANY *Index*.

POLYCHREST, in *Pharmacy*, signifies a medicine that serves many uses, or that cures many diseases.

Sal POLYCHREST, a compound salt made of equal parts of saltpetre and sulphur, deflagrated in a red-hot crucible. See MATERIA MEDICA.

POLYCNEMUM, a genus of plants, belonging to the triandria class; and in the natural method ranking under the 12th order, *Holoraceæ*. See BOTANY *Index*.

POLYCRATES, was a tyrant of Samos, famous for the good fortune which always attended him. He became very powerful; and got possession not only of the neighbouring islands, but also of some cities on the coast of Asia. He had a fleet of 100 ships of war, and was so universally esteemed, that Amasis the king of Egypt made a treaty of alliance with him. The Egyptian king was, however, afraid of his continued prosperity, and advised him to chequer his enjoyments, by relinquishing some of his most favourite objects. Polycrates, in compliance, threw into the sea a beautiful seal, the most valuable of his jewels. The loss of so precious a seal afflicted him for some time; but soon after he received as a present a large fish, in whose belly it was found. Amasis no sooner heard this, than he gave up all

(A) The miraculous part of this account is ridiculed by Dr Middleton in his Free Enquiry and Defence of it; but something is offered in its favour by Mr Jortin, who observes, "the circumstances are sufficient only to create a pause and a doubt." *Remarks on Eccl. Hist.* vol. i.

(B) Jortin, vol. i. 68. who to the particulars made out by Cotelerius, has added one from Galat. iv. 26. and another from Hebr. iv. 12, 13.

all alliance with the tyrant of Samos, and observed, that sooner or later his good fortune would vanish. Some time after Polycrates visited Magnesia on the Mæander, where he had been invited by Orontes the governor. Here he was shamefully put to death, merely because the governor wished to terminate his prosperity. The daughter of Polycrates had dissuaded her father from going to the house of Orontes on account of the bad dreams which she had, but in vain.

POLYCROTA, in the naval architecture of the ancients, is a word used to express such of their galleys as had three, four, five, or more tiers of rowers, seated at different heights; they were distinguished by this term from the *monocrota*, or those which had only single rows of oars. The number of rows of rowers in the polycrote galleys has given occasion to some to suppose those vessels of such a height from the water as is scarce credible. Commentators are not at all agreed upon the construction of these vessels.

POLYDAMAS, was a famous athlete, who imitated Hercules in whatever he did. He killed a lion with his fist; and it is reported he could stop a chariot with his hand in its most rapid course. He was one day with some of his friends in a cave, when on a sudden a large piece of rock came tumbling down, and while all fled away, he attempted to receive the falling fragment in his arms. His prodigious strength, however, was insufficient, and he was instantly crushed to pieces under the rock.

POLYDECTES, a son of Magnes, was king of the island of Seriphos. He received with great kindness Danae and her son Perseus, who had been exposed on the sea by Acrisius. He took great care of the education of Perseus; but becoming enamoured of Danae, he removed her from his kingdom, apprehensive of his resentment. He afterwards paid his adresses to Danae; and being rejected, he prepared to offer her violence. Danae fled to the altar of Minerva for protection; and Dictys, the brother of Polydectes, who had himself saved him from the sea-waters, opposed her ravisher, and armed himself in her defence. At this critical moment Perseus arrived; and with Medusa's head he turned into stones Polydectes, with the associates of his guilt. The crown of Seriphos was given to Dictys, who had shown himself so active in the cause of innocence.

POLYDORE VIRGIL. See VIRGIL.

POLYDORUS, a son of Priam by Hecuba, or, according to others, by Laothe, the daughter of Altes, king of Pedasus. Being young and inexperienced when Troy was besieged by the Greeks, his father removed him to the court of Polymnestor, king of Thrace, to whose care he entrusted the greatest part of his treasures, till his country should be freed from foreign invasion. On the death of Priam, Polymnestor made himself master of the riches which were in his possession; and to ensure them the better, he murdered the young prince, and threw his body into the sea, where it was found by Hecuba. According to Virgil, his body was buried near the shore by his assassin; and there grew on his grave a myrtle, whose boughs dropped blood, when Æneas going to Italy, attempted to tear them from the tree.

POLYGALA, MILKWORT; a genus of plants belonging to the diadelphia class; and in the natural method ranking under the 33d order, *Lomentaceæ*. See BOTANY *Index*.

POLYGAMIA (πολυς, *many*, and γαμος, *marriage*), is a term expressing an intercommunication of sexes, and is applied by Linnæus both to plants and flowers. A polygamous plant is that which bears both hermaphrodite flowers, and male or female, or both.

POLYGAMY, a plurality of wives or husbands, in the possession of one man or woman at the same time.

Polygamy is so universally esteemed unlawful, and even unnatural, through Europe, and in all Christian countries, that we have generally reasoned upon this conviction. Both religion and reason appear at first sight at least to condemn it; and with this view of the subject mankind in general rest satisfied: but some bolder geniuses have taken the opposite side of the question; have cast off the prejudices of education, and attempted to show that polygamy is not unlawful, but that it is just and necessary, and would be a public benefit. Such writers, to use the words of an intelligent critic *, "recur to the common subterfuge, of which every *setter up of strange gods*, and every CONSCIENTIOUS troubler of the public peace, have artfully availed themselves to silence the clamour of expostulation. 'TRUTH! TRUTH!' is their general cry: and with this hopeful pretence, prudence and humility, and every amiable and useful virtue, are left behind; while CONSCIENCE (*con-science!*) blindly rushes forward to oppose order, insult authority, and overturn the customs of ages."

But notwithstanding these fair pretences, it will, we doubt not, be easy to show that truth is not upon their side; prudence and delicacy are certainly at open war with them: for Dr Percival, Phil. Trans. vol. lxvi. part i. p. 163. has very justly observed, that the practice is brutal, destructive to friendship and moral sentiment, inconsistent with one great end of marriage, the education of children, and subversive of the natural rights of more than half of the species. Besides, it is injurious to population, and therefore can never be countenanced or allowed in a well-regulated state; for though the number of females in the world may considerably exceed the number of males, yet there are more men capable of propagating their species than women capable of bearing children; and it is a well known fact, that Armenia, in which a plurality of wives is not allowed, abounds more with inhabitants than any other province of the Turkish empire.

Indeed it appears, that in some countries where it is allowed, the inhabitants do not take advantage of it. "The Europeans (says M. Niebuhr †) are mistaken in thinking the state of marriage so different among the Mussulmans from what it is with Christian nations. I could not discern any such difference in Arabia. The women of that country seem to be as free and as happy as those of Europe possibly can be. Polygamy is permitted, indeed, among Mahometans, and the delicacy of our ladies is shocked at this idea; but the Arabians rarely avail ‡ themselves of the privilege of marrying four lawful wives, and entertaining at the same time any number of female slaves. None but rich voluptuaries marry so many wives, and their conduct is blamed by all sober men. Men of sense, indeed, think this privilege rather troublesome than convenient. A husband is by law obliged to treat his wives suitably to their condition, and to dispense his favours among them with perfect

perfect equality: but these are duties not a little disagreeable to most Mussulmans; and such modes of luxury are too expensive to the Arabians, who are seldom in easy circumstances. I must, however, except one case; for it sometimes happens that a man marries a number of wives in the way of commercial speculation. I know a Mullah, in a town near the Euphrates, who had married four wives, and was supported by the profits of their labour."

See a curious kind of polygamy under the article NAYRES. The ancient Britons, too, had a kind of polygamy among them, 12 women being common to 12 men.

Selden has proved, in his *Uxor Hebraica*, that plurality of wives was allowed of, not only among the Hebrews, but also among all other nations, and in all ages. It is true, the ancient Romans were more severe in their morals, and never practised it, though it was not forbid among them: and Mark Antony is mentioned as the first who took the liberty of having two wives.

From that time it became pretty frequent in the empire till the reigns of Theodosius, Honorius, and Arcadius, who first prohibited it by express law in 393. After this the emperor Valentinian, by an edict, permitted all the subjects of the empire, if they pleased, to marry several wives: nor does it appear, from the ecclesiastical history of those times, that the bishops made any opposition to the introduction of polygamy. In effect, there are some even among the Christian casuists who do not look on polygamy as in itself criminal. Jurieu observes, that the prohibition of polygamy is a positive law, but from which a man may be exempted by sovereign necessity. Baillet adds, that the example of the patriarchs is a powerful argument in favour of polygamy: of these arguments we shall speak hereafter.

It has been much disputed among the doctors of the civil law whether polygamy be adultery. In the Roman law it is called *stuprum*, and punished as such, that is, in some cases capitally. But a smaller punishment is more consistent with the Jewish law, wherein the prohibition of adultery is perpetual, but that of polygamy temporary only.

In Germany, Holland, and Spain, this offence is differently punished. By a constitution of Charles V. it was a capital crime. By the laws of ancient and modern Sweden it is punished with death. In Scotland it is punished as perjury.

In England it is enacted by statute 1 Jac. I. cap. 11. that if any person, being married, do afterwards marry again, the former husband or wife being alive, it is felony, but within the benefit of clergy. The first wife, in this case, shall not be admitted as an evidence against her husband, because she is the true wife; but the second may, for she is indeed no wife at all; and so *vice versa* of a second husband. This act makes an exception to fives cases, in which such second marriage, though in the three first it is void, is however no felony. 1. Where either party hath been continually abroad for seven years, whether the party in England had notice of the other's being living or not. 2. Where either of the parties hath been absent from the other seven years within this kingdom, and the remaining party hath had no notice of the other's being alive within that time. 3. Where there is a divorce or separation *à mensa et thoro* by sentence in the ecclesiastical court. 4. Where the first marriage is declared absolutely void by any such sentence, and the parties loosed *à vinculo*. Or, 5. Where either of the parties was under the age of consent at the time of the first marriage; for in such case the first marriage was voidable by the disagreement of either party, which this second marriage very clearly amounts to. But if at the age of consent the parties had agreed to the marriage, which completes the contract, and is indeed the real marriage, and afterwards one of them should marry again, Judge Blackstone apprehends that such second marriage would be within the reason and penalties of the act.

Bernardus Ochinus, general of the order of Capuchins, and afterwards a Protestant, published, about the middle of the 16th century, Dialogues in favour of Polygamy, which were answered by Theodore Beza. And about the conclusion of the last century we had at London an artful treatise published in behalf of a plurality of wives, under the title of *Polygamia Triumphatrix*: the author whereof assumes the name of *Theophilus Aletheus*; but his true name was *Lyserus*. He was a native of Saxony. It has been answered by several.

A new argument in favour of polygamy has been adduced by Mr Bruce, on this principle, that in some parts of the world the proportion of female children is much greater than that of the males. "From a diligent inquiry (says he) into the south and scripture part of Mesopotamia, Armenia, and Syria, from Mousul or Nineveh to Aleppo and Antioch, I find the proportion to be fully two women to one man. There is indeed a fraction over, but it is not a considerable one. From Latikea, Laodicea *ad mare*, down the coast of Syria to Sidon, the number is nearly three, or two and three-fourths, to one man. Through the Holy Land, the country called *Horan*, in the isthmus of Suez, and the parts of the Delta unfrequented by strangers, it is something less than three. But from Suez to the straits of Babelmandel, which contains the three Arabias, the proportion is fully four women to one man; which I have reason to believe holds as far as the line, and 30° beyond it. The Imam of Sama was not an old man when I was in Arabia Felix in 1769; but he had 88 children then alive, of whom 14 only were sons. The priest of the Nile had 70 and odd children: of whom, as I remember, above fifty were daughters.

"It may be objected, that Dr Arbuthnot, in quoting the bills of mortality for 20 years, gave the most unexceptionable grounds for his opinion; and that my single exception of what happens in a foreign country, without further foundation, cannot be admitted as equivalent testimony: and I am ready to admit this objection, as there are no bills of mortality in any of these countries. I shall therefore say in what manner I attained the knowledge which I have just mentioned. Whenever I went into a town, village, or inhabited place, dwelt long in a mountain, or travelled journeys with any set of people, I always made it my business to inquire how many children they had, or their fathers, their next neighbours or acquaintance. I then asked my landlord at Sidon, suppose him a weaver, how many children he has had? He tells me how many sons and how many daughters. The next I ask is a tailor, a smith, &c. in short every man who is not a stranger, from

from whom I can get the proper information. I say, therefore, that a medium of both sexes, arising from three or four hundred families, indiscriminately taken, shall be the proportion in which one differs from the other: and this, I am confident, will give the result to be three women in 50° of the 90° under every meridian of the globe."

Our author corroborates this argument by supposing that Mahomet perceived this disproportion, and that upon it he founded his institution allowing one man to have four wives. "With this view he enacted, or rather revived, the law which gave liberty to every individual to marry four wives, each of whom was to be equal in rank and honour, without any preference but what the predilection of the husband gave her."

Having thus established, as he supposes, the necessity of polygamy in the East, Mr Bruce proceeds to consider whether there is not some other reasons why it should not be practised in Britain farther than the mere equality in numbers of the sexes to one another. This reason he finds in the difference between the constitutions of the Europeans and eastern nations. "Women in England (says he) are capable of child-bearing at 14; let the other term be 48, when they bear no more; 34 years therefore an English woman bears children. At the age of 14 or 15 they are objects of our love; they are endeared by bearing us children after that time; and none, I hope, will pretend, that at 48 and 50 an Englishwoman is not an agreeable companion. The Arab, on the other hand, if she begins to bear children at 11, seldom or never has a child after 20. The time, then, of her child-bearing is nine years; and four women, taken altogether, have then the term of 36. So that the English woman that bears children for 34 years has only two years less than the term enjoyed by the four wives whom Mahomet has allowed; and if it be granted that an English wife may bear at 50, the terms are equal. But there are other grievous differences. An Arabian girl at 11 years old, by her youth and beauty, is the object of man's desire: being an infant, however, in understanding, she is not a rational companion for him. A man marries there, say at 20; and before he is 30, his wife, improved as a companion, ceases to be the object of his desires and a mother of children: so that all the best and most vigorous of his days are spent with a woman he cannot love; and with her he would be destined to live 40 or 45 years, without comfort to himself by increase of family, or utility to the public. The reasons, then, against polygamy, which subsist in England, do not by any means subsist in Arabia; and that being the case, it would be unworthy of the wisdom of God, and an unevenness in his ways, which we shall never see, to subject two nations under such different circumstances absolutely to the same observances."

To all this argumentation, however, it may be replied, that whatever we may now suppose to be the constitution of nature in the warmer parts of the globe, it certainly was different at the beginning. We cannot indeed, ascertain the exact position of the Garden of Eden; but it is with reason supposed not to have been far from the ancient seat of Babylon. In that country, therefore, where Mr Bruce contends that *four* women are necessary to the comfort of one man, it pleased God to grant only *one* to the first man; and that, too, when there was more occasion for population than ever there has been since, because the whole earth was to be peopled from a single pair. Matters were not altered at the flood; for Noah had but one wife. And this is the very argument used by our Saviour himself when speaking of divorce without any sufficient cause, and then marrying another woman, which is a species of polygamy.—Again, with respect to the alleged multiplicity of females in the eastern part of the world, it is by no means probable that the calculations of Mr Bruce or any other person can be admitted in this case. History mentions no such thing in any nation; and considering the vast destruction among the male part of the human species more than that of the females by war and other accidents, we may safely say, that if *four* women children were born for every single male, there would in such countries be five or six grown up women for every man; a proportion which we may venture to affirm does not, nor ever did, exist anywhere in the world. That it was not so in former times, we can only judge from the particular examples recorded in history, and these are but few. We read in the Greek history, indeed, of the *fifty* daughters of Danaus; but these were matched by as many *sons* of another man. Job had only one wife, yet had *seven* sons and but *three* daughters. Jacob had two wives, who bore *twelve* sons, and only one daughter. Abraham had only one child by his first wife, and that was a son. By his second wife Keturah he had six sons; and considering his advanced age at the time he married her, it is by no means probable that he could have 24 daughters; nay, if, as Mr Bruce tells us, the women in the eastern countries bear children only for nine years, it was impossible she could have so many. Gideon, who had many wives, had no fewer than seventy sons by these wives, and even his concubine had a son; so that if all these women had produced according to Mr Bruce's proportion, of nearly three females to one male, he must have had almost 284 children; a better family than any of Mr Bruce's eastern acquaintance can probably boast of.

With regard to the subject, however, it must be observed, that the procreation of male or female children depends in some degree on the health and vigour of the parents. It is by no means improbable, therefore that the eastern voluptuaries, whose constitutions are debilitated by their excesses, may have many more female than male children born to them. The women themselves, by premature enjoyment, will also be inclined to produce females instead of males; but neither of these circumstances can prove this to be an original law of nature. Something like this may be gathered from sacred history. Gideon above mentioned, who was a hardy and active warrior, had many sons. The same was the case with David, who led an active and laborious life; while Solomon, who was a voluptuary, had only one son, notwithstanding his multitude of wives.

The most barefaced defence of polygamy that has appeared in modern times is by the Rev. Mr Madan, who published a treatise, artfully vindicating, and strongly recommending it, under the title of *Thelyphthora*; or *A Treatise on Female Ruin, in its Causes, Effects, Consequences, Prevention, and Remedy*, &c. Marriage, according to this writer, simply and wholly consists in the act of personal union, or *actus coitus*. Adultery, he says, Polygamy.

says, is never used in the sacred writings but to denote the defilement of a betrothed or married woman, and to this sense he restricts the use of the term; so that a married man, in his opinion, is no adulterer, if his commerce with the sex be confined to single women, who are under no obligations by espousals or marriage to other men: but, on the other hand, the woman who should dare to have even but once an intrigue with any other man besides her husband, (let him have as many wives as Solomon), would, *ipso facto*, be an adulteress, and ought, together with her gallant, to be punished with immediate death. This, he boldly says, is the law of God: and on this foundation he limits the privilege of polygamy to the man; in support of which he refers to the polygamous connections of the patriarchs and saints of the Old Testament, and infers the lawfulness of their practice from the blessings which attended it, and the laws which were instituted to regulate and superintend it. He contends for the lawfulness of Christians having, like the ancient Jews, more wives than one; and labours much to reconcile the genius of the evangelical dispensation to an arrangement of this sort. With this view he asserts, that there is not one text in the New Testament that even hints at the criminality of a polygamous connection; and he would infer from St Paul's direction, that bishops and deacons should have but one wife, that it was lawful for laymen to have more. Christ, he says, was not the giver of a new law; but the business of marriage, polygamy, &c. had been settled before his appearance in the world, by an authority which could not be revoked. Besides, this writer not only thinks polygamy lawful in a religious, but advantageous in a civil light, and highly politic in a domestic view.

In defence of his notion of marriage, which, he says, consists in the union of man and woman as one body, the effects of which in the sight of God no outward forms or ceremonies of man's invention can add to or detract from, he grounds his principal argument on the Hebrew words made use of in Gen. ii. 24. to express the primitive institution of marriage, viz. רבק כאשתו, rendered by the LXX. *προσκολληθησεται προς την γυναικα αυτου*, which translation is adopted by the evangelist (Mat. xix. 5.) with the omission only of the superfluous preposition (*προς*) after the verb. Our translation, "shall cleave to his wife," doth not, he says, convey the idea of the Hebrew, which is literally, as Montanus renders the words, "shall be joined or cemented *in* his woman, and they shall become (i. e. by this union) one flesh." But on this criticism it is well remarked, that both the Hebrew and Greek terms mean simply and literally attachment or adherence; and are evidently made use of in the sacred writings to express the whole scope of conjugal fidelity and duty, though he would restrain them to the grosser part of it.

With respect to the Mosaic law, for which Mr Madan is a warm advocate, it was certainly a local and temporary institution, adapted to the ends for which it was appointed, and admirably calculated, in its relation to marriage, to maintain and perpetuate the separation of the Jewish people from the Gentiles. In attempting to depreciate the outward forms of marriage, this writer would make his readers believe, that because none are explicitly described, therefore none existed; and consequently that they are the superfluous ordinances of human policy. But it is evident, from comparing Ruth iv. 10, 13. with Tobit vii. 13, 14. and from the case of Dinah, related Gen. xxxiv. that some forms were deemed essential to an honourable alliance by the patriarchs and saints under the Old Testament, exclusive of the carnal knowledge of each other's persons. It is also evident in the case of the woman of Samaria, whose connection with a man not her husband is mentioned in John iv. that something besides cohabitation is necessary to constitute marriage in the sight of God.

Having stated his notion of marriage, he urges, in defence of polygamy, that, notwithstanding the seventh commandment, it was allowed by God himself, who made laws for the regulation of it, wrought miracles in support of it by making the barren woman fruitful, and declared the issue legitimate to all intents and purposes. God's allowance of polygamy is argued from Exod. xxi. 10. and particularly from Deut. xxi. 15. which, he says, amounts to a demonstration. This passage, however, at the utmost, only presupposes that the practice might have existence among so hard-hearted and fickle a people as the Jews; and therefore wisely provides against some of its more unjust and pernicious consequences, such as tended to affect the rights and privileges of heirship. Laws enacted to regulate it cannot be fairly urged in proof of its lawfulness on the author's own hypothesis; because laws were also made to regulate divorce, which Mr Madan condemns as absolutely unlawful, except in cases of adultery. Besides, it is more probable that the "hated wife" had been dismissed by a bill of divorcement, than that she was retained by her husband: and, moreover, it is not certain but that the two wives, so far from living with the same husband at the same time, might be dead; for the words may be rendered thus, "if there *should have been* to a man two wives, &c." The words expressing the original institution of marriage, Gen. ii. 24. compared with Matt. xix. 4, 5, 8. affords insuperable objections against Mr Madan's doctrine of polygamy.

If we appeal, on this subject, from the authority of Scripture to the writings of the earliest fathers in the Christian church, there is not to be found the faintest trace of any thing resembling a testimony to the lawfulness of polygamy; on the contrary, many passages occur, in which the practice of it is strongly and explicitly condemned.

Monthly Review, vol. lxiii. p. 338. See also vol. lxix.

We shall close this article with the words of an excellent anonymous writer already quoted, and to whose critique on Mr Madan's work we are indebted for the above remarks: "In a word, when we reflect that the primitive institution of marriage limited it to one man and one woman; that this institution was adhered to by Noah and his sons, amidst the degeneracy in which they lived, and in spite of the examples of polygamy which the accursed race of Cain had introduced; when we consider how very few (comparatively speaking) the examples of this practice were among the faithful; how much it brought its own punishment with it; and how dubious and equivocal those passages are in which it appears to have the sanction of divine approbation; when to these reflections we add another, respecting the limited views and temporary nature of the more ancient dispensations and institutions of religion—how often the imperfections and even vices of the patriarchs and people of God, in old time, are recorded, without any express notification of their criminality—how much is said to be commanded, which our reverence for the holiness of

Polygamy, Polygars.

of God and his law will only suffer us to suppose, were, for wise ends, permitted—how frequently the messengers of God adapted themselves to the genius of the people to whom they were sent, and the circumstances of the times in which they lived:—above all, when we consider the purity, equity, and benevolence of the Christian law; the explicit declarations of our Lord, and his apostle St Paul, respecting the institution of marriage, its design and limitation;—when we reflect, too, on the testimony of the most ancient fathers, who could not possibly be ignorant of the general and common practice of the apostolic church; and, finally, when to these considerations we add those which are founded on justice to the female sex, and all the regulations of domestic economy and national policy—we must wholly condemn the revival of polygamy; and thus bear our honest testimony against the leading design of this dangerous and ill-advised publication."

We would advise our readers to peruse the whole criticisms on Madan's book in the Monthly Review, together with their account of the several answers to it. The reverend author of the Thelyphthora has there met with a most able antagonist, who traces him through all his deceitful windings, and exposes the futility and falsehood of his arguments with singular ability. See *Monthly Review*, vol. lxiii. p. 273, &c.; see also *Paley's Moral Philosophy*, 4to. p. 262.

POLYGARS, are natives of Hindostan. They inhabit almost impenetrable woods, and are under the absolute direction of their own chieftains. In time of peace they are professionally robbers, but in times of war are the guardians of the country. The general name of these people is *Polygar*. Their original institution, for they live in distinct clans, is not very well understood. It probably took its rise from the municipal regulations relative to the destruction of tygers and other ferocious beasts. Certain tracts of woodland were indisputably allotted as rewards to those who should slay a certain number of those animals; and those lands approximating, probably laid the foundation of the several confederacies of Polygars.

"The Pollams, or woods, from which is derived the word *Polygar*, lying in profusion through all the southern parts of Hindostan, the ravages committed in the open countries by these adventurous clans, are both frequent and destructive. Cattle and grain are the constant booty of the Polygars. They not unfrequently even despoil travellers of their property, and sometimes murder, if they meet with opposition; yet these very Polygars are the hands into which the aged and infirm, the wives, children, and treasure, of both Hindoos and others are entrusted, when the circumjacent country unfortunately happens to be the seat of war. The protection they afford is paid for; but the price is inconsiderable, when the helpless situation of those who fly to them for shelter is considered, and especially when their own very peculiar character is properly attended to. The native governments of Hindostan are under the necessity of tolerating this honourable banditti. Many of them are so formidable as to be able to bring 15,000 and 20,000 men into the field.

"The Hindoo code of laws, in speaking of robberies, hath this remarkable clause, 'The mode of shares amongst robbers shall be this:—If any thief or thieves, by the command of the magistrate, and with his assistance, have committed depredations upon, and brought away any booty from, another province, the magistrate shall receive a share of one-sixth part of the whole. If they received no command or assistance from the magistrate, they shall give the magistrate in that case one-tenth part for his share, and of the remainder their chief shall receive four shares; and whosoever among them is perfect master of his occupation, shall receive three shares: also, whichever of them is remarkably strong and stout, shall receive two shares, and the rest shall receive each one share.' Here, then, we see not only a sanction, but even an inducement, to fraudulent practices.—Another singular inconsistency among a people who, in many periods of their history, have been proverbial for innocency of manners, and for uncommon honesty in their conduct towards travellers and strangers.

"At the first sight, it would appear that the toleration of the Polygars is owing to their great numbers, and to the security of their fortresses, which are in general impenetrable but to Polygars: that the government licence, in this manner given to them, to live on the spoils of the industrious, might have originally occasioned the formal division, and encouragement to perseverance, which we have just quoted: but the cause I should rather suppose to lie in the nature of certain governments, than to have arisen from any accidental circumstance afterwards: and I am the more inclined to this opinion, from the situation of the northern parts of Hindostan, which are, and always have been, uninfested by these freebooters.

"The dominion of the East was, in former days, most probably divided and subdivided into all the various branches of the feodal system. The vestiges of it remain to this hour: rajahs and zemindars are nothing more than chieftains of a certain degree of consequence in the empire. If, then, experience has shown, in other parts of the world, that clans have always been observed to commit the most pernicious acts of depredation and hostility on each other, and that the paramount lord has seldom been able effectually to crush so general and so complicated a scene of mischief—may we not reasonably venture to suppose, that the Hindoo legislature passed this ordinance for the suppression of such provincial warfare, and for the wholesome purpose of drawing the people, by unalarming degrees, more immediately under the controul of the one sovereign authority? The conclusion, I own, appears to me satisfactory. Moreover, Polygars cannot but be of modern growth; for the law relative to thefts is antecedent to the mention of Polygars in history." Sullivan's *Philosophical Rhapsodies*.

POLYGLOTT, among divines and critics, chiefly denotes a Bible printed in several languages. See BIBLE and PRINTING.

POLYGLOTTUS, a species of bird, belonging to the genus turdus. See TURDUS, ORNITHOLOGY *Index*.

POLYGNOTUS, a famous painter of Thasos, flourished about 422 years before the Christian era, and was the son and scholar of Aglaophon. He adorned one of the public porticoes of Athens with his paintings, in which he had represented the most striking events of the Trojan war. The Athenians were so pleased with him, that they offered to reward his labours with whatever he pleased to accept; but he declined the offer; and the

Amphictyonic

Amphictyonic council which was composed of the representatives of the principal cities of Greece, ordered that Polygnotus should be maintained at the public expence wherever he went.

Of the talents of Polygnotus much honourable mention is made by many of the best authors of antiquity, as Aristotle and Plutarch, Dionysius Halicarnassensis, &c. Pausanis speaks of his pictures of the events of the Trojan war, and, in his Tenth Book, introduces a very long description of other pictures by the same artist, painted also from Homer in the temple at Delphos. The passage, however, gives but a confused and imperfect idea of the painter's performance. How much the art is indebted to this ancient master, what grace and softness he gave to the human countenance, what embellishments he added to the female figure and dress, are much more happily described by Pliny. "Primus mulieres lucida veste pinxit, capita earum mitris versicoloribus operuit, plurimumque picturæ primus contulit: siquidem instituit os adaperire, dentes ostendere, vultum ab antiquo rigore variare."—The same author likewise bears honourable testimony to the liberal spirit of this great artist, who refused any reward for his ingenious labours in the portico.—"Porticum gratuito, cum partem ejus Mycon mercede pingeret." Plin. lib. xxxv. cap. 8.

POLYGON, in *Geometry*, a figure with many sides, or whose perimeter consists of more than four sides at least; such are the pentagon, hexagon, heptagon, &c.

POLYGONUM, Knot-grass; a genus of plants belonging to the octandria class; and in the natural method ranking under the 12th order, *Holoraceæ*. See Botany *Index*.

POLYGRAPHY, Polygraphia, or *Polygraphice*, the art of writing in various unusual manners or cyphers; as also of decyphering the same. The word is formed from the Greek, πολυ, *multum*, and γραφη, *scriptura*, "writing."

The ancients seem to have been very little acquainted with this art; nor is there any mark of their having gone beyond the Lacedæmonian scytala. Trithemius, Porta, Vigenere, and Father Niceron, have written on the subject of polygraphy or ciphers. See Cipher.

POLYHYMNIA, in the pagan mythology, one of the nine muses, thus named from the Greek words πολυς, "much," and μνεια, "memory." She presided over history, or rather rhetoric; and is represented with a crown of pearls and a white robe; her right hand in action as if haranguing, and holding in her left a caduceus or sceptre to show her power.

POLYHEDRON, in *Geometry*, denotes a body or solid comprehended under many sides or planes.

Polyhedron, in *Optics*, is a multiplying glass or lens, consisting of several plane surfaces disposed into a convex form. See Optics.

POLYMATHY, denotes the knowledge of many arts and sciences. The word is derived from the Greek, πολυ, *multum*, and μανθανω, *disco*.

POLYMNESTOR, was a king of the Thracian Chersonesus. He married Ilione, Priam's eldest daughter; and for the sake of the treasure with which he was entrusted by Priam during the siege of Troy, he murdered Polydorus, (see Polydorus). The fleet in which the victorious Greeks returned, together with their Trojan captives, among whom was Hecuba, stopped on the coast of Thrace, where one of the female captives discovered on the shore the body of Polydorus, whom Polymnestor had thrown into the sea. The dreadful intelligence was immediately communicated to Hecuba his mother, who recollecting the frightful dreams she had the preceding night, did not doubt but Polymnestor was the cruel assassin. Resolved to revenge her son's death, she immediately called out Polymnestor, as if to impart to him something of importance. He was drawn into the snare; and no sooner was he introduced into the apartment of the Trojan princess, than the female captives rushing upon him, put out his eyes with their pins, while Hecuba murdered his two children, who had accompanied him. Euripides informs us, that the Greeks condemned Polymnestor to be banished into a distant island for his perfidy. Hyginus, however, relates the whole differently, and tells us, that when Polydorus was sent to Thrace, Ilione his sister took him instead of her son Deiphilus, who was of the same age, being fearful of her husband's cruelty. The monarch, unacquainted with the imposition, looked upon Polydorus as his own son, and treated Deiphilus as her brother. After the destruction of Troy, the conquerors wished the house and family of Priam to be extirpated, and therefore offered Electra the daughter of Agamemnon to Polymnestor, if he would destroy Ilione and Polydorus. He accepted the offer, and immediately dispatched his own son Deiphilus, whom he took for Polydorus. Polydorus, who passed as the son of Polymnestor, consulted the oracle after the murder of Deiphilus, and being informed that his father was dead, his mother a captive in the hands of the Greeks, and his country in ruins, he communicated the answer to Ilione, whom he had always regarded as his mother. She told him the measures she had pursued to save his life, upon which he avenged the perfidy of Polymnestor by putting out his eyes.

POLYMNIA, a genus of plants belonging to the syngenesia class, and in the natural method ranking under the 49th order, *Compositæ*. See Botany *Index*.

POLYNICES, the son of Oedipus by his mother Jocasta. See Jocasta, Oedipus, and Eteocles.

POLYPE. See Polypus.

POLYPETALOUS, among botanists, an epithet applied to such flowers as consist of several petals or flower-leaves.

POLYPHEMUS (fab. hist.), a celebrated Cyclops, and king of all the Cyclops in Sicily, was the son of Neptune and Thoosa the daughter of Phorcys. He is said to have been a monster of great strength, very tall, and with one eye in the middle of the forehead. He ate human flesh, and kept his flocks on the coasts of Sicily, when Ulysses, at his return from the Trojan war, was driven there. Ulysses, together with 12 of his companions, visited the coast, and with them was seized by the Cyclops, who confined them in his cave, and daily devoured two of them. Ulysses would have shared the fate of the rest, had he not intoxicated the Cyclops, and put out his eye with a firebrand when he was asleep. Polyphemus was awakened by the sudden pain, and stopped the entrance of his cave; but Ulysses escaped, by creeping between the legs of the rams of the Cyclops, as they were led out to feed on the mountains. Polyphemus became enamoured of Galatæa; but his addresses were disregarded, and the nymph shunned his presence. The Cyclops was still more earnest; and when he saw

Polyphemus || Polypus.

Galatæa surrender herself to the pleasures of Acis, he crushed his rival with a piece of a broken rock.

POLYPODIUM, a genus of plants belonging to the cryptogamia class. See BOTANY *Index*.

POLYPREMUM, a genus of plants belonging to the tetrandria class, and in the natural method ranking under the 22d order, *Caryophillei*. See BOTANY *Index*.

POLYPUS, a species of fresh-water insects, belonging to the genus of hydra, of the order of zoophytes, and class of vermes. See HELMINTHOLOGY. The name of *hydra* was given them by Linnæus, on account of the property they have of reproducing themselves when cut in pieces, every part soon becoming a perfect animal. Dr Hill called them *biota*, on account of the strong principle of life with which every part of them is endowed.

These animals were first discovered by Leeuwenhoeck, who gave some account of them in the Philosophical Transactions for 1703; but their wonderful properties were not thoroughly known till the year 1740, when Mr Trembley began to investigate them. Previous to his discoveries, indeed, Leibnitz and Boerhaave, by reasonings *à priori*, had concluded that animals might be found which would propagate by slips like plants. Their conjectures have been verified.

Marine POLYPUS, is different in form from the fresh-water polype already described; but is nourished, increases, and may be propagated, after the same manner: Mr Ellis having often found, in his inquiries, that small pieces cut off from the living parent, in order to view the several parts more accurately, soon gave indications that they contained not only the principles of life, but likewise the faculty of increasing and multiplying into a numerous issue. It has been lately discovered and sufficiently proved by Peyssonel, Ellis, Jussieu, Reaumur, Donati, &c. that many of those substances which had formerly been considered by naturalists as marine vegetables or sea-plants, are in reality animal productions; and that they are formed by polypes of different shapes and sizes, for their habitation, defence, and propagation. To this class may be referred the corals, corallines, keratophyta, eschara, sponges, and alcyonium: nor is it improbable, that the more compact bodies, known by the common appellations of *star-stones*, *brain-stones*, *petrified fungi*, and the like, brought from various parts of the East and West Indies, are of the same origin. To this purpose Mr Ellis observes, that the ocean, in all the warmer latitudes, near the shore, and wherever it is possible to observe, abounds so much with animal life, that no inanimate body can long remain unoccupied by some species. In those regions, ships bottoms are soon covered with the habitations of thousands of animals: rocks, stones, and every thing lifeless, are covered with them instantly; and even the branches of living vegetables that hang into the water are immediately loaded with the spawn of different animals, shell-fish of various kinds: and shell-fish themselves, when they become impotent and old, are the basis of new colonies of animals, from whose attacks they can no longer defend themselves. See CORALLINA, HELMINTHOLOGY *Index*.

POLYPUS of the Heart. See MEDICINE, N° 97, 98, 274, and 290.

POLYSARCIA, or CORPULENCY. See MEDICINE, N° 335.

POLYSPERMOUS (from πολυ and σπερμα, *seed*), in *Botany*, is applied to such plants as have more than four seeds succeeding each flower, without any certain order or number.

POLYSYLLABLE, in *Grammar*, a word consisting of more than three syllables: for when a word consists of one, two, or three syllables, it is called a *monosyllable*, a *dissyllable*, and *trisyllable*.

POLYSYNDETON. See ORATORY, N° 97.

POLYTHEISM,

1 Definition.

THE doctrine of a plurality of gods or invisible powers superior to man.

"That there exist beings, one or many, powerful above the human race, is a proposition (says Lord Kames *) universally admitted as true in all ages and among all nations. I boldly call it *universal*, notwithstanding what is reported of some gross savages; for reports that contradict what is acknowledged to be general among men, require more able vouchers than a few illiterate voyagers. Among many savage tribes, there are no words but for objects of external sense: is it surprising that such people are incapable of expressing their religious perceptions, or any perception of internal sense? The conviction that men have of superior powers, in every country where there are words to express it, is so well vouched, that in fair reasoning it ought to be taken for granted among the few tribes where language is deficient."

* *Sketches of the Hist. of Man.*

2 Source of religious principles traced.

These are judicious observations, of which every man will admit the force who has not some favourite system to build upon the unstable foundation which his Lordship overturns. Taking it for granted, then, that our conviction of superior powers has long been universal, the important question is, From what cause it proceeds? The same ingenious author shows, with great strength of reasoning, that the operations of nature and the government of this world, which to us loudly proclaim the existence of a Deity, are not sufficient to account for the universal belief of superior beings among savage tribes. He is therefore of opinion, that this universality of conviction can spring only from the image of Deity stamped upon the mind of every human being, the ignorant equally with the learned. "Nothing less (he says) is sufficient: and the original impression which we have of Deity, must proceed (he thinks) from an internal sense, which may be termed the *sense of Deity*."

We have elsewhere expressed our opinion of that philosophy which accounts for every phenomenon in human nature, by attributing it to a particular instinct (see INSTINCT); but to this instinct or *sense of Deity*, considered as complete evidence, many objections, more than usually powerful, force themselves upon us. All nations, except the Jews, were once polytheists and idolaters. If therefore his Lordship's hypothesis be admitted, Theism.

mitted, either the doctrine of polytheism must be true theology, or this instinct or sense is of such a nature as to have at different periods of the world misled all mankind. All savage tribes are at present polytheists and idolaters; but among savages every instinct appears in greater purity and vigour than among people polished by arts and sciences; and instinct never mistakes its object. The instinct or primary impression of nature, which gives rise to self-love, affection between the sexes, love of progeny, &c. has in all nations, and in every period of time, a precise and determinate object which it inflexibly pursues. How then comes it to pass, that this particular instinct, which if real is surely of as much importance as any other, should have uniformly led those who had no other guide to pursue improper objects, to fall into the grossest errors and the most pernicious practices? To no purpose are we told, that the sense of Deity, like the moral sense, makes no capital figure among savages. There is reason to believe that the feeling or perception, which is called the *moral sense*, is not wholly instinctive; but whether it be or not, a single instance cannot be produced in which it multiplies its objects, or makes even a savage express gratitude to a thousand persons for benefits which his prince alone had power to confer.

For these, and other reasons which might easily be assigned, we cannot help thinking, that the first religious principles must have been derived from a source different as well from internal sense as from the deductions of reason; from a source which the majority of mankind had early forgotten: and which, when it was banished from their minds, left nothing behind it to prevent the very first principle of religion from being perverted by various accidents or causes, or, in some extraordinary concurrence of circumstances, from being perhaps entirely obliterated. This source of religion every

3 [R]evela[tion],

consistent theist must believe to be revelation. Reason, it is acknowledged, and we shall afterwards show (see RELIGION), could not have introduced savages to the knowledge of God; and we have just seen, that a *sense* of Deity is an hypothesis clogged with insuperable difficulties. Yet it is undeniable, that all mankind have believed in superior invisible powers: and if reason and instinct be set aside, there remains no other origin of this universal belief than primeval revelation, corrupted, indeed, as it passed by oral tradition from father to son, in the course of many generations. It is no slight support to this doctrine, that if there really be a Deity *, it is highly presumable that he would reveal himself to the first men—creatures whom he had formed with faculties to adore and to worship him. To other animals, the knowledge of a Deity is of no importance; to man, it is of the first importance. Were we totally ignorant of a Deity, this world would appear to us a mere chaos. Under the government of a wise and benevolent Deity, chance is excluded; and every event appears to be the result of established laws. Good men submit to whatever happens without repining, knowing that every event is ordered by Divine Providence: they submit with entire resignation; and such resignation is a sovereign balsam for every misfortune or evil in life.

* [S]ee [Ske]tches of Hist. of [Ma]n.

4 [Whi]ch [the fir]st pure [thei]sm.

Admitting, then, that the knowledge of Deity was originally derived from revelation, and that the first men professed pure theism, it shall be our business in the present article to trace the rise and progress of *polytheism* and *idolatry*; and to ascertain, if we can, the real opinions of the Pagan world concerning that multitude of gods with which they filled heaven, earth, and hell. In this inquiry, though we shall have occasion to appeal to the writings of Moses, we shall attribute to them no other authority than what is due to records of the earliest ages, more ancient and authentic than any others which are now extant.

Whether we believe, with the author of the book of Genesis, that all men have descended from the same progenitors; or adopt the hypothesis of modern theorists, that there have been successive creations of men, and that the *European* derives his origin from one pair, the *Asiatic* from another, the woolly-headed *African* from a third, and the copper-coloured *American* from a fourth—polytheism and idolatry will be seen to have arisen from the same causes, and to have advanced nearly in the same order from one degree of impiety to another. On either supposition, it must be taken for granted, that the original progenitors were instructed by their Creator in the truths of genuine theism: and there is no room to doubt, but that those truths, simple and sublime as they are, would be conveyed pure from father to son as long as the race lived in one family, and were not spread over a large extent of country. If any credit be due to the records of antiquity, the primeval inhabitants of this globe lived to so great an age, that they must have increased to a very large number long before the death of the common parent, who would of course be the bond of union to the whole society, and whose dictates, especially in what related to the origin of his being and the existence of his Creator, would be listened to with the utmost respect by every individual of his numerous progeny.

Many causes, however, would conspire to dissolve this family, after the death of its ancestor, into separate and independent tribes, of which some would be driven by violence, or would voluntarily wander, to a distance from the rest. From this dispersion great changes would take place in the opinions of some of the tribes respecting the object of their religious worship. A single family, or a small tribe banished into a desert wilderness (such as the whole earth must then have been), would find employment for all their time in providing the means of subsistence, and in defending themselves from beasts of prey. In such circumstances they would have little *leisure* for meditation, and being constantly conversant with objects of sense, they would gradually lose the *power* of meditating upon the spiritual nature of that Being by whom their ancestors had taught them that all things were created. The first wanderers would no doubt retain in tolerable purity their original notions of Deity; and they would certainly endeavour to impress those notions upon their children: but in circumstances infinitely more favourable to speculation than theirs could have been, the human mind dwells not long upon notions purely intellectual. We are so accustomed to sensible objects, and to the ideas of space, extension, and figure, which they are perpetually impressing upon the imagination, that we find it extremely difficult to conceive any being without assigning to him a form and a place. Hence a learned writer * has supposed, that the earliest generations of men (even those to whom he

5 Circumstances which led to polytheism.

* Bishop Law in his *Considerations on the Theory of Religion.*

Origin of Polytheism.

he contends that frequent revelations were vouchsafed) may have been no better than *anthropomorphites* in their conceptions of the Divine Being.

Be this as it may, it is not conceivable but that the members of those first colonies would quickly lose many of the arts and much of the science which perhaps prevailed in the parent state; and that, fatigued with the contemplation of intellectual objects, they would relieve

6 First steps in the progress.

their overstrained faculties, by attributing to the Deity a place of abode, if not a human form. To men totally illiterate, the place fittest for the habitation of the Deity would undoubtedly appear to be the sun, the most beautiful and glorious object of which they could form any idea; an object, too, from which they could not but be sensible that they received the benefits of light and heat, and which experience must soon have taught them to be in a great measure the source of vegetation. The great spirit therefore inhabiting the sun, which they would consider as the *power* of light and heat, was in all probability the first object of idolatrous adoration.

7 The spirit of light the first god of paganism.

From looking upon the sun as the habitation of their god, they would soon proceed to consider it as his body. Of pure mind entirely separated from matter, men in their circumstances could not long retain the faintest notion; but conscious each of power in himself, and experiencing the effects of power in the sun, they would naturally conceive that luminary to be animated as their bodies were animated. They would feel his influence when above the horizon; they would see him moving from east to west; they would consider him when set as gone to take his repose: and those exertions and intermissions of power being analogous to what they experienced in themselves, they would look upon the sun as a real animal. Thus would the Divinity appear to their untutored minds to be a compound being like man, partly corporeal and partly spiritual; and as soon as they imbibed such notions, though perhaps not before, they may be pronounced to have been absolute idolaters.

When men had once got into this train, their gods would multiply upon them with wonderful rapidity. Darkness and cold they could not but perceive to be contrary to light and heat; and not having philosophy enough to distinguish between mere privations and positive effects, they would consider darkness and cold as

8 The spirit or power of darkness the second.

entities equally real with light and heat; and attribute these different and contrary effects to different and contrary powers. Hence the spirit or power of darkness was in all probability the second god in the Pagan calendar; and as they considered the power of light as a benevolent principle, the source of all that is good, they must have looked upon the contrary power of darkness as a malevolent spirit, the source of all that is evil. This we know from authentic history to have been the belief of the Persian magi, a very ancient sect, who called their

9 Polytheism of the Persian magi.

good god *Yazdun*, and also *Ormuzd*, and the evil god *Ahraman*. Considering light as the symbol, or perhaps as the body, of *Ormuzd*, they always worshipped him before the fire, the source of light, and especially before the sun, the source of the most perfect light: and for the same reason fires were kept continually burning on his altars. That they sometimes addressed prayers to the evil principle, we are informed by Plutarch in his life of Themistocles; but with what particular rites he was worshipped, or where he was supposed to reside, is not so evident. Certain it is, that the worshippers held him in destestation; and when they had occasion to write his name, they always inverted it (*uɐɯɐɹɥ∀*), to denote the malignity of his nature.

Magianism.

The principles of the Magi, though widely distant from pure theism, were much less absurd than those of other idolaters. It does not appear that they ever worshipped their gods by the medium of graven images, or had any other emblems of them than light and darkness. Indeed we are told by Diogenes Laertius and Clemens Alexandrinus, that they condemned all statues and images, allowing fire and water to be the only proper emblems or representatives of their gods. And we learn from Cicero *, that at their instigation Xerxes was said to have burnt all the temples of Greece, because the builders of those edifices impiously presumed to inclose within walls the gods, to whom all things ought to be open and free, and whose proper temple is the whole world. To these authorities we may add that of all the historians, who agree, that when magianism was the religion of the court, the Persian monarchs made war upon images, and upon every emblem of idolatry different from their own.

* *De Legibus*, lib. ii. § 10.

The Magi, however, were but one sect, and not the largest sect of ancient idolaters. The worship of the sun, as the source of light and heat, soon introduced into the calendar of divinities the other heavenly bodies, the moon, the planets, and the fixed stars. Men could not but experience great benefit from those luminaries in the absence of their chief god; and when they had proceeded so far as to admit two divine principles, a good and an evil, it was natural for minds clouded with such prejudices to consider the moon and the stars as benevolent intelligences, sent to oppose the power of darkness whilst their first and greatest divinity was absent or asleep. It was thus, as they imagined, that he maintained (for all held that he did maintain) a constant superiority over the evil principle. Though to astronomers the moon is known to be an opaque body of very small dimensions when compared with a planet or a fixed star, to the vulgar eye she appears much more magnificent than either. By those early idolaters she was considered as the divinity second in rank and in power; and whilst the sun was worshipped as the king, she was adored as the queen, of heaven.

10 Sabian polytheism.

The earth, considered as the common mother of all things; the ocean, whose waters are never at rest; the air, the region of storms and tempests, and indeed all the elements—were gradually added to the number of divinities; not that mankind in this early age had so far degenerated from the principles of their ancestors as to worship brute matter. If such worship was ever practised, which to us is hardly conceivable, it was at a later period, when it was confined to the very lowest of the vulgar, in nations otherwise highly civilized. The polytheists, of whom we now treat, conceived every thing in motion to be animated, and animated by an intelligence powerful in proportion to the magnitude of the body moved.

This sect of idolaters, which remains in some parts of the east to this day, was known by the name of *Sabians*, which they pretended to have derived from *Sabius* a son of Seth; and among the books in which their sacred doctrines are contained, they have one which they call

call the book of *Seth*. We need hardly observe, that these are senseless and extravagant fables. The name *Sabian* is undoubtedly derived from the Hebrew word *Tsaba*, which signifies "an host or army;" and this class of polytheists was so called, because they worshipped "the host of heaven;" the *Tsaba hesemim*, against which Moses so pathetically cautions the people of Israel *.

* Deut. iv. 9.

11 rose in Chaldea.

The species of idolatry is thought to have first prevailed in Chaldea, and to have been that from which Abraham separated himself, when, at the command of the true God, he "departed from his country, and from his kindred, and from his father's house." But as it nowhere appears that the Chaldeans had fallen into the savage state before they became polytheists and idolaters, and as it is certain that they were not savages at the call of Abraham, their early Sabiism may be thought inconsistent with the account which we have given of the origin of that species of idolatry. If a great and civilized nation was led to worship the host of heaven, why should that worship be supposed to have arisen among savages? Theories, however plausible, cannot be admitted in opposition to facts.

True: but we beg leave to reply, that our account of the origin of polytheism is opposed by no fact; because we have not supposed that the worship of the host of heaven arose among savages *only*. That savages, between whom it is impossible to imagine any intercourse to have had place, have universally worshipped, as their first and supreme divinities, the *sun*, *moon*, and *stars*, is a fact evinced by every historian and by every traveller; and we have shown how their rude and uncultivated state naturally leads them to that species of idolatry. But there may have been circumstances peculiar to the Chaldeans, which led them likewise to the worship of the heavenly host, even in a state of high civilization.—We judge of the philosophy of the ancients by that of ourselves, and imagine that the same refined system of metaphysics was cultivated by them as by the followers of *Descartes* and *Locke*. But this is a great mistake; for so gross were the notions of early antiquity, that it may be doubted whether there was a single man, uninspired, who had any notion of mind as a being distinct and entirely separated from matter (see METAPHYSICS, Part III. chap. iv.). From several passages in the books of Moses, we learn, that when in the first ages of the world the Supreme Being, condescended to manifest his presence to men, he generally exhibited some sensible emblem of his power and glory, and declared his will from the midst of a preternatural *fire*. It was thus that he appeared to the Jewish lawgiver himself, when he spoke to him from the midst of a bush; it was by a pillar of cloud and *fire* that he led the Israelites from Egypt to the Land of Promise; and it was in the midst of smoke, and *fire*, and thunderings, that the law was delivered from Mount Sinai.—That such manifestations of the Divine Presence would be occasionally made to the descendants of Noah who settled in Chaldea soon after the deluge, must appear extremely probable to every one who admits the authority of the Hebrew Scriptures; and he who questions that authority, has no right to make the objection to which we now reply; because it is only from the book of Genesis that we know the Chaldeans to have been a civilized people when they fell into idolatry. All histories agree in representing the inhabitants of Chaldea as at a very early period corrupted by luxury and sunk in vice. When this happened, we must suppose that the moral Governor of the universe would withdraw from them those occasional manifestations of himself, and leave them to their own inventions. In such circumstances, it was not unnatural for a people addicted to the study of astronomy, who had been taught to believe that the Deity frequently appeared to their ancestors in a flame of fire, to consider the sun as the place of his permanent residence, if not as his body. But when either opinion was firmly established, polytheism would be its inevitable consequence, and the progress of Sabiism would, in the most polished nation, be such as we have traced it among savage tribes.

12 Passed into Egypt, &c.

From Chaldea the idolatrous worship of the host of heaven spread itself over all the east, passed into Egypt, and thence into Greece; for Plato affirms †, that "the first inhabitants of Greece seemed to him to have worshipped no other gods but the sun, moon, earth, stars, and heavens, as most barbarous nations (continues he) still do." That Sabiism, or the worship of the host of heaven, was the first species of idolatry, besides the probability of the thing, and the many allusions to it in sacred Scripture, we have the positive evidence of the most ancient pagan historians of whose writings any part has been transmitted to us. Herodotus *, speaking of the religion of the Persians, says, that "they worship the *sun*, *moon*, and *earth*, *fire*, *water*, and the *winds*; and this adoration they have all along paid from the beginning." He testifies the same thing of the savage Africans, of whom he affirms †, that they all worshipped the *sun* and *moon*, and no other divinity. Diodorus Siculus, writing of the Egyptians ‡, tells us, that "the first men looking up to the world above them, and terrified and struck with admiration at the nature of the universe, supposed the sun and moon to be the principal and *eternal gods*." And Sanchoniathon the Phœnician, a more ancient writer than any of these, informs us, in the fragment of his history preserved by Eusebius, that "the two first mortals were Æon and Protogonus; and their children were Genus and Genea, who inhabited Phœnicia; and when they were scorched with the heat, they lifted up their hands to the sun, whom they believed to be the Lord of Heaven, and called him *Baal-samen*, the same whom the Greeks call Ζευς."

† In Cratylo.

* Lib. i. cap. 131.

† Lib. iv. cap. 188.

‡ Lib. i.

13 and produced statue worship.

Hitherto those divinities were worshipped in person, or, as Dr Prideaux expresses it, in their *sacella*, or sacred tabernacles; for the votaries of each directed their devotions towards the planet which they supposed to be animated by the particular intelligence whom they meant to adore. But these orbs, by their rising and setting, being as much below the horizon as above it, and their grossly ignorant worshippers not supposing it possible that any intelligence, however divine, could exert its influence but in union with some body, statues or pillars were soon thought of as proper emblems of the absent gods. Sanchoniathon, in the fragment already quoted, informs us, that "*Hyspouranios* and his brother *Ousous*, Phœnician patriarchs, erected two pillars, the one to *fire* and the other to *air* or *wind*, and worshipped those pillars, pouring out to them libations of the blood of the wild beasts hunted down in the chace." As these early monuments of idolatry were called βαιτυλια, a word evidently derived from the Hebrew *Bethel*, the probability

Statue-worship.

probability is, that they were altars of loose stones, such as that which was built by Jacob *, and from him received the same name. As his was consecrated to the true God, theirs were consecrated to the host of heaven; and the form of consecration seems to have been nothing more than the anointing of the stone or pillar with oil (A), in the name of the divinity whom it was intended to represent. When this ceremony was performed, the ignorant idolaters, who fancied that their gods could not hear them but when they were visible, supposed that the intelligences by which the sun and planets were animated, took possession, in some inexplicable manner, of the consecrated pillars, and were as well pleased with the prayers and praises offered up before those pillars, as with the devotions which were addressed towards the luminaries themselves.—Hence Sanchoniathon calls them *animated* or *living stones*, λιθους εμψυχους, from the portion of the Divine Spirit which was believed to reside in them; and as they were dedicated to the host of heaven, they were generally erected on the tops of mountains; or in countries which, like Egypt, were low and level, they were elevated to a great height by the labour of men.

* *Genesis*, ch. xxxv.

14 with the idolatry of *high places.*

It has been supposed, that this practice of raising the pillars on *high places* proceeded from a desire to make the objects of worship conspicuous and magnificent: but we are strongly inclined to believe, that the erectors of βαιτυλια had something farther in view, and that they thought of nothing less than to bring the sacred stone or pillar as near as possible to the god whom it represented. Whatever be in this, we know that the practice itself prevailed universally through the east; and that there was nothing which the Jewish legislator more strictly enjoined his people to destroy, than the altars, statues, and pillars, erected for idolatrous worship upon mountains and high places. "Ye shall utterly destroy (says he) all the places wherein the nations which ye shall possess served their gods, upon the *high mountains*, and upon the *hills*, and under every green tree. And ye shall overthrow their *altars*, and break down their *pillars*, and burn their *groves* with fire †."

† *Deut.* xii. 23.

The mention of *groves* by the Hebrew lawgiver, brings to our recollection another species of idolatry, which was perhaps the second in order, as men deviating from the principles of pure theism were more and more entangled in the labyrinths of error. The Chaldeans, Egyptians, and all the eastern nations who believed in a superintendiug providence, imagined that the government of this world, the care of particular nations, and even the superintendence of groves, rivers, and mountains, in each nation, was committed by the gods to a class of spirits superior to the soul of man, but inferior to those heavenly intelligences which animated the sun, the moon, and the planets. These spirits were by the Greeks called δαιμονας, *dæmons*, and by the Romans *genii*. Timæus the Locrian, who flourished before Plato, speaking of the punishment of wicked men, says‡, all these things hath Nemesis decreed to be executed in the second period, by the ministry of vindictive terrestrial dæmons, who are overseers of human affairs; to which dæmons the Supreme God, the ruler over all, hath committed the government and administration of this world, which is made up of *gods*, *men*, and *animals*.

‡ *De Anima Mundi*, inter script. à T. Gale editos.

Dæmons

15 Origin of dæmon-worship.

Concerning the origin of these intermediate beings, scholars and philosophers have framed various hypotheses. The belief of their existence may have been derived from five different sources.

1. It seems to have been impossible for the limited capacities of those men, who could not form a notion of a God divested of a body and a place, to conceive how the influenee and agency of such a being could every instant extend to every point of the universe. Hence, as we have seen, they placed the heavenly regions under the government of a multitude of heavenly gods, the *sun*, the *moon*, and the *stars*. But as the nearest of those divinities was at an immense distance from the earth, and as the intelligence animating the earth itself had sufficient employment in regulating the general affairs of the whole globe, a notion insinuated itself into the untutored mind, that these superior governors of universal nature found it necessary, or at least expedient, to employ subordinate intelligences or *dæmons* as ministers to execute their behests in the various parts of their widely extended dominions.

2. Such an universal and uninterrupted course of action, as was deemed necessary to administer the affairs of the universe, would be judged altogether inconsistent with that state of *indolence*, which, especially in the east, was held an indispensable ingredient in perfect felicity. It was this notion, absurd as it is, which made Epicurus deny the *providence*, whilst he admitted the *existence*, of gods. And if it had such an effect upon a philosopher who in the most enlightened ages had many followers, we need not surely wonder if it made untaught idolaters imagine that the governor or governors of the universe had devolved a great part of their trouble on deputies and ministers.

3. When men came to reflect on the infinite distance between themselves and the gods, they would naturally form a wish, that there might somewhere exist a class of intermediate intelligences, whom they might employ as mediators and intercessors with their far distant divinities. But what men earnestly wish, they very readily believe. Hence the supposed distance of their gods, would, among untutored barbarians, prove a fruitful source of intermediate intelligences, more pure and more elevated than human souls.

4. These three opinions may be denominated popular; but that which we are now to state, wherever it may have prevailed, was the offspring of philosophy.—On this earth we perceive a scale of beings rising gradually above each other in perfection, from mere brute matter through the various species of fossils, vegetables, insects, fishes, birds, and beasts, up to man. But the distance between man and God is infinite, and capable of admitting numberless orders of intelligences, all superior to the human soul, and each rising gradually above the other till they reach that point, wherever it may be, at which creation stops. Part of this immense chasm

(A) Hence the proverb of a superstitious man, παντα λιθον λιπαρον προσκυνει, *he kisses or adores every anointed stone;* which Arnobius calls *lubricatam lapidem, et ex olivi unguine sordidatum.*—Stillingfleet's *Origines Sacræ.*

Dæmons.

chasm the philosophers perceived to be actually filled by the heavenly bodies; for in *philosophical* polytheism there was one invisible God supreme over all these: but still there was left an immense vacuity between the human species and the moon, which was known to be the lowest of the heavenly host: and this they imagined must certainly be occupied by invisible inhabitants of different orders and dispositions, which they called good and evil *dæmons*.

5. There is yet another source from which the universal belief of good and evil dæmons may be derived, with perhaps greater probability than from any or all of these. If the Mosaic account of the creation of the world, the peopling of the earth, and the dispersion of mankind, be admitted as true (and a more consistent account has not as yet been given or devised), some knowledge of good and evil *angels* must necessarily have been transmitted from father to son by the channel of oral tradition. This tradition would be corrupted at the same time, and in the same manner, with others of greater importance. When the true God was so far mistaken as to be considered, not as the sole governor of the universe, but only as the self-extant power of light and good, the Devil would be elevated from the rank of a rebellious created spirit to that of the independent power of darkness and evil; the angels of light would be transformed into good dæmons, and those of darkness into dæmons that are evil. This account of the origin of dæmonology receives no small support from Plato, who derives one branch of it wholly from tradition. "With respect to those dæmons (says he *) who inhabit the space between the earth and the moon, to understand and declare their generation is a task too arduous for my slender abilities. In this case we must credit the report of men of other times, who, according to their own account, were the descendants of the gods, and had, by some means or other, gained exact intelligence of that mystery from their ancestors. We must not question the veracity of the children of the gods, even though they should transgress the bounds of probability, and produce no evidence to support their assertions. We must, I say, notwithstanding, give them credit, because they profess to give a detail of facts with which they are intimately acquainted, and the laws of our country oblige us to believe them."

* *Timæus.*

Though these dæmons were generally invisible, they were not supposed to be pure disembodied spirits.—Proclus, in his Commentary upon Plato's Timæus, tells us, that "every dæmon superior to human souls consisted of an intellectual mind and an ethereal vehicle." Indeed it is very little probable, that those who gave a body and a place to the Supreme God, should have thought that the inferior orders of his ministers were spirits entirely separated from matter. Plato himself divides the class of dæmons into three orders †; and whilst he holds their souls to be particles or emanations from the divine essence, he affirms that the bodies of each order of dæmons are composed of that particular element in which they for the most part reside. "Those of the first and highest order are composed of pure ether; those of the second order consist of grosser air; and dæmons of the third or lowest rank have vehicles extracted from the element of water. Dæmons of the first and second orders are invisible to mankind. The aquatic dæmons, being invested with vehicles of grosser materials, are sometimes visible and sometimes invisible. When they do appear, though faintly observable by the human eye, they strike the beholder with terror and astonishment." Dæmons of this last order were supposed to have passions and affections similar to those of men; and though all nature was full of them, they were believed to have local attachments to mountains, *rivers*, and *groves*, where their appearances were most frequent. The reason of these attachments seems to be obvious. Polytheism took its rise in countries scorched by a burning sun; and dæmons by their composition being necessarily subject in some degree to the influence of heat and cold, it was natural to suppose that they, like men, would delight in the shady grove and in the purling stream. Hence the earliest altars of paganism were generally built in the midst of *groves*, or on the banks of *rivers*; because it was believed that in such places were assembled multitudes of those intelligences, whose office it was to regulate the affairs of men, and to carry the prayers and oblations of the devout to the far distant residence of the celestial gods. Hence too are to be derived the mountain and river gods, with the dryads and hamadryads, the satyrs, nymphs, and fauns, which held a place in the creed of ancient paganism, and make so conspicuous a figure in the Greek and Roman poets.

† *Epino-*

16
In groves and on the banks of rivers.

These different orders of intelligences, which, though worshipped as gods or demigods, were yet believed to partake of human passions and appetites, led the way to the deification of departed heroes and other eminent benefactors of the human race. By the philosophers all souls were believed to be emanations from the divinity; but "gratitude † and admiration, the warmest and most active affections of our nature, concurred to enlarge the object of religious worship, and to make man regard the inventors of arts and the founders of society as having in them more than a common ray of the divinity. So that god-like benefits, bespeaking as it were a god-like mind, the deceased parent of a people was easily advanced into the rank of a dæmon. When the religious bias was in so good a train, natural affection would have its share in promoting this new mode of adoration. Piety to parents would naturally take the lead, as it was supported by gratitude and admiration, the *primum mobile* of the whole system: and in those early ages, the *natural father* of the tribe often happened to be the *political father* of the people, and the founder of the state. Fondness for the offspring would next have its turn; and a disconsolate father, at the head of a people, would contrive to soothe his grief for the untimely death of a favourite child, and to gratify his pride under the want of *succession*, by paying divine honours to its memory." "For a father ‡ afflicted with untimely mourning, when he had made an image of his child soon taken away, now honoured him as a god, who was then a dead man, and delivered to those that were under him ceremonies and sacrifices." That this was the origin and progress of the worship of departed souls, we have the authority of the famous fragment of Sanchoniathon already quoted, where the various motives for this species of idolatry are recounted in express words. "After many generations (says he) came *Chrysor*; and he invented many things useful to civil life, for which, after his decease, he was worshipped as a *god*. Then flourished *Ouranos* and his sister *Ge*, who deified and offered sacrifices to their father *Hypsistos*, when

17
Deification of departed heroes.

† *Warburton's Div. Leg.*

‡ *Wisdom of Solomon*, xiv. 15.

Hero-Worship. when he had been torn in pieces by wild beasts. Afterwards *Cronos* consecrated *Muth* his son, and was himself consecrated by his subjects."

In the reign of Cronos flourished a personage of great reputation for wisdom, who by the Egyptians was called *Thoth*, by the Phœnicians *Taautos*, and by the Greeks *Hermes*. According to Plutarch, he was a profound politician, and chief counsellor to Osiris, then the king, and afterwards the principal divinity, of Egypt: and we are told by *Philo Byblius*, the translator of Sanchoniathon, "that it was this *Thoth* or *Hermes* who first took the matters of religious worship out of the hands of unskilful men, and brought them into due method and order." His object was to make religion serviceable to the interests of the state. With this view he appointed *Osiris* and other departed princes to be joined with the stars and worshipped as gods; and being by Cronos made king of Egypt, he was, after his death, worshipped himself as a god by the Egyptians. To this honour, if what is recorded of him be true, he had indeed a better title than most princes; for he is said to have been the inventor of letters, arithmetic, geometry, astronomy, and hieroglyphics, and was therefore one of the greatest benefactors of the human race which any age or country has ever produced.

18 a political invention, which introduced

That the gods of Greece and Rome were derived from Egypt and Phœnicia, is so universally known, that it is needless to multiply quotations in order to prove that the progress of polytheism among the Greeks and Romans was the same with that which we have traced in more ancient nations. The following translation, however, of the account given by Hesiod of the deification of departed heroes, with which we have been favoured by a learned and ingenious friend, is so just, and in our opinion so beautiful, that we cannot deny ourselves the pleasure of giving it to our readers.

"The gods who dwell on high Olympus' hill,
First fram'd a golden race of men, who liv'd
Under old Saturn's calm auspicious sway.
Like gods they liv'd, their hearts devoid of care,
Beyond the reach of pain and piercing woes;
Th' infirmities of age nor felt, nor fear'd.
Their nerves with youthful vigour strung, their days
In jocund mirth they past, remote from ills.
Now when this godlike race was lodg'd in earth,
By Jove's high will to demi-gods they rose,
And airy dæmons, who benign on earth
Converse—the guides and guardians of mankind.
In darkness veil'd, they range earth's utmost bound,
Dispensing wealth to mortals. This reward
From bounteous Jove awaits illustrious deeds ‡."

‡ Εργων και ἡμερων, lib. i. vers. 100, &c.

19 national and tutelar gods.

The deification of departed heroes and statesmen was that which in all probability introduced the universal belief of *national* and *tutelar* gods, as well as the practice of worshipping those gods through the medium of *statues* cut into a *human figure*. When the founder of a state or any other public benefactor was elevated to the rank of a god, as he was believed still to retain human passions and affections, it was extremely natural to suppose that he would regard with a favourable eye that nation for which he had done so much upon earth; that he would oppose its enemies, and protect the laws and institutions which he himself had given it. By indulging the same train of sentiment, each city, and even every family of consequence, found *Lares* and *Penates* among their departed ancestors, to whom they paid the warmest adoration, and under whose protection they believed their private affairs to be placed. As those national and household gods were believed to be in their deified state clothed with airy bodies, so those bodies were supposed to retain the form which their grosser bodies had upon earth. The image of a departed friend might perhaps be formed by the hand of sorrowful affection, before the statue or the shrine of a deity was thought of; but when that friend or benefactor became the object of religious adorations, it was natural for his votaries to enliven their devotion by a view of his similitude. Maximus Tyrius tells us ||, that "there is no race of men, whether barbarian or Grecian, living on the sea-coast or on the continent, wandering in deserts or living in cities, which hath not consecrated some kind of symbol or other in honour of the gods." This is certainly true; but there is no good evidence that the first symbols of the gods were statues of men and women. Whilst the sun and other heavenly bodies continued to be the sole objects of religious worship, the symbols consecrated to them were pillars of a *conical* or *pyramidal* figure; and if such pillars are ever called *graven* images by Moses and other ancient writers, it was probably on account of the *allegoric figures* and *characters*, or hieroglyphic writing, with which they were inscribed.

Hitherto we have considered the souls of departed heroes as holding the rank only of dæmons or demigods; but they generally rose in the scale of divinities, till they dethroned the heavenly bodies, and became themselves the *dii majorum gentium*. This revolution was effected by the combined operation of the prince and the priest; and the first step taken towards it seems to have been the complimenting of their heroes and public benefactors with the name of that being which was most esteemed and worshipped. "Thus a king for his beneficence was called the *sun*, and a queen for her beauty the *moon*. Diodorus relates, that SOL first reigned in Egypt, called so from the luminary of that name in the heavens. This will help us to understand an odd passage in the fragment of Sanchoniathon, where it is said that *Cronus had seven sons by Rhea, the youngest of whom was a GOD as soon as BORN*. The meaning probably is, that this youngest son was called after some luminary in the heavens to which they paid divine honours; and these honours came in process of time to be transferred to the terrestrial namesake. The same historian had before told us, that the sons of Genos, mortals like their father, were called by the names of the elements—*light*, *fire*, and *flame*, of which they had discovered the use."

"As this adulation advanced into an established worship, they turned the compliment the other way, and called the planet or luminary after the hero, the better to accustom the people, even in the act of *Planet-worship*, to this *new* adoration. Diodorus, in the passage already quoted, having told us, that by the first inhabitants of Egypt the sun and moon were supposed to be the principal and eternal gods, adds, that the former was called OSIRIS, and the latter ISIS. This was indeed the general practice; for we learn from Macrobius, that the Ammonites called the sun *Moloch*; the Syrians

Hero Worship.

Syrians *Adad*; the Arabs *Dionysus*; the Assyrians *Belus*; the Phœnicians *Saturn*; the Carthaginians *Hercules*; and the Palmyrians *Elegabalus*. Again, by the Phrygians the moon was called *Cybele*, or the mother of the gods; by the Athenians *Minerva*; by the Cyprians *Venus*; by the Cretans *Diana*; by the Sicilians *Proserpine*; by others *Hecate*, *Bellona*, *Vesta*, *Urania*, *Lucina*, &c. Philo Byblius explains this practice: "It is remarkable (says he) that the ancient idolaters imposed on the *elements*, and on those parts of nature which they esteemed gods, *the names of their kings*; for the natural gods which they acknowledged were only the sun, moon, planets, elements, and the like; they being now in the humour of having gods of both classes, the *mortal* and the *immortal*."

"As a farther proof that *hero*-worship was thus superinduced upon the *planetary*, it is worthy of observation, that the first statues consecrated to the *greater* hero-gods—those who were supposed to be *supreme*—were not of a human form, but *conical* or *pyramidal*, like those which in the earliest ages of idolatry were dedicated to the sun and planets. Thus the scholiast on the Vespæ of Aristophanes tells us, that the statues of Apollo and Bacchus were *conic* pillars or obelisks; and Pausanias, that the statue of Jupiter Meilichius represented a *pyramid*; that of the Argive Juno did the same, as appears from a verse of Phoronis quoted by Clemens Alexandrinus*; and indeed the practice was universal as well amongst the early barbarians as amongst the Greeks. But it is well known that the ancients represented the *rays of light* by pillars of a conical or pyramidal form; and therefore it follows, that when they erected such pillars as representatives of their hero-gods, these latter had succeeded to the titles, rights, and honours of the *natural* and *celestial divinities*†."

* *Strom.* l. i.

† *Warburton's Div Leg.* book 3. sect. 6.

22 Progress of this revolution in theology.

But though it seems to be certain that *hero*-worship was thus engrafted on the *planetary*, and that some of those heroes in process of time supplanted the planets themselves, this was such a revolution in theology as could not have been suddenly effected by the united influence of the prince and the priest. We doubt not the fact that SOL was believed to have reigned in Egypt, and was afterwards worshipped under the name *Osiris*; but it was surely impossible to persuade any nation, however stupid or prone to idolatry, that a man, whom they *remembered* discharging the duties of their sovereign and legislator, was the identical sun whom they beheld in the heavens. Osiris, if there was in Egypt a king of that name, may have been deified immediately after his death, and honoured with that worship which was paid to good *dæmons*; but he must have been dead for ages before any attempt was made to persuade the nation that he was the *supreme God*. Even then great address would be requisite to make such an attempt successful. The prince or priest who entered upon it would probably begin with declaring from the oracle, that the divine intelligence which animates and governs the sun had descended to earth and animated the person of their renowned legislator; and that, after their laws were framed, and the other purposes served for which the descent was made, the same intelligence had returned to its original residence and employment among the celestials. The possibility of this double transmigration from heaven to earth and from earth to heaven, would without difficulty be admitted in an age when the pre-existence of souls was the universal belief. Having proceeded thus far in the apotheosis of dead men, the next step taken in order to render it in some degree probable that the early founders of states, and inventors of arts, were divine intelligences clothed with human bodies, was to attribute to one such benefactor of mankind the actions of many of the same name. Vossius, who employed vast erudition and much time on the subject, has proved, that before the æra of the Trojan wars most kings who were very powerful, or highly renowned for their skill in legislation, &c. were called *Jove*; and when the actions of all these were attributed to one *Jove* of *Crete*, it would be easy for the crafty priest, supported by all the power and influence of the state, to persuade an ignorant and barbarous people, that he whose wisdom and heroic exploits so far surpassed those of ordinary men must have been the supreme God in human form.

23 Vices of the pagan gods.

This short sketch of the progress of polytheism and idolatry will enable the reader to account for many circumstances recorded of the pagan gods of antiquity, which at first view seem very surprising, and which at last brought the whole system into contempt among the philosophers of Athens and Rome. The circumstances to which we allude are the immoral characters of those divinities, and the abominable rites with which they were worshipped. Jupiter, Apollo, Mars, and the whole rabble of them, are described by the poets as ravishers of women and notorious adulterers. Hermes or Mercury was a thief, and the god of thieves. Venus was a prostitute, and Bacchus a drunkard. The malice and revenge of Juno were implacable; and so little regard was any of them supposed to pay to the laws of honour and rectitude, that it was a common practice of the Romans, when besieging a town, to evocate the tutelar deity, and to tempt him by a reward to betray his friends and votaries‡. In a word, they were, in the language of the poet,

"Gods partial, changeful, passionate, unjust,
"Whose attributes were rage, revenge, and lust."

‡ *T. Livii*, lib. v. c. 21. et *Macrob. Satur.* lib. iii. c. 9.

24 Accounted for.

This was the natural consequence of their origin. Having once animated human bodies, and being supposed still to retain human passions and appetites, they were believed, in their state of deification, to feel the same sensual desires which they had felt upon earth, and to pursue the same means for their gratification. As the men could not well attempt to surpass the gods in purity and virtue, they were easily persuaded by artful and profligate priests, that the most acceptable worship which could be rendered to any particular deity was to imitate the example of that deity, and to indulge in the practices over which he presided. Hence the worship of Bacchus was performed during the night by men and women mixing in the dark after intemperate eating and drinking. Hence too it was the practice in Cyprus and some other countries to sacrifice to Venus the virginity of young women some days before their marriage, in order, as it was pretended, to secure their chastity ever afterwards; and, if Herodotus may be credited, every woman among the Babylonians was obliged once in her life to prostitute herself in the temple of the goddess *Mylitte* (Venus), that she might thence forward be proof against all temptation.

The progress of polytheism, as far as we have traced it, it, has been regular; and after the enormous error of forsaking the worship of the true God was admitted, every subsequent step appears to be natural. It would be no difficult task to prove that it has likewise been universal. Sir William Jones, the learned president of the Asiatic Society, has discovered such a striking resemblance between the gods of Ancient Greece and those of the pagans of Hindostan†, as puts it beyond a doubt that those divinities had the same origin. The GANESA of the Hindoos he has clearly proved to be the JANUS of the Greeks and Romans. As the latter was represented with two and sometimes with four faces, as emblems of prudence and circumspection, the former is painted with an elephant's head, the well-known symbol among the Indians of sagacious discernment. The SATURN of Greece and Rome appears to have been the same personage with the MENU or SATYAVRATA of Hindostan, whose patronymic name is VAIVASWATA, or *child of the sun;* which sufficiently marks his origin. Among the Romans there were many Jupiters, of whom one appears from Ennius to have been nothing more than the firmament personified.

25 Progress of idolatry regular and universal.

† *Asiatic Researches*, vol. i.

26 Indian idolatry.

> Aspice hoc sublime candens, quem invocant omnes JOVEM.

But this Jupiter had the same attributes with the Indian god of the visible heavens called INDRA or the *king*, and DIVESPETIR or the *lord of the sky*, whose consort is *Sachi*, and whose weapon is *vajra* or the thunderbolt. INDRA is the regent of winds and showers; and though the east is peculiarly under his care, yet his Olympus is the north-pole, allegorically represented as a mountain of gold and gems. With all his power he is considered as a subordinate deity, and far inferior to the Indian triad BRAHMA, VISHNOU, and MAHADEVA or SIVA *, who are three forms of one and the same godhead. The president having traced the resemblance between the idolatry of Rome and India through many other gods, observes, that "we must not be surprised at finding, on a close examination, that the characters of all the pagan deities melt into each other, and at last into one or two; for it seems a well-founded opinion, that the whole crowd of gods and goddesses in ancient Rome, and likewise in Hindostan, mean only the powers of nature, and principally those of the sun, expressed in a variety of ways, and by a multitude of fanciful names."

* Plate ccccxxxv.

Nor is it only in Greece, Rome, Egypt, and India, that the progress of idolatry has been from planetary to hero-worship. From every account which modern travellers have given us of the religion of savage nations, it appears that those nations adore, as their first and greatest gods, the sun, moon, and stars; and that such of them as have any other divinities have proceeded in the same road with the celebrated nations of antiquity, from the worship of the heavenly bodies to that of celestial dæmons, and from celestial dæmons to the deification of dead men. It appears likewise that they universally believe their hero gods and demigods to retain the passions, appetites, and propensities of men.

27 Scandinavian and Saxon idolatry.

That the Scandinavians and our Saxon ancestors had the same notions of the gods with the other pagans whose opinions we have stated, is evident from their calling the days of the week by the names of their divinities, and from the forms of the statues by which those divinities were represented †. 1. The idol of the sun, from which *Sunday* is derived, among the Latins *dies Solis*, was placed in a temple, and adored and sacrificed to; for they believed that the sun did co-operate with this idol. He was represented like a man half naked, with his face like the sun, holding a burning wheel with both hands on his breast, signifying his course round the world; and by its fiery gleams, the light and heat with which he warms and nourisheth all things.— 2. The idol of the moon, from which cometh our *Monday*, *dies Lunæ*, anciently *Moonday*, appears strangely singular, being habited in a short coat like a man. Her holding a moon expresses what she is; but the reason of her short coat and long-eared cap is lost in oblivion.— 3. *Tuisco*, the most ancient and peculiar god of the Germans, represented in his garment of a skin according to their ancient manner of clothing, was next to the sun and moon, the idol of highest rank in the calendar of northern paganism. To him the third day in the week was dedicated; and hence is derived the name *Tuesday*, anciently *Tuisday*, called in Latin *dies Martis*, though it must be confessed that Mars does not so much resemble this divinity as he does Odin or Woden.

† Plate ccccxxxv.

4. *Woden* was a valiant prince among the Saxons. His image was prayed to for victory over their enemies; which, if they obtained, they usually sacrificed the prisoners taken in battle to him. Our *Wednesday* is derived from him, anciently *Wodensday*. The northern histories make him the father of *Thor*, and *Friga* to be his wife.

5. *Thor* was placed in a large hall, sitting on a bed canopied over, with a crown of gold on his head, and 12 stars over it, holding a sceptre in his right hand. To him was attributed the power over both heaven and earth; and that as he was pleased or displeased he could send thunder, tempests, plagues, &c. or fair, seasonable weather, and cause fertility. From him our *Thursday* derives its name, anciently *Thorsday;* among the Romans *dies Jovis*, as this idol may be substituted for Jupiter.

6. *Friga* represented both sexes, holding a drawn sword in the right hand and a bow in the left; denoting that women as well as men should fight in time of need. She was generally taken for a goddess; and was reputed the giver of peace and plenty, and causer of love and amity. Her day of worship was called by the Saxons *Frigedeag*, now *Friday*, *dies Veneris;* but the habit and weapons of this figure have a resemblance of Diana rather than Venus.

7. *Seater*, or *Crodo*, stood on the prickly back of a perch. He was thin-visaged and long-haired, with a long beard, bare-headed and bare-footed, carrying a pail of water in his right hand wherein are fruit and flowers, and holding up a wheel in his left, and his coat tied with a long girdle. His standing on the sharp fins of this fish signified to the Saxons, that by worshipping him they should pass through all dangers unhurt: by his girdle flying both ways was shown the Saxons freedom; and by the pail with fruit and flowers, was denoted that he would nourish the earth. From him, or from the Roman deity Saturn, comes *Saturday*.

Such were the principal gods of the northern nations: but these people had at the same time inferior deities, who were supposed to have been translated into heaven for their heroic deeds, and whose greatest happiness consisted in drinking *ale* out of the skulls of their enemies in the *hall of Woden*. But the limits prescribed to the present article do not permit us to pursue this subject; nor is it necessary that we should pursue it. The attentive reader of the article MYTHOLOGY, of the histories given in this work of the various divinities of paganism, and of the different nations by whom those divinities were worshipped, will perceive that the progress of polytheism and idolatry has been uniform over the whole earth.

28
Brute worship of the Egyptians

There is, however, one species of idolatry more wonderful than any thing that has yet been mentioned, of which our readers will certainly expect some account. It is the worship of *brutes*, *reptiles* and *vegetables*, among the Egyptians. To the Greeks and Romans, as well as to us, that superstition appeared so monstrous, that to enumerate every hypothesis, ancient and modern, by which philosophers have endeavoured to account for it, would swell this article beyond all proportion. Brute-worship prevailed at so early a period in Egypt, that the philosophers of antiquity, whose writings have descended to us, had little or no advantage over the moderns in pursuing their researches into its origin; and among the modern hypotheses those of *Mosheim* and *Warburton* appear to us by much the most probable of any that we have seen (B). The former of these learned writers attributes it wholly to the policy of the prince and the craft of the priest. The latter contends, with much earnestness and ingenuity, that it resulted from the use of hieroglyphic writing. We are strongly inclined to believe that both these causes contributed to the production of so portentous an effect; and that the use of hieroglyphics as sacred symbols, after they were laid aside in civil life, completed that wonderful superstition which the craft of the priest and the policy of the prince had undoubtedly begun.

* Lib. ii. c. 65.

29
Introduced with a political view;

We learn from Herodotus *, that in his time the number of useful animals in Egypt was so small as hardly to be sufficient for tillage and the other purposes of civil life; whilst serpents and other noxious animals, such as the crocodile, wolf, bear, and hippopotamus, abounded in that country. From this fact Mosheim very naturally concludes †, that the founders of society and government in Egypt would by every art endeavour to increase the number of useful animals as the number of inhabitants increased; and that with this view they would make it criminal to kill or even to hurt sheep, cows, oxen, or goats, &c. whilst they would wage perpetual war upon the noxious animals and beasts of prey. Such animals as were assisting to them in the carrying on of this warfare would be justly considered as in a high degree useful to society. Hence the most grievous punishments were decreed against the killing, or so much as the wounding, of the *ichneumon* and *ibis*; because the former was looked upon as the instinctive enemy of the crocodile, and the latter of every species of serpents. The learned writer, however, observes, that in Egypt as in other countries, people would be tempted to sacrifice the good of the public to the gratification of their own appetites, and sometimes even to the indulgence of a momentary caprice. He thinks it was found necessary to strengthen the authority of the laws enacted for the preservation of useful animals by the sanctions of religion: and he says, that with this view the priests declared that certain animals were under the immediate protection of certain gods; that some of those animals had a divine virtue residing in them; and that they could not be killed without the most sacrilegious wickedness, incurring the highest indignation of the gods. When once the idolatrous Egyptians were persuaded that certain animals were sacred to the immortal gods, and had a divine virtue residing in them, they could not avoid viewing those animals with some degree of veneration; and the priests, taking advantage of the superstition of the people, appointed for each species of sacred animals appropriated rites and ceremonies, which were quickly followed with building shrines and temples to them, and approaching them with oblations and sacrifices, and other rites of divine adoration.

† Cudworth, Intellect. Syst. cap. iv. N° 158.

To corroborate this hypothesis, he observes, that, besides the animals sacred over all Egypt, each province and each city had its particular animal to which the inhabitants paid their devotions. This arose from the universal practice among idolaters of consecrating to themselves *Lares* and *Penates*; and as the animals which were worshipped over the whole kingdom were considered as sacred to the *Dii majorum gentium*, so the animals whose worship was confined to particular cities or provinces, were sacred to the *Lares* of those cities and provinces. Hence there was in Upper Egypt a city

(B) There is, however, another hypothesis worthy of some attention, if it were only for the learning and ingenuity of its author. The celebrated Cudworth infers, from the writings of Philo and other Platonists of the Alexandrian school, that the ancient Egyptians held the Platonic doctrine of ideas existing from eternity, and constituting, in one of the persons of the godhead, the intelligible and archetypal world. (See PLATONISM). Philo, he observes, did not himself consider those ideas as so many distinct *substances* and *animals*, much less as *gods*; but he mentions others who deified the whole of this intelligible system as well as its several parts. Hence, when they paid their devotions to the *sensible sun*, they pretended only to worship the divine *idea* or *archetype* of that luminary: and hence, thinks our learned author, the ancient Egyptians, by falling down to bulls, and cows, and crocodiles, meant at first to worship only the divine and eternal *ideas* of those animals. He allows, indeed, that as few could entertain any thoughts at all of those eternal ideas, there were scarcely any who could persuade themselves that the *intelligible system* had so much reality in it as the *sensible things of nature*; and hence he thinks the devotion which was originally paid to the divine ideas had afterwards no higher object than the brutes and vegetables of which those ideas were the eternal patterns.

This hypothesis is ingenious, but not satisfactory. There is no evidence that the mysterious doctrine of Plato concerning *ideas* had anywhere been thought of for ages after brute-worship was established in Egypt. Of the state of Egyptian theology at that early period, Philo, and the other philosophers of the Alexandrian school, had no better means of forming a judgment than we have; and they laboured under many Grecian prejudices, which must have prevented them from judging with our impartiality.

Brute Worship.

city called *Lycopolis*, because its inhabitants worshipped the wolf, while the inhabitants of *Thebes*, or *Heliopolis*, paid their devotions to the eagle, which was probably looked upon as sacred to the sun. Our author, however, holds it as a fact which will admit of no dispute, that there was not one noxious animal or beast of prey worshipped by the Egyptians till after the conquest of their country by the Persians. That the earliest gods of Egypt were all benevolent beings, he appeals to the testimony of Diodorus Siculus; but he quotes Herodotus and Plutarch as agreeing that the latter Egyptians worshipped an evil principle under the name of *Typhon*. This *Typhon* was the inveterate enemy of *Osiris*, just as *Ahraman* was of *Ormuzd*; and therefore he thinks it in the highest degree probable that the Egyptians derived their belief of two self-existent principles, a good and an evil, from their Persian conquerors, among whom that opinion prevailed from the earliest ages.

From whatever source their belief was derived, Typhon was certainly worshipped in Egypt, not with a view of obtaining from him any good, for there was nothing good in his nature, but in hopes of keeping him quiet, and averting much evil. As certain animals had long been sacred to all the benevolent deities, it was natural for a people so besotted with superstition as the Egyptians to consecrate emblems of the same kind to their god Typhon. Hence arose the worship of *serpents*, *crocodiles*, *bears*, and other noxious animals and beasts of prey. It may indeed seem at first sight very inconsistent to deify such animals, after they had been in the practice for ages of worshipping others for being their destroyers; but it is to be remembered that long before the deification of crocodiles, &c. the real origin of brute worship was totally forgotten by the people, if they were ever acquainted with it. The crafty priest who wishes to introduce a gainful superstition, must at first employ some plausible reason to delude the multitude; but after the superstition has been long and firmly established, it is obviously his business to keep its origin out of sight.

Such is Mosheim's account of the origin and progress of that species of idolatry which was peculiar to Egypt; and with respect to the *rise* of *brute*-worship, it appears perfectly satisfactory. But the Egyptians worshipped several species of vegetables; and it surely could be no part of the policy of wise legislators to preserve *them* from destruction, as vegetables are useful only as they contribute to animal subsistence. We are therefore obliged to call in the aid of Warburton's hypothesis to account for this branch of Egyptian superstition.

That learned and ingenious author having proved *, with great clearness and strength of argument, that hieroglyphic writing was prior to the invention of alphabetic characters; and having traced that kind of writing from such rude pictures, as those which were in use among the Mexicans, through all the different species of what he calls *curiologic*, *tropical*, and *symbolic* hieroglyphics (see HIEROGLYPHICS)—shows, by many quotations from ancient authors, that the Egyptian priests wrapt up their theology in the symbolic hieroglyphics, after alphabetic characters had banished from the transactions of civil life a mode of communicating information necessarily so obscure. These symbols were the figures of animals and vegetables, denoting, from some imaginary analogy, certain attributes of their divinities; and when the vulgar, forgetting this analogy, ceased to understand them as a species of writing, and were yet taught to consider them as sacred, they could not well view them in any other light than as emblems of the divinities whom they adored. But if rude sculptures upon stone could be emblematical of the divinities, it was surely not unnatural to infer, that the living animals and vegetables which those sculptures represented must be emblems of the same divinities more striking and more sacred. Hence the learned author thinks arose that wonderful superstition peculiar to the Egyptians, which made them worship not only animals and vegetables, but also a thousand chimeras of their own creation; such as figures with human bodies and the heads or feet of brutes, or with brutal bodies and the heads and feet of men.

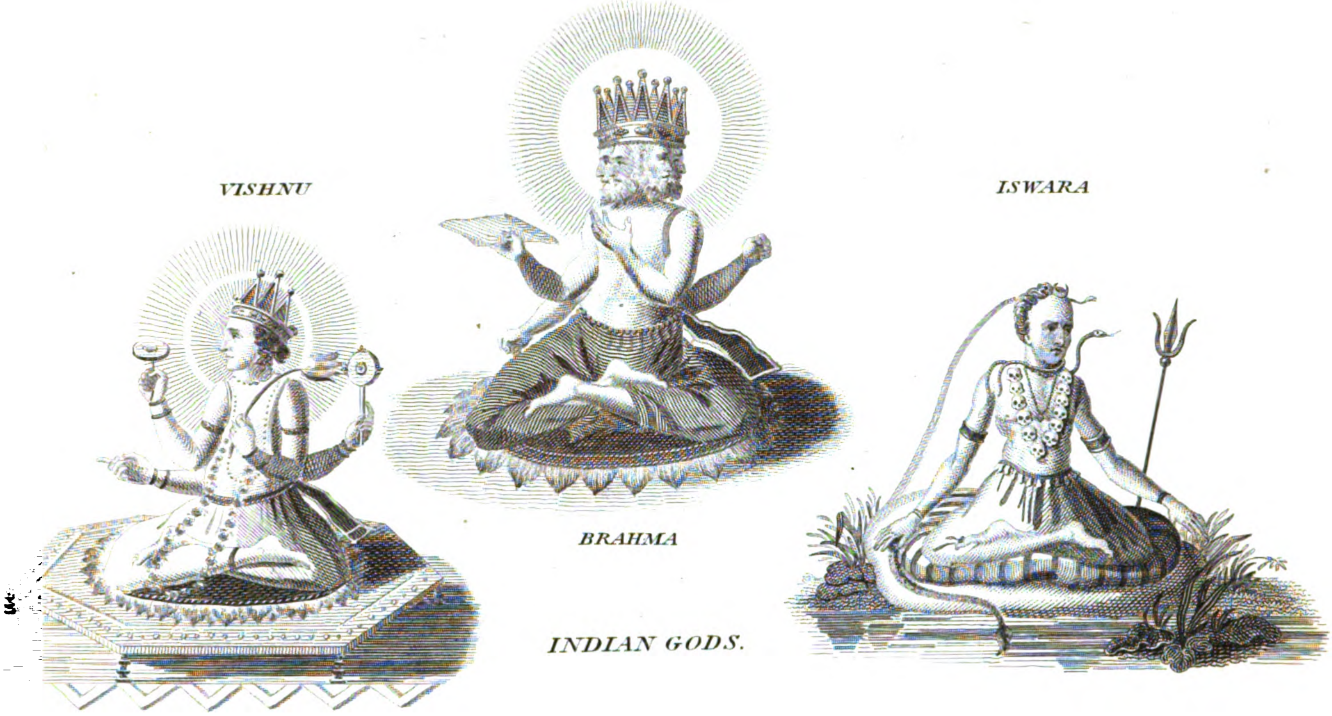
* Div. Leg. book iv. sect. 4.

These two hypotheses combined together appear to us to account sufficiently for the idolatry of Egypt, monstrous as it was. We are persuaded that with respect to the *origin* of brute-worship Mosheim is in the right (c); and it was a very easy step for people in so good training to proceed upon the crutches of hieroglyphics to the worship of plants and those chimeras, which, as they never had a real existence in nature, could not have been thought of as emblems of the divinity, had they not been used in that symbolic writing which Warburton so ably and ingeniously explains.

To this account of the origin of brute-worship, we are fully aware that objections will occur. From a learned friend, who perused the article in manuscript, we have been favoured with one which, as it is exceedingly plausible, we shall endeavour to obviate. "Brute-worship was not peculiar to Egypt. The Hindoos, it is well known, have a religious veneration for the cow and the alligator; but there is no evidence that in India the number of useful animals was ever so small as to make the interference of the prince and the priest necessary for their preservation; neither does it appear that the Hindoos adopted from any other people the worship of a self-existent principle of evil." Such is the objection. To which we reply,

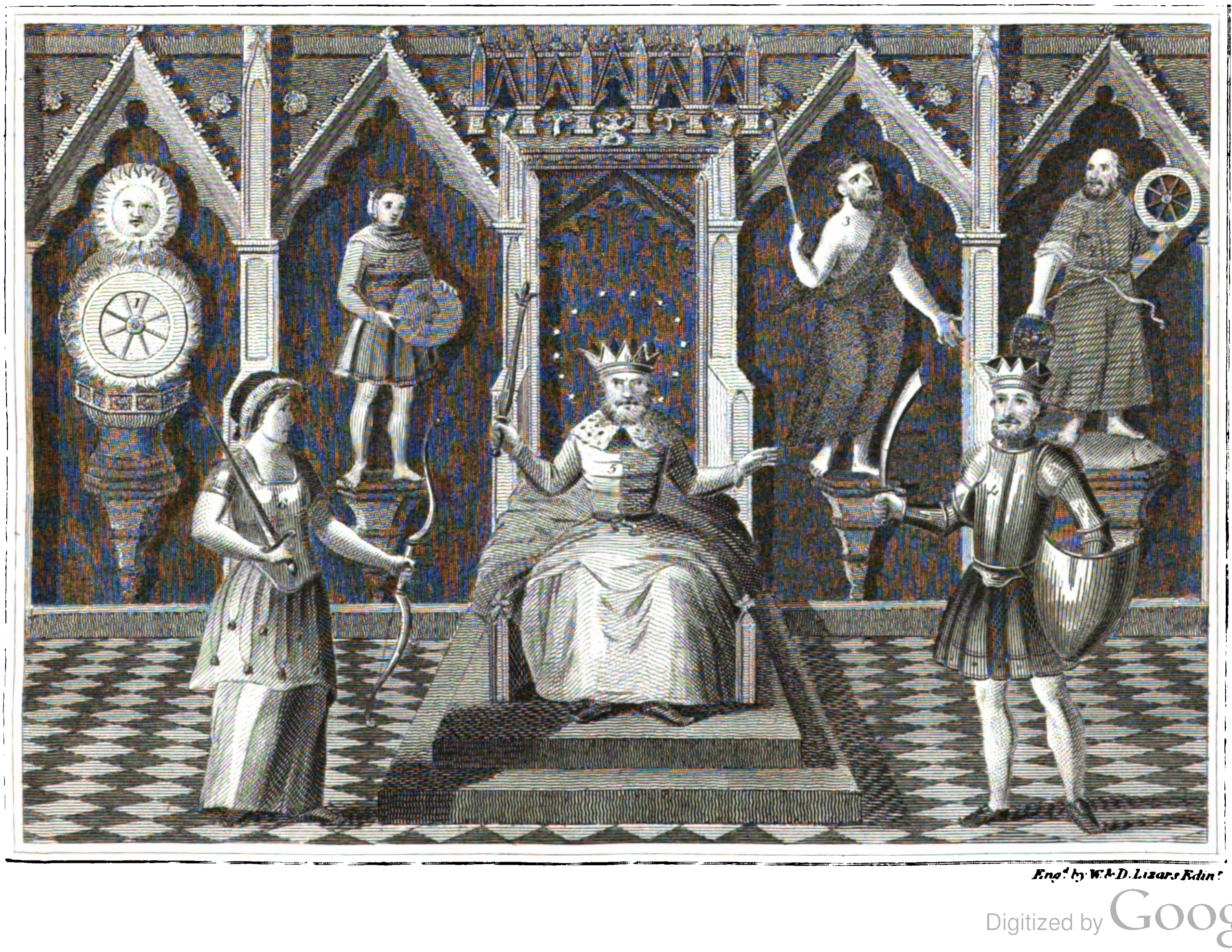
That there is every reason to believe that brute-worship was introduced into India by a colony of Egyptians at a very remote period. That between these two nations there was an early intercourse, is universally

(c) To prove that it was merely to preserve and increase the breed of useful animals in Egypt, that the prince and the priest *first* taught the people to consider such animals as sacred, he argues thus: "Hæc ita esse, non ex eo tantum liquet, quod paulo ante observavi, nullas bestias universo Ægyptiorum populo sacras fuisse, præter eas, quæ manifestam regioni utilitatem comparent; sed inde quoque apparet, quod longe major ratio habita fuit famellarum inter animalia, quam marium. Boves diis immolare licebat, vaccas nullo modo. Canes fœminæ contumulabantur, non item mares." *Lege HERODOT. Histor.* lib. ii. cap. 41. & cap. 67.



INDIAN GODS.

THE PRINCIPAL IDOLS OF THE SAXONS WORSHIPPED IN BRITAIN.



Eng.d by W. & D. Lizars Edin.r

ly allowed: and though the learned president of the Asiatic Society has laboured to prove, that the Egyptians derived all that wisdom for which they were famed, as well as the rudiments of their religious system, from the natives of Hindostan, he does not appear to us to have laboured with success. To examine his arguments at length would swell this article beyond its due proportion; and we have noticed some of them elsewhere (see PHILOLOGY, N° 33 and 39). At present we shall only observe, that Sesostris undoubtedly made an inroad into India, and conquered part of the country, whilst we nowhere read of the Hindoos having at any time conquered the kingdom of Egypt. Now, though the victors have sometimes adopted the religion of the vanquished, the contrary has happened so much more frequently, and is in itself a process so much more natural, that this single circumstance affords a strong presumption that the Egyptian monarch would rather impose his gods upon the Hindoos than adopt theirs and carry them with him to Egypt. Brute-worship might likewise be introduced into Hindostan by those vast colonies of Egyptians who took refuge in that country from the tyranny and oppression of the shepherd kings. That such colonies did settle on some occasion or other in India, seems undeniable from monuments still remaining in that country, of forms which could hardly have occurred to a native of Asia, though they are very natural as the workmanship of Africans. But we need not reason in this manner. We have seen a manuscript letter from Mr Burt, a learned surgeon in Bengal, and a member of the Asiatic Society, which puts it beyond a doubt that great numbers of Egyptians had at a very early period not only settled in Hindostan, but also brought with them writings relating to the history of their country. As the shepherd-kings were enemies to the arts and to literature, it is probable that this settlement took place on their conquest of Egypt. Mr Burt's words are: "Mr Wilford, lieutenant of engineers, has extracted most wonderful discoveries from the Shanscrit records: such as the origin and history of the Egyptian pyramids, and even the account of the expence in their building." Upon our hypothesis there is nothing incredible in this account; upon the hypothesis of Sir William Jones, it is not easy to be conceived how the history of *Egyptian* pyramids could have found a place in the *Shanscrit* records.

We may admit that the Hindoos have never adopted from the Persians or Egyptians the worship of an independent principle of evil, and yet dispose of the other part of the objection with very little difficulty. It will be seen by and bye, that the bramins believe a kind of triad of hypostases in the divine nature, of which one is viewed as the *destroyer*, and known by several names, such as *Siva* and *Iswara*. When brute-worship was introduced into Hindostan, it was not unnatural to consider the alligator as emblematical of *Iswara;* and hence in all probability it is that the Hindoos believe that a man cannot depart more happily from this world than by falling into the Ganges, and being devoured by one of those sacred animals. Upon the whole, the brute-worship of the Hindoos, instead of militating against our account of that monstrous superstition as it prevailed in Egypt, seems to lend no small support to that account, as there was unquestionably an early intercourse between the two nations, and as colonies of Egyptians settled in India. To him who is not satisfied with our reasoning on this subject, we beg leave to recommend an attentive perusal of Maurice's *Indian Antiquities*, where he will find many facts brought together, which tend to prove that Egypt has a just claim to a higher antiquity than India.

32 Polytheists acknowledged one supreme God,

Having thus traced the rise and progress of polytheism and idolatry as they prevailed in the most celebrated nations of antiquity, we now proceed to inquire into the real opinions of those nations concerning the nature of the gods whom they adored. And here it is evident from the writings of Homer, Hesiod, and the other poets, who were the principal theologians among the Greeks and Romans, that though heaven, earth, hell, and all the elements, were filled with divinities, there was yet one who, whether called *Jove*, *Osiris*, *Ormuzd*, or by any other title, was considered as supreme over all the rest. "Whence each of the gods was generated (says Herodotus *), or whether they have all existed from eternity, and what are their *forms*, is a thing that was not known till very lately; for Hesiod and Homer were, as I suppose, not above four hundred years my seniors; and these were they who introduced the theogony among the Greeks, and gave the gods their several names." Now Hesiod †, towards the beginning of his theogony, expressly invokes his muse to celebrate in suitable numbers the generation of the immortal gods who had sprung from the earth, the dark night, the starry heavens, and the salt sea. He calls upon her likewise to say, "in what manner the gods, the earth, the rivers, ocean, stars, and firmament, were generated, and what divine intelligences had sprung from them of benevolent dispositions towards mankind." From this invocation, it is evident that the poet did not consider the gods of Greece as self-existent beings: neither could he look upon them as *creatures;* for of creation the ancient Greeks had no conception (see METAPHYSICS, N° 264.); but he considered them as emanations coeval with the earth and heavens, from some superior principles; and by the divine intelligences sprung from them, there cannot be a doubt but that he understood benevolent dæmons. The first principles of all things, according to the same Hesiod, were *Chaos*, and *Tartarus* and *Love;* of which only the last being active, must undoubtedly have been conceived by this father of Grecian polytheism to be the greatest and only self-existing god. This we say must undoubtedly have been Hesiod's belief, unless by *Tartarus* we here understand a self-existent principle of evil; and in that case his creed will be the same with that of the ancient Persians, who, as we have seen, believed in the self-existence as well of *Ahraman* as of *Ormuzd*.

* Lib ii. c. 51.

† Vers. 104—112.

33 from whom the other divinities were generated:

Hesiod is supposed to have taken his theology from Orpheus; and it is evident that his doctrine concerning the generation of the gods is the same with that taught in certain verses * usually attributed to Orpheus, in which Love and Chaos are thus brought together. "We will first sing (says the poet) a pleasant and delightful song concerning the ancient Chaos, how the heavens, earth, and seas, were formed out of it; as also concerning that all-wise *Love*, the oldest and self-perfect principle, which actively produced all these things, separating one from another." In the original passage, Love is said not only to be πολυμητις, of *much wisdom* or *sagacity*, and therefore a real intelligent substance; but also

* Argonaut. p 17. edit. Steph.

Theogony. also to be πρεσβυτατος and αυτοτελης, the *oldest* and *self-perfect*, and therefore a being of superior order to the other divinities who were generated together with the elements over which they were conceived to preside.

With the theology of Homer our readers of all descriptions are so well acquainted, that we need not swell the article with quotations, to prove that the father of epic poetry held *Jove* to be the father of gods and men. But the doctrine of the poets was the creed of the vulgar Greeks and Romans; and therefore we may conclude, that those nations, though they worshipped gods and lords innumerable, admitted but one, or at the most two (D), self-existent principles; the one good and the other evil. It does not indeed appear, that in

34 though each was by the vulgar considered as unaccountable in his own province.

the system of vulgar paganism the subordinate gods were accountable to their chief for any part of their conduct, except when they transgressed the limits of the provinces assigned them. Venus might conduct the amours of heaven and earth in whatever manner she pleased; Minerva might communicate or with-hold wisdom from any individual with or without reason; and we find, that in Homer's battles the gods were permitted to separate into parties, and to support the Greeks or Trojans according as they favoured the one or the other nation. Jove indeed sometimes called them to order; but his interference was thought partial, and an instance of tyrannical force rather than of just authority. The vulgar Greeks, therefore, although they admitted but one, or at most two, self-existent principles, did not consider the inferior divinities as mediators between them and the supreme, but as gods to whom their worship was on certain occasions to be ultimately directed.

35 Creed of the philosophers and

The creed of the philosophers seems to have been different. Such of them as were theists, and believed in the administration of Providence, admitted of but one God, to whom worship was ultimately due; and they adored the subordinate divinities as his children and ministers, by whom the course of Providence was carried on. With respect to the origin of those divinities, Plato is very explicit; where he tells us *, that "when all the gods, both those who move visibly round the heavens, and those who appear to us as often as they please, were generated, that God who made the whole universe, spoke to them after this manner: Ye gods of gods, of whom I myself am father, attend." Cicero teaches the very same doctrine with Plato concerning the gods †; and Maximus Tyrius, who seems to have understood the genius of polytheism as thoroughly as any man, gives us the following clear account of that system as received by the philosophers.

"I will now more plainly declare my sense ‡ by this similitude: Imagine a great and powerful kingdom or principality, in which all agree freely and with one consent to direct their actions according to the will and command of one supreme king, the oldest and the best; and then suppose the bounds and limits of this empire not to be the river Halys, nor the Hellespont, nor the Meotian lake, nor the shores of the ocean; but heaven above, and the earth beneath. Here then let that great king sit immoveable, prescribing to all his subjects laws, in the observance of which consist their safety and happiness: the partakers of his empire being many, both visible and invisible gods; some of which that are nearest, and immediately attending on him, are in the highest regal dignity, feasting as it were at the same table; others again are their ministers and attendants; and a third sort are inferior to them both: and thus you see how the order and chain of this government descends down by steps and degrees from the supreme god to the earth and men." In this passage we have a plain acknowledgement of one supreme God, the sovereign of the universe, and of three inferior orders of gods, who were his ministers in the government of the world: and it is worthy of observation, that the same writer calls these intelligences θεους, θεου παιδας και φιλους, *gods, the sons and friends of gods*. He likewise affirms, that all ranks of men, and all nations on earth, whether barbarous or civilized, held the same opinions respecting one supreme Numen and the generation of the other gods.

"If there were a meeting (says he *) called of all these

* *Timæus.*

(D) Plutarch is commonly supposed, and we think justly supposed, to have been a believer in two self-existent principles, a good and an evil. His own opinion, whatever it was, he declares (*de Iside et Osiride*) to have been most ancient and universal, and derived from theologers and lawgivers, by poets and philosophers. "Though the first author of it be unknown, yet (says he) it hath been so firmly believed *everywhere*, that traces of it are to be found in the sacrifices and mysteries both of the *barbarians* and the *Greeks*. There is a confused mixture of good and evil in every thing, and nothing is produced by nature *pure*. Wherefore it is not one only dispenser of things, who, as it were, out of several vessels distributeth these several liquors of good and evil, mingling them together, and dashing them as he pleases; but there are two distinct and contrary powers or principles in the world, one of them always leading, as it were, to the right hand, but the other tugging the contrary way. For if nothing can be made without a cause, and that which is good cannot be the cause of evil, there must needs be a distinct principle in nature for the production of evil as well as good."

That this is palpable manicheism (see MANICHEISM), appears to us so very evident as to admit of no debate. It appeared in the same light to the learned Cudworth; but that author labours to prove that Plutarch mistook the sense of Pythagoras, Empedocles, Heraclitus, Anaxagoras, and Plato. when he attributed to them the same opinions which were held by himself. Mosheim, on the other hand, has put it beyond a doubt, that whatever was Plutarch's belief respecting the origin of evil, and the existence of two independent principles, it was taken implicitly from the writings of Plato. But the pious chancellor of *Gottingen*, actuated by the same motives with Cudworth, wishes to persuade his readers, that by Plato and Plutarch nothing *active* was understood by their evil principle, but only *that tendency to confusion* which was then deemed inseparable from matter. But that something more was meant seems undeniable: for immediately after the words which we have quoted, Plutarch proceeds to affirm that the wisest men declare θεους ειναι δυο καθαπερ αντιτεχνους, *that there are two gods, as it were, of contrary trades or crafts*, of which one is the author of all good and the other of all evil. See *Mosheim. ed. Cudworth. System. Intellect.* lib. i. cap. 4. § 13.

these several professions, a painter, a statuary, a poet, and a philosopher, and all of them were required to declare their sense concerning *the God;* do you think that the painter would say one thing, the statuary another, the poet a third, and the philosopher a fourth? No; nor the Scythian neither; nor the Greek, nor the Hyperborean. In other things we find men speaking very discordantly, all men as it were differing from all. But amidst this war, contention, and discord, you may find everywhere, throughout the whole world, one uniform law and opinion, that there is ONE GOD, THE KING AND FATHER OF ALL, and many gods, the SONS OF GOD, who reign with God. These things both the Greek and Barbarian affirm, both the inhabitants of the continent and of the sea-coast, both the wise and the unwise."

36 Indian Bramins.

This account of philosophical polytheism receives no small support from the Asiatic Researches of Sir William Jones. "It must always be remembered (says that accomplished scholar), that the learned Indians, as they are instructed by their own books, acknowledge only one supreme Being, whom they call BRAHME, or THE GREAT ONE, in the neuter gender. They believe his essence to be infinitely removed from the comprehension of any mind but his own; and they suppose him to manifest his power by the operation of his divine spirit, whom they name VISHNOU the *pervader*, and NE'RA'YAN or *moving on the waters*, both in the masculine gender; whence he is often denominated the *first male*. When they consider the divine power as exerted in *creating* or giving existence to that which existed not before, they call the deity BRAHMA'; when they view him in the light of *destroyer*, or rather *changer of forms*, they give him a thousand names, of which SIVA, ISWARA, and MAHADEVA, are the most common; and when they consider him as the preserver of created things, they give him the name of VISHNOU. As the soul of the world, or the pervading *mind*, so finely described by Virgil, we see JOVE represented by several Roman poets; and with great sublimity by Lucan in the well-known speech of Cato concerning the Ammonian oracle, "Jupiter is wherever we look, wherever we move.' This is precisely the Indian idea of VISHNOU: for since the power of preserving created things by a superintending providence belongs eminently to the godhead, they hold that power to exist transcendently in the *preserving* member of the triad, whom they suppose to be EVERYWHERE ALWAYS, not in substance, but in spirit and energy." This supreme god BRAHME, in his triple form, is the only self-existent divinity acknowledged by the philosophical Hindoos. The other divinities GENESA, INDRA, CUVERA, &c. are all looked upon either as his creatures or his children; and of course are worshipped only with inferior adoration.

Plate cccxxxiv.

37 Why the philosophers worshipped the inferior divinities.

It was upon this principle of the generation of the gods, and of their acting as ministers to the supreme *Numen*, that all the philosophers of Greece, who were not atheists, worshipped many divinities, though they either openly condemned or secretly despised the traditions of the poets respecting the amours and villanies of Jupiter, Venus, Mercury, and the rest of the tribe. It was the same principle sincerely admitted, and not an ill-timed jest, as has been absurdly supposed, that made Socrates, after he had swallowed the poison, request his friend to offer a votive cock for him to Esculapius.

But a theogony was not peculiar to the Greeks, Romans, and the Hindoos; it made part of every system of polytheism. Even the Egyptians themselves, the grossest of all idolaters, believed in one self-existing God, from whom all their other divinities descended by generation. This appears probable from the writings of Horus Apollo, Jamblicus, Porphyry, and many other ancient authors; but if the inscription on the gates of the temple of *Neith* in *Sais*, as we have it from Plutarch and Proclus, be genuine, it will admit of no doubt. This famous inscription, according to the last of these writers, was to this purpose: "I am whatever is, whatever shall be, and whatever hath been. My veil no man hath removed. The offspring which I brought forth was the sun (E)."

The Persian magi, as we have seen, believed in two self existent principles, a good and an evil: but if Diogenes Laertius deserves to be credited, they held that fire, earth, and water, which they called gods, were generated of these two. It was observed in the beginning of this article, that the first object of idolatrous worship was probably the sun, and that this species of idolatry took its rise in Chaldea or Persia. But when it became the practice of eastern monarchs to conceal themselves wholly from their people, the custom, as implying dignity, was supposed to prevail as well in heaven as on earth; and Zoroaster, the reformer of the Persian theology, taught*, that "Ormuzd was as far removed from the sun as the sun is removed from the earth." According to this modification of magianism, the sun was one of the generated gods, and held the office of prime minister or vicegerent to the invisible fountain of light and good. Still, however, a self-existent principle of evil was admitted; but though he could not be destroyed or annihilated by any power, it was believed that he would at last be completely vanquished by Ormuzd and his ministers, and rendered thenceforward incapable of producing any mischief.

* *Plutarch, de Iside et Osiride.*

From this short view of polytheism, as we find it delineated by the best writers of antiquity, we think ourselves warranted to conclude, that the whole pagan world believed in but *one*, or at most *two*, SELF-EXISTENT GODS, from whom they conceived all the other divinities to have descended in a manner analogous to human generation. It appears, however, that the vulgar pagans considered each divinity as supreme and unaccountable within his own province, and therefore intitled to worship, which rested ultimately in himself. The philosophers,

(E) Τα οντα, και τα εσομενα και τα γεγονοτα, εγω ειμι. Τον εμον χιτωνα ουδεις απεκαλυψεν. Ὁν εγω καρπον, ἡλιος εγενετο. The antiquity of this inscription is admitted by Cudworth, denied by Mosheim, and doubted by Jablonski. The reader who wishes to know their arguments may consult Mosheim's edition of the *Intellectual System*, and Jablonski's *Pantheon Ægyptiorum.*

Theogony.

philosophers, on the other hand, seem to have viewed the inferior gods as accountable for every part of their conduct to him who was their sire and sovereign, and to have paid to them only that inferior kind of devotion which the church of Rome pays to departed saints. The vulgar pagans were sunk in the grossest ignorance, from which statesmen, priests, and poets, exerted their utmost influence to keep them from emerging; for it was a maxim which, however absurd, was universally received, that "there were many things true in religion *, which it was not convenient for the vulgar to know; and some things which, though false, it was yet expedient that they should believe. The polytheism and idolatry of the vulgar, therefore, was their misfortune rather than their fault. But the philosophers were wholly "without excuse *; because that when they knew God, they glorified him not as God, neither were thankful, but became vain in their imaginations, and their foolish heart was darkened. Professing themselves wise, they became fools, and worshipped and served the creature more than the Creator, who is God blessed for ever."

38 Vulgar polytheists less culpable than the philosophers.

* *Varro apud D. August. de Civ. Dei.*

* Rom. i. 21, 22, 25.

POL POM

Polytrichum || Polyxo.

POLYTRICHUM, a genus of plants belonging to the cryptogamia class. See BOTANY *Index*. The anthera is operculated, and placed upon a very small apophysis or articulation; the calyptra villous; the star of the female is on a distinct individual. There are 16 species; the most remarkable of which, natives of Britain, is the *commune*, or great golden maiden-hair, frequently to be met with in bogs and wet places. It grows in patches; the stalks erect, generally single and unbranched, from three inches to a foot or even a yard high. The leaves are numerous, stiff, lanceolate, acute, growing round the stalk without order, and, if viewed with a microscope, appear to have their edges finely serrated. There are two varieties of this moss: the first has much shorter stalks than the preceding, and often branched; the leaves stiffer, erect, and more crowded; in other respects the same. The other has a stalk scarcely more than half an inch high, terminated with a cluster of linear, erect, rigid leaves, for the most part entire on the edges, and tipped each with a white hair. The filament is about an inch high, and the capsule quadrangular. The female flower, or gem, is of a bright red colour.

The first kind, when it grows long enough for the purpose, is sometimes used in England and Holland to make brooms or brushes. Of the female sort the Laplanders, when obliged to sleep in desert places, frequently make a speedy and convenient bed, in the following manner: Where the moss grows thick together, they mark out, with a knife, a piece of ground, about two yards square, or of the size of a common blanket; then beginning at one corner, they gently sever the turf from the ground, and as the roots of the moss are closely interwoven and matted together, they by degrees strip off the whole circumscribed turf in one entire piece; afterwards they mark and draw up another piece, exactly corresponding with the first; then, shaking them both with their hands, they lay one upon the ground, with the moss uppermost, instead of a matress, and the other over it, with the moss downwards, instead of a rug; and between the two pieces they enjoy a comfortable sleep.

POLYXÆNUS, or POLYÆNUS. See POLYÆNUS.

POLYXO, a priestess of Apollo's temple in Lemnos. She was likewise nurse to Queen Hypsipyle. It was by her advice that the Lemnian women murdered all their husbands.—There was another Polyxo, a native of Argos, who married Tlepolemus son of Hercules. She followed him to Rhodes after the murder of his uncle Licymnius; and when he departed for the Trojan war with the rest of the Greek princes, she became the sole mistress of the kingdom. After the Trojan war, Helen fled from Peloponnesus to Rhodes, where Polyxo reigned. Polyxo detained her; and to punish her as being the cause of a war in which Tlepolemus had perished, she ordered her to be hanged on a tree by her female servants, disguised in the habit of Furies.

Polyxo || Pomfret.

POMACEÆ, (*pomum*, "an apple,") the name of the 36th order in Linnæus's Fragments of a Natural Method, the genera of which have a pulpy esculent fruit, of the apple, berry, and a cherry kind. See BOTANY, *Natural Orders*.

POMATUM, an unguent generally used in dressing the hair. It is also employed as a medicine.

POMEGRANATE. See PUNICA, BOTANY *Index*.

POMERANIA, a province in Germany, in the circle of Upper Saxony, having formerly the title of a duchy. It is bounded on the north by the Baltic sea, on the east by Prussia and Poland, on the south by the marquisate of Brandenburg, and on the west by the duchy of Mecklenburg; and is about 250 miles in length, and in some places 75 miles and in others 50 in breadth. It is watered by several rivers, the most considerable of which are the Oder, the Pene, the Rega, the Persant, the Wipper, the Stolp, the Lupo, and the Lobo. The air is cold; but the soil abounds in pastures, and produces corn, of which a great deal is exported. It is a flat country, containing many lakes, woods, and forests, and has several good harbours. It is divided into the Hither and Farther Pomerania. The small part of this province held by Sweden, was given to Denmark in exchange for Norway, and by Denmark was ceded to Prussia, in 1814.

POMFRET, JOHN, an English poet, son of the rector of Luton in Bedfordshire, was born in 1667, and educated at Cambridge; after which he took orders, and was presented to the living of Malden in Bedfordshire. About 1703 he went to London for institution to a larger and very considerable living; but was stopped some time by Compton, then bishop of London, on account of these four lines of his poem, entitled the Choice:

"And

"And as I near approach'd the verge of life,
Some kind relation (for I'd have no wife),
Should take upon him all my worldly care,
While I did for a better state prepare."

The parentheses in these lines were so maliciously represented, that the good bishop was made to believe that Pomfret preferred a mistress to a wife. But he was soon convinced that this representation was the mere effect of malice, as Pomfret at that time was actually married. The opposition, however, which his slanderers had made to him had its effect; for, being by this obliged to stay in London longer than he intended, he catched the small-pox, and died of it, aged 35.

He published a volume of his poems in 1699, with a very modest and sensible preface. Two pieces of his were published after his death by his friend Philalethes; one intitled Reason, and written in 1700, when the disputes about the Trinity ran high; the other *Dies Novissima*, or the "Last Epiphany," a Pindaric ode. His versification is not unmusical; but there is not the force in his writings which is necessary to constitute a poet. A dissenting teacher of his name, and who published some rhimes upon spiritual subjects, occasioned fanaticism to be imputed to him; but his friend Philalethes has justly cleared him from the imputation. Pomfret had a very strong mixture of devotion in him, but no fanaticism.

"The Choice (says Dr Johnson) exhibits a system of life adapted to common notions, and equal to common expectations; such a state as affords plenty and tranquillity, without exclusion of intellectual pleasures. Perhaps no composition in our language has been oftener perused than Pomfret's Choice. In his other poems there is an easy volubility; the pleasure of smooth metre is afforded to the ear, and the mind is not oppressed with ponderous, or intangled with intricate, sentiment. He pleases many; and he who pleases many must have merit."

POMME, or POMMETTE, in *Heraldry*, is a cross with one or more balls or knobs at each of the ends.

POMMEL, or PUMMEL, in the *Manege*, a piece of brass or other matter at the top and in the middle of the saddle-bow.

POMMERULLIA, a genus of plants belonging to the triandria class, and in the natural method ranking under the 4th order, *Gramina*. See BOTANY *Index*.

POMOERIUM, in Roman antiquity, was, according to Livy, that space of ground, both within and without the walls, which the augurs, at the first building of cities, solemnly consecrated, and on which no edifices were allowed to be raised. Plutarch gives this account of the ceremony of drawing the pomœrium: "They dug a trench, and threw into it the first-fruits of all things, either good by custom, or necessary by nature; and every man taking a small turf of earth of the country from whence he came, they cast them in promiscuously. Then making this trench their centre, they described the city in a circle round it. After this, the founder yoking a bull and a cow together, ploughed a deep furrow, with a brazen ploughshare, round the bounds. The attendants took care that all the clods fell inwards, i. e. toward the city. This furrow they called *Pomœrium*, and built the wall upon it."—Plutarch, in this account, is to be understood as speaking of Rome.

POMERIUM *Proferre*, signifies to extend or enlarge a city, which could not be done by any, but those who had taken away some part of an enemy's country in war. But this qualification was sometimes dispensed with. *Pomœrium* is *quasi pone mœnia*, "behind the walls."

POMONA, in fabulous history, the tutelar deity of orchards and fruit-trees. See VERTUMNUS.

POMPEII (anc. geog.) a town of Campania near Herculaneum, and destroyed along with it by the great eruption of Vesuvius in the time of Titus. See HERCULANEUM. It is about 15 miles from Naples, and six or seven from Portici—So much has been said and written on the discovery of this place, as makes it unnecessary for us to say much: we shall therefore only give a short extract on the subject from an anonymous work lately published, apparently of considerable merit. "On entering the city (says our author*), the first object is a pretty square, with arcades, after the present manner of Italy. This was, as it is imagined, the quarter of the soldiers; numbers of military weapons being found here.

"A narrow, but long street, with several shops on each side, is now perfectly cleared of its rubbish, and in good preservation. Each house has a court. In some of them are paintings al fresco, principally in chiaroscuro; and their colours not the least injured by time. The few colours which the ancients knew were extracted only from minerals; and this may be a sufficient reason for their freshness. The street is paved with irregular stones of a foot and a half or two feet long, like the Appian way.

"In discovering this city, it was at first doubted whether it were actually Pompeii: but the name inscribed over the gateway put it beyond all doubt. The skeletons found were innumerable. It is said that many had spades in their hands, endeavouring, probably at first, to clear away the torrent of ashes with which they were deluged. Indeed the satisfaction which is felt at the view of ancient habitations, is much allayed by inevitable reflections on this frightful scene of desolation, though at the distance of so many centuries.

"An ancient villa is also seen entire at a little distance from Pompeii. The house is really elegant and spacious, but only two stories high. The pavement of the chambers is composed of tesselated marble, and, when polished, displays the design perfectly well.—There is some at the museum of Portici brought from this place, which the eye would really mistake for painting. Under the house is a fine triangular cellar, of which each part is 100 feet long, well filled with amphoræ. The skeletons of 29 persons were found here, supposed to have fled to it for safety. Each house is filled with ashes: they have almost penetrated through every crevice; and it is incredible how such a volume of them could have been thrown out by Vesuvius with sufficient force to have reached so far." It has been observed by some travellers that spoons were found among the ruins of Pompeii, but no forks, from which it is concluded, that table utensils of the latter description were not known to the Romans at that period. Forks, it is supposed, were invented at Constantinople, and were not in use in Italy till about the year 1000 of the Christian era.

* *Comparative Sketch of England and Italy, with Disquisitions on National Advantages.*

In

Pompeii.

In concluding our account of Herculaneum, it was stated that the means attempted for unrolling the manuscripts found among the ruins, had been unsuccessful, and that the plan had been dropped. It will not, we presume, be a little gratifying to the admirers of ancient literature, to be informed that this difficult labour has been resumed under the auspices of his Royal Highness the Prince of Wales; and that six volumes of Papyri presented to his Royal Highness by the king of Naples have reached London.

In the year 18 0 the Rev. Mr Hayter, an excellent scholar, with a liberal provision from the prince, and with permission of the king of Naples, went to Italy for the purpose of unrolling and transcribing the Papyri. The following narrative extracted from a letter addressed to his royal patron by Mr Hayter, will, we doubt not, be interesting to our readers:

"The numerous settlements (says the author) of the Greeks in Italy received the name of Magna Græcia, because their mother country was of a size considerably less than that in which they were planted: among these were nearly all the cities in the province of Campania, including Naples, the capital of his Sicilian majesty, and also Herculaneum, and Pompeii, which are supposed to boast a foundation coeval with Hercules himself, three thousand and fifty years ago, or twelve hundred and fifty years before the Christian era. This province, more than any other part of Magna Græcia, was always celebrated for the studious and successful cultivation of the arts and sciences. The two cities of Herculaneum and Pompeii ranked next to that of Naples in every respect, as places of considerable note; they had their public theatres, with every other attendant of great population, splendour, opulence, and general prosperity. These, in common with all the rest of Campania, became the elegant and favourite resort of the Romans, for the different purposes of health, luxury, repose, and erudition.

"In the ninth year of Nero's reign, these two cities experienced a most formidable shock from an earthquake, which overthrew a great part of them. Nor had they recovered altogether from the effects of this calamity by their own exertions, and the aid of imperial munificence, when a second calamity, of a different nature, but equally unexpected, consigned them both at once to the most complete oblivion. This calamity was the great eruption of Vesuvius, which happened on the 24th day of August, two full months from the accession of the emperor Titus Vespasian. Herculaneum was buried under a mass of lava, and volcanic matter, to the depth of 24 feet. Pompeii, being more distant from the mountain, was overwhelmed principally with a shower of ashes, nor in any place more than half the depth of the other city. But the fate of both was sudden and inevitable; and yet it appears that almost all of the inhabitants, and, what is an equally surprising circumstance, more of the Herculaneans than the Pompeians, escaped. By the few skeletons which have been found in either place, the relation of Dio Cassius, who states the destruction of the people while assembled at the theatre, is proved to be totally erroneous. It may be proper to remark, that before this eruption the whole of Vesuvius was in a state of cultivation and fertility, from the top to the bottom; and though the form and soil of the mountain in one particular spot seemed to denote the traces of some former explosion, yet no extant memorial of any kind had recorded it.

"Neither of these two cities was discovered again till a long period of sixteen hundred and thirty-four years had elapsed. It was in the year 1713, that some labourers, in sinking a well, struck their tools against a statue, which was on a bench in the theatre of Herculaneum. Forty years afterwards Pompeii was excavated with much less difficulty, as the incumbent stratum was neither so hard nor so deep as that of the former city.

"The number of the manuscripts saved from both those cities is said to be about 500; but, if I am rightly informed by those whose official situation must give them a competent knowledge of the subject, your royal highness, by facilitating the developement of these volumes, will probably be the means of further excavation, and of rescuing from their interment an infinite quantity of others. About thirty years ago, his Sicilian majesty ordered the developement, the transcription, and the printing of the volumes which had then been saved, to be undertaken. This operation was accordingly begun, and has never been discontinued till the late invasion of the French. But its mode, however excellent, was extremely slow; it has been performed by a single person, with a single frame only, under the direction of the marquis del Vasto, chamberlain to the king, and president of the royal academy.

"The frame consists of several taper and oblong pieces of wood, with parallel threads of silk that run on each side, the length of each piece: when the frame is laid on any volume, each piece of wood must be fixed precisely over each line of the page, while the respective threads being worked beneath each line, and assisted by the corresponding piece of wood above, raise the line upwards, and disclose the characters to view.

"The operation seems ingenious, and well adapted to the purpose: it was, I believe, invented by a capuchin at Naples. The fruits of it are said to be two publications only; one on music, by the celebrated Philodemus, who was a cotemporary of Cicero: and the other on cookery. The first is in his majesty's library, at the queen's palace. Through the obliging politeness of Mr Barnard, the king's librarian. I have had the advantage of perusing it. Indeed I hope your royal highness will not disapprove my acknowledging in this place the very warm and respectful interest which both this gentleman and the right honourable the president of the Royal Society have expressed for the furtherance of your royal highness's great and good design. Meanwhile, by this specimen of Philodemus, I am convinced that, if the frames should be multiplied to the proposed extent, several pages of thirty different manuscripts might be disclosed and transcribed within the space of one week.

"But the very period at which the manuscripts were buried, serves to point out to your royal highness that you may expect the recovery of either the whole, or at least parts, of the best writers of antiquity, hitherto deemed irrecoverable. All of these, in truth, had written before that period, if we except Tacitus, whose inestimable works were unfortunately not composed till twenty years afterwards during the reign of Trajan.

"Nor can it be imagined for a moment, that among five or six hundred manuscripts, already excavated, and especially from the numberless ones which further excavations may supply, lost at such a period in two of the most capital cities, in the richest, most frequented, and most learned province in Italy, each of them an established seat of the arts and sciences, each of them the resort of the most distinguished Romans, not any part of those illustrious authors should be discovered.

"But the manuscript of Philodemus itself makes the reverse of such an idea appear much more probable. To the moderns, who have

"Untwisted all the chains that tie
The hidden soul of harmony,"

his Treatise on Music cannot, indeed, be supposed to communicate much information; yet the subject is scientific, and scientifically treated. The author himself, too, was one of the most eminent men in his time for wit, learning, and philosophy. But in the rest of the arts and sciences, in history, in poetry, the discovery of any lost writer, either in whole or part, would be deemed a most valuable acquisition and treasure, and form a new era in literature.

"It is extremely fortunate that the characters of these manuscripts, whether they should be Greek or Latin, must be very obvious and legible. Before the year of our Lord 79, and some time after it, the Majusculæ or Unciales Litteræ, capital letters, were solely used. A page, therefore, in one of these manuscripts, would present to your royal highness an exact image of some mutilated inscription in those languages on an ancient column, statue, or sepulchre.

"There cannot remain a doubt, even omitting the assurances from men of official situation to that effect, that your royal highness's superintendant will receive every possible assistance from the marquis del Vasto; and in that case it seems improbable that the object of this mission can be altogether fruitless.

"With such a termination of it, however, your royal highness, by having proposed to concur with his Sicilian majesty in the quicker and more effectual developement, transcription, and publication of these manuscripts, will reap the satisfaction of having made a most princely attempt in behalf of knowledge and literature, on an occasion where their interests might be affected most materially, and in a manner of which no annals have afforded, or can hereafter afford, an example. Your very interposition will be your glory: your want of success will only make the learned world feel with gratitude what you would have done."

The interposition of his royal highness has had the happiest effect. The splendid encouragement which he gave to the work revived the drooping spirits of the Italian literati, and the consequence has been, that the business of unrolling and transcribing the manuscripts now proceeds with an alacrity which promises the most brilliant success. In forty-six years not more than eighteen rolls were developed before the interference of our prince. Under his encouragement, ninety have been recovered in two years! What new facilities may not now be expected when all the vigour of British intelligence is exerted on the subject!—See Swinburne's *Travels in the Two Sicilies*, vol. ii. p. 98, &c.; Lady Miller's *Letters*, or *De la Lande*; Captain Sutherland's *Tour up the Straits, from Gibraltar to Constantinople*, p. 75, &c.; Dr Smith's *Sketch of a Tour on the Continent*, in 1786 and 1787, vol. ii. p. 118, &c.; and Watkin's *Tour through Swisserland, Italy*, &c. See also Lemaistre's *Travels through France, Italy*, &c.

POMPEY the GREAT, CNEIUS POMPEIUS MAGNUS, the renowned rival of Julius Cæsar. Being defeated by him at the battle of Pharsalia, owing to the defection of his cavalry, he fled to Egypt by sea, where he was basely assassinated by order of Theodotus, prime minister to Ptolemy the Younger, then a minor, 48 B. C. See ROME.

POMPEYS, CNEIUS and SEXTUS, his sons, commanded a powerful army when they lost their illustrious father. Julius Cæsar pursued them into Spain, and defeated them at the battle of Munda, in which Cneius was slain, 45 B. C. Sextus made himself master of Sicily; but being defeated in the celebrated naval engagement at Actium by Augustus and Lepidus, he fled to Asia with only seven ships, the remains of his fleet, which consisted of more than 350; and from thence, unable to continue the war, he was obliged to retire to Lesbos, where renewing the war by raising an army, and seizing on some considerable cities, Marcus Titius, in the interest of Mark Antony, gave him battle, defeated him, took him prisoner, and basely put him to death, 35 B. C. See ROME.

POMPEY's Pillar, a celebrated column near Alexandria in Egypt, 114 feet high, and of which the shaft, composed of a single piece of granite, is 90 feet. For an account of different opinions concerning the origin and design of this pillar, see ALEXANDRIA, p. 596.

POMPONATIUS, PETER, an eminent Italian philosopher, was born at Mantua in 1462. He was of so small a stature, that he was little better than a dwarf; yet he possessed an exalted genius, and was considered as one of the greatest philosophers of the age in which he lived. He taught philosophy, first at Padua, and afterwards at Bologna, with the highest reputation. He had frequent disputations with the celebrated Achillini, whose puzzling objections would have confounded him, had it not been for his skill in parrying them by some joke. His book *De Immortalitate Animæ*, published in 1516, made a great noise. He maintained, that the immortality of the soul could not be proved by philosophical reasons; but solemnly declared his belief of it as an article of faith. This precaution did not, however, save him; many adversaries rose up against him, who did not scruple to treat him as an atheist; and the monks procured his book, although he wrote several apologies for it, to be burnt at Venice. His book upon Incantations was also thought very dangerous. He shows in it, that he believed nothing of magic and sorcery; and he lays a prodigious stress on occult virtues in certain men, by which they produced miraculous effects. He gives a great many examples of this; but his adversaries do not admit them to be true, or free from magic.—Paul Jovius says, that he died in 1525, in his grand climacteric. He was three times married; and had but one daughter, to whom he left a large sum of money. He used to apply himself to the solution of difficulties so very intensely, that he frequently forgot to eat, drink, sleep, and perform the ordinary functions of nature: nay, it made him almost distracted, and a laughing-stock to every one, as he himself tells us.

POMPONIUS MELA. See MELA.

POMUM, an APPLE; a species of seed-vessel, composed

posed of a succulent fleshy pulp; in the middle of which is generally found a membranous capsule, with a number of cells, or cavities, for containing the seeds. Seed-vessels of this kind have no external opening or valve. At the end opposite to the footstalk is frequently a small cavity, called by the gardeners the *eye of the fruit*, and by botanists *umbilicus*, the "navel," from its fancied resemblance to the navel in animals. Gourd, cucumber, melon, pomegranate, pear, and apple, furnish instances of the fruit seed-vessel in question.

POND, or *Fish-Pond*. See *Fish-Pond*.

POND, is a small pool or lake of water from whence no stream issues. In the Transactions of the Society instituted at London for the Encouragement of Arts, Manufactures, and Commerce, vol. viii. and printed in the year 1790, there is a short account of a machine for draining ponds without disturbing the mud. It was communicated to the society, together with a drawing and model of the machine, by Lieutenant-colonel Dansey. The model was made from the description of a machine used by a gentleman near Taunton for many years before, for supplying a cascade in his pleasure-grounds.—The colonel's regiment was then lying at Windsor; and thinking that the invention might be useful to supply the grand cascade at Virginia water, he made the model, and presented it to the king, who was graciously pleased to approve of it. In consequence of which, by his majesty's desire, a penstock on that principle was constructed from the model at one of the ponds in the neighbourhood.—The colonel thinks the machine may be useful in the hands of men of science, and applicable to silk, cotton, and other mills, where a steady and uniform velocity of water is wanted; which might be regulated at pleasure, occasioning no current to disturb the mud or fish, as the stream constantly runs from the surface. He says he has often made the experiment by the model in a tub of water.

Of this machine the following is a description.

Plate CCCCXXXVII. fig. 1. In fig. 1. A is the pipe, loaded with a rim of lead, of such weight as serves to sink it below the surface of the water. B is the discharging pipe, laid through the bank HI. C is the joint on which the pipe A turns its form, which is shown fig. 2. D is the ball or float, which, swimming on the surface of the pond, prevents the pipe A from descending deeper than the length of the chain by which they are connected. E is a chain winding on the windlass F, and serving to raise the tube A above the surface of the water, when the machinery is not in use. G is a stage. HI is the bank, represented as if cut throught at I, to show the tube B lying within it. K is a post to receive the tube A when lowered, and to prevent its sinking in the mud. In fig. 2. A is a cast cylinder, with a plate or cheek, B, which is fastened to the timber of the tube on one side, but not on the other, as the part of the cylinder C turns in the hollow of the wooden tube when it is immerged. A piece of strong sole leather is put inside the brass-plate B, to prevent leaking.

Pond-Weed. See POTAMOGETON, BOTANY *Index*.

PONDICHERRY, is a large town of Asia, in the peninsula on this side the Ganges, and on the coast of Coromandel. Its situation is low, and the ships anchor about a mile and a half from it; nor can the boats or canoes come nearer it than a musket-shot, on account of the breakers, so that the blacks come in flat bottomed boats to carry the men and merchandises to the fort. The fort is 200 paces from the sea, and very irregular; built with bricks, and covered with fine plaster, resembling white marble. The huts of the blacks lie here and there, and the walls are of bamboos mixed with the branches of trees. The French are greatly addicted to women, from whom they catch diseases that render them pale, livid, and meagre, with a frightful aspect. However, several of the French are married to a sort of Portuguese women, who are of a mixed breed, being a kind of Mulattoes. The country about it is barren, and consequently most of their provisions are brought from other places. Their trade consists of cotton-cloth, silks, pepper, saltpetre, and other merchandises that are brought from Bengal. With regard to the religion of the natives, the most numerous are the Gentoos; but there are Mahometans or Moors who hold a great many ridiculous opinions. The Gentoos are of different sects, and that of the Brahmins are priests. The custom of women burning themselves with the bodies of their dead husbands was very common, but of late much discountenanced. This place was taken, and the fortifications demolished, by Colonel Coote in 1761; it was restored to the French by the peace of 1763; was retaken by the English in 1793, and finally restored to France in 1814. It is 100 miles south of Madras. E. Long. 79. 58. N. Lat. 11. 42.

PONDICO, an island of the Archipelago, lying on the gulf of Ziton, near the coast of Negropont. It is small and uninhabited, as well as two others that lie near it.

PONG-HOU *Isles*, in the province of Fo-kien in China, form an archipelago between the port of Emouy and the island of Formosa. A Chinese garrison is kept here, with one of those mandarins who are called *literati*, whose principal employment is to watch the trading vessels which pass from China to Formosa, or from Formosa to China.

As these islands are only sand-banks or rocks, the inhabitants are obliged to import every necessary of life; neither shrubs nor bushes are seen upon them; all their ornament consists of one solitary tree. The harbour is good, and sheltered from every wind; it has from 20 to 25 feet depth of water. Although it is an uncultivated and uninhabited island, it is absolutely necessary for the preservation of Formosa, which has no port capable of receiving vessels that draw above eight feet of water.

PONIARD, a little pointed dagger, very sharp edged; borne in the hand, or at the girdle, or hid in the pocket. The word is formed from the French *poignard*, and that from *poignée*, "handful."—The poniard was anciently in very great use; but it is now in a good measure set aside, except among assassins.—Sword and poniard were the ancient arms of duellists; and are said to continue still so among the Spaniards. The practice of sword and poniard still make a part of the exercise taught by the masters of defence.

PONS, a town of France, in the department of Charente Inferior, very famous in the time of the Huguenots. It is seated on a hill, near the river Seigne, 10 miles from Saintes. W. Long. 0. 30. N. Lat. 45. 36.

PONT-DU-GARD, is a bridge of France, in Lower Languedoc, built over the river Gardon, which served for an aqueduct. It is a very remarkable and a most magnificent

magnificent work, and was raised by the ancient Romans. It consists of three bridges, one above another; the uppermost of which was the aqueduct, to convey water to the city of Nismes, which is eight miles to the south. They are altogether 192 feet high, and the uppermost 580 feet long. They are constructed between two rocks. E. Long. 4. 26. N. Lat. 43. 58.

PONTEDERIA, a genus of plants belonging to the hexandria class; and in the natural method ranking under the sixth order, *Ensatæ*. See BOTANY *Index*.

PONTEFRACT, or POMFRET, a town of the west riding of Yorkshire in England, situated on the river Are, which contained 3605 inhabitants in 1811. It is said to take its name from a broken bridge, which is supposed to have been laid anciently over that marshy spot called the *Wash*. Here are the ruins of a noble old castle, where Richard II. was barbarously murdered, and two of Edward V.'s uncles. The collegiate chapel of St Clement, which had a dean, three prebendaries, &c. is still distinguishable in it. This town has a good market, and fairs for horses, sheep, and other cattle. It is a corporation, governed by a mayor, recorder, aldermen, and burgesses. In the reign of Queen Elizabeth, 200l. was left by George Talbot, earl of Shrewsbury, to be lent for ever at 5l. a time, on proper security, for three years, to the poor artificers of the town; and Thomas Wentworth, Esq. ancestor to the marquis of Rockingham, left 200l. to the charity-shool. A branch of the great Roman military way called *Ermin street*, which passed from Lincoln to York, may be traced betwixt this town and Doncaster. The adjacent country yields plenty of limestone, together with liquorice and skirrets. W. Long. 1. 18. N. Lat. 53. 42.

PONTIFEX, PONTIFF, or *High-priest*, a person who has the superintendence and direction of divine worship, as the offering of sacrifices and other religious solemnities. The Romans had a college of pontiffs; and over these a sovereign pontiff, or pontifex maximus, instituted by Numa, whose function it was to prescribe the ceremonies each god was to be worshipped withal, compose the rituals, direct the vestals, and for a good while to perform the business of augury, till, on some superstitious occasion, he was prohibited intermeddling therewith. The office of the college of pontiffs was to assist the high-priest in giving judgment in all causes relating to religion, inquiring into the lives and manners of the inferior priests, and punishing them if they saw occasion, &c. The Jews, too, had their pontiffs; and among the Romanists, the pope is still styled the *sovereign pontiff*.

PONTIFICATE, is used for the state or dignity of a pontiff or high-priest; but more particularly in modern writers for the reign of a pope.

PONTIUS PILATE. See PILATE.

PONTON, or PONTOON, in *War*, a kind of flat-bottomed boat, whose carcase of wood is lined within and without with tin: they serve to lay bridges over rivers for the artillery and army to march over. The French pontoons, and those of most other powers, are made of copper on the outside: though these cost more at first, yet they last much longer than those of tin; and when worn out, the copper sells nearly for as

much as it cost at first; but when ours are rendered useless, they sell for nothing. Our pontoons are 21 feet long, five feet broad, and depth within two feet 1.5 inches.

PONTOON-Carriage, is made with two wheels only, and two long side-pieces, whose fore-ends are supported by a limber; and serves to carry the pontoon, boards, cross-timbers, anchors, and every other thing necessary for making a bridge.

PONTOON-Bridge, is made of pontoons slipped into the water, and placed about five or six feet asunder; each fastened with an anchor, when the river has a strong current; or to a strong rope that goes across the river, running through the rings of the pontoons. Each boat has an anchor, cable baulks, and chests. The baulks are about five or six inches square, and 21 feet long. The chests are boards joined together by wooden bars, about three feet broad and 12 feet long. The baulks are laid across the pontoons at some distance from one another, and the chests upon them joined close; which makes a bridge in a very short time, capable of supporting any weight.

PONT ST ESPRIT, is a town of France, in the department of Gard. It is seated on the river Rhone, over which is one of the finest bridges in France. It is 840 yards long, and consists of 26 arches. Each pier is pierced with an aperture, in order to facilitate the passage of the water when the river is high. The town is large, but the streets are narrow and ill built. It formerly contained several churches and convents. It is 17 miles south of Viviers, and 55 north-east of Montpelier. E. Long. 4. 46. N. Lat. 44. 13.

PONTUS, the name of an ancient kingdom of Asia, originally a part of Cappadocia; bounded on the east by Colchis, on the west by the river Halys, on the north by the Euxine sea, and on the south by Armenia 1
Minor. Some derive the name of Pontus from the Etymology of the name.
neighbouring sea, commonly called by the Latins *Pontus Euxinus*; others from an ancient king named *Pontus*, who imparted his name both to the country and the sea; but Bochart deduces it from the Phœnician word *botno*, signifying a filberd, as if that nut abounded remarkably in this place. But this derivation seems to be very far fetched; and the common opinion that the country derived its name from the sea, seems by far the most probable. The kingdom was divided into three parts; the first named *Pontus Galaticus*, extending from the river Halys to the Thermodon; the second, named *Pontus Polemonaicus*, extended from the Thermodon to the borders of *Pontus Cappadocicus*; and this last extended from Pontus Polemonaicus to Colchis, having Armenia Minor and the upper stream of the Euphrates for its southern boundary.

It is commonly believed, that the first inhabitants of Pontus were descended from Tubal; but in process of time mixed with Cappadocians, Paphlagonians, and other foreign nations, besides many Greek colonies which settled in those parts, and maintained their liberty till the time of Mithridates the Great and Pharnaces. The first king of this country whom we find mentioned 2
in history is Artabazes, who had the crown bestowed on Artabazes the first king.
him by Darius (A) Hystaspes. The next was Rhodobates,

(A) This country, together with the adjacent provinces, was in different periods under the dominion of the Assyrians, Pontus. bates, who reigned in the time of Darius Nothus. After him came Mithridates, who, refusing to pay the usual tribute to the Persians, was defeated by Artaxerxes Mnemon; but a peace was soon after concluded by the mediation of Tissaphernes. Besides this, we hear nothing of him farther than that he was treacherously taken prisoner by Clearchus afterwards tyrant of Heraclea, and obliged to pay a large sum for his ransom.

3 Mithridates I. Mithridates I. was succeeded by Ariobarzanes, who being appointed by Artaxerxes governor of Lydia, Ionia, and Phrygia, employed the forces that were under his care in the extending of his own dominions, and subduing those of his natural prince. The king of Persia sent one Autophrodates against him; but Ariobarzanes, having with great promises prevailed on Agesilaus and Timothæus the Athenian to come to his assistance, obliged Autophrodates to retire. He then rewarded Agesilaus with a great sum of money, and bestowed on Timothæus the cities of Sestos and Abydos, which he had lately taken from the Persians. He used his utmost endeavours to reconcile the Lacedæmonians and Thebans; but not being able to bring the latter to any reasonable terms, he assisted the Lacedæmonians with vast sums of money. The Athenians showed so much respect for this prince, that they not only made him free of their city, but granted both him and his children whatever they asked of them. He was murdered in the 28th year of his reign by one Mithridates, whom authors suppose to have been his son. This happened at the time that Alexander the Great invaded Asia, so that Pontus for a time fell under the power of the Macedonians.

4 Mithridates II. shakes off the Macedonian yoke. In the reign of Antigonus, Mithridates the son of Ariobarzanes shook off the Macedonian yoke; the particulars of which event are related as follow. Antigonus having dreamed that he had a field in which gold grew after the manner of corn, and that Mithridates cut it down and carried it into Pontus, began to be very jealous of him, and ordered him to be put to death privately. But Mithridates, having got notice of the king's intention, withdrew into Paphlagonia, attended only by six horsemen. Here, being joined by many others, he possessed himself of Ciniatum, a stronghold situated near Mount Olgasys; from whence, as his army continually increased, he made an irruption into Cappadocia; and having driven the commanders of Antigonus from that part which borders upon Pontus, he entered his paternal kingdom, which, in spite of the utmost efforts of Antigonus, he held for the space of 26 years, and transmitted to his posterity.

Under the reigns of Mithridates III. Ariobarzanes II. and Mithridates IV. the immediate successors of Mithridates II. nothing remarkable happened. But Mithridates V. made war on the inhabitants of Sinope, a city on the coast of Paphlagonia. He made himself master of all the adjacent places; but finding the whole peninsula, on which Sinope itself stood, well fortified and garrisoned, not only by the inhabitants, but by their allies the Rhodians, he abandoned the enterprise. He afterwards proved a great friend to the Rhodians, and assisted them with money to repair the losses they had sustained by an earthquake. He entered also into a strict alliance with Antiochus the Great, who married one of his daughters named *Laodice*.

After the death of Mithridates V. his son Pharnaces I. attacking the city of Sinope, unexpectedly took it by storm. On this the Rhodians sent ambassadors to Rome, complaining of the behaviour of the king of Pontus; but Pharnaces was so far from being intimidated by their threats, that he invaded the territories of Eumenes their great ally. The latter sent ambassadors to Rome, and entered into an alliance with Ariarathes king of Cappadocia; Pharnaces, in his turn, sent ambassadors to Rome, complaining of Eumenes and Ariarathes; upon which some Romans were sent into Asia to inquire into the state of matters. These found Eumenes and his associates willing to accommodate the difference, but Pharnaces in a quite opposite disposition, which they accordingly reported at Rome. 5 Pharnaces I. differs with the Romans.

In the mean time a war was commenced between Eumenes and Pharnaces; but the latter, being disappointed of assistance from Seleucus king of Syria, whom the Romans would not allow to join him, was at last forced to sue for peace; which was granted him upon the following conditions; That he should forthwith withdraw his forces from Galatia, and disannul all engagements and alliances with the inhabitants of that country; that he should in like manner evacuate Paphlagonia, and send back such as he had from thence carried into slavery; that he should restore to Ariarathes all the places which he had taken during the war, the hostages of both kings, all their prisoners without ransom, and moreover should deliver up to them such of their subjects as from the first breaking out of the war had fled to him; that he should return to Morzias, a petty king in these parts, and to Ariarathes, 900 talents which he had seized in the war, and pay down 300 more to Eumenes as a fine for invading his dominions without provocation. Mithridates, king of Armenia, having in this war joined Pharnaces, was, by the articles of the treaty, obliged to pay 300 talents to Ariarathes for having assisted his enemy contrary to an alliance at that time subsisting between them. Soon after Pharnaces died, and left the kingdom to his son Mithridates VI. more weakened by this peace than by the most destructive war. 6 Concludes a most disadvantageous peace.

The new king entered into an alliance with the Romans, and proved such a faithful friend that he was rewarded, by the senate with Phrygia Major, and honoured with the title of the friend and ally of the people of Rome. After a long and prosperous reign, he was murdered by some of his intimate acquaintance, and was succeeded by his son Mithridates VII. surnamed the *Great*. 7 His son enters into alliance with the Romans.

The new prince, though not exceeding 13 years of age, began his reign with most inhuman acts of cruelty to his mother and nearest relations. His father, by his last will, had appointed him and his mother joint heirs to 8 Mithridates the Great a cruel prince.

syrians, Medes, and Persians; the last of whom divided Cappadocia into satrapies or governments, and bestowed that division which was afterwards called *Pontus* on one of the ancestors of Mithridates. This regulation was effected in the reign of Darius the son of Hystaspes, and has been regarded as the date of the kingdom.

ontus.

to the kingdom; but he, claiming the whole, threw her into prison, where she soon died through the hard usage she met with. Those to whom the care of his education was committed, observing him to be of a cruel and unruly temper, made various attempts on his life, but could never effect their design, as the king was always on his guard, and armed, in that tender age, against all kind of treachery, without showing the least diffidence.

9 extra-nary lities.

In his youth Mithridates took care to inure himself to hardships, passing whole months in the open air, employed in the exercise of hunting, and often taking his rest amidst the frozen snow. When he came of age, he married his sister named *Laodice*, by whom he had a son named *Pharnaces*. After this he took a journey through many different kingdoms of Asia, having nothing less in view than the whole continent. He learned their different languages, of which he is said to have spoken 22; took an estimate of their strength; and above all viewed narrowly their strong holds and fortified towns. In this journey he spent three years; during which time, a report being spread abroad that he was dead, his wife Laodice had a criminal conversation with one of the lords of her court, and had a son by him. When her husband returned, she presented him with a poisoned bowl; but Mithridates had accustomed himself to take poison from his infancy, so that it had now no other effect than to hasten the destruction of his wife, which very soon took place, together with all those who had been any way accessory to her disloyalty and incontinence.

The king now began to put in execution his schemes of conquest. However, he certainly took the wrong method, by attacking first those nations which were immediately under the protection of Rome, and thus at

10 quers ral itries.

once provoking that powerful people to fall upon him. He began with Paphlagonia, which the Romans had declared a free state. This country he easily reduced, and divided between himself and Nicomedes king of Bithynia, at that time his ally. The Romans remonstrated; but Mithridates, instead of paying any regard to their remonstrances, invaded Galatia, which was immediately under their protection. This he also reduced, and then turned his eyes on Cappadocia. But as the kingdom of Cappadocia was at that time held by Ariarathes, who was a great favourite of the Romans, and married to the sister of Mithridates, the latter hired an assassin to dispatch Ariarathes, after which he thought

11 ses the of pado- to be dered.

he might succeed better in his designs. After the death of Ariarathes, Cappadocia was invaded by Nicomedes king of Bithynia, who drove out the son, and married the widow of Ariarathes. This gave Mithridates a plausible pretence for invading Cappadocia; which he instantly did, and drove Nicomedes quite out of the country. Thus Mithridates gained considerable reputation, not only as a warrior, but as a just and good-natured prince; for as it was not known that he had any hand in the murder of Ariarathes, every one imagined that he had undertaken the war against Nicomedes, merely to revenge the quarrel of his nephew, and to restore him to his right. To keep up the farce a little longer, Mithridates actually withdrew his troops out of the country, and left the young prince master of the kingdom. In a short time, however, he began to press the young king of Cappadocia to recal the assassin Gordius, who had murdered his father: but this the king of Cappadocia refused with indignation; and Mithridates, being determined on a quarrel at all events took the field with an army of 80,000 foot, 10,000 horse, and 600 chariots armed with scythes. With this force he imagined he should carry all before him: but finding the king of Cappadocia ready to oppose him with a force no way inferior to his own, he had recourse to treachery; and inviting his nephew to a conference, stabbed him, in the sight of both armies, with a dagger which he had concealed in the plaits of his garment. This barbarous and unexpected piece of treachery had such an effect on the Cappadocians that they threw down their arms, and suffered Mithridates, without opposition, to seize upon all their strongholds. He resigned the kingdom, however, to his son, a child of eight years of age. The care of the young prince, and of the whole kingdom, he committed to Gordius; but the Cappadocians, disdaining to be ruled by such a scandalous assassin, placed on the throne the brother of Ariarathes, who had kept himself concealed in some part of Asia. His reign, however, was of short duration; he being soon after driven out by Mithridates, and the Cappadocians again reduced. The unhappy prince died of grief; and in him ended the family of Pharnaces, who had ruled Cappadocia from the time of Cyrus the Great.

12 Assassinates his own nephew.

Nicomedes, king of Bithynia, being now greatly afraid of Mithridates, and supposing that his own dominions would next fall a prey to the ambitious conqueror, suborned a youth of a comely and majestic aspect to pretend that he was a third son of Ariarathes, to go to Rome, and demand the kingdom of Cappadocia as his just right. He was received by the senate with the greatest kindness, and Laodice the wife of Nicomedes even confirmed the deceit by her oath. But in the mean time Mithridates having got intelligence of the plot, sent notice of it by Gordius to the Romans, so that the imposture was soon known at Rome also. The consequence of this was, that the senate commanded Mithridates to relinquish Cappadocia, and Nicomedes that part of Paphlagonia which he possessed; declaring both these countries free. The Cappadocians protested that they could not live without a king; upon which they were allowed to choose one of their own nation. Mithridates used all his interest in favour of Gordius; but he being excluded by the Romans, one Ariobarzanes was chosen by the majority of votes.

13 Nicomedes king of Bithynia attempts to deceive the Romans.

14 The deceit exposed by Mithridates.

To enforce this election, Sylla was sent into Cappadocia. He had the character of an ambassador, but the real intent of his coming was to disappoint the ambitious designs of Mithridates. With a handful of forces he defeated a numerous army of Cappadocians and Armenians commanded by Gordius, and settled Ariobarzanes on the throne. But no sooner was Sylla gone than Mithridates stirred up Tigranes king of Armenia against Ariobarzanes, who, without making any resistance, fled to Rome, and Tigranes restored the kingdom to Ariarathes the son of Mithridates. At the same time died the king of Bithynia; upon which Mithridates immediately invaded that country, and drove out Nicomedes the natural son of the late king. But the expelled prince, having fled to Rome, and being assisted by that powerful republic, the king of Pontus was soon obliged to abandon Bithynia and Cappadocia.

15 Ariobarzanes settled on the throne of Cappadocia by the Romans, but driven out by Mithridates,

Pontus.

16 who engages in a war with the Romans.

The Romans now being exceedingly jealous of the power and ambition of Mithridates, resolved to humble him at all events. For this purpose they sent ambassadors to the kings of Bithynia and Cappadocia, desiring them to make frequent inroads into the neighbouring territories of Mithridates, and behave there as they pleased; assuring them of powerful assistance in case they should have occasion. Ariobarzanes could not by any means be induced to provoke so powerful a neighbour; but Nicomedes being induced, partly by promises and partly by menaces, to comply, entered Pontus, where he laid waste whole provinces with fire and sword. Mithridates complained to the Roman legates: but they replied, that he himself had been the first aggressor; that Nicomedes had only paid him in his own coin, and that they would not allow him to hurt their friend and ally. Upon this Mithridates, entering Cappadocia with a numerous army, put to flight the united forces of Ariobarzanes and Altinius the Roman legate; thus making himself once more master of this kingdom. In the mean time he sent ambassadors to Rome, complaining of the proceedings of Nicomedes: but his ambassadors met with a very indifferent reception; being enjoined to tell their master, that he must either restore the kingdom of Cappadocia to Ariobarzanes, and make peace with Nicomedes, or be accounted an enemy of the Roman people. With this answer they were commanded to depart the city that very day, and told that no more ambassadors could be admitted till such time as their commands were obeyed.

17 Defeats Ariobarzanes and Altinius,

In the mean time both parties prepared for war. The Roman legates in Asia drew together all the forces they could muster in Bithynia, Cappadocia, Paphlagonia, and Galatia; and, being joined by Cassius governor of Asia, took the field against Mithridates in the year 89 B. C. They divided their army into several small bodies: Cassius encamped on the confines of Bithynia and Galatia; Manius Aquilius with his body possessed himself of the avenues leading from Pontus into Bithynia; Quintus Oppius secured the entrance into Cappadocia; and the admirals Minucius Rufus and C. Popilius lay with a fleet of 300 sail at Byzantium, to prevent the enemy from entering the Euxine sea. Each of the generals had under his command an army of 40,000 men; besides a body of 50,000 foot and 6000 horse brought to their assistance by Nicomedes.

18 and Nicomedes and Manius Aquilius.

On the other hand, Mithridates having invited several of the neighbouring nations to join him, collected an army of 250,000 foot, 50,000 horse, 130 chariots armed with scythes; besides 300 ships and 100 galleys. Part of this force he detached against Nicomedes; and utterly defeated him, though much superior in number, as he was taking possession of an advantageous post by order of Cassius. Another part he detached against Manius Aquilius, whom he also defeated with the loss of 10,000 killed on the spot, and 3000 taken prisoners; on which the other Roman generals abandoned their posts, the fleet also dispersed, and most of the ships were either taken or sunk by the admirals of Mithridates.

19 Overruns Asia Minor.

The king of Pontus now resolving to improve the opportunity, and drive the Romans entirely out of Asia, overran all Phrygia, Mysia, Asia Proper, Caria, Lycia, Pamphylia, Paphlagonia, and Bithynia, with all the rest of the countries which had either belonged to or sided with the Romans, as far as Ionia. He was received everywhere with the greatest demonstrations of joy; the inhabitants flocking to him in white garments, and calling him their father, deliverer, their god, and the great and sole lord of all Asia. What gained him the affections of the people was his kind usage to the prisoners he had taken in the two engagements above mentioned; for he not only sent them all home without ransom, but furnished them with plenty of provisions, and money sufficient to defray their expences by the way. Ambassadors flocked to him from all parts; and among others, from Laodicea on the Lycus, to whom the king promised his protection, provided they delivered up to him Q. Oppius governor of Pamphylia, who had fled thither for protection. This request was readily complied with; Oppius was sent to him in chains, with lictors walking before him in derision of the Roman pride and ostentation. Mithridates was overjoyed to see a Roman general and proconsul in his power; and his joy was soon after increased by the arrival of Manius Aquilius, whom the Lesbians, revolting from the Romans, sent to him in fetters, together with many other Romans of distinction who had taken shelter among them. As he had been the chief author of the war, Mithridates led him about with him wherever he went, either bound on an ass, or on foot coupled with one Bastarnes a public malefactor, compelling him to proclaim to the crowds who came to see him, that he was Manius Aquilius the Roman legate. When he came to Pergamus, he caused him first to be publicly whipped, then to be put on the rack, and lastly melted gold to be poured down his throat.

20 Puts Aquilius to death.

Mithridates being now looked upon as invincible, all the free cities of Asia received him as their sovereign, contributing large sums towards the defraying the expences of the war; by which means he became possessed of such treasures as enabled him to keep several numerous armies in the field for five years without levying any taxes on his subjects. As many Roman citizens were dispersed in the provinces which Mithridates had subdued, he considered these as so many spies, who would not fail to send an account of his proceedings to Rome: for which reason he resolved to cut them all off at once by a general massacre; which barbarous policy, it is said, had never been heard of till his time, but has been since practised by other nations. He dispatched private letters to all the governors and magistrates of the cities where the Romans resided, enjoining them on pain of death, and the entire destruction of their country, to cause all the Italian race, women and children not excepted, to be murdered on the 30th day from the date of his letters, and to let their bodies lie unburied in the open fields. One moiety of their goods was to be forfeited to the king, and the other bestowed as a reward on the assassins. Whatever slave murdered his master was to receive his liberty, and one half of the debt was to be remitted to the debtor that should kill his creditor. Whoever concealed an Italian, under any pretence whatever, was to be punished with immediate death. On the fatal day, all the gates of the cities being shut, and the avenues kept with soldiers, the king's orders were proclaimed, which caused an universal horror, not only among the unhappy victims themselves, but among those who had any feelings of humanity, at seeing themselves obliged either to betray and murder their innocent guests, friends, and relations, or to become liable to

21 Cruelly massacres all the Romans in Asia.

Pontus. to a cruel death. However, as most of the Asiatics bore a mortal hatred to the Romans, and were moreover animated by the promise of an ample reward, the orders were without delay put in execution. The inhabitants of Ephesus, where Mithridates then resided, dragged such as had taken sanctuary in the temple of Diana from the very statue of the goddess, and put them to the sword. The Pergamenians discharged showers of darts upon them as they embraced the statues in the temple of Esculapius. At Adramyttium in Mysia many were murdered in the water, while they were attempting, with their children on their backs to swim over to the island of Lesbos. The Caunians, who not long before had been delivered from the yoke of the Rhodians, and restored to their ancient privileges, excelled all the rest in cruelty: for, as if they had apostatised from human nature, they took pleasure in tormenting and butchering the innocent children before their mothers eyes; some of them running distracted, and others dying with grief at a sight which nature could not bear. The Trallians were the only people on the continent who would not have the cruelty to imbrue their hands in the blood of the innocent Italians. However, as the king's orders were peremptory, they hired one Theophilus a Paphlagonian to dispatch the few Romans that lived among them. He, having shut them all up together in the temple of Concord, first cut off their hands as they embraced the statues of the gods, and then hacked them in pieces. Many Romans were saved on the floating islands of Lydia called *Calaminæ*, where they concealed themselves till such time as they found an opportunity of escaping out of Asia. Nevertheless, according to Plutarch and Dion, 150,000 Roman citizens were massacred on that day; but, according to others, only 80,000.

Mithridates having now got rid of those whom he was in dread of on the continent, embarked great part of his forces in order to reduce the islands of the Archipelago.

22 Reduces the island of Cos;

At Cos he was gladly received, and had delivered up to him the young Alexander, son of Alexander king of Egypt, who being driven out of that country, was killed by Chareas a sea-captain as he was retiring in a small vessel to Cyprus. With the young prince, they put into the king's hands vast sums of money, with all the golden vessels and jewels, to an immense value, which his grandmother Cleopatra had been amassing for many years. To the young prince Mithridates gave an education suitable for a king's son, but kept the treasures to himself. Here likewise he found 800 talents in ready money, which, at the first breaking out of the war, had been deposited by the Jews of Asia, and were designed for the temple of Jerusalem.

23 but fails in his attempt upon Rhodes.

From Cos Mithridates steered his course for Rhodes, where at that time all the Romans who had escaped the massacre above mentioned found a sanctuary, and, amongst others, L. Cassius the proconsul. The Rhodians, however, being very expert in maritime affairs, Mithridates did not think proper to venture an engagement. As the enemy's fleet advanced, therefore, he retired; but six of the Rhodian ships coming up with 25 of his, a sharp action ensued, in which the Rhodians sunk two of the king's ships, and put the rest to flight. In this encounter, though Mithridates had never seen a sea-fight before, he behaved with great intrepidity; but one of the ships of his own squadron falling foul of that which carried him, he was very near being taken prisoner. From this time forth he abhorred the sea, and took an aversion to all the Chians, because the pilot of that ship was a Chian. However, he again appeared before the island; but was forced anew to leave it with disgrace, and to give over all thoughts of reducing it.

24 His generals reduce all Greece.

Mithridates now retired into Asia, with a design to settle the civil government of the countries which he had conquered, committing the care of the war to his generals. Archelaus, his generalissimo, was sent into Greece with an army of 120,000 men; where, by treachery, he made himself master of Athens, and either put to the sword or sent to Mithridates all those who favoured or were suspected to favour the Romans. From Athens he dispatched parties to reduce the neighbouring castles and the island of Delos, which they did accordingly; but Orobius, a Roman general hearing that the enemy kept no guards, but passed their time in carousing and debauchery, fell upon them unexpectedly, and cut off the whole party, except Apellicon the commander.

In the mean time Metrophanes, another of the king's generals, entering Eubœa, laid waste the whole country, exerting his rage chiefly against the cities of Demetrias and Magnesia, which refused to open their gates to him. But as he was sailing off with a great booty, Bryttius, the prætor or governor of Macedonia, coming up with him, sunk some of his ships, and took others, putting all the prisoners to the sword. Mithridates, upon the news of this loss, sent his son Ariarathes with a powerful army to invade Macedonia; which he soon reduced, together with the kingdom of Thrace, driving the Romans everywhere before him. The generals whom he sent into other quarters were no less successful; so that Mithridates had, according to Aulus Gellius, 25 different nations who paid him homage. The same author adds, that he was skilled in every one of their various languages, so that he could converse with the natives without an interpreter. Among these nations we find the Rhoxani, now the Russians or Muscovites, whom Deiphontus, one of the king's generals, brought under subjection, after having slain in an engagement 50,000 of the barbarians.

All this time the Romans had been too much taken up with their own domestic quarrels to take such effectual measures as they otherwise would have done for checking the progress of Mithridates. But at last, having received certain advice that the king designed to invade Italy, and that he had even been solicited to do so by some of the revolted Italians, they sent against him Lucius Sylla, who had already given sufficient proofs of his courage, conduct, and experience in war.

25 Sylla sent against him,

He had with him only five legions and a few cohorts. With this inconsiderable force he landed in Attica, and in a short time made himself master of the capital; Archelaus not daring, or, according to others, through treachery, nor caring, to engage him. As Sylla had but a few frigates, he sent Lucullus to the island of Rhodes, with orders to the Rhodians to join him with their fleet. The undertaking was very dangerous, as the king's fleet in a manner covered the sea. However, Lucullus, despising all danger, ventured out, and sailed, without meeting with any perverse accident, to Syria, Egypt, Libya, and Cyprus; from whence he returned with

with such supplies of ships and experienced mariners, as enabled Sylla, after their conjunction with the Rhodians, to act offensively by sea also. Archelaus now dispatched messengers to Taxiles, who commanded in Thrace and Macedon, desiring him to join him with all
26 his forces; which the other readily did, and between both mustered an army of 120,000 men. Sylla met them near Cheronæa with only 15,000 foot and 1500 horse; but gave them a most dreadful overthrow, no fewer than 110,000 of the Asiatics being slaughtered, while the Romans lost only 12 men.

who totally defeats his generals in Greece.

This success having raised envy and jealousy against Sylla in Rome, the senate sent Lucius Valerius Flaccus, the consul of that year, with two legions into Asia, in appearance to attack Mithridates on that side, but with
27 private instructions to fall upon Sylla himself, if they found him disaffected to the senate. As Flaccus was a man of no experience in war, C. Fimbria, a senator of great repute among the soldiery, was appointed to attend him with the character of legate and lieutenant-general. Sylla was at that time in Bœotia; but, hearing what had happened at Rome, he marched with all expedition into Thessaly, with a design to meet Flaccus, who, he expected, was to land in that province. But no sooner had he left Bœotia, than the country was overrun by an army of Asiatics, under the command of Dorylaus the king's chief favourite. On this advice Sylla returned into Bœotia, where he gained two
28 signal victories, which put an end to the war in Greece. In the first of these Dorylaus lost 150,000 of his men according to some, or 200,000 according to others; and in the next all the rest. In this last engagement 20,000 were driven into a river, where they all perished; an equal number were pursued into a marsh, and entirely cut off; the rest were killed in the heat of the battle, the Romans giving no quarter to men who had treated their fellow-citizens after such a barbarous manner in Asia. Plutarch tells us, that the marshes were dyed with blood; that the course of the river was stopped by the dead bodies; and that even in his time, that is, near 200 years after, a great number of bows, helmets, coats of mail, and swords, were found buried in the mud. Archelaus, who had joined Dorylaus with a body of 10,000 men a few days before the battle, lay three days stripped among the slain till he found a small vessel which carried him to Eubœa, where he gathered what forces he could, but was never again able to appear in the field. Indeed Livy tells us, that Archelaus betrayed the king's cause; and Aurelius Victor, that the king's fleet was intercepted by Sylla through the treachery of Archelaus: adding, that there was a good understanding between the two commanders, as was plain from Sylla's bestowing upon Archelaus 10,000 acres of land near the city of Chalcis in Eubœa. Strabo also informs us, that Archelaus was afterwards greatly esteemed and caressed by Sylla and the senate; but Sylla himself in his commentaries, and Dio, endeavour to clear Archelaus from all suspicion of treachery.

Flaccus and Fimbria sent into Asia.

Sylla gains two other victories in Greece.

In the mean time, Sylla having given up Bœotia to be plundered by his soldiers, marched into Thessaly, where he took up his winter-quarters, caused his old ships to be refitted and several new ones built, in order to pass over into Asia in the beginning of the spring, that he might drive from thence not only Mithridates, but his rival Flaccus also, whom the senate, out of opposition to him, had appointed governor of that province. But before he arrived, some differences having arisen between Flaccus and Fimbria, the latter was by the consul deprived of his command. Upon this Fimbria, having gained over the soldiery to his side, made 29
war on the consul, took him prisoner, put him to death, and assumed the command of all the Roman forces in Asia. In this station, he behaved with the greatest cruelty, insomuch that his name became more odious than even that of Mithridates himself. This hatred the king of Pontus endeavoured to improve to his own advantage; and therefore commanded his son, by name also *Mithridates*, to join Taxiles, Diophantes, and Menander, three of his most experienced commanders, to return at the head of a numerous army into Asia; not doubting but the inhabitants, thus harassed by Fimbria, would shake off the Roman yoke when they saw such a powerful army in the field ready to protect them. But Fimbria, distrusting the Asiatics, marched out to meet the enemy, and offered them battle before they
entered the province. As the king's army was greatly 30
superior to the Romans in number, the latter suffered greatly in the engagement, but held out till night parted them, when they withdrew to the opposite side of a river, which was at a small distance from the field of battle. Here they designed to entrench themselves: but in the mean time a violent storm arising, Fimbria laid hold of that opportunity to repass the river and surprise the enemy: of whom he made such havock as they lay in their tents, that only the commanders and
some few troops of horse escaped. Among these was 31
the king's son; who, attended by a few horse, got safe to Pergamus, where his father resided. But Fimbria, pursuing him night and day without intermission, entered Pergamus sword in hand; and hearing that both Mithridates and his son had fled from thence a few hours before, he continued his pursuit, and would have taken the king himself, had he not entered Pitane with a considerable body of horse. The place was closely invested by Fimbria; but as he had no ships to block it up by sea also, he sent a messenger to Lucullus, who commanded the Roman navy in Asia, intreating him, as he tendered the welfare of the republic, to make
what haste he could to Pitane, and assist him in taking 32
the most inveterate enemy the Romans had. But Lucullus, preferring the gratification of a private pique to the good of his country, refused to come: and thus allowed the fleet of Mithridates to carry him in safety to Mitylene.

Fimbria puts Flaccus to death.

Defeats the forces of Mithridates,

and besieges the king;

who is suffered by Lucullus to escape.

Soon after the king's departure, Fimbria took Pitane by storm, and reduced most of the cities of Asia, particularly Troy, which he also took by storm in eleven days, and put most of the inhabitants to the sword, because they had sent an embassy to Sylla, offering to submit to him rather than to Fimbria.—To add to the misfortunes of Mithridates, his fleet was entirely defeated in two engagements by Lucullus; so that he began to be weary of the war, and therefore desired Archelaus to conclude a peace upon as honourable terms
as he could. The king himself had afterwards also a 33
conference with Sylla, and a peace was concluded in 85 B. C. on the following terms, viz. That Mithridates should relinquish all his conquests, and content himself with his paternal dominions, which were confined

Peace concluded.

Pontus.

ed within the limits of Pontus: that he should immediately resign Bithynia to Nicomedes, and Cappadocia to Ariobarzanes, and release without ransom all the prisoners he had taken during the war: that he should pay to the Romans 2000, or as others will have it 3000, talents, and deliver up to Sylla 80 ships with all their arms and ammunition, and 500 archers; and lastly, that he should not molest such cities or persons as had during the war revolted from him and sided with the Romans.

Sylla, having thus concluded the war with great glory to himself and advantage to the republic, turned his army against Fimbria; but the latter, finding himself in no condition to oppose his rival by force, had recourse to treachery, and attempted to get Sylla murdered. The plot miscarried, and Fimbria put an end to his own life; upon which Sylla, having now an uncontrouled power in Asia, declared the Chians, Rhodians, Lycians, Magnesians, and Trojans, free, and friends of the people of Rome, by way of reward for their having sided with the Romans: but on the other cities he laid heavy fines; condemning them in one year to pay 20,000 talents, and quartering his soldiers in the houses of those who had shown disaffection to the Romans. Each private man was to receive from his landlord 16 drachms a-day, and each officer 50; and besides, both were to be supplied with provisions, not only for themselves, but for such of their friends as they thought proper to invite. By these impositions most of the people of Asia were reduced to beggary; especially the inhabitants of Ephesus, who had above all others shown their hatred to the Romans. Sylla then, having collected immense treasure, set sail for Italy; leaving behind him Lucullus with the character of *quæstor*, and Muræna with that of *prætor*.

The two legions which Fimbria had commanded were given to Muræna, because Sylla suspected them of an inclination to the faction of Marius, whose party he was going to crush at Rome.

34
Mithridates reduces the nations which had revolted from him.

Mithridates in the mean time no sooner returned into Pontus, than he set about the reduction of those nations which had revolted from him during the war. He began with the Colchi; who immediately submitted, upon condition that Mithridates would give his son for a king over them. This was complied with; but the old king had thenceforward a jealousy of his son, and therefore first imprisoned and then put him to death. Soon after this, the king having made great preparations under pretence of reducing the Bosphori, a warlike nation who had revolted from him, the Romans began to be jealous. Their jealousy was further increased by Archelaus, who fled to them, and assured them that the preparations of Mithridates were not at all designed against the Bosphori.

35
The Romans invade his territories without provocation,

On hearing this, Muræna invaded Pontus without any farther provocation. The king put him in mind of the articles of peace concluded with Sylla: but Muræna replied that he knew of no such articles; for Sylla had set nothing down in writing, but contented himself with the execution of what had been agreed upon. Having given this answer, the Roman general began to lay waste and plunder the country, without sparing even the treasures or temples consecrated to the gods. Having put all to fire and sword on the frontiers of Pontus towards Cappadocia, he passed the river Halys, and on that side possessed himself of 400 villages without opposition; for Mithridates was unwilling to commit any hostilities before the return of an ambassador whom he had sent to Rome to complain of the conduct of Muræna. At last the ambassador returned, and with him one Callidius; who, in public assembly, commanded Muræna to forbear molesting a friend and ally of the Roman people; but afterwards, calling him aside, he had a private conference with him, in which it is supposed, as he brought no decree of the senate, that he encouraged him to pursue the war. Whatever might be in this, it is certain that Muræna still continued to practise the same hostilities, and even made an attempt on Sinope, where the king resided and the royal treasures were kept. But as the town was well fortified, he was forced to retire with some loss. 36

but are defeated.

In the mean time Mithridates himself taking the field, appeared at the head of a powerful army, drove the Romans out of their camp, and forced them with great slaughter to save themselves over the mountains into Phyrgia; which sudden victory again induced many cities to join Mithridates, and gave him an opportunity once more of driving the Romans out of Cappadocia.

In the mean time, Sylla, being created dictator at Rome, sent a messenger to Muræna, charging him in his name not to molest Mithridates, whom he had honoured with the title of a friend and ally of Rome. Muræna did not think proper to disregard this message; and therefore immediately abandoned all the places he had seized, and Mithridates again renounced Cappadocia, giving his own son as an hostage of his fidelity. Being then at leisure to pursue his other plans, Mithridates fell upon the Bosphori; and, having soon subdued them, appointed Machares one of his sons king of the country. But leading his army from thence against the Achæans, a people bordering on the Colchi, and originally descended from the Greeks, who returning from Troy had mistaken their way into Greece, and settled there, he was defeated with the loss of three-fourths of his men. 37

Engages in a new war with the Romans.

On his return to Pontus, however, he recruited his army, and made vast preparations to invade them anew; but, in the mean time, hearing of Sylla's death, he came to the imprudent resolution of entering into a second war with the Romans. Having therefore induced his son-in-law Tigranes, king of Armenia, to invade Cappadocia, he himself entered Paphlagonia at the head of 120,000 foot disciplined after the Roman manner, 16,000 horse, and 100 chariots armed with scythes. This country readily submitted; after which the king marched into Bithynia, which also submitted without opposition; the province of Asia followed the example of the rest; for these countries being oppressed with exorbitant taxes, looked upon him as their deliverer. In entering the cities of Asia, he caused M. Marius or Varius, whom Sertorius had sent him out of Spain to discipline his troops, walk before him with the ensigns of consular dignity as if he was the chief magistrate; the king following as one of his attendants. He made several cities free; but at the same time acquainted the inhabitants, that they were indebted to Sertorius for their liberty; and thus, by the connivance of that general, many cities revolted from the Romans without knowing that they had done so. But in the mean time Julius Cæsar, being at that time at Rhodes, whether he had gone to study oratory, and hearing what havock the

Pontus. the king's officers made in the adjacent countries, he collected what troops he could, and falling unexpectedly upon them, drove them quite out of the province of Asia.

38 Lucullus and Cotta sent against him. The Roman senate, now finding a war unavoidable, appointed Lucullus to manage it. The other consul Cotta, having solicited an employment in this war, was sent with a fleet to guard the Propontis and defend Bithynia. Lucullus having raised one legion in Italy, passed over with it into Asia, where he was joined by four others, two of which, as they had served under Fimbria, proved at first very mutinous and refractory; nor were the other two much better, having been immersed in the Asiatic luxuries. The disciplining of these troops took up a considerable time, which was prejudicial to the Roman affairs; for almost all the Asiatics were ready to revolt, and Mithridates was making the greatest preparations. One of his armies was ordered to march into Cappadocia, under the command of Diophantus Matharus, in order to oppose Lucullus if he should attempt to enter Pontus on that side; another commanded by Mithridates in person, consisted of 150,000 foot, 12,000 horse, and 100 chariots armed with scythes; a third army, commanded by Marius and Eumachus, two generals of great experience in war, was encamped in the neighbourhood of Heraclea in Pontus.

39 Mithridates is at first successful; The beginning of the war proved favourable to Mithridates. Cotta being desired by Lucullus to keep his fleet within the harbour, as being inferior to that of Mithridates, resolved to take the first opportunity of fighting the king by land, not doubting of an easy victory. Having for this purpose collected all the forces he could, Cotta dispatched his legate, P. Rutilius with a considerable body to observe the motions of the enemy. This commander being met by Marius and Eumachus, an engagement ensued, in which the Romans were defeated, and the greatest part of them, together with their commander, cut in pieces. The same misfortune befel several other officers of distinction sent out to oppose Mithridates; who, being elated with success, ordered his admiral to sail into the very harbour, and fire the Roman fleet. This was, accordingly performed without the least opposition from Cotta; and 60 ships were taken, sunk, or burnt, on that occasion.

These victories having increased the rebellious disposition of the Asiatics, made Lucullus hasten his march in order to stop the progress of the enemy. But finding the king's army much more numerous than he expected, he thought proper to decline an engagement. However, several skirmishes happened, in which the Romans had always so much the advantage, that they became impatient for a general engagement. But Lucullus did not at this time choose to run so great a risk; and therefore Mithridates, seeing he could not force the Romans to a battle, decamped in the night-time, and by day-break reached Cyzicum, a most important city, and greatly attached to the Romans. Lucullus pursued him; and, falling on his rear, killed 10,000, and took

40 but is reduced to great straits by Lucullus, 13,000 prisoners. After this, the Roman general, by a manœuvre, gained an important pass, which enabled him to cut off all communication between the army of Mithridates and the neighbouring country. The king, seeing himself thus in danger of famine, redoubled his efforts to gain the city; but finding that he could not batter down the walls, he resolved to undermine them. In this also he was unsuccessful; the besieged sunk countermines, and had very near taken the king himself in one of his own mines. In the mean time, winter coming on, the army of Mithridates was so distressed for want of provisions, that many died of hunger, while the survivors were forced to feed on the flesh of their dead companions. The famine was followed by a plague; which destroyed such numbers, that Mithridates was obliged to think of a retreat; and even this was become very dangerous. However, he laid hold of the opportunity when Lucullus went away to besiege a neighbouring castle, and sent off the greatest part of his cavalry in the night; ordering them not to halt till they were out of the reach of the enemy. But Lucullus having got intelligence of their march, suddenly returned, and pursued them so close, that he came up with them as they were passing a river, took 600 horse, all their beasts of burden, 15,000 men, and put the rest to the sword. On his return he fell in with Aristonicus the king's admiral, whom he took, just as he was ready to sail with a large sum of money designed to bribe the Roman army. In the mean time, Mithridates, finding himself reduced to the last extremity, embarked in the night time with the greatest part of the forces, while Marius and Eumachus, with 30,000 men, made the best of their way to Lampsacus. But being closely pursued by the Romans, they were overtaken at the river Æsopus, which at that time was not fordable, by reason of its having been swelled by heavy rains. Twenty thousand were killed on the spot; nor could a single man have escaped, had not the Asiatics scattered great quantities of gold and silver in the way, that the march of the Romans might be retarded by their stopping to gather it up. Lucullus on his return entered Cyzicum amidst the acclamations of the citizens; who afterwards instituted public sports in honour of him, which they called *Lucullea*. The city was declared free, and all the privileges, exemptions, and immunities, bestowed upon the citizens which were enjoyed by the inhabitants of Rome itself.

41 who cuts off great numbers of his men.

42 Lucullus gains a great victory. From Cyzicum, Lucullus marched along the coast of the Hellespont till he came to Troas; where he equipped his fleet, and put to sea in quest of Marius, Alexander, and Dionysius, three of the king's generals, who had a fleet of 50 ships, with 10,000 land forces on board. Lucullus came up with them near the island of Lemnos, took 32 of their ships, and put a great number of their land forces to the sword. The day after the engagement the three generals were discovered in a cave where they had concealed themselves, and dragged from thence to Lucullus; who, after having severely upbraided Marius for fighting against his country, caused him to be put to death. Alexander and Dionysius were reserved for the triumph; but the latter poisoned himself to avoid that disgrace. Lucullus then steered his course for Bithynia, on receiving intelligence that Mithridates had appeared with his fleet on those coasts: but the king having notice of his approach, made what haste he could to gain Pontus, and arrived at Heraclea on board a pirate named *Selemus;* with whom he was obliged to trust himself, his fleet being dispersed by a violent storm, and the ship that carried him cast away.

In

43 arther iccesses of ucullus.

In the mean time Mithridates was no less unfortunate by land than by sea. Triarius, one of the officers of Lucullus, reduced the cities of Apamea, Prusa, Prusias, and Nicæa. From thence he marched with all expedition to Nicomedia, where the king himself was, and near which place Cotta lay encamped. But before the two armies could be joined, Mithridates escaped, first to Heraclea, which was betrayed to him, and from thence to Sinope. Nor was Lucullus himself all this time inactive. Having reduced all Paphlagonia and Bithynia, he marched into Cappadocia, and joined Cotta and Triarius at Nicomedia, with a design to invade Pontus; but hearing that Heraclea was in the hands of Mithridates, he despatched Cotta to reduce that city. Triarius was ordered with the fleet to the Hellespont and Propontis, to intercept the king's fleet, which was daily expected from Spain with supplies from Sertorius. Lucullus himself, with the main strength of the army, pursued his march into Pontus. His army was greatly harassed, especially in the narrow passes between Cappadocia and Pontus, by flying parties of the enemy. But the greatest inconvenience was the want of provisions, as the king's troops had laid waste all the country around; insomuch that Lucullus having lost almost all his beasts of burden, was obliged to take along with the army 30,000 Galatians, each of them carrying a sack of corn on his back. At last, however, he gained the plains of Pontus; where provisions were so plentiful, than an ox was sold for a drachma, and every thing else in proportion.

The Roman general having now carried the war into the enemy's country, divided his forces, and at the same time invested a very strong town named *Amisus;* another called *Eupatoria*, built by Mithridates, and made the place of his residence; and another, named *Themiscyra*, situated on the banks of the Thermodoon. Eupatoria was soon taken, but Themiscyra made a vigorous resistance. The townsmen galled the Romans to such a degree, that, not daring to approach the walls openly, they contented themselves with undermining them: but in this too they met with no small difficulty; for the enemy countermined, and often engaged them under ground, letting into the mines bears and other wild beasts, with swarms of bees, which obliged them to abandon their works. However, the town was at last obliged to surrender for want of provisions. As for Amisus, Lucullus himself sat down before it: but finding it strongly fortified and garrisoned with the flower of the king's troops, the Roman general thought proper to reduce it by famine; and on this occasion his countrymen first complained of him as protracting the war for his own advantage.

In the mean time Mithridates having recruited his shattered army, advanced to Cabiræ, a city not far distant from Amisus. Lucullus, leaving part of the army to continue the siege, marched at the head of the rest to oppose Mithridates. But the king having drawn his cavalry into a general engagement, defeated them with considerable loss, and drove them back to the mountains, through the passes of which Lucullus had lately marched to attack him. This check obliged the Roman general to retire to a rising ground near the city of Cabiræ, where the enemy could not force him to an engagement. Here provisions beginning to grow scarce, Lucullus sent out strong parties from his army into Cappadocia, the only place from whence he could have supplies. One of these parties entirely defeated Taxiles and Diophantes, two of the king's generals, who had been stationed there to prevent Lucullus from having any communication with the country. The king, upon the news of this defeat, resolved to break up his camp and retire, not questioning but that Lucullus would attack him as soon as his forces returned. This resolution he no sooner imparted to his nobles, than they began privately to send away their most valuable goods; which being found out by the soldiers, they took it in such bad part that no intelligence had been given them, that they plundered their baggage, and put those who had the care of it to the sword. After this they betook themselves to flight, crowding out of the gates in the utmost confusion. The king hastened to stop their flight; but nobody showing him the least respect, he was carried away by the crowd, and in great danger of being trampled to death. Having with difficulty made his escape, he retired with a small retinue, first to Cabiræ, and then to his son-in-law Tigranes king of Armenia. Lucullus dispatched the best part of his cavalry to pursue the fugitives; while he himself, with the rest, invested the camp of Mithridates, where those remained who could not fly with the rest. The camp was easily taken; but most of the soldiers made their escape, while the Romans, contrary to their general's orders, were busied in plundering. Lucullus then pursued hard after the king; who, being overtaken by a company of Galatians, caused a mule loaded with part of his treasures to be driven in among them, by which means he made his escape while they quarrelled about the booty. Mithridates, remembering in his flight, that he had left his sisters, wives, and concubines at Pharnacia, dispatched an eunuch, named *Bacchus* or *Bacchides*, with orders to put them all to death, lest they should fall into the hands of the enemy; which was accordingly done.

44 The army of Mithridates mutinies, which obliges the king to fly into Armenia.

After the flight of Mithridates, the Romans no longer met with any opposition; the king's governors flocking from all parts to put themselves under the protection of the conqueror. Among these were the grandfather of Strabo the geographer, whom the king had disobliged by putting to death his cousin-german Tibias, and his son Theophilus. He was a man of such credit, that it was no sooner heard that he had abandoned the king's party, than 15 other commanders delivered up to Lucullus the places with which they had been intrusted; and about the same time Triarius falling in with the king's fleet near the island of Tenedos, obtained a complete victory, having either taken or sunk 60 of the enemy's vessels.

All this time Cotta had been employed without success in besieging Heraclea, which he could never have reduced without the assistance of Triarius. That commander, having defeated the fleet, soon reduced the town to such distress, that a third part of the garrison died of hunger; upon which the governor, Conacorix, privately agreed with Triarius to deliver one of the gates to him. This was accordingly done; and the Romans, entering, made a terrible slaughter of the helpless inhabitants. But in the mean time Cotta provoked at seeing himself deprived both of all share of the booty, and the honour of reducing a place before which he had sat so long, fell upon his countrymen as they

Pontus. were busied in plundering; which would have occasioned a great deal of bloodshed, had not Triarius promised to divide the booty equally. Conacorix, in order to conceal his treachery, after marching out of Heraclea, seized on two forts belonging to the Romans; and Triarius being sent to recover them, Cotta, in his absence, plundered the city anew, rifled the temples which the other had spared, put all the citizens he could meet with to the sword, and having carried off every thing valuable, at last set fire to the city in several places, by which means it was soon reduced to ashes. Cotta then, having no farther occasion for his troops, dismissed the auxiliaries, resigned his legions to Lucullus, and put to sea himself in order to return to Rome. But he had scarcely got out of the harbour, when part of his ships, being overloaded with the spoils of the city, sunk; and the others, driven by a violent north wind, were dashed against the shore, which occasioned the loss of a great part of the booty. On his return to Rome, however, he was highly applauded by the senate, and honoured with the title of *Ponticus*.

Lucullus, having now reduced Pontus, marched against the Chaldeans, Tibarenians, and inhabitants of Armenia Minor; who voluntarily submitted to him, and put him in possession of all their strongholds. From Armenia, he returned before Amisus, which still held out; Callimachus, governor of the place, having harassed the Romans to such a degree by engines of his own contriving, that they had given over their assaults, and contented themselves with blocking it up by land, though the garrison was at the same time plentifully supplied with provisions by sea. Lucullus, on his arrival, summoned the city to surrender, offering the inhabitants very honourable terms; but, being refused, he made a general assault at the time when he knew that Callimachus used to draw off great part of his troops to give them some respite. The Romans applying their scaling ladders, got over the wall before Callimachus could come to the assistance of those whom he had left to guard it; however, by setting the city on fire, he found means in that confusion to make his escape. Lucullus commanded his men to use their utmost endeavours to save the city; but being intent only upon plundering, they regarded nothing but the furniture. At last the fire was extinguished by a violent shower; and Lucullus, having with difficulty restrained his soldiers from committing any farther excesses, repaired the city in some measure before he left it, and suffered the inhabitants to enjoy their possessions in peace.

Nothing was now wanting but the captivity of Mithridates himself to put a final period to the war; and therefore Lucullus demanded him from his son-in-law Tigranes. But though that prince could not be prevailed on to see Mithridates on account of his misconduct, he could as little be induced to deliver him up to his enemies. After this refusal, however, he for the first time condescended to see his father-in-law, after he had resided a year and eight months in his dominions. In a private conference held by the two kings, it was agreed, that Tigranes should march against the Romans, and Mithridates with 10,000 horse return into Pontus, where he should make what levies he could, and rejoin Tigranes, before Lucullus, who was then employed in the siege of Sinope, could enter Armenia. But, in the mean time, Sinope having surrendered, Lucullus with all possible expedition marched against Tigranes, and, having drawn him into a general engagement, gave him an entire defeat, as is related under the article ARMENIA. 45 Tigranes defeated by Lucullus.

Mithridates was marching to his assistance, when he met his son-in-law flying with a small retinue to shelter himself in some remote corner of the kingdom. He encouraged him to raise new forces; not doubting but that another campaign would repair all former losses, provided he would commit to his management every thing relating to the war. 46 but resolves to try another campaign. To this Tigranes agreeing, as he thought him more fit to deal with the Romans than himself, orders were issued out for raising a new army, and all the Armenians able to bear arms summoned to meet at the place of the general rendezvous. Out of these Mithridates chose 70,000 foot and 35,000 horse; and having trained them up during the winter, after the Roman discipline, in the beginning of the spring he left part of them with Tigranes, and marched himself with the rest into Pontus, where he recovered many important places, and overcame in a pitched battle M. Fabius, whom Lucullus had appointed governor of that province. Being flushed with his success, as soon as the wounds he received in the engagement suffered him to move, he pursued Fabius, and besieged him in the city of Cabiræ, whither he had retired; but in the mean time Triarius, who was marching out of Asia to join Lucullus, hearing what distress the Romans were in, hastened to their relief, and appearing unexpectedly on the neighbouring hill, struck such terror into the enemy, that they raised the siege, and made the best of their way into Cappadocia. Triarius pursued them, and got so near them as to be parted only by a river. Here he halted, with a design to pass the river after he had allowed his men some rest, for they were tired out with long marches. But Mithridates was before-hand with him, and crossing the river on a bridge, where he had placed a strong guard, 47 Mithridates defeated. attacked the Romans with great resolution before they had time to refresh themselves. The battle was bloody, and the event doubtful, till the bridge breaking down with the weight of the multitude that passed, the king's troops, who had engaged relying chiefly on their numbers, began to lose courage, seeing they could receive no farther assistance, and the Romans charging them with fresh vigour, they betook themselves to a precipitate flight. After this engagement, as winter came on, both armies were glad to retire to their winter quarters.

During the winter, Mithridates raised new forces: and having received considerable supplies from Tigranes, took the field early in the spring, in hopes of driving the Romans quite out of Pontus, before Lucullus, who had work enough on his hands in Armenia, could come to their assistance. With this view he marched straight against Triarius and Sornatius, to whom Lucullus had committed the care and defence of that province; and finding them encamped near the city of Gaziursa, proffered them battle; which they declining, he sent a strong detachment to besiege a castle where the Romans had left all their baggage, hoping they would rather venture an engagement to relieve the place, than lose

Pontus.

lose all they had got with so much toil and labour during the war; neither was he disappointed in his hopes; for though Triarius was keeping close in his camp till the arrival of Lucullus, whom he daily expected, having acquainted him with the danger, the soldiers hearing that the castle was besieged, declared in a tumultuous manner, that if he did not lead them they would
48 Defeats Triarius. march to the relief of the place without his leave. Triarius being thus forced by his own men to fight, drew out his forces against the king, whose army was three times his number; but while they were upon the point of engaging, both armies were by a violent storm forced to retire to their respective camps; but Triarius receiving that very day intelligence of the approach of Lucullus, and fearing he would snatch the victory out of his hands, resolved to make a bold push, and next morning by break of day attack the king in his camp. If he conquered, the glory he thought would be entirely his own; if he were overcome, the enemy could reap no great advantage from his victory, Lucullus being at hand with a powerful army. The king, in that surprise, putting himself at the head of a few troops of his guards, sustained the brunt of the Romans, till the rest of his army drawing up came to his relief, and attacked the enemy with such fury, that the Roman foot were forced to give way, and were driven into a morass, where they were surrounded and great numbers of them cut in pieces.

Their horse were likewise put to flight, and pursued with great slaughter, till a Roman centurion in the king's service, pitying his countrymen, attempted to kill him. The king's life was saved by his breastplate; but as he received a deep wound in the thigh, he was obliged to give over the pursuit himself, and those that were about him caused the retreat to be sounded, which, as it was unexpected, occasioned a great confusion in the whole army. The centurion was immediately cut in pieces; but the Roman horse in the mean time getting the start of the enemy, found means to make their escape. Above 7000 of the Romans were killed in that battle: and among them 150 centurions, and 24
49 All the Romans in the service of Mithridates massacred. tribunes, the greatest number of officers that had been lost in any engagement to that day. Mithridates being cured of his wound, that he might not for the future be exposed to such dangers, caused all the Romans that served in his army to be formed into one body, as if they were to be sent out on a party, and then ordered them to retire to their tents, where they were all to a man cut in pieces.

The king, however elated with success, yet would not engage Lucullus; but with long marches hastened into Armenia Minor, and encamped on a hill near the town of Talura, expecting Tigranes, who was advancing with a strong army to join him. Lucullus, in pursuit of Mithridates, marched over the field of battle, leaving those unburied who had fallen in the engagement, which alienated the minds of the soldiery from him, and they began to be very mutinous; being stirred up by Appius Claudius, whom Lucullus had turned out of his command for his vile behaviour, notwithstanding he was nearly related to him, Lucullus having married his sister. The discontent that prevailed in the army came to such a height, that Lucullus was obliged to lie still in his camp all that summer; the soldiers declaring in a mutinous manner, that they would not follow him any longer, nor serve under a general who refused to share the booty with them.

50 Lucullus recalled, which retrieves the affairs of Mithridates.

These complaints, and the general discontent that reigned in the army, obliged the senate to recal Lucullus, and appoint Manius Acilius Glabrio, consul of that year, in his room. Glabrio arriving in Bithynia, gave notice by public criers to all the cities, that the senate had discharged Lucullus and his army, and confiscated his goods for protracting the war and refusing to comply with their injunctions. Hereupon Lucullus was abandoned by the greater part of his army, and forced to retire into Galatia, not being in a condition to make head against the joint forces of the two kings; who, laying hold of that opportunity, recovered the best part of Pontus, Bithynia, Cappadocia, and Armenia Minor: for though Glabrio had hastened into Pontus, as if he had intended to engage the enemy and rob Lucullus of the victory, yet, upon the first news of the approach of the two kings, he thought fit to retire and leave the country open on all sides to the enemy.

51 Pompey sent against him.

When this was heard at Rome, a law was enacted there by C. Manilius, a tribune of the people, whereby the management of the war against Mithridates and Tigranes was committed to Pompey, and likewise the provinces of Cilicia, then under Quintus Marcius, and of Bithynia under Glabrio. By the same law he was continued in that unlimited power by sea, with which he was invested when he first set out against the pirates of Cilicia. In virtue of this law, Pompey, who had just then ended the war with the Cilician pirates, took upon him the command of the army, and directed all the allies of the Roman people to join him with all possible expedition: but before he took the field, he renewed the alliance which Sylla and Lucullus had concluded with Phrahates king of Parthia, and then sent friendly proposals to Mithridates: who at first seemed inclined to give ear to them, and accordingly dispatched an ambassador to the Roman army to treat of a peace. Pompey required of him to lay down his arms if he was in earnest, and deliver up to him all those who had revolted from the Romans during the war. This demand was no sooner reported abroad in the king's camp, but the deserters, who were very numerous in the king's army, betaking themselves to their arms, threatened to put Mithridates himself to death; and would have occasioned a great disturbance, had not the king appeased the growing tumult, by assuring them, that he had sent ambassadors, not to treat of a peace, but only to take, under pretence of suing for peace, a view of the enemy's strength. He moreover obliged himself, by a solemn oath in presence of the whole army, never to enter into any treaty of friendship with the Romans, nor to deliver up to them such as had ever served under him.

52 Mithridates rejects his proposals of peace.

Pompey, finding his proposals rejected, advanced against the king with an army of 30,000 foot and 20,000 horse, as Plutarch writes, or 30,000, as we read in Appian, all chosen troops; for he discharged most of those who had served under Glabrio and Lucullus. As he entered Galatia, he was met by Lucullus, who endeavoured to persuade him to march back, the war being near finished, and even deputies sent by the republic to settle the province of Pontus; but not being able to prevail with him, after mutual complaints against each other, they parted; and Pompey removing his camp, commanded the troops that were with Lucullus to join him, except 1600 whom he left to attend Lucullus in his triumph. From thence Lucullus set out for Rome, where he was received by the senate with great marks of esteem, most men thinking him highly injured by the authors of the Manilian law. Pompey pursued his march into Pontus; but finding that he could not by any means draw the king to a battle, he marched back into Armenia Minor, with a design either to reduce that province, or oblige Mithridates to venture a battle in order to relieve it. Mithridates followed him at some distance; and entering Armenia, encamped on a hill over against the Romans, and, by intercepting their convoys, reduced them to such distress, that they were obliged to remove to a more convenient place, the king cutting off many in their rear, and harassing them with frequent attacks, till he fell into an ambuscade laid by Pompey, whose personal courage and prudent conduct on that occasion confirmed the king in his resolution not to hazard a general engagement. The two armies encamped overagainst each other; Pompey on one hill, and the king on another, near the city of Dastira, in the province of Acisilene, at a small distance from the Euphrates, which divides Cisilene from Armenia Minor.

53 Is besieged by Pompey.

Here Pompey, seeing he could neither draw the king to a battle, nor force his camp, which was pitched on a steep and craggy mountain, began to block him up with a ditch which he carried round the bottom of the hill where the king was encamped; and meeting with no opposition, finished his work, and quite cut off the enemy's communication with the country. Pompey was amazed to see the king thus tamely suffer himself to be shut up; and could not help saying, That he was either a great fool or a great coward; a fool, if he did not apprehend the danger he was in; a coward, if, being apprised of it, he did not to the utmost of his power prevent it. By this ditch, which was 150 furlongs in circuit, and defended by many forts raised at small distances from each other, the king was so closely besieged, that he could neither send out parties to forage, nor receive the supplies that came to him from Pontus. He was thus besieged for the space of 45 or 50 days; and his army reduced to such straits, that, having consumed all their provisions, they were at last forced to live on their dead horses. Hereupon Mithridates resolved at all events to break through the Roman fortifications: and accordingly, having put to the sword all those that were sick or disabled, that they might not fall into the enemy's hands, he attacked in the dead of the night the Roman guards; and having overpowered them with his numbers, got safe into the open fields, and continued his march till night towards Armenia Major, where he was expected by Tigranes.

54 but breaks through Roman lines.

Pompey next morning by break of day pursued the enemy with his whole army; and having with much ado overtaken them, found the king encamped on a hill, to which there was but one ascent, and that guarded by a strong body of foot. The Romans encamped overagainst them; but Pompey, fearing the king should make his escape in the night-time, privately decamped, and taking the same route the enemy were to hold in order to gain Armenia, possessed himself of all the eminences and defiles through which the king was to pass. Mithridates thinking that Pompey was returned to his former camp, pursued his march, and about the dusk of the evening entered a narrow valley, which was surrounded on all sides by steep hills. On these hills the Romans lay concealed, expecting the signal to fall upon the enemy and attack them on all sides at once, while they were tired by their march, and seemingly, as they had sent out no scouts, in great security. Pompey was at first for putting off the attack till the next morning, thinking it not safe to engage in the night-time among such steep and craggy mountains; but was at last prevailed upon, by the earnest prayers and intreaties of all the chief officers of the army, to fall upon the enemy that very night. It was therefore agreed, that in the dead of the night all the trumpets should at once sound the charge, that this signal should be followed by an universal shout of the whole army, and that the soldiers should make what noise they could, by striking their spears against the brass vessels that were used in the camp. The king's army at this sudden and unexpected noise, which was echoed again by the mountains, imagined at first that the gods themselves were come down from heaven to destroy them; and the Romans charging them on all sides with showers of stones and arrows from the tops of the hills, they took themselves to a precipitate flight; but finding all the passes beset with strong bodies of horse and foot, were forced to fly back into the valley, where for many hours together, they were exposed to the enemy's shot, without being able, in that confusion, either to attack them or defend themselves. They attempted indeed to make some resistance when the moon rose; but the Romans running down upon them from the hills, did not give them time to draw up, and the place was so narrow that they had not room even to make use of their swords. The king lost on that occasion 10,000 men according to Appian, but 40,000 according to Eutropius and others. On Pompey's side there fell between 20 and 30 private men, and two centurions.

55 Is over-reached by Pompey, and totally defeated.

56 Distress of Mithridates.

Mithridates, at the head of 800 horse, broke through the Roman army, and being after this effort abandoned by all the rest, because they were closely pursued by the enemy, he travelled all night attended by three persons only, viz. his wife, or, as Plutarch calls her, his *concubine*, by name *Hypsicratia*, his daughter Dripetine, and an officer. At day-break he fell in with a body of mercenary horse, and 3000 foot, who were marching to join him. By these he was escorted to the castle of Sinoria, situated on the borders of the two Armenias. As great part of his treasures was lodged here, he rewarded very liberally those who accompanied him in his flight; and taking 6000 talents withdrew into Armenia. As soon as he entered the borders, he dispatched ambassadors to Tigranes, acquainting him with his arrival; but that prince, who was then on the point of concluding a separate peace with the Romans clapped his ambassadors in irons, pretending that his son Tigranes had, at the instigation of Mithridates, revolted first to the Parthians, and then to the Romans. Mithridates finding himself thus abandoned, even by his son-in-law, left Armenia; and directing his course towards Colchis, which was subject to him, and not as yet invaded by the Romans, passed the Euphrates the fourth day, and got safe into his own territories.

Pompey

Pompey sent out several parties in pursuit of the king; but remained himself with the main body of the army in the field of battle, where he built a city, calling it from that remarkable victory *Nicopolis*. This city, with the adjoining territory, he bestowed upon such of his soldiers as were old or disabled; and many flocking to it from the neighbouring countries, it became in a short time a very considerable place. This battle was certainly attended with very fatal consequences for Mithridates; who was forced, his army being entirely either cut off or dispersed, to abandon his own dominions, and fly for shelter to the most remote parts of Scythia. Pompey having concluded a peace with Tigranes, as we have related in the history of Armenia, and settled the affairs of that kinggom, began his march in pursuit of Mithridates through those countries that lie about Mount Caucasus. The barbarous nations through which he passed, chiefly the Albanians and Iberians, attempted to stop his march, but were soon put to flight. However, he was obliged, by the excessive cold and deep roads, to pass the winter near the river Cyrus. Early in the spring he pursued his march; but meeting with great opposition from the Iberians, a warlike nation, and entirely devoted to Mithridates, he was employed most part of the summer in reducing them. In the mean time, Mithridates, who had wintered at Dioscurias, on the isthmus between the Euxine and Caspian seas, and had been joined there by such of his troops as had made their escape from the late unfortunate battle, continued his flight through the countries of the Achæans, Zygians, Heniochians, Cercetans, Moschi, and Colchians. Of these nations some received him kindly, and even entered into alliance with him; through others he was forced to fight his way with the sword.

57 He flies into Scythia, and from thence into other countries.

Pompey took the same route, directing his course by the stars, especially in the northern parts of Scythia, and carrying with him even a supply of water for the army in the vast deserts through which he marched. He spent two years in warring with these nations, and was often in danger of losing both his life and his army: but at last he overcame them all; and believing Mithridates, of whom he could have no account, to be dead, he marched back into Armenia Minor, where he allowed some rest to his soldiers, who were quite worn out with the hardships they had endured in that expedition. Having refreshed his army, he marched into Pontus, to reduce some strongholds which were still garrisoned by the king's troops. While he was at Aspis in Pontus, many of the king's concubines were brought to him; but he sent them all home to their parents, without offering them the least injury, and thereby gained the affection of the chief lords of Pontus, whose daughters they were. The strong castle of Symphori was delivered up to him by Stratonix, one of the king's concubines, upon no other terms than that he would spare her son Xiphares, who was with the king, in case he should fall into his hands. She likewise discovered to him great treasures hid under ground, which he, with great generosity, bestowed upon her, reserving for himself only some vessels to set off his triumph. Having taken another fort, called the *New Castle*, and to that time looked upon as impregnable, he found in it great store of gold, silver, and other valuable things, which he afterwards consecrated to Jupiter Capitolinus. Here, in looking over the king's manuscripts, he came to discover where the rest of his treasures were concealed, what troops he could raise and maintain, what sums were yearly paid him by his subjects and tributaries, &c. whereby he could make a true estimate of his whole power and wealth. Amongst other manuscripts he found some books of physic, wrote by Mithridates himself, which he commanded Lenæas, a learned grammarian, to translate into Latin.

58 Pompey's further conquests.

Pompey, having thus reduced all Pontus, marched into Syria, with a design to recover that kingdom, and passing through Arabia to penetrate as far as the Red sea. But while he was employed in this expedition, news was brought him that Mithridates, whom he believed dead, had appeared unexpectedly in Pontus at the head of a considerable army, and surprised Panticapæum, a famous empory at the mouth of the Euxine sea. He had lain all this time concealed in the territories of a Scythian prince, adjoining to the Palus Mœotis; but hearing that Pompey had left Pontus, and was engaged in other wars, he ventured out of his hiding-place, resolved either to recover his paternal kingdom, or die in the attempt. He returned privately into Pontus, and managed matters there so dexterously, that the Roman garrisons knew nothing of his arrival till he appeared with a considerable army in the field. He advanced first to the castle of Symphori; and understanding that Stratonix had delivered it up to Pompey, on condition he would save the life of her son in case he should take him prisoner, the king immediately caused the youth, who was in his army, to be put to death, and his body to be left unburied, Stratonix beholding from the walls the cruel and unnatural murder, for he was her son by Mithridates, and had served him with great fidelity. At the same time he sent ambassadors to Pompey to treat of a peace, offering to pay a yearly tribute to the republic, on condition he restored to him his kingdom. Pompey replied, that he would hearken to no proposals whatsoever, without the king came to treat with him in person, as Tigranes had done. This Mithridates looked upon as nowise consistent with his dignity, and therefore laying aside all thoughts of an accommodation, began to make what preparations he could for renewing the war.

59 Mithridates appears again at the head of a considerable army.

He summoned all his subjects that were able to bear arms to meet at an appointed place; and having chosen out of the whole multitude 60 cohorts, each consisting of 100 men, he incorporated them with the regular troops that were already on foot. Being now in a condition to act offensively, for Pompey had left but a small number of troops in Pontus, he possessed himself of Phanagorium, Chersonesus, Theodosia, Nymphæum, and several other important places. But, in the mean time, Castor, whom Mithridates had appointed governor of Phanagorium, falling out with Tripho, one of the king's favourite eunuchs, killed him, and dreading the king's resentment, stirred up the inhabitants to a revolt: by which means Phanagorium was again lost; but the castle, which was defended by four of the king's sons, Artaphernes, Darius, Xerxes, and Oxathres, held out for some time. The king hastened to their relief; but the castle being set on fire by the rebels, they were forced to surrender themselves to Castor before his arrival. These four sons, with one of the king's daughters, by name *Cleopatra*, Castor sent to the Romans; and fortifying himself in the town, persuaded

60 Recovers several places.

Pontus.

suaded most of the neighbouring cities, which were oppressed with heavy taxes, and strangely harassed by the king's collectors, to join in the rebellion.

61 His subjects discontented.

Mithridates finding that he could neither rely upon the soldiery, most of them being forced into the service, nor on his other subjects, who were dissatisfied by reason of the exorbitant taxes, sent ambassadors to invite the princes of Scythia to his relief, and with them his daughters, to be bestowed in marriage on such as showed themselves most inclined to assist him. But as the ambassadors he employed on this occasion were eunuchs, a race of men no less abhorred by the army than favoured by the king, over whom they had a great ascendant, especially in his old age, the soldiers who were sent to attend them on their journey, put them all to the sword as soon as they were out of the king's reach, and delivered his daughters up to the Romans. Mithridates, finding himself thus deprived of his children, betrayed by his army, and forsaken even by those on whom he chiefly relied, could not yet be induced to submit to the Romans, though Pompey promised him honourable conditions, provided he came to treat with him in person. In this desperate condition, he left no stone unturned to stir up the princes of Asia against the Romans, especially the Parthians; but finding them awed by the great opinion they all had of Pompey, he had recourse at last to the European Gauls, whom he understood to be at war with the Romans; and having sent before some of his trusty friends to engage them in his favour, taking leave of his own kingdom, he began his long march, designing to pass through Bosphorus Cimmerius, Scythia, Panonia, &c. and joining the Gauls, pass the Alps, and invade Italy.

62 His extraordinary design of invading Italy.

This design was no sooner known in the army, but the soldiers openly began to complain and mutiny; exaggerating the boldness of the attempt, the length of the march, and the unsurmountable difficulties that must necessarily attend such a desperate enterprise. The chief commanders did all that lay in their power to divert him from it; representing to him, that if he was not able to cope with the Romans in his own kingdom, much less would he be a match for them in Italy or Gaul, where they could daily receive new supplies; whereas he would lose the greatest part of his army in so long and difficult a march, and the rest, perhaps in the first engagement, without any possibility of repairing the loss. But all was to no purpose; for they found him so unalterably fixed in his resolution, that he caused those to be put to death who with most warmth remonstrated against it, not sparing even his own son Exipodras, for dropping some unguarded expressions on that occasion. Thus they were forced to let him pursue his own measures, till they found a more proper opportunity to oppose them, which soon after offered, as they were encamped at Bosphorus Cimmerius, on their march into Scythia.

63 His son Pharnaces revolts.

Here Pharnaces, the king's favourite son, whom he had appointed to succeed him, observing the general discontent that reigned in the army, began to entertain thoughts of placing the crown on his own head; and not doubting but the soldiery would stand by him, if he declared against the intended expedition into Italy, openly protested among the Roman deserters, who were a considerable part of the army, that if they would follow him he would return into Pontus. The Romans, who were well apprised of the danger that attended such an undertaking, and had most of all exclaimed against it, promised to support him to the utmost of their power, and even encouraged him, upon some expressions which he purposely dropped, to assume the title of *king*, a title which his father seemed determined to hold till he had destroyed, by his rash and desperate attempts, himself, his friends, and his army. Pharnaces, finding he could depend on the Romans, engaged the same night most of the chief commanders in his party, and by their means the greater part of the soldiery. It was agreed, that next morning by break of day all those who had declared in his favour should appear in arms, and with a loud shout proclaim Pharnaces king; which was done accordingly, and the shout returned even by those whom Pharnaces had not thought fit to let into the secret. The king, who had taken up his quarters in the city, being awakened by the noise, sent out some of his domestics to know what had happened in the army. Neither did the officers or soldiers dissemble the matter, but boldly answered, that they had chosen a young king instead of an old dotard governed by eunuchs.

Hereupon Mithridates mounting on horseback, and attended by his guards, went out to appease the tumult: but his guards forsaking him, and his horse being killed under him, he was obliged to fly back into the city; from whence he sent several of his attendants one after another to desire of his son a safe conduct for himself and his friends. But as none of the messengers returned, some being slain, and others siding with the new king, Mithridates endeavoured to move his son to compassion, by signifying to him from the walls the distressed condition he was reduced to by a son whom he had favoured above the rest of his children; but finding him nowise affected by his speech, turning to the gods, he beseeched them with many tears to make his son know one day by experience the grief and agony which a father must feel in seeing his love and tenderness requited with such ungrateful and monstrous returns. Having thus spoken, he thanked in a very obliging manner those who had stood by him to the last, and exorted them to make their submission to the new king on the best terms they could procure, adding, that as for himself, he was determined not to outlive the rebellion of a son whom he had always distinguished with particular marks of paternal affection.

64 Mithridates attempts to destroy himself.

After this, he withdrew into the apartment of his wives and concubines, where he first took poison himself, and then presented it to them, and to his favourite daughters Mithridatis and Nissa, who not long before had been betrothed to the kings of Egypt and Cyprus. To the women it proved immediate death; but on the king, who from his infancy had inured his constitution to poisonous potions, it had so slow an operation, that he was forced, through fear of falling into the rebels hands, to recur to his sword. Neither did the wound, as he was greatly weakened by the poison, prove mortal: so that the rebels, having in the mean time stormed the town, and broke into the house, found the king wallowing in his blood, but still alive, and in his senses; which Pharnaces hearing, sent some of those that were about him to dress his wounds, with a design to deliver him up to the Romans, Pontus. mans, and thereby ingratiate himself with Pompey.—But, in the mean time, a Gaul, who served in the army, by name *Bitætus*, or *Bithocus*, entering the king's room in quest of booty, and being touched with compassion in seeing him forsaken by all his friends, and struggling on the bare ground with the pangs of death, drawing his sword, put an end to his present agonies, and prevented the insults which he chiefly apprehended if he should fall alive into his son's hands. The barbarian is said, when he first saw the king, to have been so awed with the majesty of his countenance, that, forgetful of his booty, he fled out of the room; but being called back, and earnestly intreated by the dying prince to put an end to his misery, he summoned all his courage to perform, as he did, with a trembling hand, that office; and immediately retired without touching any thing that belonged to the king, though the hope of a rich booty was the only motive that had led him thither.

65 A Gaul puts an end to his life out of compassion.

66 Excessive joy of the Romans at his death.

Pompey, who was at that time engaged in a war with the Jews, received the first notice of the death of Mithridates as he was on his march to Jerusalem. The messenger who brought the joyful tidings was sent by Pharnaces, and appeared unexpectedly before Pompey with the branch of a laurel, as was customary on the like occasions, twisted round the head of his javelin. When he heard what had happened at Panticapæum, he was so impatient to impart it to the soldiery, that he could not even wait till they had raised him a mount of turf from whence to speak to the army, according to the custom of the camp; but ordered those who were by him to form a kind of mount with their saddles, and from thence acquainted the soldiery that Mithridates had laid violent hands on himself, and his son Pharnaces was ready to acknowledge the kingdom as a gift of the people of Rome, or resign it if they were unwilling he should reign. This news was received with joyful shouts of the whole army, and the day solemnized with feasts and sacrifices throughout the camp, as if in Mithridates alone all the enemies of the republic had died. Pompey dispatched without delay a messenger with letters to the senate, acquainting them with the death of Mithridates, and the submission of his son Pharnaces. When his letters were read, the senators were so overjoyed, that they appointed at the proposal of Cicero, then consul, 12 days for returning due thanks to the gods, who had delivered them from such an insulting and powerful enemy; and the tribunes of the people enacted a law, whereby Pompey, in consideration of his eminent service in the Mithridatic war, was to wear a crown of laurel, with the triumphal gown at the Circensian sports, and a purple gown at the scenical plays.

Pharnaces, when he heard of his father's death, caused his body to be preserved in brine, proposing to present it to Pompey, who had promised to return into Pontus after the reduction of Judæa, and there settle matters to his satisfaction. And accordingly having taken the city and temple of Jerusalem, he set out with two legions for Pontus; and being arrived at Sinope, he was there met by ambassadors from Pharnaces, acquainting him, that their master had forebore assuming the title of king till his will and pleasure were known; that he put both himself and the kingdom entirely into his hands; and that he was willing to attend him at what time or place he thought fit to appoint. The same ambassadors delivered up to Pompey those who had taken Manius Aquilius the Roman legate, whom Mithridates had put to a cruel death, all the prisoners, hostages, and deserters, whether Romans, Greeks, or Barbarians, and the body of Mithridates, with his rich apparel and arms, which were greatly admired by Pompey and the other Romans. Both soldiers and officers flocked to see the king's body; but Pompey declined that sight; and, saying that all enmity between that great prince and the people of Rome was ended with his life, he returned the body to the ambassadors, and caused it to be interred with the utmost pomp and magnificence among his ancestors in the burying-place of the kings of Pontus, Pompey defraying all the charges of that ceremony, which was the most costly and pompous that ever had been seen in those parts. With the body Pompey restored his wearing apparel and armour; but the scabbard of his sword, which cost 400 talents, was stolen by Rublius a Roman, and sold to Ariarathes king of Cappadocia; and his cap or turban, which was a very curious piece of workmanship, was privately taken by one Caius, who presented it to Faustus the son of Sylla, in whose house it was kept, and shown for many years after among the many rarities which Sylla had brought out of Asia.

67 Submissive embassy of Pharnaces to Pompey;

68 who bestows upon him the kingdom of Bosphorus.

Pompey bestowed the kingdom of Bosphorus on Pharnaces, and honoured him with the title of a friend and ally of the people of Rome. Pharnaces being thus acknowledged king of Bosphorus, sent orders to all the garrisons of Pontus to submit themselves, with the castles and treasures with which they were entrusted, to Pompey, who by that means amassed an immense booty. In the city of Talaura, which Mithridates used to call his wardrobe, he found 2000 cups of onyx set in gold, with such store of gold and silver vessels, of costly furniture, of saddles, bridles, and trappings, set with jewels and precious stones, that the Roman commissaries spent 30 days in taking the inventory of the whole. In another castle he found three large tables with nine salvers of massy gold, enriched with precious stones to an inestimable value; the statues of Minerva, Mars, and Apollo, of pure gold and most curious workmanship; and a pair of gaming-tables of two precious stones, three feet broad, and four feet long, on which was a moon of gold weighing 30 pounds, with their men, all of the same precious stone. In a fort situated among the mountains, were delivered up to him the king's statue of massy gold, eight cubits high, his throne and sceptre, and the bed of Darius the son of Hystaspes. Most of these treasures had been transmitted to him from his ancestors, chiefly from Darius king of Persia; some belonged to the Ptolemies of Egypt, and had been deposited by Cleopatra, as we have hinted above, in the hands of the Coans, who delivered them to Mithridates; and great part of them had been collected by the king himself, who was very fond of rich and stately furniture.

Pompey having thus got entire possession of Pontus, and reduced it to the form of a Roman province, marched into *Asia* properly so called; and having wintered at Ephesus, early in the spring set out for Italy, with a fleet of 700 ships. As he brought over his army with him, the senate was under no small apprehension lest he should make himself absolute, and rule without controul. But he no sooner landed at Brundusium, than he disbanded the army, without waiting for any decree either of the senate or people; what neither his friends nor his enemics

Pontus. mies had believed. His triumph lasted two whole days; and though he was attended in his triumphal chariot by 324 captives of distinction, among whom were five sons and two daughters of Mithridates, yet he would not suffer any of them to be put to death, as had been done by others; but sent them all back, except such as were of royal extraction, to their respective countries, and even supplied them with money to defray the charges of their journey. After his triumph he delivered into the treasury 20,000 talents, though, at the dismissing of the army he had divided 16,000 talents among the tribunes and centurions, 2000 sestertiums among the quæstors, and had given to each soldier 50 sestertiums.

69 Pharnaces falls out with the Romans,

Pompey had no sooner left Asia, but Pharnaces fell unexpectedly upon the Phanagorenses, a people of Bosphorus, whom Pompey had declared free, because they had revolted the first of all from Mithridates, and by their example induced others to abandon the king's party. Pharnaces besieged their chief city Phanagoria, and kept them blocked up till, for want of provisions, they were forced to sally out, and put all to the issue of a battle; which proving unsuccessful, they delivered up themselves and the city to the conqueror. Some years after, the civil war breaking out between Cæsar and Pompey, he laid hold of that opportunity to recover the provinces which his father had formerly possessed; and having raised a considerable army, overran Pontus, Colchis, Bithynia, Armenia, and the kingdom of Moschis, where he plundered, as Strabo observes, the temple of the goddess Leucothea. He took the strong and important city of Sinope, but could not reduce Amisus. But, in the mean time, Cæsar having got the better of Pompey and his party, appointed Cn. Domitius Calvinus governor of Asia, enjoining him to make war upon Pharnaces with the legions that were quartered in that province. Domitius immediately dispatched ambassadors to Pharnaces, commanding him to withdraw his troops from Armenia and Cappadocia. The king returned answer, that he was willing to abandon Cappadocia; but as for the kingdom of Armenia Minor, it was part of his hereditary dominions, and therefore he would not resign it till he had an opportunity of laying his pretensions before Cæsar himself, whom he was ready to obey in all things. Hereupon Domitius drawing together what forces he could, marched into Cappadocia, which he recovered without opposition, Pharnaces having abandoned it to make a stand in Armenia, which lay nearer his own dominions. Thither Domitius pursued him; and having overtaken him near Nicopolis, found his army drawn up in battle-array, and the king ready to come to an engagement; which Domitius not declining, both armies advanced.

70 and defeats them.

The king, at the head of a choice body of men, fell upon the Romans left wing, consisting mostly of raw and undisciplined Asiatics; and having with little difficulty put them to flight, penetrated to the centre, where the thirty-fifth legion, the only one which Domitius had, after a faint resistance, gave ground, and, retiring to the neighbouring mountains, left their allies to shift for themselves, who were all cut off. Domitius with the remains of his scattered army marched back into Cappadocia; and from thence, winter drawing on, into the province of Asia. The king being puffed up with this victory, and hearing that Cæsar, with the flower of the Roman forces, was engaged at the siege of Alexandria, appointed one Asander governor of Bosphorus, and marched himself into Cappadocia in pursuit of Domitius, with a design to invade Asia, and recover all the provinces which had been once subdued by his father. Bithynia and Cappadocia readily submitted; but Armenia the Lesser, which was held by Dejotarus, made so vigorous a resistance, that he was forced to give over the enterprise lest the Romans should in the mean time strengthen themselves in Asia, whither he was in haste to march, in hopes of meeting there with the same success as his father Mithridates had done. But before he reached that province, he was informed that Asander had revolted, in hopes of gaining thereby the good will of the Romans, and obtaining of them the kingdom of Bosphorus for himself. At the same time, he received intelligence that Cæsar, having at last reduced Alexandria, and settled the affairs of Syria, was marching into Armenia.

71 Attempts to outwit Julius Cæsar,

He was not a little dismayed at this news, and therefore without delay dispatched ambassadors to sue for peace; hoping that Cæsar, who was hasting into Italy with a design to pass over into Africa, would willingly give ear to any proposals of that nature.—Cæsar courteously entertained the ambassadors; and though he did not propose to agree to their conditions, yet, that he might come upon Pharnaces unawares, he shewed himself very desirous of entering into a treaty of peace. But, in the mean time, he pursued his march with all possible expedition; and arriving on the confines of Pontus, ordered all the troops that were quartered in the neighbouring provinces to join him; for he had brought from Alexandria but one legion, namely, the sixth, and that consisting of 1000 men only, the rest having been killed at the siege of Alexandria. Besides this veteran legion, he found at the place of general rendezvous three others, but all of them very indifferently armed, and worse disciplined. With these forces, however, such as they were, he advanced against Pharnaces; who being greatly frightened at his approach, by reason of the success that had attended him in all his expeditions, again dispatched ambassadors to him with a crown of gold, offering him his daughter in marriage, and promising to do whatever he should require. The ambassadors took care to let him know, that their master, though highly obliged to Pompey, yet had never been prevailed upon to send him any supplies during the civil war, which Dejotarus, king of Armenia the Lesser, whom he had honoured with his friendship, had done. Cæsar returned for answer, that he was willing to conclude a peace with Pharnaces, provided he retired without delay from Pontus, returned all the captives and hostages whether Roman or their allies, and restored the goods of the Roman citizens and publicans which he had siezed since he first took up arms. He added, that as to his not sending supplies to Pompey, they ought rather to have concealed such an ungrateful proceeding of their master, than alleged it as any merit, since the forsaking of one to whom he was indebted for his crown, bespoke him a man of mean, selfish, and unworthy principles.

Pharnaces, upon the return of his ambassadors, acquainted Cæsar that he agreed to the conditions; but finding that Cæsar's affairs called him into Italy, he required a longer term of time for the performance of what was stipulated between them, starting daily new difficulties, in hopes that Cæsar would in the mean time be obliged to depart, and leave the affairs of Pontus in the

Pontus. the same posture he had found them. Cæsar seeing himself disappointed, and put off from day to day, could not longer brook the king's deceitful behaviour. Wherefore he determined to put himself at the head of his small army, and attack the enemy in his camp, when he least expected it. And accordingly, marching out in the night, he came by break of day in sight of the king's army; and uttering these words, *Shall this treacherous parricide go unpunished?* broke into the camp at the head of 1000 horse. The king's chariots, which were armed with scythes, caused some small disorder among Cæsar's horse; but in the mean time the rest of his army coming up, he put the enemy to flight, and obtained a complete victory. This battle was fought near the place where Mithridates had routed with great slaughter the Roman army under the command of Triarius. Most of the king's army were either taken or cut in pieces; but Pharnaces himself had the good luck to make his escape while the Romans were busy in plundering the camp. This victory was so quick, that Cæsar, in a letter to his friend Aminitius, or Anitius, at Rome, expressed it in three words; thus: "I came, I saw, I conquered." He ever afterwards used to call Pompey a fortunate rather than a great commander, since he had gained his chief glory in the Mithridatic war, fighting with so cowardly an enemy. He divided the rich booty and the spoils of the camp among his soldiers; and because Mithridates had erected a trophy near that place as a monument of his victory over Triarius, which Cæsar, as it was consecrated to the gods, did not think lawful to pull down, he set up another over against it to transmit to posterity his victory over Pharnaces. After this victory he recovered and restored to the allies of the people of Rome all the places which Pharnaces had possessed himself of during the war, declared Amisus a free city, and appointed Mithridates Pergamenus king of Bosphorus in the room of Pharnaces.

72 by whom he is entirely defeated.

Having thus settled the affairs of Pontus, he set sail for Italy; leaving Domitius Calvinus to pursue the war against Pharnaces, if he should appear again in the field. Pharnaces had retired after the battle to Sinope with 1000 horse, where he was quickly besieged by Domitius, to whom he surrendered the town, upon no other condition than that he should be suffered to retire into Bosphorus with the small body that attended him. This Domitius willingly granted; but caused all the king's horses to be killed, since he had asked a safe conduct only for his horsemen. With these and a band of Scythians and Sarmatians he attempted to recover the kingdom of Bosphorus, but being met between Theodocia and Panticapeum, both which cities he had reduced, by Asander, who was still in possession of the kingdom, a sharp engagement ensued, wherein the king's men, as not being used to fight on foot, were put to flight, and Pharnaces himself, who remained alone in the field, was surrounded by the enemy, and cut in pieces, after having reigned in Bosphorus Cimmerius, the kingdom which Pompey had bestowed upon him, according to Appian, fifteen years, according to others, seventeen.

73 Is killed in another engagement.

Upon the death of Pharnaces the kingdom of Pontus was again reduced to the form of a province, and so continued to the triumvirate of Mark Antony, who after the battle at Philippi conferred it upon Darius the son of Pharnaces for his services during the civil war. He continued faithful to the Romans; but did nothing during his reign worth mentioning.

74 Pontus again made a kingdom by Mark Antony.

Darius was succeeded in the kingdom by Polemon, likewise preferred to that honour by Mark Antony. He was the son of Zeno, a famous orator of Laodicea, and greatly favoured by Antony. From him that part of Pontus which borders on Cappadocia borrowed the name of *Polemonaicus*. He attended Mark Antony in his expedition against the Parthians: and being taken prisoner in that unsuccessful battle fought by Statianus, he was sent by the king of the Medes, an ally of the Parthians, to conclude a peace with the Romans. In which embassy he acquitted himself so well, that Antony added the kingdom of Armenia to his own dominions. In the war between Antony and Augustus he joined the former: but after the battle of Actium he was received into favour by the latter; and being sent by Agrippa against Scribonius, who upon the death of Asander had usurped the kingdom of Bosphorus, he overcame him, and reduced the kingdom of Colchis, which was bestowed upon him by Agrippa, who likewise honoured him with the title of *friend and ally of the people of Rome*. He afterwards waged war with the neighbouring barbarians refusing to live in subjection to the Romans; but was overcome, taken, and put to death, by the Aspungitani, a people bordering, according to Strabo, on the Palus Mœotis.

Upon his death his son Polemon II. was by the emperor Caligula raised to the throne of Bosphorus and Pontus. But the emperor obliged him to exchange the kingdom of Bosphorus with part of Cilicia; and Nero, with his consent, reduced that part of Pontus which he enjoyed to the form of a province. He fell in love with Berenice, daughter to Agrippa king of Judæa; and in order to marry her embraced the Jewish religion. But as she soon became tired of his riotous way of living, and returned to her father; so he renounced his new religion, and again embraced the superstitions of Paganism. Polemon dying without issue, the ancient kingdom of Pontus was parcelled out into several parts, and added to the provinces of Bithynia, Galatia, and Cappadocia, only that part of it which was called *Pontus Polemonaicus* retaining the dignity of a distinct and separate province. During the civil discords between Vespasian and Vitellius, one Anicetus, first a slave, afterwards freedman to King Polemon, and lastly commander of the royal navy, took up arms with a design to rescue the kingdom from the Roman bondage; and being joined by great multitudes drawn together with the prospect of spoil, overran the country, and possessed himself of Trapesund, a city founded by the Grecians on the utmost confines of Pontus. Here he cut in pieces a cohort made up of the inhabitants, but which had been formerly presented with the privilege of Roman citizens. He likewise burnt the fleet, and with scorn and insults scoured the sea; Mucianus having called to Byzantium most of the Roman galleys. Hereupon Vespasian, who was at that time in Syria, sent Verdius Gemnius into Pontus with a choice body of auxiliaries from the legions. He assailing the enemy while they were in disorder, and roaming asunder in pursuit of prey, drove them into their vessels; then with some galleys chased Anicetus into the mouth of the river Chobus, where he thought himself safe under the protection of Sedochus king

75 Is parcelled out into several provinces.

Pontus || Ponza. king of the Lazians, whose alliance he had purchased, with large sums and rich presents. Sedochus at first refused to deliver him up to the Romans; but was soon prevailed upon, partly by threats, partly by presents, to surrender both him and all the other fugitives who had taken sanctuary in his dominions. Thus ended that servile war; and the kingdom of Pontus continued to be a province of the empire till the time of David and Alexis Comneni, who being driven from Constantinople by the French and Venetians A. D. 1204, under the command of Baldwin earl of Flanders, settled, the one at Heraclea, the other at Trebisond. The troubles that arose among the Latins gave Alexis Comnenus an opportunity of erecting here a new empire, which comprehended great part of Pontus, and was known by the name of the *empire of Trebisond*. The Comneni held it about 250 years, till the time of Mohammed II. who carried David Comnenus, the last emperor of Trebisond, prisoner to Constantinople, A. D. 1462, with all his family, and subjected his empire to that of Constantinople; in which abject slavery Trebisond and all Pontus have continued ever since.

PONTYPOOL, a town of Monmouthshire in England, seated between two hills. It is a small place; but noted for its iron-mills, and great manufacture of japanned vessels, called Pontypool. W. Long. 3. 6. N. Lat. 51. 42.

PONZA, or PONTIA, is a small island of the Tuscan sea, well known to be the place to which many illustrious Romans were formerly banished. It is situated on the coast of Italy near Terracina, and in the neighbourhood of other small islands or rocks named *Palmarole*, *Zannone*, &c. between the island of Ventotienne and Monte Circello. All these islands were visited by Sir William Hamilton in the year 1785; and an account of his journey is given in a letter to Sir J. Banks, which appeared in the Phil. Trans. vol. lxxvi. p. 365. Sir William arrived at Ponza on the 20th August; and, according to his account, it lies about 30 miles from Ventotienne. On the 21st he went round it in a boat. Its length is about five miles, but its breadth is nowhere above half a mile, and in some places not more than 500 feet. It is surrounded by a multitude of detached rocks, some of them very high, and most of them composed of a compact lava. There are many irregularly formed basaltes, but none in large columns. In some places they have a reddish tinge from iron ochre, are very small, and irregularly laid over one another. Some stand perpendicularly, others obliquely, and some lie horizontally. The rocks themselves in which these masses are found are lava of the same nature with the basaltes. At first sight they appear like the ruins of ancient Roman brick or tyle buildings. One rock is composed of large spherical basalts, and in other places our author found the lava inclined to take the like spherical form, though on a much smaller scale, some of the former basalts being near two feet in diameter. All these rocks, in our author's opinion, have been detached by the sea from this island, which is entirely composed of volcanic matter, lavas, and tufas of various qualities and colours, as green, yellow, black, and white. Some of these matters are more compact in their texture than others; and in some parts great tracts seem to have undergone similar operations, which still subsist at a spot called the *Pisciarelli*, on the outside of the Solfatara, near Puzzole, and where a hot sulphureous vitriolic acid vapour converts all which it penetrates, whether lavas, tufas, volcanic ashes, or pumice-stones, into a pure clay, mostly white, or with a tint of red, blue, green, or yellow. Ponza || Pool.

In one part of this island there is a sort of tufa remarkably good for the purpose of building. It is as hard as Bath-stone, and nearly of the same colour, without any mixture of lava or pumice-stone, which usually abound in the tufas of Naples, Baiæ, and Puzzoli.

The island of Palmarole, which is about four miles from Ponza, is not much more than a mile in circumference. It is composed of the same volcanic matter, and probably was once a part of Ponza; and in our author's opinion it looks as if the island of Zannone, which lies about the same distance from Ponza, was once likewise a part of the same; for many rocks of lava rise above water in a line betwixt the two last-mentioned islands, and the water there is much more shallow than in the gulf of Terracina.

Zannone is much larger and higher than Palmarole; and that half of it next the continent is composed of a lime-stone similar to that of the Apennines near it; the other half is composed of lavas and tufas, resembling in every other respect the soil of the islands just described. Neither Palmarole nor Zannone are inhabited; but the latter furnishes abundance of brushwood for the use of the inhabitants of Ponza, whose number, including the garrison, amounts to near 1700. The uninhabited island of St Stefano in like manner furnishes wood for the people of Ventotienne. It is probable that all these islands and rocks may in time be levelled by the action of the sea. Ponza, in its present state, is the mere skeleton of a volcanic island; little more than its hard or vitrified parts remaining, and they seem to be slowly and gradually mouldering away. The governor of the castle of Ponza, who had resided there 53 years, told our author that the island was still subject to earthquakes; that there had been one violent shock there about four years before; but that the most violent one he ever felt was on the very day and at the hour that Lisbon was destroyed. Two houses out of three which were then on the island were thrown down. "This (says our author) seems to prove that the volcanic matter which gave birth to these islands is not exhausted."

Fig. 1. is a plan of the island of Ponza as it is given in the Philosophical Transactions. Fig. 2. is a view of the inside of the harbour of the island. A in the same figure is a rock of lava. In many parts it is formed into regular basaltes of a reddish colour, tinged in all probability with some ochre. Most of the detached rocks of the island resemble this. BB represents a tract of volcanic country, converted by a hot sulphureous vitriolic acid vapour into a pure clay, the ground colour of which is mostly white.—Fig. 3. is a view from the outside of the harbour, near the lighthouse. C is a rock of volcanic matter converted to pure clay; D is a rock of the same kind, with strata of pumice-stone. E is a rock of lava, inclining to take basaltic forms; and F is a rock composed of spherical basaltes. Plate cccxxxvi. fig. 1. and 2. Fig. 3.

POOD is a Russian weight, equal to 40 Russian or 36 English pounds.

POOL is properly a reservoir of water supplied with springs, and discharging the overplus by sluices, defenders, weirs, and other causeways.

POOL, a sea-port town of Dorsetshire in England. It

Fig. 1.

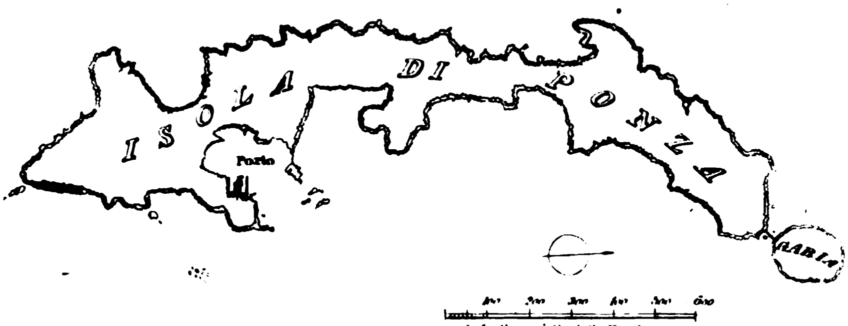


Fig. 2

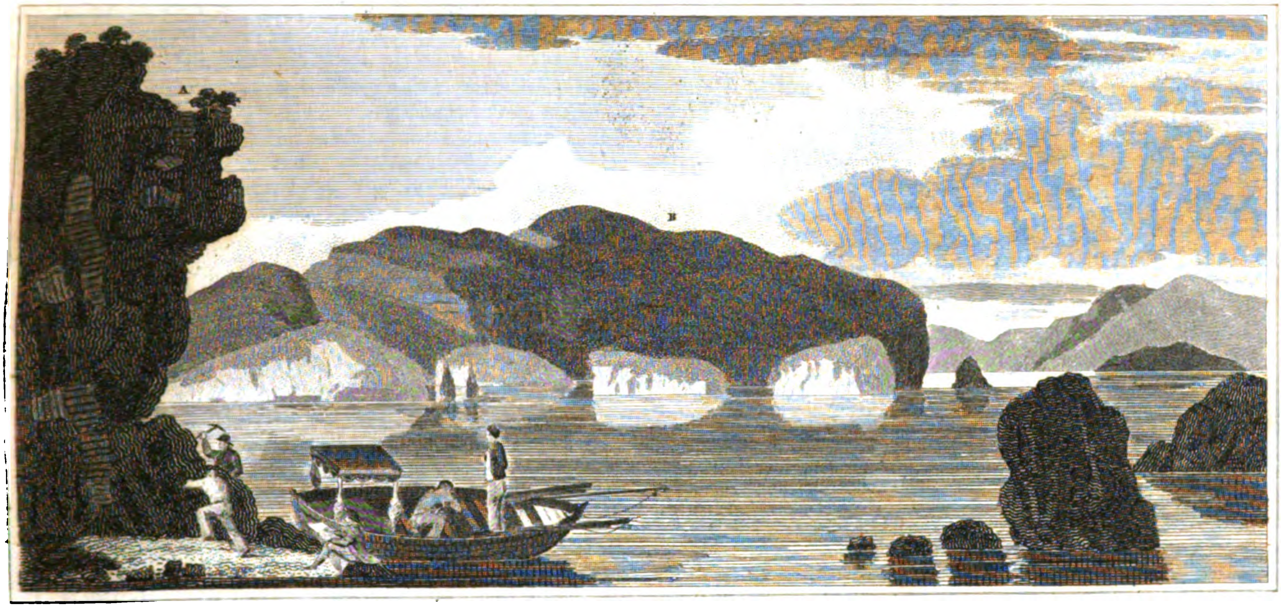


Fig. 3.

Drawn & Engraved by W.H. Lizars Edinburgh.

It is surrounded on all sides by the sea, except on the north, where there is an entrance through a gate. It was formerly nothing but a place where a few fishermen lived; but in the reign of Henry VI. it was greatly enlarged, and the inhabitants had the privilege to wall it round. It was also made a county of itself, and sent two members to parliament. It is governed by a mayor, a senior bailiff, four other justices, and an indeterminate number of burgesses. The number of inhabitants in 1811 was estimated at 4816; and the number of vessels belonging to this port is stated at 230. It is 47 miles west-south-west of Winchester, and 110 west-by-south of London. W. Long. 2. 0. N. Lat. 50. 42.

POOLE, MATTHEW, a very learned writer in the 17th century, was born at York in 1624. He was educated at Emmanuel-college, Cambridge, and afterwards incorporated in the university of Oxford. He succeeded Dr Anthony Tuckney in the rectory of St Michael de Quern, in London, about 1648. In 1658 he set on foot a project for maintaining youths of great parts at the universities, and had the approbation of the heads of houses in both of them. He solicited the affair with so much vigour, that in a short time 900l. *per annum* was procured for that purpose; but this design was laid aside at the Restoration. In 1662 he was ejected from his living for nonconformity. He was ten years employed in composing his *Synopsis Criticorum*, &c. Besides this great work he published several other pieces. When Dr Oates's depositions concerning the popish plot were printed, our author found his name in the list of those who were to be cut off, on the account (as was supposed) of what he had written against the papists in his *Nullity of the Romish Faith*. So that he was obliged to retire to Holland, where he died in 1679, and left behind him the character of a very able critic and casuist.

POOP, the stern of a ship; or the highest, uppermost, and hinder part of a ship's hull. See STERN.

POOR, in law, an appellation given to all those who are in such a low and mean condition, that they either are or may become a burden to the parish.

They who rank pity amongst the original impulses of our nature rightly contend, that when it prompts us to the relief of human misery, it indicates sufficiently the Divine intention, and our duty. Indeed, the same conclusion is deducible from the existence of the passion, whatever account be given of its origin. Whether it be instinct, or a habit founded in association (see PASSION), it is in fact a property of our nature which God appointed: and the final cause for which it was appointed is to afford to the miserable, in the compassion of their fellow-creatures, a remedy for those inequalities and distresses to which many are necessarily exposed under every possible rule for the distribution of property. That the poor have a claim upon the rich, founded in the law of nature, can be questioned by no man who admits the benevolence of the Deity, and considers his purpose in creating the world (see THEOLOGY, Part I. Sect. ii.); and upon this claim the Christian Scriptures are more explicit than almost upon any other.

The rights of the poor, however, to be relieved by the rich, as they originate in nature, and are sanctioned by Christianity, are evidently of that kind which is called *imperfect* (See *MORAL Philosophy*, N° 151.). It is surely needless to warn our readers in this place, that imperfect rights are in themselves as sacred, and the duties resulting from them as obligatory in *foro conscientiæ*, as the most rigid claims of justice. Every one knows, that they are called *imperfect* only because the extent of them in particular instances cannot be ascertained by positive laws, nor the breach of them be punished by the civil magistrate. Hence the apostle, though he enjoins a weekly contribution to be made for the poor in the church of Corinth, yet leaves the sum to be contributed by each individual wholly undetermined. "Now concerning the collection for the saints, as I have given order to the churches of Galatia, even so do ye. Upon the first day of the week let every one of you lay by him in store as God hath *prospered him*." By which St Paul certainly recommends to every man to contribute, not a fixed sum, but as much as, from a deliberate comparison of his fortune, with the reasonable expences and expectations of his family, he finds he can spare for charitable purposes.

It is well known that those weekly contributions were laid at the feet of the apostles, who transferred the management of the fund thence arising to deacons elected by the people, and ordained by them to see that the money was properly distributed. Hence, under Christianity, the maintenance of the poor became chiefly an ecclesiastical concern; and when that holy and benevolent religion was established in the Roman empire, a fourth part of the tithes was in some countries of Europe, and particularly in England, set apart for that purpose. Afterwards, when the tithes of many parishes were appropriated to the monasteries, these societies were the principal resource of the poor, who were farther relieved by voluntary contributions. Judge Blackstone observes, that till the statute 26 Hen. VIII. cap. 26. he finds no compulsory method for providing for the poor; but upon the total dissolution of the monasteries, abundance of statutes were made in the reign of King Henry VIII. Edward VI. and Elizabeth, which at last established the

POOR's Rate, or legal assessment for the support of the poor. The sums that had been appropriated for charitable uses before the Reformation were immense, and the wealth that had been accumulated through a succession of ages by mendicant orders of religious persons was inconceivably great; nor was it in the power of any laws to confine men who were in the possession of such wealth from gratifying those desires which money can so easily find means of supplying. Yet among the various abuses to which this opulence had given rise, these religious orders had never so far lost sight of their original institution as ever to neglect the poor. These were indeed provided for by them with an indiscriminate profusion of largesse, better proportioned to their own opulence than to the wants of the claimants, who were too often, without examination, all equally served, whether deserving or undeserving of that bounty which they claimed.

When the *religious houses*, as they were called, were entirely suppressed at the Reformation, and the wealth that belonged to them was diverted into other channels, the poor, who had been in use to receive their support from thence, were of course left entirely destitute; and this soon became a grievance so intolerable not only to the poor themselves, but to the whole nation, as to

Poor.

excite an universal desire to have it remedied. Accordingly, by the 14 Eliz. cap. 5. power was given to the justices to lay a general assessment; and this hath continued ever since. For by 43 Eliz. cap. 2. the church-wardens and overseers of the poor of every parish, or the greater part of them (with the consent of two justices, one of whom is of the quorum, dwelling in or near the parish), are empowered to raise weekly, or otherwise, by taxation of every inhabitant, parson, vicar, and other, and of every occupier of lands, houses, &c. materials for employing the poor, and competent sums for their relief. Notice shall be given in church of every such rate the next Sunday after it is allowed, which may be inspected by every inhabitant, paying 1s. and copies of it granted on demand, 6d. being paid for every 24 names; and a church-warden or overseer refusing, shall forfeit 20l. to the party aggrieved. The rate is to be levied by distress on those who refuse to pay it; and, by 17 Geo. II. cap. 2. cap. 38. appeals against it are allowed.

If the justices find that the inhabitants of any parish are not able to levy among themselves sufficient sums for the purposes specified in the act, they may assess any other parish within the hundred; and if the hundred be unable to grant necessary relief, they may rate and assess any parish within the county. 43 Eliz. cap. 2.

In order to compel husbands and parents to maintain their own families, the law hath provided, that all persons running away out of their parishes, and leaving their families upon the parish, shall be deemed and suffer as incorrigible rogues (7 Jac. cap. 4.). And if a person merely threatens to run away and leave his wife and children upon the parish, he shall, upon conviction, before one justice by confession, or oath of one witness, be committed to the house of correction for any time not exceeding one month (17 Geo. II. cap. 5.). For the farther maintenance of the poor, there are many fines and forfeitures payable to their use; as for swearing, drunkenness, destroying the game, &c. And also parts of wastes, woods, and pastures, may be inclosed for the growth and preservation of timber and underwood for their relief. See *Work-House*.

The famous statute of the 43d of Elizabeth, which is the basis of all the poor-laws in England, was constructed with a cautious forethought that can perhaps be equalled by few laws that ever were enacted; and if prospective reasoning alone were to be relied on in matters of legislation, it seemed impossible to amend it: yet experience has now proved, with a most demonstrative certainty, that it is not so salutary as was undoubtedly expected.

The persons who composed that law had before their eyes such a recent proof of the abuse that had been made of the charitable beneficence of individuals, that they seem to have been chiefly solicitous to obviate similar abuses in future; and to guard against that partial kind of seduction, they rather chose to establish a despotic power which should be authorised to wrest from every individual in the nation whatever sums it might think proper to call for, trusting to a few feeble devices which they contrived, for curbing that power which was virtually armed with force sufficient to set all these aside whenever it pleased. The consequence has been, that the sums levied for the relief of the poor, which were at first but small, are now enormous, and that the demands are increasing in such a rapid manner as to give rise to the most serious and well-grounded apprehensions. In the year 1774, parliament instituted an inquiry into the amount of the poor's-rates in England and Wales, and again in 1783. On comparing these together, the rise during that short period was found to be in England upwards of 850,000l. per annum, being nearly in the proportion of one-third of the rate at the first period. In Wales, during the same period of time, the rates were more than doubled. Nor was this a temporary start, but a part only of a gradual progression. Mr Wendeborn, in his View of England, observes, that "in the year 1680 the poor's-rates produced no more than 665,390l. in 1764 they stood at 1,200,000l. and in 1773 they were estimated at 3,000,000l." It is a known fact (says Mr Beaufoy, in the debate on Mr Gilbert's poor bill, April 17th 1788), that within the last nine years, the poor's-rates have increased one-third, and should they continue increasing in the same proportion for 50 or 53 years, they would amount to the enormous sum of 11,230,000l. a burden which the country could not possibly bear. It was therefore, he added, highly necessary that something should be attempted to prevent this alarming addition, if not to annihilate the present glaring misconduct in the management of the poor.

Such has been the fate of England with regard to poor laws.

In Scotland, the reformation having been carried forward with a still more violent precipitancy than in England, and the funds of the regular clergy being more entirely alienated, the case of the poor there became still more seemingly desperate, and the clamours were also there considerable at that time. Then also it was that the Scottish court, imitating as usual at that time the practice of England, made several feeble attempts to introduce a system of compulsory poor's-rates into that country, but never digested the system so thoroughly as to form a law that could in any case be carried into effect. Many crude laws on this head were indeed enacted; but all of them so evidently inadequate for the purpose, that they never were, even in one instance that we have heard of, attempted at the time to be carried into effect. Indeed it seems to have been impossible to carry them into effect; for they are all so absurd and contradictory to each other, that hardly a single clause of any one of them can be obeyed without transgressing others of equal importance.

The last statute which in Scotland was enacted on this subject bears date September 1st 1691, William and Mary, parl. 1. sess. 7. chap. 21. and it "ratifies and approves *all* former acts of parliament and proclamations of council for repressing of beggars, and maintaining and employing the poor." If this law therefore were now in force, and it never was repealed, no person could with impunity countervail any one of those statutes which it ratifies; but to be convinced how impossible it is to observe them all, the attentive reader needs only to consider those laws and proclamations with respect to the following particulars, viz.

1. *The persons appointed to make up the poor's roll.* By the act 1579 this duty is entrusted to the provost and bailies within burgh, and the judge constitute be the king's commission in paroches to landwart. By act 1663, it is the heritors of each parish. By act 1672, it

it is the ministers and elders of each parish who are to make up this list. By the proclamation of 1692, it is the heritors, ministers, and elders of every parish. By that of 1693, it is the magistrates of royal burghs, and the heritors of vacant [country] parishes; in both cases without either minister or elders. Among this chaos of contradictions how is it possible to act without transgressing some law.

2. Not less contradictory are the enactments in regard *to the persons who are to pay*, and the mode of apportioning the sums among them. By act 1579, the haill inhabitants of the parochin shall be taxed and stented according to the estimation of their substance, without exception of persons. By that of 1663, the one-half is to be paid by the heritors, and the other half by the tenants and possessors, according to their means and substance. By the proclamation of 1692, the one-half is to be paid by the heritors, the other by the householders of the parish. By that of 1693, in burghs royal, the magistrates are to stent themselves, conform to such order and custom used and wont in laying on stents, annuities, or other public burdens, in the respective burgh, as may be most effectual to reach all the inhabitants; and the heritors of several vacant [landwart] parishes to stent themselves for the maintenance of the respective poor.

3. A still greater diversity takes place in regard to the *application of the sums so stented*. By the act 1579, it would seem that the whole of the money assessed was to be applied to the use of the helpless poor alone, and no part of it for the relief of those who were capable of working. By the act 1663, on the contrary, the whole of this assessment is to be applied for the support of those *only who are able to work*. This is still more especially provided for by the act 1672; where the poor who are unable to work are to be supported by the weekly collections at the kirk doors; and the stented assessments to be applied to the support of those in the correction houses.

It would be tiresome to enumerate all the contradictions that these laws authorise. In regard *to the persons who are required to carry these acts into execution*. It is at different times the chancellor; magistrates; commissioners of excise; sheriffs; justices of the peace; ministers and elders; the presbyteries; heritors, ministers, and elders; heritors alone; commissioners nominated by presbyteries and appointed by the king; the lords of the privy council: in short no two laws can be found that do not vary from each other in this respect one way or other.

The same variations take place with regard to the building of correction-houses, confinement and punishment of vagrants, application of their work, awarding their services and those of children. In short, there is not one particular in which these laws do not vary from and contradict each other; so that, let any person try to act in virtue of any one of them, it is impossible for him to avoid going in direct opposition to the enactments of some other law which is of equal force with that he has chosen for his guide. In these circumstances, it is so far from being surprising that these acts have been suffered to remain in perpetual desuetude, that it would have been truly wonderful if this had not been the case. They have, however, been permitted to remain on the statute-book as a disgrace to the times when they were formed, and as a stumbling-block to those that were to follow. That not one of them is now in force, was lately proved by a learned and public-spirited gentleman, to whom his country is on that and many other accounts deeply indebted. Refusing to pay the poor's tax, with which he was assessed by the overseers of the parish in which he happened to reside, he stood an action in the court of session, and prevailed, upon the broad ground, *that there is no law IN FORCE in Scotland, by which an INVOLUNTARY poor's rate can be established in any parish.*

But how, it will be asked by our English readers, are the poor in Scotland really maintained? We answer, by the private alms of individuals, and by certain funds under the management of the *kirk-sessions* (see PRESBYTERIANS). It is the universal practice, each Lord's day, in every parish, for such of the audience as are in easy circumstances, to give to the poor such an offering of alms as they shall deem proper. This offering is generally dropped into a bason placed at the church-door, and under the immediate care of an elder. When the service is begun, the elder removes with the bason, which he keeps under his charge till the congregation be dismissed. The session then meets, and the money is told over, its amount marked down in the session account book, and deposited in a box kept for that purpose. This box has usually a small slit in the top, through which the pieces of money can be dropped without opening it; and it is closed with two locks, the key of one of which is usually kept by the minister, and the other by the kirk-treasurer, so that it can never be opened but in the presence of these two at least.

A kirk-session, when regularly constituted, must always consist of the minister, elders, session-clerk, and kirk-treasurer. None of these ever receive any salary except the session-clerk, who is usually the schoolmaster of the parish, and has a small salary allowed for minuting the transactions. The kirk-treasurer is for the most part one of the elders; and he is an important member of this court. Without his intervention no distribution of the poor's funds is deemed legal; nor can any payments be made, receipts granted, or money transferred, but by him; the minister and session being personally liable to make good all money that may otherwise be given away, should it ever afterwards be challenged by any heritor in the parish.

The precautions taken for the distribution of the poor's funds are likewise simple and excellent, and are as follow:

No money can be legally issued from the poor's funds even by the treasurer and session, unless legal proof can be brought that public intimation has been given from the pulpit immediately after divine service, and before the congregation has dispersed, that a distribution of poor's money is to be made by the session, at such a time and place, specifying the same, and inviting all who have interest in the case to attend if they shall incline. This intimation must be made a full fortnight before the time of distribution; and as every heritor (owner of landed property) in the parish has a right to vote in the distribution of the poor's funds, they may all, if they so incline, then attend and exercise that right; but if none of them should attend, which is often the case, the session has then a right to proceed; and whatever they shall thus do, is deemed strictly legal,

gal, and is liable to no challenge. But should they proceed without having given this previous intimation, they may, if the heritors should afterwards challenge it, be made to repay out of their own pockets every shilling they shall have so issued. It sometimes happens, that young ministers, though heedlessness in this respect, expose themselves and families to considerable trouble and loss, which by attention might be easily avoided. In the same way, should a minister and session, without the intervention of a treasurer regularly constituted, lend upon bond or otherwise any of the poor's funds, and should the person so borrowing afterwards fail, these lenders are personally liable to make good the whole, and any heritor in the parish who chooses it can compel him to do so.

The members of the session are also liable to pay all losses, and to account for all sums that it can be instructed they received, if they neglected to keep regular books, in which every transaction shall be entered, or if these books have not been revised and approved of by the presbytery (A); but if they shall have been so revised, they cannot be challenged for omission of forms, and can only be made to account for errors, or frauds, or evident dilapidations.

Under this wise and economical system of management, it has been found by the experience of more than 200 years, that in the low parts of the country, where the parishes are in general of such moderate extent as to admit of the people of every part of the parish generally to attend divine service every Lord's day, the ordinary funds have been amply sufficient to supply all the real demands of the poor, and in most parishes a fund has been accumulated from the savings of ordinary years to help the deficiencies that may arise in years of uncommon scarcity.

Besides the weekly collections, the extra offerings at the administration of the Lord's supper, the pious donations of charitable individuals, which are all voluntary, together with some small fees paid for the use of a *mort-cloth* (a black velvet pall) at funerals, which is generally purchased with the poor's money, go to make up this parochial fund. Nor must any one believe that the money which comes through the hands of the administrators of the poor's funds is all that is bestowed upon the poor in Scotland; far from it: there are a thousand other channels through which the indigent derive consolation and support, all of them tending to produce the happiest effects upon society. A son feels himself ashamed to think that his parents should require the assistance of another to support them; he therefore strains every nerve, when in the vigour of life, to spare a little of his earning to render their old age more easy than it might have been; and sweet to a parent is the bread that is given by the pious attention of a child. If there are several children, they become emulous who shall discover most kindness. It is a pious contention which serves to unite them the closer to each other, by commanding their mutual esteem.

Directly contrary to this is the effect of the poor laws in England, where, in London at least, it is not uncommon to see men in good business neglecting their aged and diseased parents for no better reason than that the parish is bound to find them bread. These laws have other pernicious consequences; for they are obviously subversive of industry as well as morality among the lower orders of the people. "This is a heavy charge, but not less true than heavy. Fear of want is the only effectual motive to industry with the labouring poor: remove that fear, and they cease to be industrious. The ruling passion of those who live by bodily labour, is to leave a pittance for their children, and for supporting themselves in old age. Stimulated by desire of accomplishing those ends, they are frugal and industrious; and the prospect of success is a continual feast to them. Now, what worse can malice invent against such a man, under colour of friendship, than to secure bread to him and his children whenever he takes a dislike to work; which effectually deadens his sole ambition, and with it his honest industry? Relying on the certainty of a provision against want, he relaxes gradually till he sinks into idleness; idleness leads to profligacy; profligacy begets disease; and the wretch becomes an object of public charity before he has run half his course. Wisely therefore is it ordered by Providence, that charity should in every instance be voluntary, to prevent the idle and profligate from depending on it for support. During the reign of Elizabeth when the monasteries were recently suppressed, and all their revenues squandered, some compulsion might be necessary to prevent the poor from starving. A temporary provision for this purpose, so contrived as not to supersede voluntary charity, but rather to promote it, would have been a measure extremely proper. Unlucky it is for England that such a measure was overlooked; but the queen and her parliaments had not the talent of foreseeing consequences without the aid of experience. A perpetual tax for the poor was imposed, the most pernicious tax, says Lord Kames (B), that ever was imposed in any country."

POPA-MADRE, is a town of South America, in Terra Firma. In this place there is a convent and chapel dedicated to the Virgin Mary, to whose image the Spaniards in those parts go in pilgrimage, particularly those who have been at sea. It is seated on a high mountain, 50 miles east of Carthagena. W. Long. 74. 32. N. Lat. 10. 15.

POPÆ. See VICTIMARIUS.

POPAYAN, a province of South America, in the kingdom of New Granada, between the audience of Panama, that of Quito, and the South sea; 400 miles in length, and 300 in breadth. A chain of barren mountains runs through the country from north to south; and

(A) The presbytery is by law appointed auditor of the poor's accounts of the several parishes within its bounds, and if they find any difficult case occur in the discharge of this duty, they may lay it before the synod for advice.

(B) See *Sketches of Man*, book ii. sketch 10. where many other arguments equally forcible are urged against all involuntary *poor-rates*, and where many ingenious expedients are proposed for gradually abolishing them where they are established.

and near the sea the soil is so soaked with almost continual rains, that few care to reside there, except for the sake of the gold that is met with in great plenty in the sands of the rivulets. This bewitching metal brings many in search of it, though it is a great doubt whether they ever return back alive or not. For this reason the savage Americans are still masters of a great part of it, and continually annoy the Spaniards.

POPAYAN, the capital town of a province of that name in South America, with a bishop's see, a Spanish governor, and where the courts of justice are held. The inhabitants are almost all Creoles. It is 220 miles north-east of Quito. W. Long. 75. 55. N. Lat. 2. 35.

POPE, a name which comes from the Greek word Παπα, and signifies *Father*. In the east this appellation is given to all Christian priests; and in the west, bishops were called by it in ancient times: but now for many centuries it has been appropriated to the bishop of Rome, whom the Roman Catholics look upon as the common father of all Christians.

Much has been said, much written, and many warm disputes have been carried on concerning the pope, and the power belonging to him, within these two or three last centuries. We shall here, without entering into controversy, lay down distinctly, from the best authority, what the Roman Catholics really believe concerning the *pope*, after having described the manner of his election; and we shall give some other particulars relating to this subject that seem to deserve notice, and are in this country not generally known.

All in communion with the see of Rome unanimously hold, that our Saviour Jesus Christ constituted St Peter the apostle chief pastor under himself, to watch over his whole flock here on earth, and to preserve the unity of it; giving him the power requisite for these ends. They also believe, that our Saviour ordained, that St Peter should have successors with the like charge and power, to the end of time. Now, as St Peter resided at Rome for many years, and suffered martyrdom there, they consider the bishops of Rome as his successors in the dignity and office of the universal pastor of the whole Catholic church. There have been some varieties in the manner of choosing the bishop of Rome in different ages, as alterations may be made in discipline; but still the clergy of Rome have justly had the chief part in that election: and that clergy is now represented by, or in some manner consists of, the *cardinals*, who have for several centuries been the sole electors of the pope.

These *cardinals* or *principal persons* of the church of Rome are 70 in number, when the *sacred college*, as it is called, is complete. Of these six are cardinal bishops, the bishops of Ostia, of Porto, Albano, Sabino, Tusculum or Frascati, and Præneste or Palestrina; which are the six suburbicarian churches; 50 are cardinal priests, who have all titles from parish churches in Rome; and fourteen are cardinal deacons, who have their titles from churches in Rome of less note, called *Diaconias* or *Deaconries*. These cardinals are created by the pope when there happen to be vacancies; and sometimes he names one or two only at a time; but commonly he defers the promotion until there be ten or twelve vacancies or more; and then at every second such promotion the emperor, the kings of Spain and France, and of Britain, when Catholic, are allowed to present one each, to be made cardinal, whom the pope always admits if there be not some very great and evident objection. These cardinals are commonly promoted from among such clergymen as have borne offices in the Roman court; some are assumed from religious orders; eminent ecclesiastics of other countries are likewise often honoured with this dignity, as the archbishops of Toledo and Vienna are at present cardinal priests of Rome. Sons of sovereign princes have frequently been members of the sacred college; and there ends the direct line of the royal family of Stuart. Their distinctive dress is scarlet, to signify that they ought to be ready to shed their blood for the faith and church, when the defence and honour of either require it. They wear a scarlet cap and hat: the cap is given to them by the pope if they are at Rome, and is sent to them if they are absent; but the hat is never given but by the pope's own hand. These cardinals form the pope's standing council or *consistory* for the management of the public affairs of church and state. They are divided into different *congregations* for the more easy dispatch of business; and some of them have the principal offices in the pontifical court, as that of cardinal-vicar—penitentiary—chancellor—camerlingo or chamberlain—prefect of the signature of justice—prefect of memorials—and secretary of state. They have the title given them of *eminence* and *most eminent*. But here we consider them principally as the persons entrusted with the choice of the pope. See CARDINAL.

On the demise of a pope his pontifical seal is immediately broken by the chamberlain, and all public business is interrupted that can be delayed: messengers are dispatched to all the Catholic sovereigns to acquaint them of the event, that they make take what measures they think proper; and that the cardinals in their dominions, if any there be, may hasten to the future election if they choose to attend; whilst the whole attention of the sacred college is turned to the preservation of tranquillity in the city and state, and to the necessary preparations for the future election. The cardinal chamberlain has, during the vacancy of the holy see, great authority; he coins money with his own arms on it, lodges in the pope's apartments, and is attended by body-guards. He, and the first cardinal bishop, the first cardinal priest, and the first cardinal deacon, have during that time, the government almost entirely in their hands. The body of the deceased pope is carried to St Peter's, where funeral service is performed for him with great pomp for nine days, and the cardinals attend there every morning. In the mean time, all necessary preparations for the election are made; and the place where they assemble for that purpose, which is called the *conclave*, is fitted up in that part of the Vatican palace which is nearest St Peter's church, as this has long been thought the most convenient situation. Here is formed by partitions of wood a number of cells or chambers equal to the number of cardinals, with a small distance between every two, and a broad gallery before them. A number is put on every cell, and small papers with corresponding numbers are put into a box: every cardinal, or some one for him, draws out one of these papers, which determines in what cell he is to lodge. The cells are lined with cloth; and there is a part of each one separated for the conclavists or attendants, of whom two are allowed to each cardinal, and three to cardinal princes. They are persons of some

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some rank, and generally of great confidence; but they must carry in their master's meals, serve him at table, and perform all the offices of a menial servant. Two physicians, two surgeons, an apothecary, and some other necessary officers, are chosen for the conclave by the cardinals.

On the 10th day after the pope's death, the cardinals, who are then at Rome, and in a competent state of health, meet in the chapel of St Peter's, which is called the *Gregorian Chapel*, where a sermon on the choice of a pope is preached to them, and mass is said for invoking the grace of the holy Ghost. Then the cardinals proceed to the conclave in procession two by two, and take up their abode. When all is properly settled, the conclave is shut up, having boxed *wheels* or places of communication in convenient quarters: there are also strong guards placed all around. When any foreign cardinal arrives after the inclosure, the conclave is opened for his admission. In the beginning every cardinal signs a paper, containing an obligation, that if he shall be raised to the papal chair he will not alienate any part of the pontifical dominion; that he will not be prodigal to his relations; and such other stipulations as may have been settled in former times or framed for that occasion.

We come now to the election itself; and that this may be effectual, two-thirds of the cardinals present must vote for the same person. As this is often not easily obtained, they sometimes remain whole months in the conclave. They meet in the chapel twice every day for giving their votes; and the election may be effectuated by *scrutiny*, *accession* or *acclamation*. Scrutiny is the ordinary method; and consists in this: every cardinal writes his own name on the inner part of a piece of paper, and this is folded up and sealed; on a second fold of the same paper a conclavist writes the name of the person for whom his master votes. This, according to agreements observed for some centuries, must be one of the sacred college. On the outer side of the paper is written a sentence at random, which the voter must well remember. Every cardinal, on entering into the chapel, goes to the altar and puts his paper into a large chalice.

When all are convened, two cardinals number the votes; and if they are more or less than the number of cardinals present, the voting must be repeated. When that is not the case, the cardinal appointed for the purpose reads the outer sentence, and the name of the cardinal under it, so that each voter hearing his own sentence and the name joined with it, knows that there is no mistake. The names of all the cardinals that are voted for are taken down in writing, with the number of votes for each; and when it appears that any one has two-thirds of the number present in his favour the election is over: but when this does not happen, the voting papers are all immediately burnt without opening up the inner part. When several trials of coming to a conclusion by this method of *scrutiny* have been made in vain, recourse is sometimes had to what is called *accession*. By it, when a cardinal perceives that one or very few votes are wanting to any one for whom he had not voted at that time, he may say that he *accedes* to the one who has near the number of votes requisite; and if his one vote suffices to make up the two-thirds, or if he is followed by a sufficient number of *acceders* or new voters for the said cardinal, the election is accomplished. Lastly, a pope is sometimes elected by *acclamation*; and that is, when a cardinal, being pretty sure that he will be joined by a number sufficient, cries out in the open chapel, that such a one shall be pope. If he is supported properly, the election becomes unanimous; those who would perhaps oppose it foreseeing that their opposition would be fruitless, and rather hurtful to themselves. It is to be observed, that the emperor of Germany and the kings of France and Spain claimed a right of excluding one cardinal from being pope at every election. Hence, when the ambassador at Rome of any of these sovereigns perceived that any cardinal, disagreeable to his master, according to the instructions he had received, was likely to be made pope, he demanded an audience of the conclave, was admitted, and there declared his master's will, which was always attended to for the common good. But each of those sovereigns was allowed thus to exclude only one at one time; and they unwillingly and seldom put this right in execution.

When a pope is chosen in any of the three abovementioned ways, the election is immediately announced from the balcony in the front of St Peter's, homage is paid to the new pontiff, and couriers are sent off with the news to all parts of Christendom. The pope appoints a day for his coronation at St Peter's, and for his taking possession of the patriarchal church of St John Lateran; all which is performed with great solemnity. He is addressed by the expression of *Holiness*, and *most holy Father*.

Let us now proceed to see what authority Roman Catholics attribute to the pope thus chosen. They believe then, that the bishop of Rome is, under Christ, supreme pastor of the whole church; and as such is not only the first bishop in order and dignity, but has also a power and jurisdiction over all Christians, in order to preserve unity and purity of faith and moral doctrine, and to maintain order and regularity in all churches. Wherefore they hold, that when the pope understands that any error has been broached against faith or manners, or that any considerable difference on such subjects has arisen in any part of Christendom, it belongs to him, after due deliberation and consultation, to issue out his pastoral decree, condemning the error, clearing up the doubt, and declaring what has been delivered down, and what is to be believed. Some Catholic divines are of opinion that the pope cannot err, when he thus addresses himself *to all the faithful* on matters of doctrine. They well know, that as a private doctor he may fall into mistakes as well as any other man; but they think, that when he teaches the whole church Providence must preserve him from error; and they apprehend, that this may be deduced from the promises of Christ to St Peter, and from the writings of the ancient fathers. However, this infallibility of the pope, even when he pronounces in the most solemn manner, is only an opinion, and not an article of Roman Catholic faith. Wherefore, when he sends for the doctrinal decrees, the other bishops, who are also guardians of the faith in an inferior degree, may, with due respect, examine these decrees; and if they see them agree with what has been always taught, they either formally signify their acceptance, or they tacitly acquiesce, which, considering their duty, is equivalent to a formal approbation. When the acceptation of the generality of the bishops has been obtained,

obtained, either immediately or after some mutual correspondence and explanation, the decrees of the pope thus accepted come to be the sentence of the whole church, and are believed to be beyond the possibility of error!

Sometimes it may happen that the disputes and differences may be so great and intricate, that to the end it may be seen more clearly what has really been delivered down, and to give all possible satisfaction, it may appear proper to convene all the bishops who can conveniently attend to one place, to learn from them more distinctly what has been taught and held in their respective churches. Roman Catholics believe that it belongs to the pope to call such general councils, and to preside in them in person or by his legates. They likewise hold, that when the pope has approved the decrees of such councils concerning faith or manners, such decrees are then final, and must be received as such by all Catholics. In all this they believe, that the particular assistance of the Holy Ghost is with the pastors of the church, that so *the gates of hell may never prevail against her*.

The see of Rome, according to Roman Catholics, is the centre of Catholic unity. All their bishops communicate with the pope, and by his means with one another, and so form one body. However distant their particular churches may be, they all meet at Rome either in person or by their delegates, or at least by their letters. And, according to the discipline of the latter ages, though they are presented to the pope for their office from their respective countries, yet from him they must receive their bulls of consecration before they can take possession of their sees.

In matters of church discipline, the pope, as chief pastor, not only ought to take care that the canons actually in force be observed in all churches, but he may also make new canons and regulations when he sees it necessary or expedient for the spiritual benefit of the faithful, according to times and circumstances. But in doing this he must not infringe the established rights or customs with injury to any person; which if, through mistake or wrong information, he should ever do, the persons who think themselves aggrieved may remonstrate with respect and sue for redress. He may establish new episcopal sees, where there have been none before; and he may alter the limits of former dioceses; but in such alterations he always of course consults the temporal sovereign, if in communion with him. He sends pastors to preach the gospel to all countries where the Catholic religion is not by law established; and to him appeals may be made from all parts of Christendom in ecclesiastical causes of great importance.

The pope may dispense with the observation of ecclesiastical canons when there are just reasons for it, as may frequently happen; he may also dispense with vows when they are made with that express or tacit condition (A) that he really may dispense with them; he may also on some occasions declare that obligations have really ceased when that is truly the case, from a great alteration of circumstances: But he can never grant any dispensation, to the injury of any third person, and can never allow any one to do what is unjust, or to say what he knows to be false, whatever advantage might be expected from it.

The pope is also a temporal prince, and possesses considerable dominions in the middle part of Italy, besides Avignon, which the French have lately taken from him, and the duchy of Benevento inclosed within the kingdom of Naples. It is also supposed that the kingdoms of Naples and Sicily, and the duchies of Parma and Placentia, are still held of him in fief as they were before. His predecessors have acquired these possessions at different times and on different occasions, by various donations, concessions, treaties, and agreements, in like manner as has happened with regard to the establishment of other sovereignties; and his title to them is like to that of other potentates to their respective possessions. The revenue arising from this estate, and what he receives for various reasons from Catholic countries, which is now much reduced, is employed for the support of government, in salaries to the officers of his court, for the education of clergymen, and for the maintaining of missionaries in infidel countries. Great sums are particularly expended for the propagation of the Christian faith in different parts of Asia, especially in Armenia, Syria, and China. Nor is it much to be wondered at, if the families, of which the sovereign pontiffs happen to have been born, acquire greater riches and splendour from that connection. The princely families of Barberini, Borghese, Chigi, Corsini, Albani, are examples of this kind: but regulations have been made in later times to prevent excessive nepotism. Beyond the limits of his own temporal dominions the pope has no temporal power or jurisdiction, excepting what any nation may be pleased to allow him: when any thing of that kind has been granted or brought in by custom, it is evident that it ought not to be taken away rashly nor without just reason. But, as chief pastor of the church, he has no right to any temporal jurisdiction over his flock. As such, his power is entirely spiritual, and has no means of coercion originally or necessarily connected with it, but only ecclesiastical censures. It must be owned, that the popes, in some ages, sometimes imagining that they could do much good, sometimes by the consent, or even at the desire, of the sovereigns, and sometimes no doubt out of ambitious views, have interfered a great deal in the temporal affairs of the different kingdoms of Europe, which has frequently given scandal and done harm to religion. But it is known to those most versant in history, that their faults of this kind have been exaggerated, and their conduct often misunderstood or misrepresented. However, in this a Roman Catholic is not obliged to approve what they have done; nay, without acting contrary to his religion, he may judge of them freely, and blame them if he think they deserve it; only he will do it with respect and regret. Thus a Roman Catholic may either apologise, if he think he can do it, for the conduct of Innocent III. in deposing King John of England; or, without being guilty of any offence against his religion, he may blame the pontiff for what he did on that occasion; because the power of the pope to depose princes, or to absolve subjects from their allegiance, was never proposed as an article of faith, or made

(A) Any other man may unquestionably do the same when they are made with that express condition.

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made a term of communion with the church of Rome. Some Catholic divines, indeed, especially among the Jesuits, are universally known to have held this extravagant and dangerous opinion; but by far the greater part of them condemn and abhor it as absurd and impious: and surely it is but fair and just to allow them to know best what they themselves believe. And here, to conclude, we shall add, that it is very desirable that Christians of all denominations endeavour to understand one another better than they have often done; and instead of supposing imaginary differences, strive to remove real ones, for the general good of mankind, for the glory of God, and honour of religion; and that all vie with one another to excel in just and charitable sentiments, language, and behaviour.

The reader, who wishes to know what can be urged for and against the supremacy of the pope, and who is fitted by his knowledge of ecclesiastical history to understand the nature of the question at issue, may consult, on the one hand, the works of Bellarmine, together with a small tract lately published in English, under the title of *The Divine Economy of Christ in his Kingdom or Church;* and on the other, Barrow's treatise *on the Pope's Supremacy*, together with Chillingworth's *Religion of Protestants*, &c.

Pope, *Dominions of*, or *Ecclesiastical States*, a country of Italy, bounded on the north by the gulf of Venice and the Venetian dominions, on the south by the Mediterranean, on the east by the kingdom of Naples and the Adriatic, and on the west by Tuscany and Modena. It is 200 miles long on the coast of the Adriatic from Naples to the Venetian territory. Its breadth from sea to sea is about 130 miles, and the area of the whole 15,500 square English miles. The population in 1815 was estimated at 2,424,000.

The soil, in general, of the pope's dominions is very fertile, but ill cultivated; and there are many fens and marshy grounds which are very prejudicial to the air. That the lands are badly cultivated and inhabited, the air bad, and the inhabitants poor, idle, lazy, and grossly superstitious, is owing to a variety of causes. With respect to the accommodations of life, this country is but in a very indifferent condition; for, notwithstanding the fertility of its soil, its advantageous situation for traffic, the large sums spent in it by travellers, or remitted to it from foreign countries, and its having, for its ruler, the successor of St Peter, the prince of the apostles, and the vicar of Jesus Christ; yet it is poor and thin of inhabitants, ill cultivated, and without trade and manufactures. This is partly owing to the great number of holidays, of sturdy beggars called *pilgrims*, and of hospitals and convents, with the amazing but perhaps useless wealth of churches and convents, and the inquisition: but the chief cause is the severity of the government, and the grievous exactions and hardships to which the subjects are exposed. The legates, though mostly clergymen, whose thoughts should be chiefly employed about laying up treasures in heaven, and who ought to set an example to the laity of disinterestedness and a contempt of this world, too often, it is said, scruple no kind of rapaciousness: even the holy father himself, and the cardinals, frequently make the enriching of their nephews and other relations, and the aggrandizing their families, too much the business of their lives. The extensive claims and great pretensions of the pope are well known, and, by a large part of Christendom, are now treated with contempt and mockery. The Reformation gave a great blow to his spiritual power; and the French revolution has lessened it still more. His temporal dominions, however, still continue much the same; though how long this may be the case, considering how much he hath lost, and is daily losing, of his ghostly empire, and the veneration in which he was formerly held, it is difficult to say. See Pope.—The Campania of Rome is under the pope's immediate government; but the other provinces are governed by legates and vice-legates, and there is a commander in chief of the pope's forces in every province. The pope is chosen by the cardinals in the conclave: See this particularly described above. The pope holds a consistory of cardinals on ecclesiastical affairs; but the cardinals do not meddle with his civil government. The pope's chief minister is the cardinal-patron, usually his nephew, who amasses an immense estate, if the reign be of any long duration. The cardinal that is chosen pope must generally be an Italian, and at least 55 years of age. The spiritual power of the pope, though far short of what it was before the Reformation, is still considerable. It was formerly computed that the monks and regular clergy, who were absolutely at his devotion, amounted to 2,000,000 of people, dispersed through all the Roman Catholic countries, to promote the interest of the church. The revenues of these monks were supposed not to fall short of 20,000,000l. sterling, besides the casual profits arising from offerings, and the people's bounty to the church, who are taught that their salvation depends on this kind of benevolence. The number of monks is now much reduced.

The pope's revenues, including contributions from Catholic countries, were estimated at 800,000l. in 1815. The vast sums which formerly flowed into the papal treasury from all the Roman Catholic countries, for dispensations, indulgences, canonizations, annates, the pallia, and investitures of archbishops and bishops, are now much diminished.

The pope has a considerablo body of regular forces, well clothed and paid; but his fleet consists only of a few galleys. His life guards are 40 Switzers, 75 cuirassiers, and as many light horse. Since the beginning of the French revolutionary war he had at one time a guard of English horse.

In 1797 the northern part of the states of the church was annexed to the Cisalpine republic, and in 1808 the remainder of the states east of the Apennines. In 1810 the shadow of independence which the western part of the pope's territories had enjoyed disappeared, and it was formally annexed to the French empire, forming two departments, Rome and Thrasimene. The successes of the allies in 1814 and 1815 restored the pope to the full possession of his dominions.

Pope, *Alexander*, a celebrated English poet, descended from a respectable family, was born the 8th of June 1688, at London, where his father was then a considerable merchant. He was taught to read very early by an aunt; and learned to write without any assistance, by copying printed books. The family being of the Romish religion, he was put, at eight years of age, under one Taverner, a priest, who taught him the rudiments of the Latin and Greek tongues together; and soon after was sent to a Popish seminary at Winchester, from whence he was removed to a school at Hyde-

Pope. Hyde-Park Corner. He discovered early an inclination to versifying; and the translation of Ogilby and Sandys from Virgil and Ovid first falling in his way, they were his favourite authors. At twelve he retired with his parents to Binfield, in Windsor Forest; and there became acquainted with the writings of Spenser, Waller, and Dryden. Dryden struck him most, probably because the cast of that poet was most congenial with his own; and therefore he not only studied his works intensely, but ever after mentioned him with a kind of rapturous veneration. He once obtained a sight of him at a coffee-house, but never was known to him: a misfortune which he laments in these short but expressive words, *Virgilium tantum vidi.* Though Pope had been under more tutors than one, yet it seems they were so insufficient for the purpose of teaching, that he had learned very little from them: so that, being obliged afterwards to begin all over again, he may justly be considered as one of the αὐτοδίδακτοι or *self-taught*. At fifteen he had acquired a readiness in the two learned languages; to which he soon after added the French and Italian. He had already scribbled a great deal of poetry in various ways; and this year set about an epic poem called *Alcander*. He long after communicated it to Atterbury, with a declared intention to burn it; and that friend concurred with him: "Though (adds he) I would have interceded for the first page, and put it, with your leave, among my curiosities." What the poet himself observes upon these early pieces is agreeable enough; and shows, that though at first a little intoxicated with the waters of Helicon, he afterwards arrived to great sobriety of thinking. "I confess (says he) there was a time when I was in love with myself; and my first productions were the children of Self-love upon Innocence. I had made an epic poem, and panegyrics on all the princes; and I thought myself the greatest genius that ever was. I cannot but regret these delightful visions of my childhood, which, like the fine colours we see when our eyes are shut, are vanished for ever." His pastorals, begun in 1704, first introduced him to the wits of the time; among whom were Wycherly and Walsh. This last gentleman proved a sincere friend to him; and soon discerning that his talent lay, not so much in striking out new thoughts of his own, as in improving those of other men, and in an easy versification, told him, among other things, that there was one way left open for him to excel his predecessors in, which was correctness: observing, that though we had several great poets, yet none of them were correct. Pope took the hint, and turned it to good account; for no doubt the distinguishing harmony of his numbers was in a great measure owing to it. The same year, 1704, he wrote the first part of his Windsor Forest, though the whole was not published till 1710. In 1708, he wrote the Essay on Criticism; which production was justly esteemed a masterpiece in its kind, and showed not only the peculiar turn of his talents, but that those talents, young as he was, were ripened into perfection. He was not yet twenty years old; and yet the maturity of judgment, the knowledge of the world, and the penetration into human nature, displayed in that piece, were such as would have done honour to the greatest abilities and experience. But whatever may be the merit of the Essay on Criticism, it was still surpassed, in a poetical view, by the Rape of the Lock, first completely published in 1712. The former excelled in the didactic way, for which we was peculiarly formed, a clear head, strong sense, and a sound judgment, being his characteristical qualities; but it is the creative power of the imagination that constitutes what is properly called a *poet;* and therefore it is in the Rape of the Lock that Pope principally appears one, there being more *vis imaginandi* displayed in this poem than perhaps in all his other works put together. In 1713, he gave out proposals for publishing a translation of Homer's Iliad, by subscription; in which all parties concurred so heartily, that he acquired a considerable fortune by it. The subscription amounted to 6000l. besides 1200l. which Lintot the bookseller gave him for the copy. Pope's finances being now in good condition, he purchased a house at Twickenham, whither he removed with his father and mother in 1715: where the former died about two years after. As he was a Papist, he could not purchase, nor put his money to interest on real security; and as he adhered to the cause of King James, he made it a point of conscience not to lend it to the new government; so that, though he was worth near 20,000l. when he laid aside business, yet, living afterwards upon the quick stock, he left but a slender subsistence to his family. Our poet, however, did not fail to improve it to the utmost: he had already acquired much by his publications, and he was all attention to acquire more. In 1717, he published a collection of all he had printed separately; and proceeded to give a new edition of Shakespeare: which, being published in 1721, discovered that he had consulted his fortune more than his fame in that undertaking. The Iliad being finished, he engaged upon the like footing to undertake the Odyssey. Mr Broome and Mr Fenton did part of it, and received 500l. of Mr Pope for their labours. It was published in the same manner, and on the same conditions to Lintot; excepting that, instead of 1200l. he had but 600l. for the copy. This work being finished in 1725, he was afterwards employed with Swift and Arbuthnot, in printing some volumes of Miscellanies. About this time he narrowly escaped losing his life, as he was returning home in a friend's chariot; which, on passing a bridge, happened to be overturned, and thrown with the horses into the river. The glasses were up, and he was not able to break them: so that he had immediately been drowned, if the postilion had not broke them, and dragged him out to the bank. A fragment of the glass, however, cut him so desperately, that he ever after lost the use of two of his fingers. In 1727 his Dunciad appeared in Ireland; and the year after in England, with notes by Swift, under the name of *Scriblerus*. This edition was presented to the king and queen by Sir Robert Walpole; who, probably about this time, offered to procure Pope a pension, which however he refused, as he had formerly done a proposal of the same kind made him by Lord Halifax. He greatly cultivated the spirit of independency; and "Unplac'd, unpension'd, no man's heir or slave," was frequently his boast. He somewhere observes, that the life of an author is a state of warfare: he has shewn himself a complete general in this way of warring. He bore the insults and injuries of his enemies long; but at length, in the Dunciad, made an absolutely universal slaughter of them: for even Cibber, who was afterwards advanced to be the

Pope. hero of it, could not forbear owning, that nothing was ever more perfect and finished in its kind than this poem. In 1729, by the advice of Lord Bolingbroke, he turned his pen to subjects of morality; and accordingly we find him, with the assistance of that noble friend, who furnished him with the materials, at work this year upon the Essay on Man. The following extract of a letter to Swift discovers the reason of his lordship's advice: Bid him (says Bolingbroke) talk to you of the work he is about, I hope in good earnest; it is a fine one, and will be, in his hands, an original. His sole complaint is, that he finds it too easy in the execution. This flatters his laziness: it flatters my judgement; who, always thought, that, universal as his talents are, this is eminently and peculiarly his, above all the writers I know, living or dead; I do not except Horace." Pope tells the dean in the next letter, that "the work Lord Bolingbroke speaks of with such abundant partiality, is a system of ethics, in the Horatian way." In pursuing the same design, he wrote his Ethic Epistles: the fourth of which, upon Taste, giving great offence, as he was supposed to ridicule the duke of Chandos under the character of Timon, is said to have put him upon writing satires, which he continued till 1739. He ventured to attack persons of the highest rank, and set no bounds to his satirical rage. A genuine collection of his letters were published in 1737. In 1738, a French translation of the Essay on Man, by the Abbé Resnel, was printed at Paris; and Mr Crousaz, the German professor, animadverted upon this system of ethics, which he represented as nothing else but a system of naturalism. Mr Warburton, afterwards bishop of Gloucester, wrote a commentary upon the Essay in which he defends it against Crousaz, whose objections he supposes owing to the faultiness of the Abbé Resnel's translation. The poem was republished in 1740, with the commentary. Our author now added a fourth book to the Duncaid, which was first printed separately in 1742; but the year after, the whole poem came out together, as a specimen of a more correct edition of his works. He had made some progress in that design, but did not live to complete it. He had all his life long been subject to the headach; and that complaint, which he derived from his mother, was now greatly increased by a dropsy in his breast, under which he expired the 30th of May 1744, in the 56th year of his age. In his will, dated December 11. 1743, Miss Blount, a lady to whom he was always devoted, was made his heir during her life: and among other legacies, he bequeathed to Mr Warburton the property of all such of his works, already printed, as he had written, or should write commentaries upon, and which had not otherwise been disposed of or alienated; with this condition, that they were published without future alterations. In discharge of this trust, that gentleman gave a complete edition of all Mr Pope's works, 1751, in nine vols. 8vo. A work, entitled, *An Essay on the Writings and Genius of Pope*, by Mr Warton, two vols. 8vo, will be read with pleasure by those who desire to know more of the person, character, and writings of this excellent poet. Lord Orrery's account of him is very flattering: "If we may judge of him by his works (says this noble author), his chief aim was to be esteemed a man of virtue. His letters are written in that style; his last volumes are all of the moral kind; he has avoided trifles, and consequently has escaped a rock which has proved very injurious to Swift's reputation. He has given his imagination full scope, and yet has preserved a perpetual guard upon his conduct. The constitution of his body and mind might really incline them to the habits of caution and reserve. The treatment which he met with afterwards, from an innumerable tribe of adversaries, confirmed this habit; and made him slower than the dean in pronouncing his judgment upon persons and things. His prose-writings are little less harmonious than his verse; and his voice in common conversation was so naturally musical, that I remember honest Tom Southern used to call him the *little nightingale*. His manners were delicate, easy, and engaging; and he treated his friends with a politeness that charmed, and a generosity that was much to his honour. Every guest was made happy within his doors; pleasure dwelt under his roof, and elegance presided at his table."

Yet, from Dr Johnson's account of his domestic habits, we have reason to doubt the latter part of this character. His parsimony (he informs us) appeared in very petty matters, such as writing his compositions on the backs of letters, or in a niggardly reception of his friends, and a scantiness of entertainment—as the setting a single pint on the table to two friends, when, having himself taken two small glasses, he would retire, saying I leave you to your wine. He sometimes, however, the Doctor acknowledges, made a splendid dinner; but this happened seldom. He was very full of his fortune, and frequently ridiculed poverty; and he seems to have been of an opinion not very uncommon in the world, that to want money is to want every thing. He was almost equally proud of his connection with the great, and often boasted that he obtained their notice by no meanness or servility. This admiration of the great increased in the advance of life; yet we must acknowledge, that he could derive but little honour from the notice of Cobham, Burlington, or Bolingbroke.

By natural deformity, or accidental distortion, his vital functions were so much disordered, that his life was a long disease; and from this cause arose many of his peculiarities and weaknesses. He stood constantly in need of female attendants; and to avoid cold, of which he was very sensible, he wore a fur doublet under his shirt, &c. The indulgence and accommodation which his sickness required, had taught him all the unpleasing and unsocial qualities of a valetudinary man.—When he wanted to sleep, he nodded in company; and once slumbered at his own table when the prince of Wales was talking of poetry. He was extremely troublesome to such of his friends as asked him out, which many of them frequently did, and plagued the servants beyond description. His love of eating is another fault, to which he is said to have fallen a sacrifice. In all his intercourse with mankind, he had great delight in artifice, and endeavoured to attain all his purposes by indirect and unsuspected methods.

In familiar conversation it is said he never excelled; and he was so fretful and so easily displeased, that he would sometimes leave Lord Oxford's silently without any apparent reason, and was to be courted back by more letters and messages than the servants were willing to carry.

Dr

Dr Johnson also gives a view of the intellectual character of Pope, and draws a parallel between Dryden and him. For particulars, however, we must refer our readers to *Johnson's Lives of the Poets.*

POPERY, in ecclesiastical history, comprehends the religious doctrines and practices adopted and maintained by the church of Rome. The following summary, extracted chiefly from the decrees of the council of Trent, continued under Paul III. Julius III. and Pius IV. from the year 1545 to 1563, by successive sessions, and the creed of Pope Pius IV. subjoined to it, and bearing date November 1564, may not be unacceptable to the reader. One of the fundamental tenets, strenuously maintained by Popish writers, is the infallibility of the church of Rome; though they are not agreed whether this privilege belongs to the pope or a general council, or to both united; but they pretend that an infallible living judge is absolutely necessary to determine controversies, and to secure peace in the Christian church. However, Protestants allege, that the claim of infallibility in any church is not justified by the authority of Scripture; much less does it pertain to the church of Rome; and that it is inconsistent with the nature of religion, and the personal obligations of its professors; and that it has proved ineffectual to the end for which it is supposed to be granted, since popes and councils have disagreed in matters of importance, and they have been incapable, with the advantage of this pretended infallibility, of maintaining union and peace.

Another essential article of the popish creed is the supremacy of the pope, or his sovereign power over the universal church. See POPE.

Farther, the doctrine of the seven sacraments is a peculiar and distinguishing doctrine of the church of Rome; these are baptism, confirmation, the eucharist, penance, extreme unction, orders, and matrimony.

The council of Trent (sess. 7. can. 1.) pronounces an anathema on those who say, that the sacraments are more or fewer than seven, or that any one of the above number is not truly and properly a sacrament. And yet it does not appear that they amounted to this number before the 12th century, when Hugo de St Victore and Peter Lombard, about the year 1144, taught that there were seven sacraments. The council of Florence, held in 1438, was the first council that determined this number. These sacraments confer grace, according to the decree of the council of Trent, (sess. 7. can. 8.) *ex opere operato*, by the mere administration of them; three of them, viz. baptism, confirmation, and orders, are said, (can. 9.) to impress an indelible character, so that they cannot be repeated without sacrilege; and the efficacy of every sacrament depends on the intention of the priest by whom it is administered (can. 11.). Pope Pius expressly enjoins, that all these sacraments should be administered according to the received and approved rites of the Catholic church. With regard to the eucharist in particular, we may here observe, that the church of Rome holds the doctrine of transubstantiation; the necessity of paying divine worship to Christ under the form of the consecrated bread, or host; the propitiatory sacrifice of the mass, according to their ideas of which Christ is truly and properly offered as a sacrifice as often as the priest says mass; it practises likewise solitary mass, in which the priest alone, who consecrates, communicates, and allows communion only in one kind, viz. the bread, to the laity. Sess. 14.

The doctrine of merits is another distinguishing tenet of popery; with regard to which the council of Trent has expressly decreed (sess. 6. can. 32.) that the good works of justified persons are truly meritorious; deserving not only an increase of grace, but eternal life, and an increase of glory; and it has anathematized all who deny this doctrine. Of the same kind is the doctrine of satisfaction; which supposes that penitents may truly satisfy, by the afflictions they endure under the dispensations of Providence, or by voluntary penances to which they submit, for the temporary penalties of sin, to which they are subject, even after the remission of their eternal punishment. Sess. 6. can. 30. and sess. 14. can. 8. and 9. In this connection we may mention the popish distinction of venial and mortal sins: the greatest evils arising from the former are the temporary pains of purgatory; but no man, it is said, can obtain the pardon of the latter without confessing to a priest, and performing the penances which he imposes.

The council of Trent (sess. 14. can. 1.) has expressly decreed, that every one is accursed, who shall affirm that penance is not truly and properly a sacrament, instituted by Christ in the universal church, for reconciling those Christians to the divine majesty, who have fallen into sin after baptism: and this sacrament, it is declared, consists of two parts, the matter and the form; the matter is the act of the penitent, including contrition, confession, and satisfaction; the form of it is the act of absolution on the part of the priest. Accordingly it is enjoined, that it is the duty of every man, who hath fallen after baptism, to confess his sins, once a year at least, to a priest: that this confession is to be secret; for public confession is neither commanded nor expedient; and that it must be exact and particular, including every kind and act of sin, with all the circumstances attending it. When the penitent has so done, the priest pronounces an absolution; which is not conditional or declarative only, but absolute and judicial. This secret or auricular confession was first decreed and established in the fourth council of Lateran, under Innocent III. in 1215, (cap. 21.). And the decree of this council was afterwards confirmed and enlarged in the council of Florence, and in that of Trent; which ordains, that confession was instituted by Christ, that by the law of God it is necessary to salvation, and that it has been always practised in the Christian church. As for the penances imposed on the penitent by way of satisfaction, they have been commonly the repetition of certain forms of devotion, as paternosters, or ave-marias, the payment of stipulated sums, pilgrimages, fasts, or various species of corporal discipline. But the most formidable penance, in the estimation of many who have belonged to the Romish communion, has been the temporary pains of purgatory. But under all the penalties which are inflicted or threatened in the Romish church, it has provided relief by its indulgences, and by its prayers or masses for the dead, performed professedly for relieving and rescuing the souls that are detained in purgatory.

Another article that has been long authoritatively enjoined and observed in the church of Rome, is the celibacy of her clergy. This was first enjoined at Rome by Gregory VII. about the year 1074, and established

Popery.

in England by Anselm archbishop of Canterbury about the year 1175; though his predecessor Lanfranc had imposed it upon the prebendaries and clergy that lived in towns. And though the council of Trent was repeatedly petitioned by several princes and states to abolish this restraint, the obligation of celibacy was rather established than relaxed by this council; for they decreed, that marriage contracted after a vow of continence, is neither lawful nor valid; and thus deprived the church of the possibility of ever restoring marriage to the clergy. For if marriage, after a vow, be in itself unlawful, the greatest authority upon earth cannot dispense with it, nor permit marriage to the clergy, who have already vowed continence.

Papist misrepresented and represented.

To the doctrines and practices above recited may be farther added the worship of images, of which Protestants accuse the Papists. But to this accusation the Papist replies, that he keeps images by him to preserve in his mind the memory of the persons represented by them; as people are wont to preserve the memory of their deceased friends by keeping their pictures. He is taught (he says) to use them so as to cast his eyes upon the pictures or images, and thence to raise his heart to the things represented, and there to employ it in meditation, love, and thanksgiving, desire of imitation, &c. as the object requires.

These pictures or images have this advantage, that they inform the mind by one glance of what in reading might require a whole chapter. There being no other difference between them, than that reading represents leisurely and by degrees; and a picture, all at once. Hence he finds a convenience in saying his prayers with some devout pictures before him, he being no sooner distracted, but the sight of these recals his wandering thoughts to the right object; and as certainly brings something good into his mind, as an immodest picture disturbs his heart with filthy thoughts. And because he is sensible that these holy pictures and images represent and bring to his mind such objects as in his heart he loves, honours, and venerates; he cannot but upon that account love, honour, and respect, the images themselves.

Ibid.

The council of Trent likewise decreed, that all bishops and pastors who have the cure of souls, do diligently instruct their flocks, *that it is good and profitable to desire the intercession of saints reigning with Christ in heaven.* And this decree the Papists endeavour to defend by the following observations. They confess that we have but one Mediator of redemption; but affirm that it is acceptable to God that we should have many mediators of intercession. Moses (say they) was such a mediator for the Israelites; Job for his three friends; Stephen for his persecutors. The Romans were thus desired by St Paul to be his mediators; so were the Corinthians, so the Ephesians, *Ep. ad* Rom. Cor. Eph. so almost every sick man desires the congregation to be his mediators, by remembering him in their prayers. And so the Papist desires the blessed in heaven to be his mediators; that is, that they would pray to God for him. But between these living and dead mediators there is no similarity: the living mediator is present, and certainly hears the request of those who desire him to intercede for them; the dead mediator is as certainly absent, and cannot possibly hear the requests of all those who at the same instant may be begging him to intercede for them, unless he be possessed of the divine attribute of omnipresence; and he who gives that attribute to any creature is unquestionably guilty of idolatry. And as this decree is contrary to one of the first principles of natural religion, so does it receive no countenance from Scripture, or any Christian writer of the three first centuries. Other practices peculiar to the Papists are the religious honour and respect that they pay to sacred relicks; by which they understand not only the bodies and parts of the bodies of the saints, but any of those things that appertained to them, and which they touched; and the celebration of divine service in an unknown tongue: to which purpose the council of Trent hath denounced an anathema on any one who shall say that mass ought to be celebrated only in the vulgar tongue; sess. 25. and sess. 22. can. 9. Though the council of Lateran under Innocent III. in 1215 (can. 9.) had expressly decreed, that because in many parts within the same city and diocese there are many people of different manners and rites mixed together, but of one faith, the bishops of such cities or dioceses should provide fit men for celebrating divine offices, according to the diversity of tongues and rites, and for administering the sacraments.

We shall only add, that the church of Rome maintains, that unwritten traditions ought to be added to the holy Scriptures, in order to supply their defect, and to be regarded as of equal authority; that the books of the Apocrypha are canonical scripture; that the vulgate edition of the Bible is to be deemed authentic; and that the Scriptures are to be received and interpreted according to that sense which the holy mother church, to whom it belongs to judge of the true sense, hath held, and doth hold, and according to the unanimous consent of the fathers.

Such are the principal and distinguishing doctrines of Popery, most of which have received the sanction of the council of Trent, and that of the creed of Pope Pius IV. which is received, professed, and sworn to by every one who enters into holy orders in the church of Rome; and at the close of this creed, we are told that the faith contained in it is so absolutely and indispensably necessary, that no man can be saved without it.

Many of the doctrines of Popery were relaxed, and very favourably interpreted by M. de Meaux, bishop of Condom, in his Exposition of the Doctrine of the Catholic Church, first printed in the year 1671: but this edition, which was charged with perverting, in endeavouring to palliate, the doctrine of the church, was censured by the doctors of the Sorbonne, and actually suppressed; nor does it appear that they ever testified their approbation in the usual form of subsequent and altered editions. It has, however, been published in this country, by a clergyman of the Romish church, whose integrity, piety, and benevolence, would do honour to any communion.

Popham.

POPHAM, Sir John, lord chief justice of the common pleas in the reign of Queen Elizabeth, was the eldest son of Edward Popham, Esq. of Huntworth in Somersetshire, and born in the year 1531. He was some time a student of Baliol college in Oxford; "being then (says Ant. Wood) given at leisure hours to many sports and exercises." After quitting the university, he fixed in the Middle Temple; where, during his novitiate, he is said to have indulged in that kind of dissipation to which youth and a vigorous constitution more naturally

naturally incline than to the study of voluminous *reports*: but, satiated at length with what are called the *pleasures of the town*, he applied sedulously to the study of his profession, was called to the bar, and in 1568 became summer or autumn reader. He was soon after made serjeant at law, and solicitor-general in 1579. In 1581 he was appointed attorney-general, and treasurer of the Middle Temple. In 1592 he was made lord chief justice of the king's bench, and the same year received the honour of knighthood. In the year 1601 his lordship was one of the council detained by the unfortunate earl of Essex, when he formed the ridiculous project of defending himself in his house: and, on the earl's trial, he gave evidence against him relative to their detention. He died in the year 1607, aged 76; and was buried in the south aisle of the church at Wellington in Somersetshire, where he generally resided as often as it was in his power to retire. He was thought somewhat severe in the execution of the law against capital offenders: but his severity had the happy effect of reducing the number of highway robbers. He wrote, 1. Reports and cases adjudged in the time of Queen Elizabeth. 2. Resolutions and judgments upon cases and matters agitated in all the courts at Westminster in the latter end of Queen Elizabeth's reign.

POPLAR. See POPULUS, BOTANY *Index*.

POPLITÆUS, in *Anatomy*, a small muscle obliquely pyramidal, situated under the ham. See ANATOMY, *Table of the Muscles*.

POPPY. See PAPAVER, BOTANY *Index*, and OPIUM, MATERIA MEDICA *Index*.

POPULAR, something that relates to the common people.

POPULATION, means the state of a country with respect to the number of people. See *Bills of MORTALITY*, and *POLITICAL Arithmetic*.

The question concerning the number of men existing upon earth has been variously determined by different writers. Riccioli states the population of the globe at 1000 millions, Vossius at 500; the journalists of Trevoux at 720; and the editor (Xavier de Feller) of the small Geographical Dictionary of Vosgien, reprinted at Paris in 1778, at 370 millions. This last estimate is perhaps too low, although the writer professes to have taken considerable pains to ascertain the point with as much accuracy as the nature of the subject will admit. It may, perhaps, not be deemed unworthy the attention of the curious speculatist to observe, that assuming the more probable statement of the learned Jesuits of Trevoux, and that the world has existed about 6006 years in its present state of population, then the whole number of persons who have ever existed upon earth since the days of Adam amounts only to about one hundred and thirty thousand millions; because $720,000,000 \times 182$ (the number of generations in 6006 years) $= 131,040,000,000$. See on this subject the authors above mentioned, as likewise Beausobre's *Etude de la Politique*.

With regard to the population of England, the reader may consult, together with our article *POLITICAL Arithmetic*, An Inquiry into the present State of Population, &c. by W. Wales, F. R.S.; and Mr Howlett's Examination of Dr Price's Essay on the same subject. But for a later account of the population of England, see the different counties under their proper names; for that of Scotland, see the different counties, and for the general population, see SCOTLAND.

POPULUS, the POPLAR, a genus of plants belonging to the diœcia class; and in the natural method ranking under the 50th order, *Amentaceæ*. See BOTANY *Index*.

The poplar, one of the most beautiful of the aquatic trees, has frequently been introduced into the poetical descriptions of the ancients; as by Virgil, *Ecl.* vii. 66. ix. 41. *Georg.* ii. 66. iv. 511. *Æn.* viii. 31. 276.; by Ovid, *Amom. Parid.* 27.; by Horace, *Carm.* ii. 3. and by Catullus, *Nupt. Phil. et Thet.* 290, &c. &c.

POQUELIN, or POCQUELIN, JOHN BAPTIST. See MOLIERE.

PORANA, a genus of plants belonging to the pentandria class. See BOTANY *Index*.

1 Nature of porcelain.

PORCELAIN, in its more general signification, comprehends all kinds of earthen ware, which are white, semitransparent, and have some degree of a vitreous texture. Hence, in this extensive meaning of the term, it includes all kinds of pottery, stoneware, delft ware, &c.: but in a more limited sense, the word *Porcelain* is employed to denote only the finer kinds of earthen ware; and because this kind of ware has been, from time immemorial, manufactured in the greatest degree of perfection in China, it has obtained the name of *Chinese Porcelain*, or *China Ware*.

2 Derivation of the name.

In the Chinese language, porcelain is denoted by the word *tse-ki*, so that the derivation of the term is not to be sought for in that language; and hence it is supposed to be of European extraction, and to be derived from the Portuguese language; for in this language the word *porcellana* signifies a cup or vessel.

3 Porcelain first brought from Japan and China, and afterwards made in Europe.

The first porcelain which was seen in Europe was brought from Japan and China. Its whiteness, transparency, fineness of texture, with its elegance and beautiful colours, soon introduced it as an ornament of the tables of the rich and powerful, while at the same time it excited the admiration and industry of the European manufacturer. Accordingly attempts were made to imitate this kind of ware, in different countries of Europe. These attempts have succeeded so well, that the produce of the manufacture has acquired the name of *Porcelain*. The first European porcelains were made in Saxony; the manufacture was afterwards introduced into France, and successively into England, Germany, and Italy, where it has arrived at various degrees of perfection, according to the nature of the materials which can be obtained, and the industry and ingenuity of the artist who superintends and directs it; but after all, to whatever degree of perfection the manufacture of this ware has reached in Europe, it must still yield, in excellence and perfection, to the porcelain of eastern countries.

4 Antiquity of the Chinese manufactory.

Of the antiquity of the manufacture of porcelain in China, little precise information can be expected from a people who have always shown themselves so extremely averse to the freedom of intercourse with other nations; but it is said that the village or town of King-te-ching has furnished the emperors of China with porcelain since the year 442 of the Christian era, and that it is an object of so much attention to the Chinese government, that the manufacture is carried on under the superintendance of one or two mandarins sent from court.

I.

Grosier's general descript. of China.

1. *History of the Manufacture of Porcelain in China.*

The fullest account which has yet been received in Europe of the manufacture of Chinese porcelain, has been given by Father D'Entrecolles, a Romish missionary, who lived for some time in the village or town where the principal manufactory is established. The account which is given of this village, and of the manufacture of porcelain, by this author, is the following:

5 and history of it.

This village or town, which is celebrated as producing the best porcelain of China, is in the province of Kiang-si, and it is said to be a league and a half in length, containing not less than 1,000,000 of inhabitants. Other manufactories, indeed, have been established in different parts of the Chinese empire, and particularly in those places which are convenient for the European trade, as in the provinces of Fo-kien and Canton; but the porcelain produced at these manufactories is said to be held in inferior estimation. A Chinese emperor wishing to have a manfacture of porcelain under his own inspection at Pekin, ordered workmen to be collected for the purpose, with all the necessary materials and implements; but after erecting furnaces and other expensive operations, the attempt failed, so that King-te-tching, in the time of our author, continued to be the most celebrated place in China for beautiful porcelain, and from this it was transported to all parts of the world.

6 Materials employed in its composition.

The chief ingredients which enter into the composition of fine porcelain are petuntse and kaolin, two kinds of earth from the mixture of which the paste is obtained. The petuntse is of a pure white, and, when fully prepared, is in the form of an impalpable powder, so that it is very fine to the touch. The kaolin, he observes, is intermixed with small shining particles. These materials are carried to the manufactory in the shape of bricks. The petuntse is origiually the fragments of rock dug out from certain quarries, and reduced to powder, and the colour of the stone which answers the purpose best, according to the Chinese, inclines somewhat to green. The fragments of rock are broken to pieces with a large iron club; they are then put into mortars, and by means

7 Preparation of petuntse,

of levers headed with hard stone, strongly secured with iron, they are reduced to the state of fine powder. The levers, it is scarcely necessary to observe, are moved either by the labour of men, or by water. The powder, which is afterwards collected, is thrown into a large vessel of water, which is strongly agitated with an iron shovel. When this mixture has been allowed to settle for some time, a substance resembling cream rises to the top, which is skimmed off, and poured into another vessel also filled with water. The water in the first vessel is again agitated, and the frothy substance which rises to the surface is collected as before, and the same operation is repeated till it appear that nothing remains but a coarse sediment which falls to the bottom by its own weight. This sediment is carefully collected, and again subjected to the process of pulverization.

The fluid in the second vessel is allowed to remain at rest till a sediment is produced, forming a kind of crust at the bottom; and when the water above seems to be quite transparent, it is poured off by gently inclining the vessel, that the sediment may not be disturbed. The paste is then put into large moulds, and allowed to dry slowly; but before it becomes quite hard, it is divided into small square cakes, which are sold by the hundred. This is the substance which is called by the Chinese *petuntse*, and the name is said to be derived from the colour and form of this paste.

8 and of kaolin.

The kaolin, the other substance which is employed in the fabrication of porcelain, requires fewer operations in its preparation than the former, as it is found in nature in a state almost ready for the manufacturer. Of this substance it is said, that there are extensive mines in certain mountains; the external strata of which are composed of a kind of red earth. The kaolin is found in these mines in small lumps, and it is formed into bricks by being subjected to a similar process with the petuntse, &c.

9 Nature of the finer porcelain.

The fine porcelain, it has been observed, derives its fabric and texture from the kaolin. It is to this that the qualities which it possesses of resisting the most powerful agents is owing; and it has been remarked as an extraordinary circumstance, that a soft earth should communicate strength and consistency to the petuntse, which is obtained from some of the hardest rocks. The author relates an anecdote which he received from a rich Chinese merchant, that the English and Dutch having purchased a quantity of petuntse, conveyed it to Europe for the purpose of manufacturing porcelain; but having procured none of the kaolin, the attempt failed. They wanted, added the Chinese with a smile, to form a body, the flesh of which would support itself without bones.

10 Substitute for kaolin.

It is said that the Chinese have discovered of late years a new substance which may be employed in the composition of porcelain. This stone is called *hoa-chè*, the first part of the word signifies glutinous, because it is of a saponaceous quality. Porcelain made with this substance is very rare, and bears a much higher price than any other. The grain is extremely fine, and the painting with which it is ornamented, when compared with that of common porcelain, seems to exceed it as much as vellum surpasses paper. This variety of porcelain, it is added, is also remarkable for its lightness. It is besides much more brittle, and it is found difficult to hit upon the proper degree of heat for tempering it. This substance, we are farther informed, is but rarely employed in the fabrication of the body of the porcelain; the reason of this perhaps is, the scarcity and high price of this precious article, in consequence of which the workman is contented with making it into a fine size, into which the vessel is immersed when it is dry, that it may receive a coat before it is painted and glazed; and by this process he finds that he can communicate to the ware a high degree of beauty. The previous processes in the preparation of this substance are similar to those which are followed in the preparation of kaolin. When hoa-che is dug out from the mine, it is washed in rain or river water, for the purpose of separating a yellowish earth with which it is contaminated. It is then reduced to powder, thrown into a vessel filled with water, and then formed into cakes. The hoa-chè prepared in this manner, without the addition of any other earth, is said to be alone sufficient in the fabrication of porcelain. It is employed, as has been already noticed, as a substitute for kaolin; but, on account of its scarcity, is much dearer. The price of the former is three times that of the latter, and from this circumstance the value of porcelain made with hoa-

Porcelain.

chè is much higher than that which is manufactured with kaolin.

11 Material for glazing porcelain.

The principal ingredients in the fabrication of porcelain are petuntse and kaolin; but to these must be added the glaze or varnish, or, as it is called in the account given of Chinese porcelain, the oil, on which depend its splendour and whiteness. This varnish is of a whitish colour, and is obtained from the same kind of stone which yields the petuntse; but for this purpose the whitest stone is always preferred. The glaze is obtained by a process similar to that which is followed in the preparation of petuntse. This stone is first washed and reduced to powder; it is then thrown into a vessel with water, and after being purified, a frothy matter rises to the surface. To 100 pounds of this matter, one pound of a substance called che-kao, is added. This latter is a saline substance, somewhat like alum, which is put into the fire, and allowed to remain till it become red hot, when it is reduced to powder. By the addition of this substance the glaze acquires a greater degree of consistence, but at the same time a proper degree of fluidity must be preserved. The glaze prepared in this manner is not employed alone. Another glaze is mixed with it, which is obtained from lime and ashes; to 100 pounds weight of which is also added one pound of che-kao, or the aluminous substance mentioned above. When the two substances are mixed, it is necessary to attend that they be nearly of the same consistence, and the workman ascertains this point by dipping into each of them some cakes of petuntse; and by a close examination of their surfaces after they are drawn out, he is able to judge of the consistence of the fluids. The proportions of the two which are usually employed, are 10 parts of the glaze obtained from the stone, to one of that which is prepared from the lime and from ashes.

In the manufacture of the Chinese porcelain, the first process after the separate preparation of the materials, is a second purification of the petuntse and kaolin; and when they are found to be in a state of sufficient purity, the workmen proceed to mix the two ingredients together.

12 Proportion and mixture of the ingredients.

The proportions employed for the finer kinds of porcelain are equal parts of kaolin and petuntse; for an inferior kind, four parts of kaolin to six of petuntse are employed; and in some kinds of porcelain, only one part of the former is added to three of the latter. This is the smallest proportion of kaolin which is employed in the Chinese manufactories. When the proportions are fixed, and the mixture finished, the mass is thrown into a large pit, which is well paved and cemented. It is then trodden upon, and kneaded till it become hard. This is the most fatiguing part of the labour, for it must be continued without intermission. From the mass prepared in this manner the workmen detach different pieces, which they spread out upon large slates, where they knead and roll them in all directions, taking care that no vacuum be left, and that there be no mixture of any foreign body. The whole work would be entirely spoiled by the addition of a hair, or a particle of sand. When the paste has been properly prepared, the porcelain, when exposed to heat in the furnace, retains its form without becoming soft, or entering into fusion, and becomes semitransparent, without exhibiting cracks or superficial fissures; but when there is any defect in the mixture or preparation, the porcelain cracks, and becomes warped, or melts in the furnace.

13 Method of forming porcelain ware.

The paste being thus prepared, the next operation is to form the vessels for which it is designed. All kinds of plain ware are formed with the wheel. When a cup, for instance, has undergone this operation, the outside of the bottom is quite round. The workman first gives it the requisite height and diameter, and it comes from his hands almost the moment he has received it. Great dexterity and expedition are absolutely necessary, on account of the low price of labour in these manufactories. A workman, it is said, scarcely receives a farthing per board, each board containing no less than 26 pieces. The cup then passes to a second workman, by whom the base is formed; it is then delivered to a third, who applies it to the mould, and gives it the proper form. When it is taken off the mould, it must be turned carefully, and not pressed more to one side than the other; for without this necessary precaution it would become warped or disfigured. The business of the fourth workman is to polish it with the chisel, especially round the edges, and diminish the thickness, to give it the proper degree of transparency. Having at length passed through the different hands from whom it receives its form and various ornaments, it then comes to the last workman, who forms the bottom with a chisel. It is wonderful, it is said, to see with how much dexterity and expedition the workmen convey the vessels from one to another; and it is added, that a single piece of porcelain, before it is completely finished, must pass through the hands of no fewer than 70 different workmen. It is indeed, we may observe, to this minute division of labour that its low price is owing; and on the same circumstance the remarkable dexterity and expedition which have been noticed, depend.

14 Of large works.

In the execution of large works of porcelain, different parts are first formed individually; and when all the pieces are finished, and nearly dry, they are put together and cemented with a paste formed of the same substance, and softened with water. Some time after, the seams are polished with a knife on both sides of the vessel, so that when it is covered with a varnish, or glazed, they are so completely concealed, that the least trace of them is not perceptible. It is in this way that spouts, handles, rings, and other parts of a similar nature, are united. In this way particularly are fabricated those pieces which are formed upon moulds, or by the hand, such as embossed works, grotesque images, idols, figures of trees or animals, and busts. All these are formed of four or five pieces joined together, which are afterwards brought to perfection by means of instruments proper for carving, polishing, and finishing the different traces which the mould has left imperfect. Flowers and ornaments which are not in relief, are either engraved, or the impression is made by means of a stamp; but ornaments in relief are prepared separately, and added to the pieces of porcelain to which they are destined.

15 Painting.

The piece of porcelain being prepared according to the operations now described, is next conveyed to the painter: and in this art it is observed that the Chinese workmen follow no certain rule, and seem to be unacquainted with any of the principles of perspective. Their knowledge is the effect of practice, guided often by a whimsical imagination. The labour of painting porcelain in the Chinese manufactories is also divided among

Porcelain. among a great number of hands. The business of one man, for instance, is solely limited to tracing out the first coloured circle with which the brim of the vessel is adorned; another designs the flowers, and a third paints them. One delineates waters and mountains, while it is the province of another to draw and paint birds and other animals. Of the painting on Chinese porcelain, it has been observed, that the human figure is often most indifferently executed.

16
Veined porcelain and fret-work.

A peculiar kind of glaze or varnish, we are informed, is obtained from white flint. This glaze, it is said, has the singular property of making the pieces of porcelain to which it is applied exhibit the appearance of veins distributed in all directions. Vessels glazed with this material seem as if the surface were cracked, without the fragments being separated or displaced. The colour of this glaze is whitish gray; and when it is applied to porcelain having an azure blue ground, it communicates a beautifully variegated appearance. Vases of Chinese porcelain are sometimes fabricated in a different manner. They are ornamented with a kind of fret-work, which has something of the appearance of fine lace, in the middle of which is placed a cup proper for holding any liquid; which constitutes one body with the surrounding fret-work.

17
Singular kind of porcelain.

We are informed that the Chinese workmen formerly possessed the secret of fabricating a kind of porcelain of a more singular nature. On the sides of the vessel thus formed were painted the figures of fishes, insects, and other animals, which could not be seen unless the vessel was filled with water. It is said that this secret is in a great measure lost; but the following is given as part of the process of preparing this kind of porcelain. The vessel which is to be painted, for the purpose of producing this peculiar effect, must be extremely thin and delicate. When it is dry, the colour is laid on, not on the outside, however, as is usually the case, but on the inside of the vessel, and it is laid on pretty thick. The figures which are painted upon it are usually fishes, as being more characteristic of the element in which they live. When the colour is perfectly dry, it is coated over with a kind of glaze, composed of porcelain earth, so that the azure is thus inclosed between two layers of earthy matter; and when the glaze becomes dry, the workman pours some oil into the vessel, and putting it upon a mould, applies it to the lathe. Porcelain fabricated in this manner, having received its consistence and body within, it is the object of the workmen to make it as thin as possible on the outside, without penetrating to the colour. The external surface is then dipped into a mixture for glazing, and when it is dry it is baked in a common furnace. This kind of porcelain is known by the name of *kia-tsing*, signifying pressed azure. It is supposed that the Chinese do not at present possess the art of making porcelain of this description, which requires a great deal of dexterity and delicate management; and it is added, that they have imperfectly succeeded in the attempts which have been occasionally made to discover the secret of this curious process.

18
Chinese furnaces.

The next process in the manufacture of porcelain is baking; but before we describe the method of arranging and managing the furnaces employed for this purpose, we shall give a short account of their construction. The Chinese furnaces for baking porcelain are furnished with a long porch, for the purpose of conveying air, and in some measure as a substitute for bellows. This porch answers the same purpose as the arch of a glass-house; but the furnaces which, as the author from whom the account is taken observes, were formerly only six feet in height, and the same in length, are now constructed upon a much more extensive plan. They are 12 feet high, and nearly four broad; and the roof and sides are so thick, that the powerful heat which is applied internally does not penetrate to the outside, at least so much as to be inconvenient to bear it on the application of the hand. The dome or roof is in the form of an inverted funnel, having a large aperture at the top by which the smoke escapes. Beside the principal aperture, there are five others of smaller dimensions, which are covered with broken pots in such a manner that the workman can increase or diminish the heat as he finds it necessary. Through these apertures also he is able to see the progress of the baking of the porcelain, and can judge when it is completed. By uncovering the hole which is nearest the principal opening, he opens with a pair of pincers one of the cases containing the pieces of porcelain, and if he perceives a bright fire in the furnace, and all the pieces brought to a red heat, as well as the colours of the porcelain appearing with a full lustre, he concludes that the process is finished. He then diminishes the fire, and entirely shuts up the mouth of the furnace for some time. In the bottom of the furnace there is a deep hearth about two feet in breadth, over which a plank is laid, in order that the workman may enter to arrange the porcelain. When the fire is kindled on the hearth, the mouth of the furnace is immediately closed up, and an aperture is left only sufficient for the admission of faggots, about a foot in length, but very narrow. The furnace is first heated for a day and a night, after which two men keep continually throwing wood into it, and relieve each other by turns. One hundred and eighty loads are consumed for one baking. As the porcelain is burning hot, the workman employs for the purpose of taking it out, long scarfs or pieces of cloth, which are suspended from his neck.

Method of baking porcelain.

Having thus given a concise account of the construction of the Chinese furnaces, we proceed now to lay before our raaders the method of baking porcelain which is followed in that country. After the porcelain has received its proper form, its colours, and all the intended ornaments, it is transported from the manufactory to the furnace, which is sometimes situated at the other end of the village already mentioned. In a kind of portico, which is erected before it, may be seen vast numbers of boxes and cases made of earth, for the purpose of inclosing the porcelain. Each piece, however inconsiderable it may be, has its own case; and the Chinese workman, by means of this procedure, imitates nature, which, in order to bring the fruits of the earth to maturity, clothes them in a covering, to defend them from the excessive heat of the sun during the day, and from the severity of the cold during the night.

A layer of fine sand is put into the bottom of these boxes, which is covered over with the powder of kaolin, to prevent the sand from adhering too closely to the bottom of the vessel. The piece of porcelain is then placed upon this bed of sand, and pressed gently down, in order that the sand may take the form of the bottom of the vessel, which does not touch the sides of its case: the case has no cover. A second, prepared in the same manner, Porcelain. manner, and containing its vessel, is fitted into the first, so that it entirely shuts it, without touching the porcelain which is below; and thus the furnace is filled up with piles of cases, which defend the pieces they contain from the direct action of the fire.

With regard to small pieces of porcelain, such as tea-cups, they are inclosed in common cases about four inches in height. Each piece is placed upon a saucer of earth about twice as thick as a crown-piece, and equal in breadth to its bottom. These small cases are also sprinkled over with the dust of the kaolin. When the cases are large, the porcelain is not placed in the middle, because it would be too far removed from the sides, and consequently from the action of the fire.

These piles of cases are put into the furnace, and placed upon a bed of coarse sand six inches thick; those by which the middle space is occupied are at least seven feet high. The two boxes which are at the bottom of each pile remain empty, because the fire acts too feebly upon them, and because they are partly covered by the sand. For the same reason, the case which is placed at the top of each pile is also allowed to remain empty. The piles containing the finest porcelain are placed in the middle part of the furnace; the coarsest are put at its farthest extremity; and those pieces which have the most body and strongest colouring are near its mouth.

These different piles are placed very closely in the furnace; they materially support each other by pieces of earth, which bind them at the top, bottom, and middle, but in such a manner, that a free passage is left for the flame to insinuate itself everywhere around them.

20 ifferent nds of rcelain.

The Chinese divide their porcelain into several kinds or classes, distinguishing each according to the different degrees of beauty and fineness. The whole of the first or most perfect kind is reserved for the emperor; none of it, we are assured, ever comes into the hands of the public, unless, on account of blemishes or imperfections, it is unworthy of being presented to the sovereign. Many have doubted whether at any time the largest and finest porcelain of China has ever been brought to Europe. None of that kind, at least, is offered to sale at Canton. The Chinese, who are apt to undervalue the productions of other countries, entertain a favourable opinion of the Dresden porcelain, and hold in still higher estimation the porcelain which is produced in the French manufactories.

21 George aunton's count of manu-ture of celain China.

The following is a short account of the Chinese porcelain manufactures by Sir George Staunton. "From the river," says he, "were seen several excavations made in extracting from the sides of the adjoining hills, the petuntse useful in the manufacture of porcelain. This material is a species of fine granite, or compound of quartz, feldspar, and mica, in which the quartz seems to bear the largest proportion. It appears from several experiments, that it is the same as the growan stone of the Cornish miners. The micaceous part, in some of this granite from both countries, often contains some particles of iron, in which case it will not answer the potter's purpose. This material can be calcined and ground much finer by the improved mills of England, than by the very imperfect machinery of the Chinese, and at a cheaper rate than the prepared petuntse of their own country, notwithstanding the cheapness of labour there.

"The kaolin, or principal matter mixed with the petuntse, is the growan clay also of the Cornish miners. The wha-she of the Chinese is the English soap-rock; and the she-kan is asserted to be gypsum. It was related by a Chinese manufacturer in that article, that the asbestos, or incombustible fossil stone, entered also into the composition of porcelain. A village, or unwalled town, called Kin-te-chin, was not very far distant from this part of the present traveller's route, in which 3000 furnaces for baking porcelain were said to be lighted at a time, and gave to the place at night the appearance of a town on fire. The genius or spirit of that element is indeed, with some propriety, the principal deity worshipped there. The manufacture of porcelain is said to be precarious, from the want of some precise method of ascertaining and regulating the heat within the furnaces, in consequence of which their whole contents are baked sometimes into one solid and useless mass. Mr Wedgwood's thermometer, founded on the quality observed by him, of clay contracting in proportion to the degree of fire to which it is exposed, might certainly be of use to a Chinese potter*."

* Embassy to China, iii. 299.

2. *Inquiries of Reaumur into the Nature of Porcelain.*

The first scientific investigation which was made into the nature of porcelain, was undertaken by the celebrated Reaumur; and the result of his researches was communicated to the French Academy of Sciences in the years 1727 and 1729. It was not the external form or appearance, nor was it the decorations of painting and gilding, which are by no means essential to porcelain, that constituted the object of his inquiries. His examination was particularly directed to the peculiar texture and fabric of this substance, with the view of ascertaining the nature and proportions of its constituent parts. For this purpose, he broke to pieces some of the Japanese, the Saxon, and the French porcelains, and carefully noted the peculiarities and differences in their texture. The grain or texture of the Japanese porcelain appeared to possess a considerable degree of closeness and compactness, with a smooth and somewhat shining aspect. He found that the Saxon porcelain was still more compact, and that it was smooth, and shining like enamel, but had nothing of the granular texture. In his examination of the French porcelain, he observed that it had much of the shining appearance, and that its grain was not so close and fine as that of the oriental porcelain, having some resemblance to the grain or texture of sugar. Such were the observations which occurred to the French philosopher at the commencement of his inquiries into the nature of porcelains, and hence he justly concluded, that they were characterised by very marked differences.

22 Composition of porcelain examined.

Proceeding in his investigation, the same philosopher subjected different porcelains to the action of heat; and the result of his experiments with this powerful agent proved, that they might be distinguished by still more decisive characters; for it appeared that the porcelain of the east suffered no change from the action of the greatest heat, whereas that of European manufacture underwent fusion at no very high temperature. This remarkable difference between the Chinese and European porcelains, suggested to Reaumur an ingenious thought, which at last led him to the discovery of the true

23 Effects of heat on porcelain.

Porcelain.

true nature of the composition of porcelain. Having observed that all porcelains have some resemblance to glass in some of their general properties, although they are less compact, he considered them as in the state of a semivitrified substance. An earthy substance, he observed, may be in a semivitrified state in two ways. It may, in the first place, be entirely composed of vitrifiable or fusible matters; and this being the case, when it is exposed to the action of fire, provided the heat be sufficiently strong and long continued, it will be melted or vitrified. But as this change is not effected instantly, particularly where a violent degree of heat is not applied; and as it passes through different degrees, the progress of which may be more easily observed, according as the heat is managed and regulated; it followed, that by stopping in proper time the application of the heat to porcelain prepared in this way, the ware may be obtained in an intermediate state between those of crude earths and completely vitrified substances, while, at the same time, it possesses the semitransparency and other distinguishing properties of porcelain. Porcelain of this nature, it is well known, being exposed to a stronger degree of heat, undergoes perfect fusion and complete vitrification. All the European porcelains which were subjected to experiment by Reaumur, were found to be of this fusible nature.

24 Porcelain composed of fusible and infusible matter.

But on the other hand, porcelain may be composed of fusible or vitrifiable matter, mixed in certain proportions with another matter, which is absolutely infusible in the strongest heat to which it can be exposed in the furnace; and hence, if a mixture of this kind be subjected to a heat sufficient to melt entirely the vitrifiable part of its composition, this will enter into fusion; but being mixed with another matter which is infusible, and which consequently retains its consistency and opacity, the whole will form a compound, partly opaque, and partly transparent, or, in other words, a semitransparent mass; that is, a semivitrified substance, or porcelain, but possessing qualities totally distinct from those of the former. For as the fusible part of the latter has been brought to its utmost degree of fusibility during the process of baking, although the compound may be exposed a second time to a still stronger degree of heat, it will not approach nearer to complete vitrification, that is, it will retain all the qualities of perfect porcelain. Reaumur found that the porcelain of the east was distinguished by the properties now described; and hence he concluded, that its component parts were arranged on the principle above alluded to. This opinion was afterwards confirmed by the most incontrovertible facts, deduced from a train of the most satisfactory and well directed experiments.

25 The kaolin infusible, the petuntse a vitrifiable matter.

The ingredients which enter into the composition of the Chinese porcelain, namely, the petuntse and kaolin, were the next object of Reaumur's inquiries. Having obtained quantities of each, he subjected them separately to a strong heat, and he found that the petuntse entered into fusion, without addition; but it appeared that the kaolin was absolutely infusible. He then mixed the two ingredients, formed them into cakes, and exposed them in a furnace to the proper degree of heat; so that by baking they were converted into porcelain exactly similar to that of the Chinese. From these experiments it appeared, that the petuntse of the Chinese was a vitrifiable substance, and that the kaolin was of a different nature, quite refractory, and totally infusible. After this discovery Reaumur, it would seem, entertained hopes that he might find materials in France, capable of making porcelain, possessing the same valuable qualities as that of China; but whether his researches in the discovery of proper materials in his own country, particularly that which corresponds to the petuntse of the Chinese, or whether he was prevented by other avocations from prosecuting his inquiries, it does not appear. But in his second memoir upon porcelain, we find, that he afterwards attempted to compose an artificial petuntse, by mixing vitrifiable stones with such saline bodies as were capable of rendering them fusible, or even by substituting for this artificial preparation glass ready formed, with the addition of such matters as he supposed might be successfully employed in the place of kaolin; but it would appear that he did not at the time prosecute his inquiries, for the subject was not resumed till the year 1739, when he announced the discovery of a process for converting common glass to a peculiar kind of porcelain, which has been since known by the name of *Reaumur's porcelain*.

Although it must appear, from the detail now given, that Reaumur was directed in his researches by the true spirit of philosophical inquiry, he seems to have been misled in certain points. One of his errors was relative to the Saxon porcelain, which he confounded with the other fusible porcelains of European manufacture, unless it be supposed that the porcelain of Saxony was formerly composed of entirely fusible or vitrifiable matters, and that it was porcelain of this description which he examined; for it is now certain, that all the porcelain of that country is capable of resisting the most powerful heat, and is therefore equally infusible with that of China or Japan. The appearance of the internal texture of the Saxon porcelain may have led the philosopher to this erroneous conclusion; for when it is broken, the internal surface does not exhibit a granular texture, but is uniform, smooth, shining, and compact, having much resemblance to white enamel. This appearance, however, so far from proving that the porcelain of Saxony is a fused or vitrified substance, shews, that it is not entirely composed of fusible matters. The internal surface of the most fusible porcelains, it is well known to those who are acquainted with the subject, is also the least dense, and the least compact; for no vitreous matter can be internally smooth and dense, without having been in a state of complete fusion. But if the density and shining appearance of the porcelain of Saxony depended only on the effects of the fusion of a vitreous matter, how is it to be supposed, that vessels formed of that fusible matter should have sustained the necessary degree of heat for producing the density and shining appearance, without having entirely lost their shape?

This peculiar quality of the Saxon porcelain, it is inferred, must then depend on another cause. Like every other porcelain, especially that of China and Japan, it contains a fusible substance, which has been in a state of complete fusion during the process of baking. The density and the internal lustre depend chiefly on this fused matter; but it is also certain, that the Saxon porcelain contains a large proportion of a substance which is absolutely infusible, and from which it derives its beautiful white appearance, its firmness and solidity, during

during the process of baking. It is this infusible substance which is to be considered as the substitute for the kaolin of China, and which possesses the property of considerably contracting its dimensions, while it unites with the fusible material. According to the observation of Macquer, if it be subjected to the most decisive trial, namely, the action of a violent fire, which is capable of melting every porcelain composed only of fusible materials, it appears as the result of numerous experiments, that it remains infusible, unless it be exposed to a heat which is also capable of melting the best and most perfect porcelain of Japan. The Saxon porcelain, therefore, is not to be confounded with porcelain manufactured of vitreous and fusible materials; for it seems to be equally excellent as that of Japan, and in some of its properties perhaps superior, as will appear from an examination of the qualities which constitute the peculiar excellence of porcelain.

28 and with regard to the Chinese kaolin.

Reaumur seems also to have taken an erroneous view of the nature of the Chinese kaolin. According to his account, this matter is a fine talky powder, from the mixture of which with petuntse, the porcelain of the east is manufactured. It is not impossible, it has been observed, that a porcelain similar to the Chinese might be produced from a talky substance of this nature mixed with petuntse; but it is well known to those who are at all familiar with the manufacture of any porcelain, that no vessels can be formed, unless the paste of which they are made possess that degree of ductility and tenacity which renders them fit for being worked upon the lathe, or fashioned in the mould. But substances of a talky nature, to whatever degree of fineness they may be reduced, never acquire the requisite ductility and tenacity which clays of all earthy substances only possess. But as it appears that the Chinese porcelain has been turned upon the lathe, it is obvious that they must have been formed of a very tenacious paste; and hence it is concluded, that kaolin is not purely a talky matter, but mixed with clay, otherwise the petuntse and kaolin, according to the supposition of Reaumur, are not the only ingredients which enter into the composition of Chinese porcelain; but the addition of a certain proportion of some matter of a tenacious quality is absolutely requisite.

3. *Peculiar Properties of Porcelain.*

It may be worth while now to consider the properties which constitute the perfection of porcelain; and here it is necessary, carefully to discriminate between the qualities which are to be regarded as only contributing to the external decoration, and the intrinsic and essential properties in which the fabric and perfection of porcelain consist.

29 Essential qualities of porcelain.

Those who have been occupied in experiments on this subject, have not found it difficult to form compositions which are very white, beautifully semitransparent, and covered with a shining glazing; but which are extremely deficient in the more essential properties, as it appears they cannot be subjected to the necessary operations for want of a proper degree of tenacity; are not sufficiently compact; are quite fusible, subject to break by the sudden application of heat or cold, and from the softness of the glazing, which cracks and becomes rough, are soon deprived of their lustre. On the other hand, it is by no means difficult to form compositions of pastes, which are very tenacious, and which are capable of being easily worked and well baked, and in the process of baking which acquire the requisite degree of hardness and density; which are infusible, and capable of resisting the effects of sudden changes of heat and cold, and, in short, which possess all the qualities of the most excellent porcelain, excepting its whiteness and beauty. Materials fit for the composition of such porcelains, it will appear, may be found abundantly in most countries; but the difficulty in the manufacture of this ware is to unite beauty and goodness in one composition. The materials fit for the manufacture of the finer and more perfect porcelains, seem to be sparing productions of nature; and therefore the best kind of porcelain, it is presumed, will always be regarded as a valuable and high-priced commodity.

30 Nature of stoneware.

It may be observed, that the potteries called *stoneware*, possess all the essential qualities of the Japanese porcelain; for, excepting the whiteness, on which alone the semitransparency depends, if we compare the properties of Japanese porcelain with those of our stoneware, little difference is found to exist between them. Both seem to possess the same granular texture; both have the same sonorous quality, when struck with a hard body; both have the same density; they possess also the same hardness, by which they strike fire with steel; they can resist the effects of the heat of boiling liquors without breaking, and are equally infusible when subjected to violent heat. Hence it is inferred, that if the earth which enters into the composition of stoneware, were free from foreign colouring matters, which prevent the whiteness and semitransparency, and if the vessels were carefully formed and coloured with a fine glaze, they would not be less perfect than the porcelain of the east. Earths fit for the production of the more perfect kinds of porcelain, are supposed to be more rare in Europe than in Japan and China; and hence probably it has happened, that, from the want of these earths, the first manufacturers of the porcelain in Europe confined themselves to an external imitation, by employing only vitrifiable matters with fusible salts, and a small quantity of white earth, from which fusible and vitreous porcelains were composed. Such might not improperly be denominated *false porcelains;* but great improvements have taken place since the first introduction of the manufacture of porcelain into Europe. Genuine white porcelains have been long ago produced in Germany, and especially in Saxony. These porcelains are in no respect inferior to those of China or Japan. They are found even to be considerably superior in beauty and whiteness to the productions of the eastern manufactories of modern times; for in these qualities the porcelains of the latter have greatly degenerated. And in one of the most valuable qualities of porcelain, namely, the property of resisting the effects of sudden changes of heat and cold, the European porcelain exceeds that of China or Japan. The quality of porcelain, it is to be observed, is not to be judged of by a slight trial; for as numerous circumstances concur to render a piece of porcelain capable or incapable of resisting the effects of heat or cold, boiling water may be at the same time poured into two vessels, one of which is good porcelain, and the other of an opposite quality, it is not impossible that the former may break, and the latter may remain entire. The true method of discover-

Porcelain. ing what is good porcelain, is to examine several pieces of it which are in daily use; and it has been found, that in many such pieces of porcelain of oriental manufacture, which have been long used, cracks are always seen in the direction of their height, which are never perceived in the more perfect porcelains of European manufacture.

31 Japanese porcelain reckoned the most perfect, It has long been a very general opinion, that the Japanese porcelain is the most perfect; it has indeed continued to be the object of admiration and emulation, and has been held up as a model for the European manufacturer; a model which has not yet been equalled, and which, according to the opinion of some, cannot be equalled. In deciding on this subject, the Saxon porcelain is considered as inferior to the Japanese, on account of its greater smoothness, lustre, and less granular aspect of its internal texture, qualities in which it ought really to be regarded as superior to the porcelain from Japan. This surface has a near resemblance to that of glass, and it is supposed that this similarity has suggested the opinion; and it would be well founded, if the density and lustre of the European porcelain depended on the fusible and vitreous property of the ingredients of which it is composed: but this not being the case, and the Saxon porcelain being equally fixed and infusible as that of Japan, its superior density must be admitted as a valuable property. For in the comparison of different porcelains which are equal in other properties, that which is most firm and compact certainly claims the superiority. Hence it is that the internal texture of the Japanese porcelain is held in greater estimation, because it possesses a greater degree of density, compactness and lustre, than the European porcelain, which is composed only of vitreous sand or fritt. For a similar reason the superior density of the Saxon porcelain ought to obtain for it a preference to that which is imported from the east. It is supposed besides, that it would be no difficult matter to

32 but not superior to that of Saxony. communicate to the Saxon porcelain the granular texture of the Japanese, by mixing with the paste a certain proportion of sand or siliceous earth. But in this point, in producing by these means a nearer resemblance to the Japanese porcelain, those who conducted and brought to perfection the Saxon manufactures, were not insensible that their porcelain would sink in its valuable properties.

4. *Porcelain Manufactories in different parts of Europe.*

Manufactories of porcelain have been long established in almost every country of Europe. Besides that of Saxony, which was the first established in Europe, porcelain is made to a considerable extent at Vienna, at Frankendal, and in the neighbourhood of Berlin, and in other places of the German states. The German porcelains are similar to those of Saxony, and are composed of similar materials, although from differences in the proportions, or in the modes of managing the manufactories, considerable differences arise in the porcelains manufactured at different places. Italy also is celebrated for its porcelain manufactures, the chief of which, it is said, are carried on at Naples. When M. de la Condamine travelled into Italy, he visited a manufacture of porcelain established at Florence, by the marquis de la Ginor, who was then governor of Leghorn. The French traveller was particularly struck with the large size of some of the pieces of this porcelain. Statues, and even groups of figures half as large as nature, and modelled from some of the finest antiques, were formed of it. The furnaces, he observed, in which the porcelain was subjected to the process of baking, were constructed with a great deal of ingenuity, and were lined with bricks made of the same materials as those which entered into the composition of the porcelain itself; and hence they were able to resist the effects of high degrees of heat. The paste of the porcelain manufactured at Florence appeared to be extremely beautiful, and to possess all the qualities of the best oriental porcelain. The glazing employed in this manufactory seemed to be inferior in whiteness, a circumstance which is supposed to be owing to the desire of using those materials only which are found in the country.

In France a greater number of manufactories of porcelain has been established than in any other country; and it must be allowed that the French have had wonderful success in the improvement and perfection of this manufacture. 33 Manufactures of porcelain in France. Some time even before Reaumur communicated the result of his inquiries, porcelain was manufactured at St Cloud, and in the suburb of St Antoine at Paris. This porcelain indeed was of the vitreous or fusible kind, but at the same time possessed no inconsiderable degree of beauty. Since the period to which we allude, extensive manufactories of porcelain have been established at Villeroy, Chantilly, and Orleans, and at those places the manufacture has been brought to a great degree of perfection. But the productions of the celebrated porcelain manufactory at Sevres, on account of the pure shining white, the fine glazing and coloured grounds, the splendour and magnificence of the gilding, and the elegance and taste displayed in the shape and figures, are universally allowed to surpass every thing of the kind which has yet appeared.

In speaking of the French porcelain, we may notice the result of some researches which were made on this subject by Guettard, and of which an account appeared in the Memoirs of the Academy of Sciences for the year 1765. In the neighbourhood of Alençon, M. Guettard discovered a whitish argillaceous earth, in which mica considerably predominated. This earth he employed as a substitute for kaolin. The substance which he used in place of the petuntse, he obtained from a hard stone, which is described as a quartzose gritt stone, very abundant in that country, and with which the streets of Alençon are paved. With these materials Guettard instituted a series of experiments on porcelain, previous to the year 1751, and was associated in his inquiries with the duke of Orleans. For many years the count de Lauraguais, a member of the Academy of Sciences, was keenly engaged in prosecuting experiments to discover the true nature of porcelain, and the means by which the manufacture might be improved and perfected. To obtain the object of his researches, which was to produce porcelain that in its essential qualities might be equal to that of eastern countries, he spared no trouble or expence; and it would appear that he was not unsuccessful in his labours; for in the year 1766, when he exhibited some species of porcelain from his manufactory to the members of the Academy of Sciences, the persons who were appointed by that learned body to examine their properties, delivered it as their opinion, that of all the porcelain made in France, that of

Porcelain. of the count de Lauraguais approached most nearly in the essential properties of solidity, texture and infusibility, to that of China and Japan. It is, said, however, that it was considerably deficient in whiteness and lustre, when compared with the ancient porcelain of Japan.

34 In England.

The manufacture of porcelain has been brought to a great degree of perfection in England. In many of the essential qualities, and particularly in the beauty and richness of the paintings, as well as in the elegance of the forms, the English porcelain is little inferior to that of any other country. Manufactories of this ware have been established in different parts of England. This manufacture was first established at Derby about the year 1750, by a Mr Duesbury, who is said to have been a very ingenious artist. Since his death the manufactories received very considerable improvement, and chiefly in the judicious methods pursued in the preparation of the paste, and increasing the beauty of the ornaments. The ware itself is said not to equal in fineness that which is manufactured in Saxony and France, although it is greatly superior in respect of decoration and workmanship. The paintings in general are rich, and executed with taste, and the gilding and burnishing are extremely beautiful. The body of the semi-vitreous kind, which is formed of a fine white clay, in combination with various proportions of different fusible matters, has obtained the name of porcelain. The best kind is wholly infusible, and is glazed with a vitreous substance which has not a single particle of lead in its composition.

35 In Staffordshire

The most famous manufactory of stone-ware, as well as of other kinds of pottery, is at Burslem in Staffordshire. This can be traced with certainty at least two centuries back; but of its first introduction no tradition remains. In 1686, as we learn from Dr Plot's Natural History of Staffordshire published in that year, only the coarse yellow, red, black, and mottled wares, were made in this country; and the only materials employed for them appear to have been the different coloured clays which are found in the neighbourhood, and which form some of the measures or strata of the coal-mines. These clays made the body of the ware, and the glaze was produced by powdered lead-ore, sprinkled on the pieces before firing, with the addition of a little manganese for some particular colours. The quantity of goods manufactured was at that time so inconsiderable, that the chief sale of them, the Doctor says, was "to poor cratemen, who carried them on their backs all over the country."

About the year 1690, two ingenious artisans from Germany, of the name of Eller, settled near Burslem, and carried on a small work for a little time. They brought into this country the method of glazing stone-ware, by casting salt into the kiln while it is hot, and some other improvements of less importance; but finding they could not keep their secrets to themselves, they left the place rather in disgust. From this time various kinds of stone-ware, glazed by the fumes of salt in the manner above mentioned, were added to the wares before made. The white kind, which afterwards became, and for many succeeding years continued, the staple branch of pottery, is said to have owed its origin to the following accident. A potter, Mr Astbury, travelling to London, perceived something amiss with one of his horse's eyes; an hostler at Dunstable said he could soon cure him, and for that purpose put a common black flint stone into the fire. The potter observing it, when taken out, to be of a fine white, immediately conceived the idea of improving his ware by the addition of this material to the whitest clay he could procure: accordingly he sent home a quantity of the flint stones of that country, where they are plentiful among the chalk, and by mixing them with tobacco-pipe clay, produced a white stone-ware much superior to any that had been seen before.

Some of the other potters soon discovered the source of this superiority, and did not fail to follow his example. For a long time they pounded the flint stones in private rooms by manual labour in mortars; but many of the poor workmen suffered severely from the dust of the flint getting into their lungs, and producing dreadful coughs, consumptions, and other pulmonary disorders. These disasters, and the increased demand for the flint powder, induced them to try to grind it by mills of various constructions; and this method being found both effectual and safe, has continued in practice ever since. With these improvements, in the beginning of the present century, various articles were produced for tea and coffee equipages. Soon after attempts were made to furnish the dinner table also; and before the middle of the century, utensils for the table were manufactured in quantity as well for exportation as home consumption.

But the salt glaze, the only one then in use for this purpose, is in its own nature so imperfect, and the potters, from an injudicious competition among themselves for cheapness, rather than excellence, had been so inattentive to elegance of form and neatness of workmanship, that this ware was rejected from the tables of persons of rank; and about the year 1760, a white ware, much more beautiful and better glazed than ours, began to be imported in considerable quantities from France.

36 Improved by Wedgwood.

The inundation of a foreign manufacture, so much superior to any of our own, must have had very bad effects upon the potteries of this kingdom, if a new one, still more to the public taste, had not appeared soon after. In the year 1763, Mr Josiah Wedgwood, who had already introduced several improvements into this art, invented a species of earthen ware for the table quite new in its appearance, covered with a rich and brilliant glaze, bearing sudden alternations of heat and cold, manufactured with ease and expedition, and consequently cheap, and having every requisite for the purpose intended. To this new manufacture the queen was pleased to give her name and patronage, commanding it to be called *Queen's ware*, and honouring the inventor by appointing him her majesty's potter.

37 Queen's ware.

The common clay of the country is used for the ordinary sorts; the finer kinds are made of clay from Devonshire and Dorsetshire, chiefly from Biddeford; but the flints from the Thames are all brought rough by sea, either to Liverpool or Hull, and so by Burton. The convenience of plenty of coals, which abound in that part of the country, is supposed, and with good reason, to be the chief cause of the manufacture having been established here.

The flints are first ground in mills, and the clay prepared by breaking, washing, and sifting, and then they are mixed in the requisite proportions. The flints are bought

bought first by the people about the country, and by them burnt and ground, and sold to the manufacturers by the peck.

The mixture is then laid in large quantities in kilns to evaporate the moisture; but this is a nice work, as it must not be too dry: next it is beaten with large wooden hammers, and then is in order for throwing, and is moulded into the forms in which it is to remain; this is the most difficult work in the whole manufacture. A boy turns a perpendicular wheel, which by means of thongs turns a small horizontal one, just before the thrower, with such velocity, that it twirls round the lump of clay he lays on it into any form he directs it with his fingers.

There are 300 houses, which are calculated to employ upon an average twenty hands each, or 6000 in the whole; but of all the variety of people that work in what may be called the preparation for the employment of the immediate manufacturers, the total number cannot be much short of 10,000, and it is increasing every day. Large quantities are exported to Germany, Ireland, Holland, Russia, Spain, the East Indies, and much to America; some of the finest sorts to France.

5. *Different Processes in the Manufacture of Porcelain.*

38
Vitreous or fusible porcelain.

The basis of those porcelains which are known by the name of *vitreous* or *fusible*, and sometimes *false porcelain*, is denominated by the workmen a *fritt*. This is a mixture of sand or powdered flints, with a saline substance, capable of bringing it to a state of fusion when the mixture is exposed to a sufficient degree of heat. The fritt is then mixed with a proper proportion of clay or argillaceous earth, so that it may have such a degree of tenacity as to make it capable of being worked upon the wheel. The whole mixture is, after being well ground in a mill, to be made into a paste, which is to be formed, either upon the wheel or in moulds, into pieces of such forms or figures as may be required. Each of the pieces, when it is sufficiently dried, is put into a case made of earthen ware, and placed in the furnace, that it may be subjected to the process of baking. These cases are known among the English potters by the name of *seggars* or *saggars*, and they are generally formed of a coarser kind of clay, but this clay must possess the property of resisting the action of heat necessary for the baking of porcelain, without being fused. The porcelain contained in the cases is thus protected from the smoke of the burning fuel: the whiteness of the porcelain depends greatly on the purity of the clay of which it is made, so that being of a more compact texture, the smoke is more effectually excluded. These cases are arranged in the furnace or kiln in piles, one upon the other, to the very top of the furnace.

The furnaces are chambers or cavities of various forms and sizes, and they are so constructed that the fire-place is situated on the outside, opposite to one or more openings, which have a communication with the furnace internally. The flame of the fuel is drawn within the furnace, the air of which being rarefied, determines a strong current of air to the inside, as is the case in other furnaces. A small fire is first made, that the furnaces may be gradually heated, and it is to be increased more and more, till the process of baking is completed; that is, till the porcelain shall have acquired a proper degree of hardness and transparency. To ascertain this point, a good deal of attention is necessary; and this is done by taking out of the furnace from time to time, and examining, small pieces of porcelain placed for that purpose in the cases, which have lateral openings to render them accessible. When it appears from the examination of those pieces, that the porcelain is sufficiently baked, the fire is no longer to be supplied with fuel; the furnace is allowed to cool gradually, and the porcelain is afterwards taken out. In this state the porcelain has the appearance of white marble, having nothing of that shining surface which it acquires by covering it with a vitreous composition known by the name of *glazing*, a process which is afterwards to be described; but in the mean time we shall speak of the infusible porcelains.

The materials which enter into the composition of the infusible porcelains, and such as approach to the nature of stone ware, are first to be ground in a mill, and the earths or clays being well washed, are next to be carefully mixed and formed into a paste. The pieces at first receive a rude form from the wheel or lathe of the potter, according to their nature and magnitude. As the wheel and lathe are the principal machines employed in the manufacture of porcelain or pottery, we shall here give a short description of their construction. The potter's wheel, which is used for larger works, consists principally in the nut, which is a beam or axis, whose foot or pivot plays perpendicularly on a free-stone sole or bottom. From the four corners of this beam, which does not exceed two feet in height, arise four iron bars, called the *spokes of the wheel;* which forming diagonal lines with the beam, descend, and are fastened at bottom to the edges of a strong wooden circle, four feet in diameter, perfectly like the felloes of a coach-wheel, except that it has neither axis nor radii, and is only joined to the beam, which serves it as an axis, by the iron bars. The top of the nut is flat, of a circular figure, and a foot in diameter; and on this is laid the clay which is to be turned and fashioned. The wheel thus disposed is encompassed with four sides of four different pieces of wood fastened on a wooden frame; the hind-piece, which is that on which the workman sits, is made a little inclining towards the wheel; on the fore-piece is placed the prepared earth; on the side pieces he rests his feet, and these are made inclining to give him more or less room. Having prepared the earth, the potter lays a round piece of it on the circular head of the nut, and sitting down turns the wheel with his feet till it has got the proper velocity; then, wetting his hands with water, he presses his fist or his finger-ends into the middle of the lump, and thus forms the cavity of the vessel continuing to widen it from the middle; and thus turning the inside into form with one hand, while he proportions the outside with the other, the wheel constantly turning all the while, and he wetting his hands from time to time. When the vessel is too thick, he uses a flat piece of iron, somewhat sharp on the edge, to pare off what is redundant; and when it is finished, it is taken off from the circular head by a wire passed under the vessel.

Potter's wheel.

Potter's lathe.

The potter's lathe is also a kind of wheel, but more simple and slight than the former: its three chief members are an iron beam or axis three feet and a half high, and two feet and a half diameter, placed horizontally

Porcelain. tally at the top of the beam, and serving to form the vessel upon: and another large wooden wheel, all of a piece, three inches thick, and two or three feet broad, fastened to the same beam at the bottom, and parallel to the horizon. The beam or axis turns by a pivot at the bottom of an iron stand. The workman gives the motion to the lathe with his feet, by pushing the great wheel alternately with each foot, still giving it a greater or lesser degree of motion as his work requires. He works with the lathe with the same instruments, and after the same manner, as with the wheel. The mouldings are formed by holding a piece of wood or iron cut in the form of the moulding to the vessel, while the wheel is turning round; but the feet and handles are made by themselves and set on with the hand; and if there be any sculpture in the work, it is usually done in wooden moulds, and stuck on piece by piece on the outside of the vessel. The lathe is employed for smaller works in porcelain.

After the first application of the pieces of porcelain to the wheel or lathe, they are allowed to become nearly dry; and to give the requisite form, or a greater degree of accuracy and perfection, they are again subjected to the same operation. They are afterwards introduced into the furnace, not, however, for the purpose of baking them completely, but only to apply a sufficient heat, to give them that firmness and solidity that they may undergo the various necessary manipulations without being disfigured or broken. In this state they are ready for the process of glazing. As the pieces of porcelain, after being subjected to this moderate degree of heat, are very dry, they readily imbibe water, and it is this property of absorbing water, which greatly assists in the application of the glazing; and having received this covering, the pieces of porcelain are again put into the furnace, to complete the process of baking. The heat is gradually raised, and at last brought to that degree that all the objects within the furnace shall be white, and the cases shall be scarcely distinguished from the flame. To ascertain when the porcelain is sufficiently baked, small pieces are taken out in the manner already described, after which the fire is withdrawn, and the furnace allowed to cool gradually. If the process of baking have succeeded properly, the pieces of porcelain will, after this operation, be sonorous, compact, having a moderate degree of lustre, and covered externally with a fine coat of glaze. If this porcelain is destined to receive the ornaments of painting and gilding, these operations are performed in the manner to be afterwards described.

41 [Un]glazed [por]celain [cal]led bis[cui]t.

After the porcelain has been subjected to the process of baking, and before it is glazed, it is said to be in the state of *biscuit*, in which it possesses various degrees of beauty and perfection, according to the nature and proportions of the materials employed. For particular purposes, the porcelain is sometimes allowed to remain in this state, and particularly when it is employed in smaller and finer pieces of sculpture, where the fineness of the workmanship and the sharpness of the figures are wished to be preserved, as it is well known that these will be greatly injured by being covered with a coat of glazing. The celebrated manufactory of Sevres in France has been long distinguished for figures or small statues, and even for larger works, as ornamental vases, &c. which are left in the state of biscuit. The English manufactories, and particularly that of Mr Wedgwood, are probably not inferior in the delicacy and accuracy of execution of ornamental productions of this kind.

42 Method of glazing porcelain.

The next operation in the manufacture of porcelain is the process of glazing. This process consists in covering the porcelain with a thin coat of vitreous or fusible matter, which adds greatly to its beauty, by its lustre or shining appearance. In preparing and applying the materials fit for glazing porcelain, it has been found that the same kind of glass will not admit of general application; for it appears that a glass which forms a fine glazing for one kind of porcelain, will not answer the same purpose when applied to another. In the former it may have all the necessary requisites, but in the latter it may crack in many places, may have no lustre, and may contain bubbles or be apt to scale off. The first thing then is to prepare a glass which shall be suited to the nature of the porcelain for which it is intended. The glazing must be appropriated to each kind of porcelain, that is, to the ingredients which enter into its composition, or to the degree of hardness or density of the ware. The materials of which the glazing is composed are prepared by previously fusing together all the substances of which they consist, and thus forming a vitreous mass (A). This mass of vitrified matter is to be finely ground in a mill, and the vitreous powder thus obtained is to be mixed with a sufficient quantity of water, so that the liquor shall have the consistence of cream of milk. The pieces of porcelain are to be covered with a thin coating of this matter, which is done by immersing them hastily in the liquid, and as they greedily imbibe the water, there remains on the surface a uniform covering of the glazing materials. This covering, which, it is necessary to observe, should be very thin, in a short time becomes so dry, that it does not adhere to the fingers when the pieces are handled. When they are sufficiently dry, they are replaced in the furnace in the same manner as in preparing the biscuit, and the heat is continued till the glazing be completely fused; but the degree of heat necessary for that purpose is far inferior to that which is requisite in baking the paste. The pieces of porcelain which are intended to remain white, are now finished, but those which are to be ornamented with painting and gilding must go through various other operations, of which the following is a general account.

43 Of painting.

The colours which are employed in painting porcelain are similar to those which are applied in the painting of enamel. They are all composed of metallic oxides or calces, combined with a very fusible, vitreous matter. The different colours are obtained from different metals. The oxides of iron afford a red colour; gold precipitated by means of tin, furnishes a purple and violet colour; copper precipitated from its solution in acids by means of an alkali, gives a fine green; cobalt, or

(A) The proportion of the materials employed for common white pottery-ware are 60 parts of litharge, 10 of clay, and 20 of ground flint.

Porcelain. or when combined with vitreous matter, *zaffar*, as it is called, yields a fine blue. Earthy matters which are slightly ferruginous, produce a yellow colour, and brown and black colours are obtained from iron in different states, and from manganese. A coloured glazing has been recommended by O'Reilly *, which may be applied to coarse articles of earthen ware. It is obtained from the residuum after the distillation of oxymuriatic acid. The manganese contained in this residuum is said to communicate a blackish appearance like that of bronze, which, says the author, is far from being disagreeable to the eye. This glazing he employed several times by way of trial, first fusing it with sand in a potter's furnace, throwing it into cold water to facilitate its division, and grinding it in a mill, that it may be more completely diffused in water. This glazing is attended with the advantage of being free from those dangerous qualities so common in all preparations made from the oxides of lead. Whatever colouring matters are employed, they are finely ground with gum water, or with some essential oil, in which state they are fit to be employed for the painting of porcelain with figures of flowers, or any other design with which it is intended to be adorned.

* *Essay on Bleaching, Phil. Mag.* x. 260.

44 and gilding. In gilding porcelain, the oxide or calx of gold (B) is employed, and it is applied nearly in the same manner as the coloured enamels. The gold, which is in the state of very minute division, is mixed with gum water and borax, and in this state is applied to the clean surface of the porcelain with a fine camel's hair pencil. The painted and gilded porcelains are then exposed to such a degree of heat in the furnace as is capable of fusing the vitreous matter with which the metallic colours are mixed. The gold is fixed by means of the borax undergoing the process of vitrification, and thus strongly adhering to the porcelain. Most of the metallic colouring matters exhibit all their beauty when the porcelain is taken from the furnace; but to bring out the lustre and beauty of the gold, those parts of the porcelain which have been gilt are afterwards subjected to the operation of burnishing.

45 Use of platina in colouring porcelain. The use of platina in porcelain painting has been recommended by Klaproth; and experiments have been made on the subject by that celebrated chemist, with the view of ascertaining its effects for this purpose. The following is the conclusion of his observations.

"The process which I employ in the application of platina to painting on porcelain is simple and easy: it is as follows:—I dissolve crude platina in aqua regia, and precipitate it by a saturated solution of sal ammoniac in water. The red crystalline precipitate thence produced is dried, and being reduced to a very fine powder, is slowly brought to a red heat in a glass retort. As the volatile neutral salt combined with the platina in this precipitate, becomes sublimated, the metallic part remains behind in the form of a gray soft powder. This powder is then subjected to the same process as gold; that is to say, it is mixed with a small quantity of the same flux as that used for gold, and being ground with oil of spike, is applied with a brush on the porcelain; after which it is burnt-in under the muffle of an enameller's furnace, and then polished with a burnishing tool.

"The colour of platina burnt into porcelain in this manner is a silver white, inclining a little to a steel gray. If the platina be mixed in different portions with gold, different shades of colour may be obtained; the gradations of which may be numbered, from the white colour of unmixed platina to the yellow colour of gold. Platina is capable of receiving a considerable addition of gold before the transition from the white colour to yellow is perceptible. Thus, for example, in a mixture of four parts of gold and one of platina, no signs of the gold were to be observed, and the white colour could scarcely be distinguished from that of unmixed platina: it was only when eight parts of gold to one of platina were employed that the gold colour assumed the superiority.

"I tried in the like manner, different mixtures of platina and silver; but the colour produced was dull, and did not seem proper for painting on porcelain.

"Besides this method of burning-in platina in substance on porcelain, it may be employed also in its dissolved state; in which case it gives a different result both in its colour and splendour. The solution of it in aqua regia is evaporated, and the thickened residuum is then applied several times in succession to the porcelain. The metallic matter thus penetrates into the substance of the porcelain itself, and forms a metallic mirror of the colour and splendour of polished steel."

The same substance has been applied as a glazing to porcelain in some of the English manufactories, but however valuable and important the application of platina to this purpose may be, the scarcity of that metal, and its consequent high price, must always prevent it from coming into very general use.

We have already noticed the establishment of the manufacture of porcelain in Derby. The following is a short detail of the method of conducting that manufacture. After the paste has been properly prepared, by grinding and other necessary operations, it is delivered to the workmen, by whose dexterity the shapeless mass is converted into various beautiful forms. Vessels of a round form are usually made by a man called a *thrower*, by whom they are worked on a circular block moving horizontally on a vertical spindle. They are next carried to the lathe; and being fixed to the end of a horizontal spindle, they are reduced to the proper form and thickness. 46 Manufacture of porcelain at Derby.

(B) A powder of gold is prepared for this purpose in other two different ways. By one of those methods a quantity of gold leaf is put into a glass or earthen mortar, with a little honey or thick gum water, and ground till the gold is reduced to very minute particles; a little warm water is then added, which will wash out the honey or gum, and leave the gold behind: but the process by which the finest ground gold is obtained, is by gradually heating a gold amalgam in an open earthen vessel, and continuing the heat till the mercury is entirely evaporated, stirring the mixture with a glass rod, or tobacco pipe, that the particles of gold may be prevented from adhering as the mercury flies off. The gold remaining after the evaporation of the mercury is then ground with a little water in a Wedgwood-ware mortar, and after being dried is fit for use.

thickness. They are afterwards finished, and handled by other persons, if that should be necessary, and are then introduced into a stove, where the moisture is entirely evaporated, and they become fit for the process of baking. Vessels of an oval figure, such as tea-pots, tureens, &c. acquire their form by being pressed with the hand into moulds of plaster or gypsum. The pieces of porcelain being thus prepared, are put into the saggars or cases, which are of various sizes and dimensions, and these are set in the kiln or furnace, one upon the other, till they are filled up nearly to the top, in the manner already described. The furnace being full, the ware is baked, and after this first baking, the porcelain is in the state of *biscuit*.

47 Glazing.

The next process is the glazing, which, according to the description already given, is performed by dipping the pieces of porcelain in glaze of the consistence of cream. They are then conveyed to the glaze furnace, where they are again baked, but in a degree of heat inferior to that necessary for the first baking.

48 Painting.

If the pieces of porcelain are to receive the additional ornaments of painting and gilding, they are next delivered to another set of workmen. The colouring matters, as already noticed, are extracted from mineral bodies, and after proper preparation, they are applied to the ware by the painters, in the form of landscapes or figures, according to the requisite pattern. After this process the ware is again conveyed to the furnace, and the colours are vitrified, to give them the proper degree of fixation and lustre. After every coat or layer of colour, a fresh burning is necessary. In the common kind of porcelain, once or twice is found sufficient for the ornaments it requires; but in the finer decorations, the colours must be laid on several times, and as often subjected to the action of heat, before the full effect can be produced. This completes the process for those articles of porcelain in which glazing and painting only are required.

49 Gilding.

But when the pieces of porcelain are to be farther decorated with gilding, they are pencilled with a mixture of oil and gold, dissolved or thrown down by quicksilver with the aid of heat, and are again introduced to the furnace. Here the gold returns to its solid state, but comes out with a dull surface; and to recover its lustre and usual brilliancy, it is burnished with bloodstones, and other polishing substances. Much care and attention are necessary in the latter part of the process; for if the gold be not sufficiently burnt, it will be apt to separate in thin flakes, and if it have been exposed to too great a heat, it is not susceptible of a fine polish. In this manufactory, when pieces of porcelain are to be finished in the highest style, they are frequently returned to the enamel furnace, where the colours are fluxed six or seven different times; and having gone through the processes now described, the porcelain is fit for the market.

50 Biscuit figures.

White ware, or biscuit figures, are made at this manufactory, which are supposed to be equal in beauty and delicacy to any European productions of a similar kind. In this kind of porcelain, the lathe is of no use, for the figures are cast in moulds of plaster or gypsum. The materials of which they are composed being properly prepared, and previously reduced to a liquid of the appearance and consistence of thick cream, are poured into the moulds, which from the absorbent property of the plaster, imbibe the water contained in the mixture, so that the paste soon becomes sufficiently hard to part freely from the mould. The different parts of figures, as the head, arms, legs, &c. are cast in separate moulds, and after being dried and repaired, they are joined by a paste of the same kind, but of a thinner consistence. The porcelain pieces thus formed are then conveyed to the furnace, and after being subjected for a proper length of time, to a regular and continued heat, they come out extremely white and delicate.

51 Manufactory at Tournay.

Porcelain manufactories have been long established at Tournay in Flanders; one of these manufactories furnishes all Flanders with blue and white porcelain. At this manufactory they have a particular process in forming cups and other vessels, which is somewhat similar to that now described. They are neither turned on the lathe, nor is the clay compressed in a mould; but after being diluted in water, and when the liquid has acquired a proper consistency, the workmen pour it into moulds, two or three hundred of which are arranged together. When they have filled them all, they return to the first in the row. The liquid part is drawn off by a gentle inclination; the surplus adheres to the side of the vessel, and thus forms the piece which it is intended to make. The piece is detached from the mould by means of a slight stroke, and after being sufficiently dried, is conveyed to the furnace, to undergo the process of baking.

52 Utensils for chemical purposes.

In the manufacture of utensils for chemical purposes, where they are to be subjected to the effects of powerful agents, greater attention is necessary. Vessels of this description should be infusible at any degree of heat; possess a sufficient compactness of texture, to retain saline and other fluxes in fusion, without undergoing any change; and should bear sudden changes of temperature, particularly sudden heating, without cracking, or in any degree giving way. It has been found impracticable to have the three requisites now mentioned united in the same ware, so that it becomes necessary to select the kind of ware according to the purpose for which they are intended. For bearing high degrees of heat, Hessian crucibles are found to answer best; they are composed of a very refractory clay, mixed with sand, of which the finest part is separated by a sieve, and thrown away. These vessels are made by mixing the clay with a smaller proportion of water than usual, so that a stiffer mass is obtained, and the vessel brought to the requisite shape by ramming the clay strongly into an iron mould. In this way they are very compact, and for a considerable time retain saline fluxes. Ordinary crucibles, it is found, are rendered more retentive by lining them on the inside, before they are quite dry, with a thin coating of pure clay, without the addition of any other mixture. But the most refractory material known is a mixture of unburnt with burnt clay. Vessels made of this material are found capable of resisting the effects of saline fluxes longer than any other, and hence this material is employed in making large crucibles for glasshouses.

One of the most valuable qualities of porcelain ware, is to bear sudden changes of heat and cold; but in this quality some of the most perfect kinds of ware in other respects are extremely deficient, and can scarcely be subjected, without danger of cracking, to the draught of a wind furnace, even when the heat is slowly and gradually applied. This happens to the celebrated porcelain fire ware invented by an enlightened and philosophical manufacturer, the late Mr Wedgwood. This effect of cracking, on sudden changes of temperature, seems to depend on the hardness and closeness of texture; and the closeness of texture is found to be in proportion to the minute division of the materials before baking. The clay and flint of Wedgwood's ware are brought to a most impalpable powder before mixture, so that the texture is uncommonly hard and close. It may be worth while to mention, that Wedgwood's porcelain resists the effects of sudden heat and cold much better, by being covered with a thin coating of Windsor loam, or of a fire lute composed of coarse sand and clay, and tow or horse-dung. When crucibles are intended merely for the fusion of metals, they are greatly improved by a mixture of black lead. This substance being involved in the clay, is protected from the access of air, and is then incombustible. It has no affinity for the earths at any temperature, and being absolutely infusible, it enables the clay to bear, without melting, the greatest degree of heat. The mixture of this substance, as a material for crucibles, has another advantage, that no part of the melted metal is detained in the crucible, as is the case in the common rough ware. It also bears sudden heating and cooling better than any other.

53 Wedgwood's porcelain.

6. *General Principles of the Manufacture of Porcelain.*

Convinced that every accurate and scientific investigation into the nature and processes of any important art, will always be deemed of some value to the philosophic observer, or the enlightened manufacturer, we shall introduce the following observations on the principles of the manufacture of porcelain.

Observations by Vauquelin.

According to this celebrated chemist, four things may occasion difference in the qualities of earthen-ware: 1*st*, The nature or composition of the matter; 2*d*, The mode of preparation; 3*d*, The dimensions given to the vessels; 4*th*, The baking to which they are subjected. By composition of the matter, the author understands the nature and proportions of the elements of which it is formed. These elements, in the greater part of earthen ware, either valuable or common, are silex, argil, lime, and sometimes a little oxide of iron. Hence it is evident that it is not so much by the diversity of the elements that good earthen-ware differs from bad, as by the proportion in which they are united. Silex or quartz makes always two-thirds at least of earthen-ware; argil or pure clay, from a fifth to a third; lime, from 5 to 20 parts in the hundred; and iron from 0 to 12 or 15 parts in the hundred. Silex gives hardness, infusibility, and unalterability; argil makes the paste pliable, and renders it fit to be kneaded, moulded, and turned at pleasure. It possesses at the same time the property of being partially fused by the heat which unites its parts with those of the silex; but it must not be too abundant, as it would render the earthen-ware too fusible and too brittle to be used over the fire.

54. Nature of the component parts of porcelain.

Hitherto it has not been proved by experience that lime is necessary in the composition of pottery: and if traces of it are constantly found in that substance, it is because it is always mixed with the other earths, from which the washings and other manipulations have not been able to separate it. When this earth, however, does not exceed five or six parts in a hundred, it appears that it is not hurtful to the quality of the pottery; but if more abundant, it renders it too fusible.

The oxide of iron, besides the inconvenience of communicating a red or brown colour, according to the degree of baking, to the vessels in which it forms a part, has the property of rendering them fusible, and even in a greater degree than lime.

55 Mode of preparation.

As some kinds of pottery are destined to melt very penetrating substances, such as salts, metallic oxides, glass, &c. they require a fine kind of paste, which is obtained only by reducing the earths employed to very minute particles. Others destined for melting metals, and substances not very penetrating, and which must be able to support, without breaking, a sudden transition from great heat to great cold, require for their fabrication a mixture of calcined argil with raw argil. By these means you obtain pottery, the coarse paste of which resembles *breche*, or small-grained pudding-stone, and which can endure sudden changes of temperature.

56 Baking.

The baking of pottery is also an object of great importance. The heat must be capable of expelling humidity, and agglutinating the parts which enter into the composition of the paste, but not strong enough to produce fusion; which, if too far advanced, gives to pottery a homogeneousness that renders it brittle. The same effect takes place in regard to the fine pottery, because the very minute division given to the earths reduces them nearly to the same state as if this matter had been fused. This is the reason why porcelain strongly baked is more or less brittle, and cannot easily endure alternations of temperature. Hence coarse porcelain, in the composition of which a certain quantity of calcined argil is employed, porcelain retorts, crucibles, tubes, and common pottery, the paste of which is coarse, are much less brittle than dishes and saucers formed of the same substance, ground with more labour.

57 Dimensions of the different parts of vessels.

The general and respective dimensions of the different parts of vessels of earthen-ware have also considerable influence on their capability to stand the fire.

In some cases the glazing or covering, especially when too thick, and of a nature different from the body of the pottery, also renders them liable to break. Thus, in making some kinds of pottery, it is always essential, 1*st*, To follow the best proportion in the principles; 2*d*, To give to the particles of the paste, by grinding, a minuteness suited to the purpose for which it is intended, and to all the parts the same dimensions as far as possible; 3*d*, To carry the baking to the highest degree that the matter can bear without being fused; 4*th*, To apply the glazing in thin layers, the fusibility of which ought to approach as near as possible to that of the matter, in order that it may be more intimately united.

C. Vauquelin, being persuaded that the quality of good pottery depends chiefly on using proper proportions of the earthy matters, though it might be of importance, to those engaged in this branch of manufacture, to make known the analysis of different natural clays employed for this purpose, and of pottery produced by some of them, in order that, when a new earth is

Porcelain. is discovered, it may be known by a simple analysis whether it will be proper for the same object, and to what kind of pottery already known it bears the greatest resemblance.

	Hessian Crucibles.	Argil of Dreux.	Porcelain Capsules.	Wedgwood's Pyrometers.
Silex . . .	69	43.5	61	64.2
Argil . . .	21.5	33.2	28	25
Lime . . .	1	3.5	6	6
Oxide of iron .	8	1.	0.5	0.2
Water . . .	..	18.	...	6.2

Raw kaolin 100 parts.—Silex 74, argil 16.5, lime 2, water 7. A hundred parts of this earth gave eight of alum, after being treated with the sulphuric acid.

Washed kaolin 100 parts.—Silex 55, argil 27, lime 2, iron 0.5, water 14. This kaolin, treated with the sulphuric acid, gave about 45 or 50 *per cent.* of alum.

Petuntzé.—Silex 74, argil 14.5, lime 5.5, loss 6. A hundred parts of this substance, treated with the sulphuric acid, gave seven or eight parts of alum. But this quantity does not equal the loss sustained.

Porcelain of retorts.—Silex 64, argil 28.8, lime 4.55, iron 0.50, loss 2.77. Treated with the sulphuric acid, this porcelain gave no alum.

There is a kind of earthen vessels, called *Alcarrezes*, used in Spain for cooling the water intended to be

58 Porous ware. drunk. These vessels consist of 60 parts of calcareous earth, mixed with alumina and a little oxide of iron, and $36\frac{1}{2}$ of siliceous earth, also mixed with alumina and the same oxide. The quantity of iron may be estimated at almost one hundredth part of the whole. This earth is first kneaded into a tough paste, being for that purpose previously diluted with water; formed into a cake of about six inches in thickness, and left in that state till it begin to crack. It is then kneaded with the feet, the workman gradually adding to it a quantity of sea-salt, in the proportion of seven pounds to a hundred and fifty: after which it is applied to the lathe, and baked in any kind of furnace used by potters. The alcarrezes, however, are only about half as much baked as the better kinds of common earthen ware; and being exceedingly porous, water oozes through them on all sides. Hence the air, which comes in contact with it, by making it evaporate, carries off the caloric contained in the water in the vessel, which is thus rendered remarkably cool.

Observations of Brongniart.

The author of the following observations is superintendant of the celebrated porcelain manufactory at Sevres in France. The extensive views he has taken of the subject, and the general principles which he has advanced, will, we doubt not, be favourably received by the intelligent manufacturer, and meet with attention and consideration adequate to their importance and utility.

59 Enamel of the ancients. "The art of employing metallic oxides for colouring by fusion different vitreous matters, is of very great antiquity: every body knows that the ancients manufactured coloured glass and enamel, and that this art was practised in particular by the Egyptians, the first people who in this manner imitated precious stones. The practice of this art in modern times has been carried to a high degree of perfection: but the theory has been neglected; it is almost the only one of the chemical arts in which no attempt has yet been made to apply the new principles of that science. Porcelain.

"It is well known that all vitrifiable colours have for their basis metallic oxides; but all the metallic oxides are not proper for this purpose: besides, as they are not vitrifiable by themselves, they can scarcely ever be employed alone. 60

"Highly volatile oxides, and those which adhere little to the great quantity of oxygen they contain, either cannot be employed in any manner, as the oxide of mercury and that of arsenic, or are employd only as agents. The colour they present cannot be depended on, since they must lose it in the slightest heat by losing a part of their oxygen: such are the puce-coloured and red oxides of lead, the yellow oxides of gold, &c. Oxides in which the proportions of oxygen are susceptible of varying with too much facility are rarely employed: the oxide of iron, though black, is never employed for that colour, and the green oxide of copper is, under many circumstances, very uncertain. I have said that oxides alone are not susceptible of fusion: however, as they are destined to be applied to thin strata on vitrifiable substances, they may be attached to them by a violent heat. But, except the oxides of lead and bismuth, they would give only dull colours. The violent heat, often necessary to fix them, would change or totally destroy the colours. A flux then is added to all metallic oxides. Metallic oxides employed as colours for porcelain.

"This flux is glass, lead, and silex; glass of borax, or a mixture of both. Its general effect is, to give splendour to the colours after their fusion; to fix them on the article which is painted, by promoting more or less the softening of its surface; to envelope the metallic oxides, and to preserve their colour by sheltering them from the contact of the air: in a word, to facilitate the fusion of the colour at a low temperature not capable of destroying it. 61

"I shall speak here only of the application of metallic colours to vitreous bodies or to vitreous surfaces. These bodies may be divided into three classes, very distinct by the nature of the substances which compose them, the effects produced on them by the colours, and the changes they experience. These classes are: 1*st*, Enamel, soft porcelain, and all crusts, enamels, or glass, that contain lead in a notable quantity. 2*d*, Hard porcelain, or porcelain which has a crust of feldspar. 3*d*, Glass in the composition of which no lead enters, such as common window-glass. Nature of the substances to which they are applied.

"I shall here examine in succession the principles of the composition of these colours, and the general phenomena they exhibit on these three kinds of bodies.

"It is well known that enamel is glass rendered opake by the oxide of tin, and exceedingly fusible by the oxide of lead. It is the oxide of lead, in particular, contained in it, that gives it properties very different from those of the other excipients of metallic colours. Thus all glass and glazing that contain lead will participate in the properties of enamel; and what we shall say of one may be applied to the rest with very trifling differences.

Such are the white and transparent glazing of stone ware, and the glazing of porcelain called *soft glazing*.

"Enamel

Porcelain.

"Enamel or soft porcelain colours require less flux than others, because the glass on which they are applied becomes sufficiently soft to be penetrated by them. This flux may be either glass of lead and pure silex, called *rocaille*, or the same glass mixed with borax. Montamy asserts that glass of lead ought to be banished from among the enamel fluxes; and he employs only borax. He then dilutes his colours in a volatile oil. On the other hand, the painters of the manufactory of Sevres employ only colours without borax, because they dilute them in gum; and borax does not dilute well in that substance. I have found that both methods are equally good; and it is certain that Montamy was wrong to exclude fluxes of lead, since they are daily employed without any inconvenience, and as they even render the application of colours easier.

62 Flux for soft porcelain colours.

"I have said that in the baking of these colours, the crust, softened by the fire, suffers itself to be easily penetrated by them. This is the first cause of the change which they experience. By mixing with the crust they become weaker, and the first heat changes a figure which appeared to be finished into a very light sketch.

The two principal causes of the changes which colours on enamel and soft porcelain are susceptible of experiencing do not depend in any manner on the composition of these colours, but on the nature of the glass to which they are applied. It follows from what has been said, that painting on soft procelain has need of being several times retouched, and of several heats, in order that it may be carried to the necessary degree of strength. These paintings have always a certain faintness; but they are constantly more brilliant, and they never are attended with the inconvenience of detaching themselves in scales.

"Hard porcelain, according to the division which I have established, is the second sort of excipient of metallic colours. This porcelain, as is well known, has for its base a very white clay called *kaolin*, mixed with a silicious and calcareous flux, and for its covering feldspar fused without an atom of lead.

63 Colours applied to hard porcelain.

"This porcelain, which is that of Saxony, is much newer at Sevres than the soft porcelain. The colours applied to it are of two kinds: the first, destined to represent different objects, are baked in a heat very inferior to that necessary for baking porcelain. They are exceedingly numerous and varied. The others, destined to be fused in the same heat as that which bakes porcelain, lay themselves flat, and are much less numerous. The colours of painting are made nearly like those destined for soft porcelain; they only contain more flux. Their flux is composed of glass of lead and borax. When porcelain is exposed to heat in order to bake the colours, the covering of feldspar dilates itself and opens its pores, but does not become soft; as the colours do not penetrate it, they experience none of those changes which they undergo on soft porcelain. It must however be said that they lose a little of their intensity by acquiring that transparency which is given to them by fusion.

"One of the greatest inconveniences of these colours, especially in the manufactory of Sevres, is the facility with which they scale off when exposed several times in the fire.

"To remedy this defect without altering the quality of the paste, I was of opinion that the crust only ought to be softened by introducing into it more siliceous or calcareous flux, according to the nature of the feldspar. This method has succeeded; and for about a year past the colours might be exposed two or three times to the fire without scaling, if not overcharged with flux, and if not laid on too thick.

"The third sort of excipient of vitrifiable metallic colours is glass without lead.

64 And to glass.

"The application of these colours to glass constitutes painting on glass; an art very much practised some centuries ago, and which was supposed to be lost because out of fashion; but it has too direct a dependence on painting in enamel and porcelain to be entirely lost.

"The matters and fluxes which enter into the composition of the colours employed on glass are in general the same as those applied to porcelain. Neither of them differ but in their proportions; but there are a great number of enamel or porcelain colours which cannot be applied to glass, where they are deprived of the white ground which serves to give them relief.

Of Colours in particular.

"After collecting the general phenomena exhibited by each class of vitrifiable colours, considered in regard to the body on which they are applied, I must make known the most interesting particular phenomena exhibited by each principal kind of colours employed on soft porcelain and glass in a porcelain furnace.

Of Reds, Purples, and Violets, made from Gold.

"Carmine red is obtained by the purple precipitate of cassius: it is mixed with about six parts of its flux; and this mixture is employed directly, without being fused. It is then of a dirty violet, but by baking it acquires a beautiful red carmine colour: it is, however, exceedingly delicate; a little too much heat and carbonaceous vapours easily spoil it. On this account it is more beautiful when baked with charcoal than with wood.

"This colour and the purple, which is very little different, as well as all the shades obtained from it, by mixing it with other colours, really change on all porcelain and in every hand. But it is the only one that changes on hard porcelain. Its place may be supplied by a rose-colour from iron which does not change; so that by suppressing the carmine made with gold, and substituting for it the rose oxide of iron here alluded to, you may exhibit a palette composed of colours none of which change in a remarkable manner. This rose-coloured oxide of iron has been long known; but it was not employed on enamel, because on that substance it changes too much. As the painters on enamel, however, have become the painters on porcelain, they have preserved their ancient method.

"It might be believed that, by first reducing to a vitreous matter the colour called *carmine* already mixed with its flux, it might be made to assume its last tint. But the heat necessary to fuse this vitreous mass destroys the red colour, as I have experienced. Besides, it is remarked that, to obtain this colour very beautiful, it must be exposed to the fire as few times as possible.

"The carmine for soft porcelain is made with fulminating gold slowly decomposed, and muriate of silver; no tin enters into it; which proves that the combination of the oxide of this metal with that of gold is not necessary to the existence of the purple colour.

"Violet

"Violet is made also with purple oxide of gold. A greater quantity of lead in the flux is what gives it this colour, which is almost the same crude or baked.

"These three colours totally disappear when exposed to a great porcelain heat.

"Carmine and purple have given us in glass tints only of a dirty violet. The violet, on the other hand, produces on glass a very beautiful effect, but it is liable to turn blue. I have not yet been able to discover the cause of this singular change, which I saw for the first time a few days ago.

Red, Rose, and Brown Colours, extracted from Iron.

"These colours are made from red oxide of iron prepared with nitric acid. These oxides are further calcined by keeping them exposed to the action of heat. If heated too much, they pass to brown.

"Their flux is composed of borax, sand, and minium, in small quantity.

"These oxides give rose and red colours capable of supplying the place of the same colours made with oxide of gold. When properly employed on hard porcelain, they do not change at all. I have caused roses to be painted with these colours, and found no difference between the baked flower and that not baked, except what might be expected to result from the brilliancy given to colours by fusion.

"These colours may be employed indiscriminately, either previously fused or not fused.

"In a great heat they in part disappear, or produce a dull brick red ground, which is not agreeable.

"The composition of them is the same both for soft porcelain and for glass. They do not change on the latter; but on soft porcelain they disappear almost entirely on the first exposure to heat, and to make any thing remain they must be employed very deep.

"This singular effect must be ascribed to the presence of lead in the crust or glazing. I assured myself of this by a very simple experiment. I placed this colour on window glass, and having exposed it to a strong baking, it did not change.

"I covered several parts of it with minium; and again exposing it to the fire, the colour was totally removed in the places where the red oxide of lead had been applied.

"By performing this operation on a larger scale in close vessels, a large quantity of oxygen gas was disengaged.

"It appears to me that this observation clearly proves the action of oxidated lead on glass as a destroyer of colour: it is seen that it does not act, as was believed, by burning the combustible bodies, which might tarnish the glass, but by dissolving, discolouring, or volatilizing with it the oxide of iron, which might alter its transparency.

Yellows.

"Yellows are colours which require a great deal of care in the fabrication on account of the lead which they contain, and which, approaching sometimes to the metallic state, produces on them black spots.

"The yellows for hard and soft porcelain are the same: they are composed of the oxide of lead, white oxide of antimony, and sand.

"Oxide of tin is sometimes mixed with them; and when it is required to have them livelier, and nearer the colour *du souci*, red oxide of iron is added, the too great redness of which is dissipated in the previous fusion to which they are exposed by the action of the lead contained in this yellow. These colours, when once made, never change: they disappear, however, almost entirely when exposed to a porcelain heat.

"These yellows cannot be applied to glass: they are too opake and dirty. That employed by the old painters on glass has, on the contrary, a beautiful transparency, is exceedingly brilliant, and of a colour which approaches near to that of gold. The processes which they gave clearly showed that silver formed part of their composition; but, when exactly followed, nothing satisfactory was obtained. C. Miraud, whom I have already had occasion to mention, has found means to make as beautiful paintings on glass as the ancients, by employing muriate of silver, oxide of zinc, white argil, and yellow oxide of iron. These colours are applied on glass merely pounded, and without a flux. The oxide of iron brings the yellow to that colour which it ought to have after baking, and contributes with the argil and oxide of zinc to decompose the muriate of silver without deoxidating the silver. After the baking, there remains a dust which has not penetrated into the glass, and which is easily removed.

"This yellow, when employed thicker, gives darker shades, and produces a russet.

Blues.

"It is well known that these are obtained from the oxide of cobalt. All chemists are acquainted with the preparation of them. Those of Sevres, which are justly esteemed for their beauty, are indebted for it only to the care employed in manufacturing them, and to the quality of the porcelain, which appears more proper for receiving them in proportion to the degree of heat which it can bear.

"I remarked respecting the oxide of cobalt a fact which is perhaps not known to chemists: it is volatile in a violent heat: it is to this property we must ascribe the blueish tint always assumed by white in the neighbourhood of the blue. I have placed expressly on purpose, in the same case, a white piece close to a blue one, and found that the side of the white piece next the blue became evidently blueish.

"The blue of hard porcelain, destined for what is called the ground for a great heat (*les fonds au grand feu*) is fused with feldspar; that of soft porcelain has for its flux silex, potash, and lead: it is not volatilized like the preceding; but the heat it experiences is very inferior to that of hard porcelain.

"These colours, when previously fused, do not change at all in the application.

"Blues on glass exhibit the same phenomena as those on soft porcelain.

Greens.

"The greens employed in painting are made with green oxide of copper, or sometimes with a mixture of yellow or blue. They must be previously fused with their flux, otherwise they will become black; but after this first fusion they no longer change.

"They cannot stand a strong heat, as it would make them disappear entirely. Green grounds for a strong heat

heat are composed with the oxides of cobalt and nickel, but a brownish green only is obtained.

"Blueish greens, called *celestial blues*, which were formerly colours very much in vogue, can be applied only upon soft porcelain; on hard porcelain they constantly become scaly, because potash enters into their composition.

"These greens cannot be applied on glass: they give a dirty colour. To obtain a green on glass, it is necessary to put yellow on one side, and blue, more or less pale, on the other. This colour may be made also by a mixture of blue with yellow oxide of iron. I hope to obtain from oxide of chrome a direct green colour. The trials I have made give me reason to hope for success. Pure chromate of lead, which I applied to porcelain in a strong heat, gave me a pretty beautiful green of great intensity and very fixed.

Bistres and Russets.

"These are obtained by mixtures in different proportions of manganese, brown oxide of copper, and oxide of iron from ombre earth. They are also previously fused with their flux, so that they do not change in any manner on soft porcelain, as lead has not the same action on oxide of manganese as on that of iron, as I assured myself by an experiment similar to that already mentioned.

"This colour fades very speedily on glass.

"Russet grounds in a great heat, known under the name of *tortoise-shell grounds*, are made in the some manner. Their flux is feldspar: no titanium enters into their composition, though said so in all printed works. Titanium was not known at the manufactory of Sevres when I arrived there. I treated this singular metal in various ways, and never obtained but grounds of a pale dirty yellow, and very variable in its tone.

Blacks.

"Blacks are the colours most difficult to be obtained very beautiful. No metallic oxide gives alone a beautiful black. Manganese is that which approaches nearest to it. Iron gives an opake, dull, cloudy black, which changes very easily to red: the colour-makers, therefore, to obtain a black which they could not hope for from the best theorist, have united several metallic oxides which separately do not give black, and have obtained a very beautiful colour, which, however, is liable to become scaly and dull.

"These oxides are those of mangenese, the brown oxides of copper, and a little of the oxide of cobalt. The gray is obtained by suppressing the copper, and increasing the dose of the flux.

"The manufactory of Sevres is the only one which has hitherto produced beautiful blacks in a strong heat. This is owing rather to the quality of its paste than to any peculiar processes, since it does not conceal them. It is by darkening the blue by the oxides of manganese and iron that they are able in that manufactory to obtain very brilliant blacks.

"Having here made known the principles of the fabrication of each principal colour, it may be readily conceived that by mixing these colours together all the shades possible may be obtained. It is evident also that care in the preparation, choice in the raw materials, and a just proportion of doses, must produce in the results differences very sensible to an eye accustomed to painting. A mere knowledge of the composition of the colours does not give the talent of executing them well.

"In recapitulating the facts above mentioned, to present them under another general point of view, it is seen,

"1st, That among colours generally employed on hard porcelain one only is susceptible of changing, viz. carmine, and the tints into which it enters: that its place may be supplied by the reds of iron, and that no colour then changes.

"I have presented to the Institute a head not baked, executed according to this method: and the painting of two roses, that of the one baked, and that of the other not baked. It has been seen that there was no difference between them.

"2d, That among the colours for soft porcelain and enamel, several change in a considerable degree. These are principally the reds of gold and iron, the yellows, the greens, the browns. They have not been replaced by others, because this kind of painting has been almost abandoned.

"3d, That several of the colours on glass change also by acquiring complete transparency. These in particular are the yellows and greens.

"4th, That it is neither by calcinating the colours in a higher degree, nor previously fusing them, as supposed by some, that they are prevented from changing, since these means really alter the changing colours, and produce no effect on the rest. The change which several colours experience on soft porcelain and on glass does not then depend on the nature of their composition, but rather on that of the body on which they are applied.

"Consequently, by suppressing from the colours of hard porcelain the carmine of gold, which is not indispensably necessary, we shall have a series of colours which do not change."

As it must be of no small importance to the chemical manufacturer to be acquainted with the results of experiments on the effects of heat, when applied to different proportions of the materials employed in making porcelain, or other analogous ware, we shall insert the following tables, exhibiting those results. The first table contains the results of the numerous experiments of Achard and Morveau on the vitrification of earths with saline bodies. The mixture of the earths and salts was made in a clay crucible, and, in the experiments of Morveau, the crucible was exposed for two hours to a heat from 22° to 26° of Wedgwood's pyrometer; but in those of Achard, the crucible was kept for three hours in the heat of a strong wind furnace, in which the temperature was probably higher than the former.

The second table presents a view of the effects of the vitrification of earths by means of metallic oxides. The mixtures were exposed in earthen crucibles to the heat of a porcelain furnace during the whole time required to bake porcelain ware.

In the third table are exhibited the curious results of the effects of vitrifying materials on the crucibles in which the vitrification takes place. It is to be observed, that the effects of the same materials, and in the same proportions, are very different, in different vessels; and without attending to this circumstance, very erroneous conclusions will be drawn in estimating the action of vitrifiable substances on each other. This diversity of the effects of the same materials in different crucibles, was

was first noticed by Pott. The subject was still farther prosecuted by Gerrard, who made a number of experiments, from which he obtained the results expressed in the table He exposed various natural minerals to a degree of heat sufficient to melt cast iron for an hour, under precisely the same circumstances, with this difference only, that one specimen of each mineral was inclosed in a crucible of clay, another in one of chalk, and a third in one of charcoal. The difference of the result which is given in the tables was particularly noticed.

TABLE I. *Shewing the Results of the Vitrification of Earths with Saline Bodies.*

	Mixture.		*Results.*
A.	SILEX Carbonate of potash	1. 1.	A yellow glass, not hard enough to give sparks with steel.
M.	Silex Carbonate of soda (dry)	1. 2.	A colourless transparent glass, but deliquescent from the excess of alkali.
A.	Silex Carbonate of potash	3. 1.	A yellow glass, not scintillant.
A.	Silex Carbonate of potash	4. 1.	A vitriform mass, yellow, hard, and scintillant.
M.	Silex Borax (calcined)	1. 2.	A beautiful transparent glass, not at all soluble in water.
A.	Silex Boracic acid	1. 1.	A white porcellanous mass, scarcely scintillant.
A.	Silex Boracic acid	1. 2.	A hard transparent glass—scintillant.
A.	Silex Boracic acid	4. 1.	A white opake melted porous mass—scintillant.
A.	Silex Calcined borax	3. 1.	A transparent glass—hard and scintillant.
A.	Silex Calcined borax	4. 1.	A mass resembling agate—but perfectly fused and scintillant.
A.	Silex Sulphate of soda	2. 1.	A green scintillant glass.
A.	Silex Nitre	3. 1	A soft green transparent glass.
A.	Silex Common salt	1. 2.	Scoria—the crucible entirely destroyed.
M.	Silex Phosphate of soda and ammonia	1. 2.	A white opake, puffy, vitreous mass, deliquescent, and reddening litmus.
M.	LIME Carbonate of soda	1. 2.	A white spongy opake mass, crumbling between the fingers.
A.	Chalk Carbonate of potash	2. 1.	Partly fused—the rest pulverulent—the crucible strongly corroded.
A.	Chalk Carbonate of potash	1. 2.	A well-fused, polished, black scintillant glass.
A.	Chalk Carbonate of potash	4. 1.	Remained a white powder.
M.	Lime Borax	1. 2.	A fine transparent yellowish glass—the crucible strongly corroded.
A.	Chalk Borax	4. 1.	A well-fused, black, scintillant, polished mass.
A.	Chalk Borax	3. 1.	A yellow scintillant glass.
A.	Chalk Boracic acid	1. 2.	A yellow glass—run through the crucible.

	Mixture.		*Result.*
A.	Chalk Sulphate of soda	3. 1.	A hard yellow scintillant glass.
A.	Chalk Sulphate of soda	1. 4.	A hard brown scoria—the crucible totally destroyed.
A.	Chalk Nitrate of soda	1. 1.	A hard yellow glass.
A.	Chalk Common salt	1. 1.	A yellow scintillant glass—the crucible entirely destroyed.
M.	Lime Phosphate of soda and ammonia	1. 2.	A white opake crumbly mass.
M.	ALUMINE Carbonate of soda	1. 2.	A gray opake ill fused fritt, not cohering to the crucible and deliquescent.
A.	Alumine Carbonate of soda and potash in all proportions from 1 to	4. 12.	Remained unmelted and uncohering.
A.	Alumine Carbonate of potash	1. 4.	Partially melted, but soft and friable.
M.	Alumine Borax	1. 2.	A fine transparent clear green glass.
A.	Alumine Borax	1. 1.	Remained pulverulent.
A.	Alumine Boracic acid	1. 4.	Part unfused and remaining pulverulent, the rest partially melted.
M.	Alumine Phosphate of soda and ammonia	1. 2.	A green fritt easily friable.
M.	MAGNESIA Carbonate of soda	1. 2.	A white opake uncohering mass.
M.	Magnesia Borax	1. 2.	A semi-transparent somewhat milky glass of a gelatinous appearance, but very hard and brilliant on the surface.
M.	Magnesia Phosphate of soda and ammonia	1. 2	A white mass a little agglutinated but not adhering to the crucible.
M.	Barytes (pure) Carbonate of soda	1. 2.	A very hard semi-vitrified mass, of a clear green.
M.	Barytes Borax	1. 2.	A beautiful transparent glass with a faint yellow tinge, strongly adhering to the crucible.
M.	Barytes Phosphate of soda and ammonia	1. 2.	A remarkably fine transparent glass.

TABLE II. *Containing the Results of the Vitrification of Earths by Metallic Oxides.*

Mixture.		*Result.*	*Colour and Texture.*
Silex Oxide of iron	1. 1.	Scoria	Black and polished—hard, giving sparks with steel.
Silex Oxide of iron	2. 1.	Not fused	Black and friable.
Silex Oxide of iron	1. 2.	Scoria run through the crucible	Black and hard—scintillant.
Silex Oxide of copper	1. 1.	Not fused.	
Silex Oxide of copper	4. 1.	Not fused.	

celain. Porcelain.

Mixture.		Result.	Colour and Texture.
Silex - - Oxide of lead -	1. 1.	A solid mass but not fused -	White and hard.
Silex - Oxide of lead -	1. 2.	Fused, porous, and semi-vitrified -	Yellow—not scintillant.
Silex - Oxide of lead -	1. 3.	Perfect glass - - -	Green—not scintillant.
Silex - Oxide of tin -	1. 1.	A coherent mass - -	Gray—easibly friable.
Silex - Oxide of tin -	1. 2.	Vitrified - -	Greenish yellow—not scintillant.
Silex - Oxide of bismuth	1. 1.	Remained in powder.	
Silex - Oxide of bismuth	1. 4.	Perfect glass - -	Deep yellow—not scintillant.
Silex - Oxide of antimony	1. 1.	Glass - - -	Colourless—scintillant.
Silex - Oxide of antimony	2. 1.	Not melted - - -	Gray and friable.
Silex - Oxide of zinc -	1. 1.	Remained in powder.	
Silex - Oxide of zinc -	1. 2.	Melted only where touching the crucible.	White—hard.
Silex - Oxide of zinc -	1. 3.	Perfectly fused - -	Gray—scintillant.
LIME (carbonated) Oxide of iron -	1. 1.	A melted porous mass	Black—scintillant.
Lime - Oxide of copper	1. 1.	Melted, polished in the fracture, part of the copper reduced - -	Red—scintillant.
Lime - Oxide of copper	3. 1.	Melted, but porous - -	The same.
Lime - Oxide of copper	4. 1.	Part only melted, the rest pulverulent	Gray.
Lime - Oxide of lead -	1. 1.	Glass - -	Greenish yellow—scintillant.
Lime - Oxide of lead -	2. 1.	Glass run through the crucible -	Yellow—scintillant.
Lime - Oxide of lead -	3. 1.	Remained in powder.	
Lime - Oxide of tin -	1. 1.	Semi-vitrified - -	Yellow—scintillant.
Lime - Oxide of tin -	2. 1.	Glass - -	Greenish yellow—scintillant.
Lime - Oxide of tin -	3. 1.	Melted only where touching the crucible	Gray.
Lime - Oxide of tin -	4. 1.	Glass - -	Greenish yellow—scintillant.
Lime - Oxide of bismuth	1. 2.	Vitriform mass - -	Green.
Lime - Oxide of antimon	1. 1.	Glass penetrating the crucible	Yellow—scintillant.

Mixture.		*Result.*	*Colour and Texture.*
Lime - Oxide of antimony	2. 1.	Remained in powder.	
Lime - Oxide of antimony	1. 4.	Glass penetrating the crucible -	Deep yellow—scintillant.
Lime - Oxide of antimony	4. 1.	A semi-transparent polished mass -	Gray yellow—scintillant.
Lime - Oxide of zinc -	1. 1.	Glass - - - -	Deep yellow—scintillant.
ALUMINE - Oxide of iron -	1. 1.	Only partially fused.	
Alumine - Oxide of iron -	1. 3.	A melted porous mass - -	Black—scintillant.
Alumine - Oxide of copper -	1. 1.	Only partially fused.	
Alumine - Oxide of copper -	1. 4.	The same.	
Alumine - Oxide of lead -	1. 1.	Remained in powder.	
Alumine - Oxide of lead -	1. 3.	The same.	
Alumine - Oxide of lead -	1. 4.	Glass - - - -	Deep yellow—scintillant.
Alumine - Oxide of tin -	1. 2.	A melted porous mass, not polished in the fracture - - -	Gray—scintillant.
Alumine - Oxide of bismuth	1. 2.	Partially fused.	
Alumine - Oxide of antimony	1. 4.	Only partially fused.	
Alumine - Oxide of zinc -	1. 4.	Remained in powder.	
MAGNESIA - Oxide of iron -	1. 3.	Half fused, but not cohering.	
Magnesia - Oxide of copper -	1. 3.	A porous half-fused mass - -	Gray—scintillant.
Magnesia - Oxide of lead -	1. 3.	Not fused.	
Magnesia - Oxide of lead -	1. 4.	A porous melted mass, part of the oxide reduced.	
Magnesia - Oxide of antimony	1. 3.	Beginning to fuse - - -	Gray—scintillant.

TABLE III. *Shewing the Action of the Vitrifying matters on the Crucibles that contain them.*

Substances used.	*Result in the Clay crucible* (A).	*Result in the Chalk crucible* (B).	*Result in the Charcoal crucible* (C).
Common flint.	Opake and milk-white, but without fusion.	Opake and white, but with beginning fusion where in contact with the crucible.	As in A.
Marble.	Run into a green glass.	No change.	No change.
Gypsum.	Run into a radiated green glass.	No change.	No change.

Fluor

Substances used.	Result in the Clay crucible (A.)	Result in the Chalk crucible (B).	Result in the Charcoal crucible (C).
Fluor spar.	Melted and ran through the crucible.	Melted down with the crucible to a tough slag.	Scarcely altered, except slight fusion at the edges.
Porcelain clay.	Compact, white and no signs of fusion.	Run into a hard blue clear glass.	As in A.
Ditto, another kind.	A compact mass partially melted.	A perfectly black glass.	As in A.
Reddle.	A black glass covered with a crust of reduced iron.	A semitransparent apple-green glass.	A brown scoria containing grains of iron.
Jasper.	No fusion, but the colour changed to brown.	Completely fused in the parts touching the crucible.	As in A.
Muscovy talc.	A black glass with interspersed grains of iron.	The whole crucible was penetrated with a scoria so as not to fall to powder on exposure to air.	As in A.
Spanish chalk.	Only hardened.	A gray semitransparent glass	As in A.
Basalt.	Brown-yellow glass with a crust of iron.	A green scoria, also with a crust of iron.	A green glass with many grains of iron.

For an account of some valuable experiments of a similar nature, which were made by the celebrated Klaproth, in crucibles of clay and charcoal, in which the differences of the results are very striking, the reader is referred to his Analyt. Essays, or to Aikin's Dictionary of Chemistry and Mineralogy.

Porcelain-Shell, a species of Cypræa. See Cypræa, Conchology *Index*.

PORCH, in *Architecture*, a kind of vestibule supported by columns; much used at the entrance of the ancient temples, halls, churches, &c.

A porch, in the ancient architecture, was a vestibule, or a disposition of insulated columns usually crowned with a pediment, forming a covert place before the principal door of a temple or court of justice. Such is that before the door of St Paul's, Covent-Garden, the work of Inigo Jones. When a porch had four columns in front, it was called a *tetrastyle;* when six, *hexastyle;* when eight, *octostyle*, &c.

Porch, in Greek στοα, a public portico in Athens, adorned with the pictures of Polygnotus and other eminent painters. It was in this portico that Zeno the philosopher taught; and hence his followers were called *Stoics*. See Stoics and Zeno.

PORCUPINE. See Hystrix, Mammalia *Index*.

Porcupine-Man, the name by which one Edward Lambert, who had a distempered skin, went in London. We have the following account of him in the Philosophical Transactions for 1755, by Mr Henry Baker, F. R. S. "He is now (says he) 40 years of age, and it is 24 years since he was first shown to the society. The skin of this man, except on his head and face, the palms of his hands, and the soles of his feet, is covered with excrescences that resemble an innumerable company of warts, of a brown colour and cylindrical figure; all rising to an equal height, which is about an inch, and growing as close as possible to each other at their basis; but so stiff and elastic as to make a rustling noise when the hand is drawn over them. These excrescences are annually shed, and renewed in some of the autumn or winter months. The new ones, which are of a paler colour, gradually rise up from beneath as the old ones fall off; and at this time it has been found necessary for him to lose a little blood, to prevent a slight sickness which he had been used to suffer before this precaution was taken. He has had the small-pox, and he has been twice salivated, in hopes to get rid of this disagreeable covering; but though just when the pustules of the smallpox had scaled off, and immediately after his salivations, his skin appeared white and smooth, yet the excrescences soon returned by a gradual increase, and his skin became as it was before. His health, during his whole life has been remarkably good; but there is one particular of his case more extraordinary than all the rest; this man has had six children, and all of them had the same rugged covering as himself, which came on like his own about nine weeks after the birth. Of these children only one is now living, a pretty boy, who was shown with his father. It appears therefore, as Mr Baker remarks, that a race of people might be propagated by this man, as different from other men as an African is from an Englishman; and that if this should have happened in any former age, and the accidental original have been forgotten, there would be the same objections against their being derived from the same common stock with others: it must therefore be admitted possible, that the differences now subsisting between one part of mankind and another may have been produced by some such accidental cause, long after the earth had been peopled by one common progenitor."

PORE, in *Anatomy*, a little interstice or space between the parts of the skin, serving for perspiration.

PORELLA, a genus of plants belonging to the cryptogamia class. See Botany *Index*.

PORENTRU, a town of Switzerland, in Elsgaw, and capital of the territory of the bishop of Basle, which is distinguished only by its castle and cathedral. The bishop was formerly a prince of the empire. It is seated on the river Halle, near Mount Jura, 22 miles south of Basle. E. Long. 7. 2. N. Lat. 47. 34.

PORISM, in *Geometry*, is a name given by the ancient geometers to two classes of mathematical propositions. Euclid gives this name to propositions which are involved in others which he is professedly investigating, and which, although not his principal object, are yet obtained along with it, as is expressed by their name *porismata*, "acquisitions." Such propositions are now called

called *corollaries*. But he gives the same name, by way of eminence, to a particular class of propositions which he collected in the course of his researches, and selected from among many others on account of their great subserviency to the business of geometrical investigation in general. These propositions were so named by him, either from the way in which he discovered them, while he was investigating something else, by which means they might be considered as gains or acquisitions, or from their utility in acquiring farther knowledge as steps in the investigation. In this sense they are porismata; for πορίζω signifies both to investigate and to acquire by investigation. These propositions formed a collection, which was familiarly known to the ancient geometers by the name of Euclid's *porisms;* and Pappus of Alexandria says, that it was a most ingenious collection of many things conducive to the analysis or solution of the most difficult problems, and which afforded great delight to those who were able to understand and to investigate them.

Unfortunately for mathematical science, this valuable collection is now lost, and it still remains a doubtful question in what manner the ancients conducted their researches upon this curious subject. We have, however, reason to believe that their method was excellent both in principle and extent; for their analysis led them to many profound discoveries, and was restricted by the severest logic. The only account we have of this class of geometrical propositions, is in a fragment of Pappus, in which he attempts a general description of them as a set of mathematical propositions, distinguishable in kind from all others; but of this description nothing remains, except a criticism on a definition of them given by some geometers, and with which he finds fault, as defining them only by an accidental circumstance, "*A Porism is that which is deficient in hypothesis from a local theorem.*"

Pappus then proceeds to give an account of Euclid's porisms; but the enunciations are so extremely defective, at the same time that they refer to a figure now lost, that Dr Halley confesses the fragment in question to be beyond his comprehension.

The high encomiums given by Pappus to these propositions have excited the curiosity of the greatest geometers of modern times, who have attempted to discover their nature and manner of investigation. M. Fermat, a French mathematician of the 17th century, attaching himself to the definition which Pappus criticises, published an introduction (for this is its modest title) to this subject, which many others tried to elucidate in vain. At length Dr Simson, Professor of Mathematics in the University of Glasgow, was so fortunate as to succeed in restoring the Porisms of Euclid. The account he gives of his progress and the obstacles he encountered will always be interesting to mathematicians. In the preface to his treatise *De Porismatibus*, he says, "Postquam vero apud Pappum legeram Porismata Euclidis Collectionem fuisse artificiosissimam multarum rerum, quæ spectant ad analysin difficiliorum et generalium problematum, magno desiderio tenebar, aliquid de iis cognoscendi; quare sæpius et multis variisque viis tum Pappi propositionem generalem, mancam et imperfectam, tum primum lib. I. porisma, quod, ut dictum fuit, solum ex omnibus in tribus libris integrum adhuc manet, intelligere et restituere conabar; frustra tamen, nihil enim proficiebam. Cumque cogitationes de hac re multum mihi temporis consumpserint, atque tandem molestæ admodum evaserint, firmiter animum induxi nunquam in posterum investigare; præsertim cum optimus Geometra Halleius spem omnem de iis intelligendis abjecisset. Unde quoties menti occurrebant, toties eas arcebam. Postea tamen accidit ut improvidum et propositi immemorem invaserint, meque detinuerint donec tandem lux quædam effulserit quæ spem mihi faciebat inveniendi saltem Pappi propositionem generalem, quam quidem multa investigatione tandem restitui. Hæc autem paulo post una cum Porismate primo lib. I. impressa est inter Transactiones Philosophicas anni 1723, N° 177."

Dr Simson's Restoration has all the appearance of being just; it precisely corresponds to Pappus's description of them. All the lemmas which Pappus has given for the better understanding of Euclid's propositions are equally applicable to those of Dr Simson, which are found to differ from local theorems precisely as Pappus affirms those of Euclid to have done. They require a particular mode of analysis, and are of immense service in geometrical investigation; on which account they may justly claim our attention.

While Dr Simson was employed in this inquiry, he carried on a correspondence upon the subject with the late Dr M. Stewart, professor of mathematics in the university of Edinburgh; who, besides entering into Dr Simson's views, and communicating to him many curious porisms, pursued the same subject in a new and very different direction. He published the result of his inquiries in 1746, under the title of General Theorems, not wishing to give them any other name, lest he might appear to anticipate the labours of his friend and former preceptor. The greatest part of the propositions contained in that work are porisms, but without demonstrations; therefore, whoever wishes to investigate one of the most curious subjects in geometry, will there find abundance of materials, and an ample field for discussion.

Dr Simson defines a porism to be "a proposition, in which it is proposed to demonstrate, that one or more things are given, between which, and every one of innumerable other things not given, but assumed according to a given law, a certain relation described in the proposition is shown to take place."

This definition is not a little obscure, but will be plainer if expressed thus: "A porism is a proposition affirming the possibility of finding such conditions as will render a certain problem indeterminate, or capable of innumerable solutions." This definition agrees with Pappus's idea of these propositions, so far at least as they can be understood from the fragment already mentioned; for the propositions here defined, like those which he describes, are, strictly speaking, neither theorems nor problems, but of an intermediate nature between both; for they neither simply enunciate a truth to be demonstrated, nor propose a question to be resolved, but are affirmations of a truth in which the determination of an unknown quantity is involved. In as far, therefore, as they assert that a certain problem may become indeterminate, they are of the nature of theorems; and, in as far as they seek to discover the conditions by which that is brought about, they are of the nature of problems.

We shall endeavour to make our readers understand this

this subject distinctly, by considering them in the way in which it is probable they occurred to the ancient geometers in the course of their researches: this will at the same time show the nature of the analysis peculiar to them, and their great use in the solution of problems.

It appears to be certain, that it has been the solution of problems which, in all states of the mathematical sciences, has led to the discovery of geometrical truths: the first mathematical inquiries, in particular, must have occurred in the form of questions, where something was given, and something required to be done; and by the reasoning necessary to answer these questions, or to discover the relation between the things given and those to be found, many truths were suggested, which came afterwards to be the subject of separate demonstrations.

The number of these was the greater, because the ancient geometers always undertook the solution of problems, with a scrupulous and minute attention, insomuch that they would scarcely suffer any of the collateral truths to escape their observation.

Now, as this cautious manner of proceeding gave an opportunity of laying hold of every collateral truth connected with the main object of inquiry, these geometers soon perceived, that there were many problems which in certain cases would admit of no solution whatever, in consequence of a particular relation taking place among the quantities which were given. Such problems were said to become impossible; and it was soon perceived, that this always happened when one of the conditions of the problem was inconsistent with the rest. Thus, when it was required to divide a line, so that the rectangle contained by its segments might be equal to a given space, it was found that this was possible only when the given space was less than the square of half the line; for when it was otherwise, the two conditions defining, the one the magnitude of the line, and the other the rectangle of its segments, were inconsistent with each other. Such cases would occur in the solution of the most simple problems; but if they were more complicated, it must have been remarked, that the constructions would sometimes fail, for a reason directly contrary to that just now assigned. Cases would occur, where the lines, which by their intersection were to determine the thing sought, instead of intersecting each other as they did commonly, or of not meeting at all, as in the above-mentioned case of impossibility, would coincide with one another entirely, and of course leave the problem unresolved. It would appear to geometers upon a little reflection, that since, in the case of determinate problems, the thing required was determined by the intersection of the two lines already mentioned, that is, by the points common to both; so in the case of their coincidence, as all their parts were in common, every one of these points must give a solution, or, in other words, the solutions must be indefinite in number.

Upon inquiry, it will be found that this proceeded from some condition of the problem having been involved in another, so that, in fact, the two formed but one, and thus there was not a sufficient number of independent conditions to limit the problem to a single or to any determinate number of solutions. It would soon be perceived, that these cases formed very curious propositions of an intermediate nature between problems and theorems; and that they admitted of being enunciated in a manner peculiarly elegant and concise. It was to such propositions that the ancients gave the name of *porisms.* This deduction requires to be illustrated by an example: suppose, therefore, that it were required to resolve the following problem.

A circle ABC (fig. 1.), a straight line DE, and a point F, being given in position, to find a point G in the straight line DE such, that GF, the line drawn from it to the given point, shall be equal to GB, the line drawn from it touching the given circle.

Plate CCCCXXXVII. fig. 1.

Suppose G to be found, and GB to be drawn touching the given circle ABC in B, let H be its centre, join HB, and let HD be perpendicular to DE. From D draw DL, touching the circle ABC in L, and join HL; also from the centre G, with the distance GB or GF, describe the circle BKF, meeting HD in the points K and K′. It is evident that HD and DL are given in position and magnitude: also because GB touches the circle ABC, HBG is a right angle; and since G is the centre of the circle BKF, HB touches that circle, and consequently HB^2 or $HL^2 = KH \times HK'$; but because KK′ is bisected in D, $KH \times HK' + DK^2 = DH^2$; therefore $HL^2 + DK^2 = DH^2$. But $HL^2 + LD^2 = DH^2$, therefore $DK^2 = DL^2$ and $DK = DL$. But DL is given in magnitude, therefore DK is given in magnitude, and consequently K is a given point. For the same reason K′ is a given point, therefore the point F being given in position, the circle KFK′ is given in position. The point G, which is its centre, is therefore given in position, which was to be found. Hence this construction:

Having drawn HD perpendicular to DE, and DL touching the circle ABC, make DK and DK′ each equal to DL, and find G the centre of the circle described through the points K′FK; that is, let FK′ be joined and bisected at right angles by MN, which meets DE in G, G will be the point required; or it will be such a point, that if GB be drawn touching the circle ABC, and GF to the given point, GB is equal to GF.

The synthetical demonstration is easily derived from the preceding analysis; but it must be remarked, that in some cases this construction fails. For, first, if F fall anywhere in DH, as at F′, the line MN becomes parallel to DE, and the point G is nowhere to be found; or, in other words, it is at an infinite distance from D.—This is true in general; but if the given point F coincide with K, then MN evidently coincides with DE; so that, agreeable to a remark already made, every point of the line DE may be taken for G, and will satisfy the conditions of the problem; that is to say, GB will be equal to GK, wherever the point G is taken in the line DE: the same is true if F coincide with K. Thus we have an instance of a problem, and that too a very simple one, which, in general, admits but of one solution; but which, in one particular case, when a certain relation takes place among the things given, becomes indefinite, and admits of innumerable solutions. The proposition which results from this case of the problem is a porism, and may be thus enunciated:

"A circle ABC being given by position, and also a straight line DE, which does not cut the circle, a point K may be found, such, that if G be any point whatever

Porism. in DE, the straight line drawn from G to the point K shall be equal to the straight line drawn from G touching the given circle ABC."

The problem which follows appears to have led to the discovery of many porisms.

Fig. 2. A circle ABC (fig. 2.) and two points D, E, in a diameter of it being given, to find a point F in the circumference of the given circle; from which, if straight lines be drawn to the given points E, D, these straight lines shall have to one another the given ratio of α to β, which is supposed to be that of a greater to a less.— Suppose the problem resolved, and that F is found, so that FE has to FD the given ratio of α to β; produce EF towards B, bisect the angle EFD by FL, and DFB by FM: therefore EL : LD :: EF : FD, that is in a given ratio, and since ED is given, each of the segments EL, LD, is given, and the point L is also given; again, because DFB is bisected by FM, EM : MD :: EF : FD, that is, in a given ratio, and therefore M is given. Since DFL is half of DFE, and DFM half of DFB, therefore LFM is half of (DFE + DFB), that is, the half of two right angles, therefore LFM is a right angle; and since the points L, M, are given, the point F is in the circumference of a circle described upon LM as a diameter, and therefore given in position. Now the point F is also in the circumference of the given circle ABC, therefore it is in the intersection of the two given circumferences, and therefore is found. Hence this construction: Divide ED in L, so that EL may be to LD in the given ratio of α to β, and produce ED also to M, so that EM may be to MD in the same given ratio of α to β; bisect LM in N, and from the centre N, with the distance NL, describe the semicircle LFM; and the point F, in which it intersects the circle ABC, is the point required.

The synthetical demonstration is easily derived from the preceding analysis. It must, however, be remarked, that the construction fails when the circle LFM falls either wholly within or wholly without the circle ABC, so that the circumferences do not intersect; and in these cases the problem cannot be solved. It is also obvious that the construction will fail in another case, viz. when the two circumferences LFM, ABC, entirely coincide. In this case, it is farther evident, that every point in the circumference ABC will answer the conditions of the problem, which is therefore capable of numberless solutions, and may, as in the former instances, be converted into a porism. We are now to inquire, therefore, in what circumstances the point L will coincide with A, and also the point M with C, and of consequence the circumference LFM with ABC. If we suppose that they coincide, EA : AD :: α : β :: EC : CD, and EA : EC :: AD : CD, or by conversion, EA : AC :: AD : CD—AD :: AD : 2DO, O being the centre of the circle ABC; therefore, also, EA : AO :: AD : DO, and by composition, EO : AO :: AO : DO, therefore $EO \times OD = AO^2$. Hence, if the given points E and

Fig 3. D (fig. 3.) be so situated that $EO \times OD \times AO^2$, and at the same time $\alpha : \beta$ :: EA : AD :: EC : CD, the problem admits of numberless solutions; and if either of the points D or E be given, the other point, and also the ratio which will render the problem indeterminate, may be found. Hence we have this porism:

"A circle ABC, and also a point D being given, another point E may be found, such that the two lines inflected from these points to any point in the circumference ABC, shall have to each other a given ratio, which ratio is also to be found." Hence also we have an example of the derivation of porisms from one another; for the circle ABC, and the points D and E remaining as before (fig. 3.), if, through D we draw any line whatever HDB, meeting the circle in B and H; and if the lines EB, EH be also drawn, these lines will cut off equal circumferences BF, HG. Let FC be drawn, and it is plain from the foregoing analysis, that the angles DFC, CFB, are equal; therefore if OG, OB, be drawn, the angles BOC, COG, are also equal; and consequently the angles DOB, DOG. In the same manner, by joining AB, the angle DBE being bisected by BA, it is evident that the angle AOF is equal to AOH, and therefore the angle FOB to HOG; hence the arch FB is equal to the arch HG. It is evident that if the circle ABC, and either of the points DE were given, the other point might be found. Therefore we have this porism, which appears to have been the last but one of the third book of Euclid's Porisms. "A point being given, either within or without a circle given by position. If there be drawn, anyhow through that point, a line cutting the circle in two paints; another point may be found, such, that if two lines be drawn from it to the points in which the line already drawn cuts the circle, these two lines will cut off from the circle equal circumferences."

The proposition from which we have deduced these two porisms also affords an illustration of the remark, that the conditions of a problem are involved in one another in the porismatic or indefinite case; for here several independent conditions are laid down, by the help of which the problem is to be resolved. Two points D and E are given, from which two lines are to be inflected, and a circumference ABC, in which these lines are to meet, as also a ratio which these lines are to have to each other. Now these conditions are all independent of one another, so that any one may be changed without any change whatever in the rest. This is true in general; but yet in one case, viz. when the points are so related to another that the rectangle under their distances from the centre is equal to the square of the radius of the circle; it follows from the preceding analysis, that the ratio of the inflected lines is no longer a matter of choice, but a necessary consequence of this disposition of the points.

From what has been already said, we may trace the imperfect definition of a porism which Pappus ascribes to the later geometers, viz. that it differs from a local theorem, by wanting the hypothesis assumed in that theorem.—Now, to understand this, it must be observed, that if we take one of the propositions called *loci*, and make the construction of the figure a part of the hypothesis, we get what was called by the ancient geometers, a *local theorem*. If, again, in the enunciation of the theorem, that part of the hypothesis which contains the construction be suppressed, the proposition thence arising will be a porism, for it will enunciate a truth, and will require to the full understanding and investigation of that truth, that something should be found, viz. the circumstances in the construction supposed to be omitted.

Thus, when we say, if from two given points E, D, (fig. 3.) two straight lines EF, FD, are inflected to a third point F, so as to be to one another in a given ratio, Fig. 3.

Fig. 1.

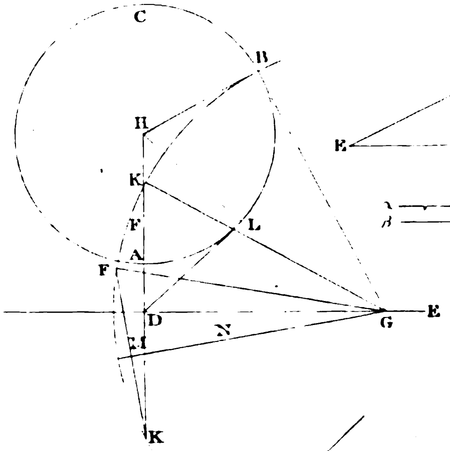


Fig. 2.

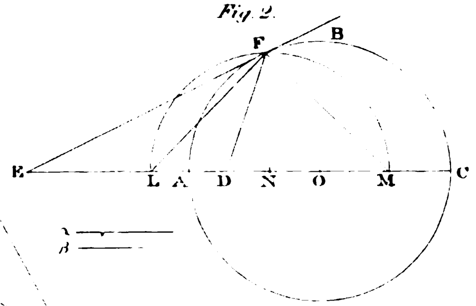


Fig. 3.

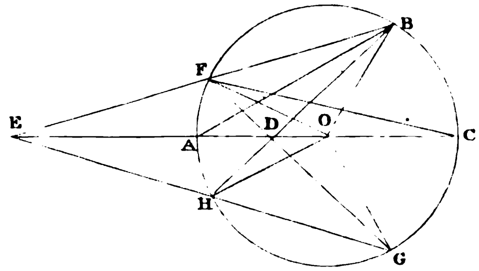


Fig. 6.

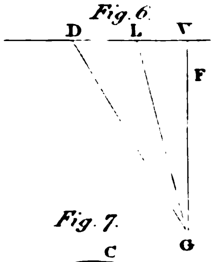


Fig. 5.

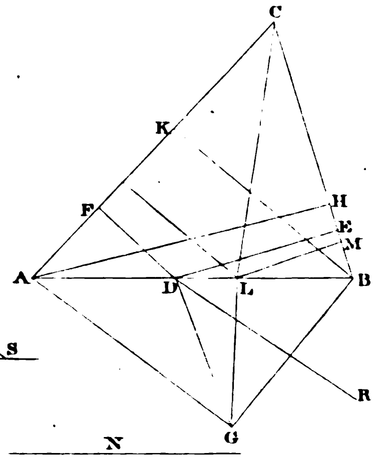


Fig. 4.

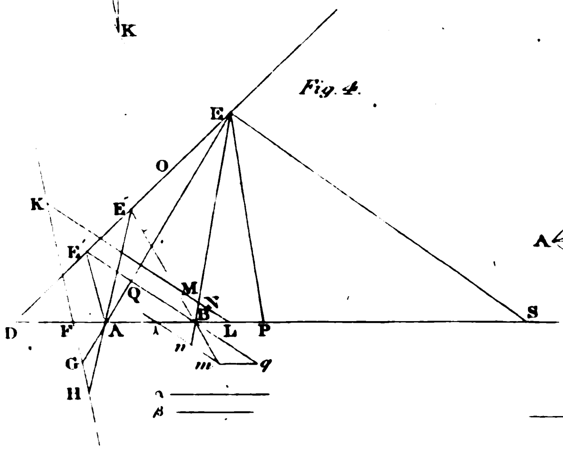
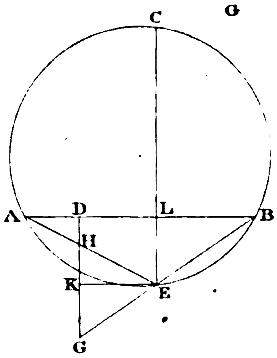
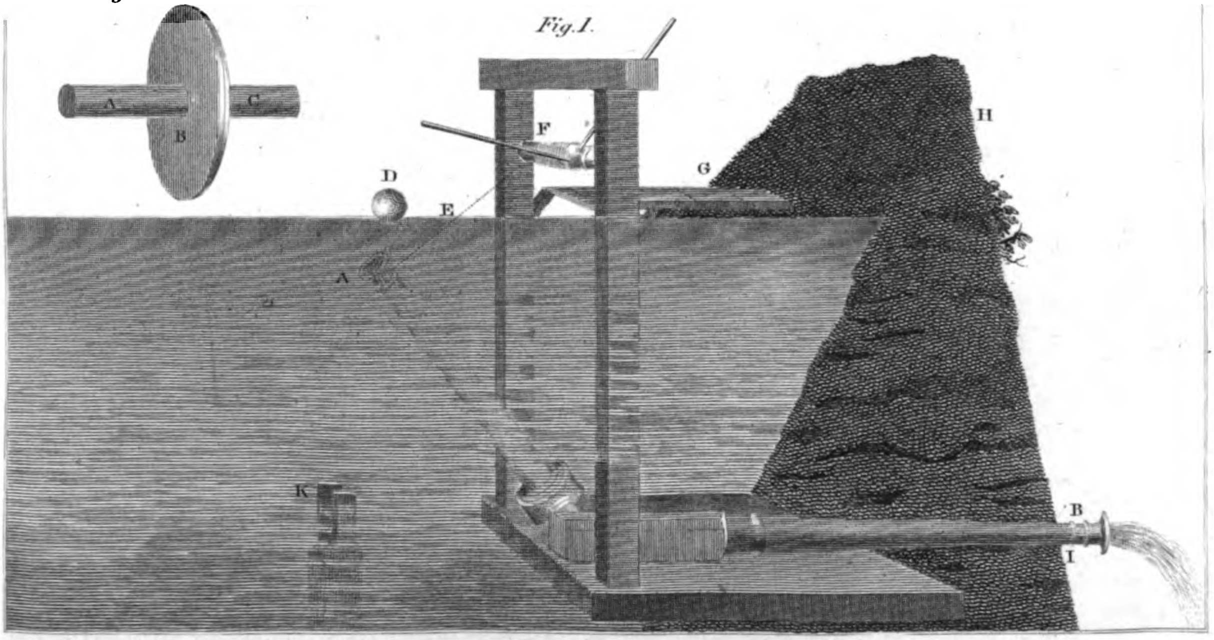


Fig. 7.



Machine for draining Ponds without disturbing the Mud.

Fig. 2.



F. Mitchell, Sculp.t

Porism. tio, the point F is in the circumference of a given circle, we have a locus. But when conversely it is said, if a circle ABC, of which the centre is O, be given by position, as also a point E; and if D be taken in the line EO, so that $EO \times OD = AO^2$; and if from E and D the lines EF, DF be inflected to any point of the circumference ABC, the ratio of EF to DF will be given, viz. the same with that of EA to AD, we have a local theorem.

Lastly, when it is said, if a circle ABC be given by position, and also a point E, a point D may be found such that if EF, FD be inflected from E and D to any point F in the circumference ABC, these lines shall have a given ratio to one another, the proposition becomes a porism, and is the same that has just now been investigated.

Hence it is evident, that the local theorem is changed into a porism, by leaving out what relates to the determination of D, and of the given ratio. But though all propositions formed in this way from the conversion of loci, are porisms, yet all porisms are not formed from the conversion of loci; the first, for instance of the preceding cannot by conversion be changed into a locus; therefore Fermat's idea of porisms, founded upon this circumstance, could not fail to be imperfect.

To confirm the truth of the preceding theory, it may be added, that Professor Dugald Stewart, in a paper read a considerable time ago before the Philosophical Society of Edinburgh, defines a porism to be "A proposition affirming the possibility of finding one or more conditions of an indeterminate theorem;" where, by an indeterminate theorem, he means one which expresses a relation between certain quantities that are determinate and certain others that are indeterminate; a definition which evidently agrees with the explanation which has been here given.

If the idea which we have given of these propositions be just, it follows, that they are to be discovered by considering those cases in which the construction of a problem fails, in consequence of the lines which by their intersection, or the points which by their position, were to determine the problem required, happening to coincide with one another. A porism may therefore be deduced from the problem to which it belongs, just as propositions concerning the *maxima* and *minima* of quantities are deduced from the problems of which they form limitations; and such is the most natural and obvious analysis of which this class of propositions admits.

The following porism is the first of Euclid's, and the first also which was restored. It is given here to exemplify the advantage which, in investigations of this kind, may be derived from employing the *law of continuity* in its utmost extent, and pursuing porisms to those extreme cases where the indeterminate magnitudes increase *ad infinitum*.

This porism may be considered as having occurred in the solution of the following problem: Two points A, B,
Fig. 4. (fig. 4.) and also three straight lines DE, FK, KL, being given in position, together with two points H and M in two of these lines, to inflect from A and B to a point in the third line, two lines that shall cut off from KF and KL two segments, adjacent to the given points H and M, having to one another the given ratio of α to β. Now, to find whether a porism be connected with this problem, suppose that there is, and that the following proposition is true. Two points A and B, and two straight lines DE, FK, being given in position, and also a point H in one of them, a line LK may be found, and also a point in it M, both given in position, such that AE and BE inflected from the points A and B to any point whatever of the line DE, shall cut off from the other lines FK and LK segments HG and MN adjacent to the given points H and M, having to one another the given ratio of α to β.

First, let AE′, BE′, be inflected to the point E′, so that AE′ may be parallel to FK, then shall E′B be parallel to KL, the line to be found; for if it be not parallel to KL, the point of their intersection must be at a finite distance from the point M, and therefore making as β to α, so this distance to a fourth proportional, the distance from H at which AE′ intersects FK, will be equal to that fourth proportional. But AE′ does not intersect FK, for they are parallel by construction; therefore BE′ cannot intersect KL, which is therefore parallel to BE′, a line given in position. Again, let AE″, BE″, be inflected to E″, so that AE″ may pass through the given point H: then it is plain that BE″ must pass through the point to be found M; for if not, it may be demonstrated just as above, that AE″ does not pass through H, contrary to the supposition. The point to be found is therefore in the line E″B, which is given in position. Now if from E there be drawn EP parallel to AE′, and ES parallel to BE′, BS : SE :: BL : $LN = \frac{SE \times BL}{BS}$, and AP : PE :: AF : $FG = \frac{PE = AF}{AP}$; therefore FG : LN :: $\frac{PE \times AF}{AP} : \frac{SE \times BL}{BS}$ :: $PE \times AF \times BS : SE \times BL \times AP$; wherefore the ratio of FG to LN is compounded of the ratios of AF to BL, PE to ES, and BS to AP; but PE : SE :: AE′ : BE′, and BS : AP :: DB : DA, for DB : BS :: DE′ : E′E :: DA : AP; therefore the ratio of FG to LN is compounded of the ratios of AF to BL, AE′ to BE′, and DB to DA. In like manner, because E″ is a point in the line DE and AE″, BE″ are inflected to it, the ratio of FH to LM is compounded of the same ratios of AF to BL, AE′ to BE′, and DB to DA; therefore FH : LM :: FG : NL (and consequently) :: HG : MN; but the ratio of HG to MN is given, being by supposition the same as that of α to β; the ratio of FH to LM is therefore also given, and FH being given, LM is given in magnitude. Now LM is parallel to BE′, a line given in position; therefore M is in a line QM, parallel to AB, and given in position; therefore the point M, and also the line KLM, drawn through it parallel to BE′, are given in position, which were to be found. Hence this construction: From A draw AE′ parallel to FK, so as to meet DE in E′; join BE′, and take in it BQ, so that $\alpha : \beta$ :: HF : BQ, and through Q draw QM parallel to AB. Let HA be drawn, and produced till it meet DE in E″, and draw BE″, meeting QM in M; through M draw KML parallel to BE′, then is KML the line and M the point which were to be found. There are two lines which will answer the conditions of this porism; for if in QB, produced on the other side of B, there be taken $Bq = BQ$, and if $q\,m$ be drawn parallel to AB, cutting MB in m; and if $m\,\lambda$ be drawn parallel to BQ, the part $m\,n$, cut

Porism.

off by EB produced, will be equal to MN, and have to HG the ratio required. It is plain, that whatever be the ratio of α to β, and whatever be the magnitude of FH, if the other things given remain the same, the lines found will be all parallel to BE. But if the ratio of α to β remain the same likewise, and if only the point H vary, the position of KL will remain the same, and the point M will vary.

Another general remark which may be made on the analysis of porisms is, that it often happens, as in the last example, that the magnitudes required may all, or a part of them, be found by considering the extreme cases; but for the discovery of the relation between them, and the indefinite magnitudes, we must have recourse to the hypothesis of the porism in its most general or indefinite form; and must endeavour so to conduct the reasoning, that the indefinite magnitudes may at length totally disappear, and leave a proposition asserting the relation between determinate magnitudes only.

For this purpose Dr Simson frequently employs two statements of the general hypothesis, which he compares together. As for instance, in his analysis of the last porism, he assumes not only E, any point in the line DE, but also another point O, anywhere in the same line, to both of which he supposes lines to be inflected from the points A, B. This double statement, however, cannot be made without rendering the investigation long and complicated; nor is it even necessary, for it may be avoided by having recourse to simple *porisms*, or to *loci*, or to propositions of the *data*. The following porism is given as an example where this is done with some difficulty, but with considerable advantage both with regard to the simplicity and shortness of the demonstration. It will be proper to premise the following lemma. Let AB (fig. 7.) be a straight line, and D, L any two points in it, one of which D is between A and B; also let CL be any straight line. Then shall

Fig. 7.

$$\frac{LB}{CL}\cdot AD^2+\frac{LA}{CL}\cdot BD^2=\frac{LB}{CL}\cdot AL^2+\frac{LA}{CL}\cdot BL^2+\frac{AB}{CL}DL^2.$$

For place CL perpendicular to AB, and through the points A, C, B describe a circle, and let CL meet the circle again in E, and join AE, BE. Also draw DG parallel to CE, meeting AE and BE in H and G, and draw EK parallel to AB. Then, from the elements of geometry,

$$CL : LB :: (LA : LE ::)\ LA^2 : LA\times LE,$$

$$\text{and hence } LB\times LE=\frac{LB}{CL}\cdot LA^2.$$

$$\text{Also } CL : LA :: (LB : LE ::)\ LB^2 : LB\times LE,$$

$$\text{and hence } LB\times LE=\frac{LA}{CL}\cdot LB^2.$$

$$\text{Now } CL : LB :: LA : LE :: EK \text{ or } LD : KH,$$

$$\text{and } CL : LA :: LB : LE :: EK \text{ or } LD : KG,$$

therefore, (Geom. Sect. III. Theor. 8.)

$$CL : AB :: (LD : GH ::)\ LD^2 : EK\times GH,$$

$$\text{and hence } EK\times GH=\frac{AB}{CL}\cdot LD^2.$$

From the three equations which we have deduced from the first, second, and fifth of these propositions, it is manifest that

$$\frac{LB}{LC}\cdot LA^2+\frac{LA}{CL}\cdot LB^2+\frac{AB}{CL}\cdot LD^2=AB\times LE+EK\times GH.$$

Again, because

$$CL : LA :: (LB : LE :: DB : DG ::)\ DB^2 : DB\times DG,$$

$$\text{therefore } DB\times DG=\frac{LA}{CL}\cdot DB^2.$$

And because

$$CL : LB :: (LA : LE :: DA : DH ::)\ DA^2 : DA\times DH,$$

therefore $DA\times DH=\frac{LB}{CL}DA^2$. From the result of these two last propositions we have

$$\frac{LB}{CL}\cdot DA^2+\frac{LA}{CL}\cdot DB^2=DA\times DH+BD\times DG;$$

but $DA\times DH=$ *twice trian.* ADH, and $DB\times DG=$ *twice trian.* BDG, and therefore $DA\times DH+DB\times DG=2$ (*trian.* ADH + *trian.* BDG) $=2$ (*trian.* AEB + *trian.* HEG) $=AB\times LE+EK\times HG$. Now it has been proved, that $DA\times DH+DB\times DG=\frac{LB}{CL}\cdot DA^2+\frac{LA}{CL}\cdot BD^2$, and that $AB\times LE+EK\times HG=\frac{LB}{CL}\cdot LA^2+\frac{LA}{CL}\cdot LB^2+\frac{AB}{CL}\cdot LD^2$, therefore $\frac{LB}{CL}\cdot AD^2+\frac{LA}{CL}BD^2=\frac{LB}{CL}\cdot AL^2+\frac{LA}{CL}\cdot BL^2+\frac{AB}{CL}\cdot DL^2$, as was to be demonstrated.

Porism. Let there be three straight lines AB, AC, CB given in position (fig. 5.); and from any point whatever in one of them, as D, let perpendiculars be drawn to the other two, as DF, DE, a point G may be found, such, that if GD be drawn from it to the point D, the square of that line shall have a given ratio to the sum of the squares of the perpendiculars DF and DE, which ratio is to be found.

Draw AH, BK perpendicular to BC and AC; and in AB take L, so that $AL : LB :: AH^2 : BK^2 :: AC^2 : CB^2$. The point L is therefore given; and if a line N be taken, so as to have to AL the same ratio that AB^2 has to AH^2, N will be given in magnitude. Also, since $AH^2 : BK^2 :: AL : LB$, and $AH^2 : AB^2 :: AL : N$, *ex equo*, $BK^2 : AB^2 :: LB : N$. Draw LO, LM perpendicular to AC, CB; LO, LM are therefore given in magnitude. Now, because $AB^2 : BK^2 :: AD^2 : DF^2$, $N : LB :: AD^2 : DF^2$, and $DF^2=\frac{LB}{N}\cdot AD^2$; and for the same reason $DE^2=\frac{AL}{N}\cdot BD^2$; but, by the preceding lemma, $\frac{LB}{N}\cdot AD^2+\frac{AL}{N}\cdot BD^2=\frac{LB}{N}\cdot AL^2+\frac{AL}{N}\cdot BL^2+\frac{AB}{N}\cdot DL^2$; that is, $DE^2+DF^2=LO^2+LM^2+\frac{AB}{N}\cdot DL^2$. Join LG, then by hypothesis LO^2+LM^2 has to LG^2, the same ratio as DF^2+DE^2 has to DG^2; let it be that of R to N, then LO^2+LM^2

$LM^2 = \frac{R}{N} \cdot LG^2$; and therefore $DE^2 + DF^2 = \frac{R}{N} \cdot LG^2 + \frac{AB}{N} \cdot DL^2$; but $DE^2 + DF^2 = \frac{R}{N} \cdot DG^2$; therefore, $\frac{R}{N} \cdot LG^2 + \frac{BA}{N} \cdot DL^2 = \frac{R}{N} \cdot DG^2$ and $\frac{AB}{N} \cdot DL^2 = \frac{R}{N} (DG^2 - LG^2)$; therefore $DG^2 - LG^2$ has to DL^2 a constant ratio, viz. that of AB to R. The angle DLG is therefore a right angle, and the ratio of AB to R that of equality, otherwise LD would be given in magnitude, contrary to the supposition. LG is therefore given in position: and since $R : N :: AB : N :: LO^2 + LM^2 : LG^2$; therefore the square of LG, and consequently LG, is given in magnitude. The point G is therefore given, and also the ratio of $DE^2 + DF^2$ to DG^2, which is the same with that of AB to N.

The construction easily follows from the analysis, but it may be rendered more simple; for since $AH^2 : AB^2 :: AL : N$, and $BK^2 : AB^2 :: BL : N$; therefore $AH^2 + BK^2 : AB^2 :: AB : N$. Likewise, if AG, BG, be joined, $AB : N :: AH^2 : AG^2$, and $AB : N :: BK^2 : BG^2$; wherefore $AB : N :: AH^2 + BK^2 : AG^2 + BG^2$, but it was proved that $AB : N :: AH^2 + BK^2 : AB^2$, therefore $AG^2 + BG^2 = AB^2$; therefore the angle AGB is a right one, and $AL : LG :: LG : LB$. If therefore AB be divided in L, so that $AL : LB :: AH^2 : BK^2$; and if LG, a mean proportional between AL and LB, be placed perpendicular to AB, G will be the point required.

The step in the analysis, by which a second introduction of the general hypothesis is avoided, is that in which the angle GLD is concluded to be a right angle; which follows from $DG^2 - GL^2$ having a given ratio to LD^2, at the same time that LD is of no determinate magnitude. For, if possible, let GLD be obtuse (fig. 6.), and let the perpendicular from G to AB meet it in V, therefore V is given: and since $GD^2 - LG^2 = LD^2 + 2DL \times LV$; therefore, by the supposition, $LD^2 + 2DL \times LV$ must have a given ratio to LD^2; therefore the ratio of LD^2 to $DL \times VL$, that is, of LD to VL, is given, so that VL being given in magnitude, LD is also given. But this is contrary to the supposition; for LD is indefinite by hypothesis, and therefore GLD cannot be obtuse, nor any other than a right angle. The conclusion that is here drawn immediately from the indetermination of LD would be deduced, according to Dr Simson's method, by assuming another point D′ any how, and from the supposition that $GD'^2 - GL^2 : LD'^2 :: GD^2 - GL^2 : LD^2$, it would easily appear that GLD must be a right angle, and the ratio that of equality.

These porisms facilitate the solution of the general problems from which they are derived. For example, let three straight lines AB, AC, BC (fig. 5.), be given in position, and also a point R, to find a point D in one of the given lines, so that DE and DF being drawn perpendicular to BC, AC, and DR, joined; $DE^2 + DF^2$ may have to DR^2 a given ratio. It is plain, that having found G, the problem would be nothing more than to find D, such that the ratio of GD^2 to DR^2, and therefore that of GD to DR, might be given, from which it would follow, that the point D is in the circumference of a given circle, as is well known to geometers.

The same porism also assists in the solution of another problem. For if it were required to find D such that $DE^2 + DF^2$ might be a given space; having found G, DG^2 would have to $DE^2 + DF^2$ a given ratio, and DG would therefore be given; whence the solution is obvious.

The connection of this porism with the impossible case of the problem is evident; the point L being that from which, if perpendiculars be drawn to AC and CB, the sum of their squares is the least possible. For since $DF^2 + DE^2 : DG^2 :: LO^2 + LM^2 : LG^2$; and since LG is less than DG, $LO^2 + LM^2$ must be less than $DF^2 + DE^2$.

It is evident from what has now appeared, that in some instances at least there is a close connection between these propositions and the *maxima* or *minima*, and of consequence the impossible cases of problems. The nature of this connection requires to be farther investigated, and is the more interesting because the transition from the indefinite to the impossible case seems to be made with wonderful rapidity. Thus in the first proposition, though there be not properly speaking an impossible case, but only one where the point to be found goes off *ad infinitum*, it may be remarked, that if the given point F be anywhere out of the line HD (fig. 1.), the problem of drawing GB equal to GF is always possible, and admits of just one solution; but if F be in DH, the problem admits of no solution at all, the point being then at an infinite distance, and therefore impossible to be assigned. There is, however, this exception, that if the given point be at K in this same line, DH is determined by making DK equal to DL. Then every point in the line DE gives a solution, and may be taken for the point G. Here therefore the case of numberless solutions, and of no solution at all, are as it were *conterminal*, and so close to one another, that if the given point be at K the problem is indefinite; but if it remove ever so little from K, remaining at the same time in the line DH, the problem cannot be resolved. This affinity might have been determined *à priori*: for it is, as we have seen, a general principle, that a problem is converted into a porism when one or when two of the conditions of it necessarily involve in them some one of the rest. Suppose, then, that two of the conditions are exactly in that state which determines the third; then while they remain fixed or given, should that third one vary or differ ever so little from the state required by the other two, a contradiction will ensue: therefore if, in the hypothesis of a problem, the conditions be so related to one another as to render it indeterminate, a porism is produced; but if, of the conditions thus related to one another, some one be supposed to vary, while the others continue the same, an absurdity follows, and the problem becomes impossible. *Wherever, therefore, any problem admits both of an indeterminate and an impossible case, it is certain, that these cases are nearly related to one another, and that some of the conditions by which they are produced are common to both.*

It is supposed above, that *two* of the conditions of a problem involve in them a third; and wherever that happens, the conclusion which has been deduced will invariably take place. But a porism may in some cases be so simple as to arise from the mere coincidence of *one* condition with another, though in no case whatever any inconsistency can take place between them. There are, Porism. however, comparatively few porisms so simple in their origin, or that arise from problems where the conditions are but little complicated; for it usually happens that a problem which can become indefinite may also become impossible; and if so, the connection already explained never fails to take place.

Another species of impossibility may frequently arise from the porismatic case of a problem which will affect in some measure the application of geometry to astronomy, or any of the sciences depending on experiment or observation. For when a problem is to be resolved by means of data furnished by experiment or observation, the first thing to be considered is, whether the data so obtained be sufficient for determining the thing sought; and in this a very erroneous judgment may be formed, if we rest satisfied with a general view of the subject; for though the problem may in general be resolved from the data with which we are provided, yet these data may be so related to one another in the case under consideration, that the problem will become indeterminate, and instead of one solution will admit of an indefinite number. This we have already found to be the case in the foregoing propositions. Such cases may not indeed occur in any of the practical applications of geometry; but there is one of the same kind which has actually occurred in astronomy. Sir Isaac Newton, in his *Principia*, has considered a small part of the orbit of a comet as a straight line described with an uniform motion. From this hypothesis, by means of four observations made at proper intervals of time, the determination of the path of the comet is reduced to this geometrical problem: Four straight lines being in position, it is required to draw a fifth line across them, so as to be cut by them into three parts, having given ratios to one another. Now this problem had been constructed by Dr Wallis and Sir Christopher Wren, and also in three different ways by Sir Isaac himself in different parts of his works; yet none of these geometers observed that there was a particular situation of the lines in which the problem admitted of innumerable solutions: and this happens to be the very case in which the problem is applicable to the determination of the comet's path, as was first discovered by the abbé Boscovich, who was led to it by finding, that in this way he could never determine the path of a comet with any degree of certainty.

Besides the geometrical there is also an algebraical analysis belonging to porisms; which, however, does not belong to this place, because we give this account of them merely as an article of ancient geometry; and the ancients never employed algebra in their investigations. Mr Playfair, formerly professor of mathematics, and now of natural philosophy in the university of Edinburgh, has written a paper on the origin and geometrical investigation of porisms, which is published in the third volume of the Transactions of the Royal Society of Edinburgh, from which this account of the subject is taken. He has there promised a second part to his paper, in which the algebraical investigation of porisms is to be considered. This will no doubt throw considerable light upon the subject, as we may readily judge from that gentleman's known abilities, and from the specimen he has already given us in the first part.

Such as are desirous of knowing more of this subject may consult Dr Simson's treatise *De Porismatibus*, which is contained in his *Opera Reliqua*, published after his death at the sole expence of the earl of Stanhope. We have already mentioned Dr Stewart's *General Theorems* which contain many beautiful porisms, but without demonstrations. A considerable number of them, however, have been demonstrated by the late Dr R. Small, of Dundee, in the Trans. R. S. Edin. vol. ii. There is also a paper upon the subject of porisms by Mr W. Wallace, now of the Royal Military College, in the fourth volume of the same work, entitled *Some Geometrical Porisms, with examples of their application to the Solution of Problems.*

PORK, the flesh of swine killed for the purposes of food. See Sus.

The hog is the only domestic animal that we know of no use to man when alive, and therefore seems properly designed for food. Besides, as loathsome and ugly to every human eye, it is killed without reluctance. The Pythagoreans, whether to preserve health, or on account of compassion, generally forbade the use of animal food; and yet it is alleged that Pythagoras reserved the use of hog's flesh for himself. The Jews, the Egyptians, &c. and other inhabitants of warm countries, and all the Mahometans at present, reject the use of pork. It is difficult to find a satisfactory reason for this, or for the precept given to the Jews respecting it, though unquestionably there was some good one for it. The Greeks gave great commendations to this food; and Galen, though indeed that is suspected to be from a particular fondness, is everywhere full of it. The Romans considered it as one of their delicacies; and if some of the inhabitants of the northern climates have taken an aversion to it, that probably arose from the uncultivated state of their country not being able to rear it. Pork is of a very tender structure; increased perhaps from a peculiarity in its economy, viz. taking on fat more readily than any other animal. Pork is a white meat even in its adult state, and then gives out a jelly in very great quantity. On account of its little perspirability and tenderness it is very nutritious, and was given for that intention to the *athletæ*. With regard to its alkalescency, no proper experiments have yet been made; but as it is of a gelatinous and succulent nature, it is probably less so than many others. Upon the whole, it appears to be a very valuable nutriment; and the reason is not very obvious why it was in some countries forbid. It is said that this animal is apt to be diseased; but why were not inconveniences felt on that account in Greece? Again, it has been alleged, that as Palestine would not rear these animals, and as the Jews had learned the use of them in Egypt, it was necessary they should have a precept to avoid them. But the Egyptians themselves did not use the meat; and this religious precept, indeed, as well as many others, seems to have been borrowed from them. Possibly, as pork is not very perspirable, it might increase the leprosy, which was said to be epidemic in Palestine; though this is far from being certain. (Cullen's Mat. Med.)

PORLOCK, in the county of Somerset in England, is a small sea-port town six miles west from Minehead. This whole parish, including hamlets, contained 633 inhabitants in 1811. The situation of the town is very romantic, being nearly surrounded on all sides, except towards the sea, by steep and lofty hills, intersected by deep vales and hollow glens. Some of of the hills are beautifully wooded, and contain numbers of wild deer. The valleys are very deep and picturesque; the sides being steep, scarred with wild rocks, and patched with woods and forest shrubs. Some of them are well cultivated and studded with villages or single farms and cottages, although agriculture here is very imperfectly understood. Most of the roads and fields are so steep, that no carriages of any kind can be used; all the crops are therefore carried in with crooks on horses, and the manure in wooden pots called *dossels*. Many of the poor are employed in spinning yarn for the Dunster manufactory. W. Long. 3. 32. N. Lat. 51. 14.

PORO. See CALAURIA.

PORPESSE. See DELPHINUS, CETOLOGY *Index*.

PORPHYRIUS, a famous Platonic philosopher, was born at Tyre in 233, in the reign of Alexander Severus. He was the disciple of Longinus, and became the ornament of his school at Athens; from thence he went to Rome, and attended Plotinus, with whom he lived six years. After Plotinus's death he taught philosophy at Rome with great applause; and became well skilled in polite literature, geography, astronomy, and music. He lived till the end of the third century, and died in the reign of Dioclesian. There are still extant his book on the Categories of Aristotle; a Treatise on Abstinence from Flesh; and several other pieces in Greek. He also composed a large treatise against the Christian religion, which is lost. That work was answered by Methodius bishop of Tyre, and also by Eusebius, Apollinarius, St Augustin, St Jerome, St Cyril, and Theodoret. The emperor Theodosius the Great caused Porphyrius's book to be burned in 338. Those of his works that are still extant were printed at Cambridge in 1655, 8vo, with a Latin version.

"Porphyrius (says Dr Enfield) was, it must be owned, a writer of deep erudition; and had his judgment and integrity been equal to his learning, he would have deserved a distinguished place among the ancients. But neither the splendour of his diction, nor the variety of his reading, can atone for the credulity or the dishonesty which filled the narrative part of his works with so many extravagant tales, or interest the judicious reader in the abstruse subtilties and mystical flights of his philosophical writings."

PORPHYRY, a compound rock, essentially consisting of some base or ground, in which are interspersed crystals of some other substance, as when an argillaceous stone, or a pitchstone, has crystals of feldspar or quartz interspersed in it, and hence is denominated an argillaceous or pitchstone porphyry. See GEOLOGY *Index*. Porphyry is still found in immense strata in Egypt. The hard red-lead coloured porphyry, variegated with black, white, and green, is a most beautiful and valuable substance. It has the hardness and all the other characters of the oriental porphyry; and even greatly excels it in brightness, and in the beauty and variegation of its colours. It is found in great plenty in the island of Minorca; and is well worth importing, being greatly superior to all the Italian marbles. The hard, pale-red porphyry, variegated with black, white, and green, is of a pale-flesh colour; often approaching to white. It is variegated in blotches from half an inch to an inch broad. It takes a high polish, and emulates all the qualities of the oriental porphyry. It is found in immense strata in Arabia Petræa, and in the Upper Egypt; and in separate nodules in Germany, England, and Ireland.

Ficoroni takes notice of two exquisitely fine columns of black porphyry in a church at Rome. In Egypt there are three celebrated obelisks or pillars of porphyry, one near Cairo and two at Alexandria. The French call them *aguglias*, and in England they are called *Cleopatra's needles*.

The art of cutting porphyry, practised by the ancients, appears now to be lost. Indeed it is difficult to conceive what tools they used for fashioning those huge columns and other porphyry works in some of the ancient buildings in Rome. One of the most considerable of these, still entire, is a tomb of Constantia, the emperor Constantine's daughter. It is in the church of St Agnes, and is commonly called *the tomb of Bacchus*. In the palace of the Thuilleries there is also a bust of Apollo and of twelve emperors, all in porphyry. Some ancient pieces seem to have been wrought with the chissel, others with the saw, others with wheels, and others gradually ground down with emery. Yet modern tools will scarcely touch porphyry. Dr Lister therefore thinks *, that the ancients had the secret of tempering steel better than we; and not, as some imagine, that they had the art of softening the porphyry; though it is probable that time and air have contributed to increase its hardness. Mr Addison says, he saw a workman at Rome cutting porphyry; but his advances were extremely slow and almost insensible. The Italian sculptors work the pieces of old porphyry columns still remaining (for the porphyry quarries are long since lost) with a brass saw without teeth. With this say, emery, and water, they rub and wear the stone with infinite patience. Many persons have endeavoured to retrieve the ancient art, and particularly Leon Baptista Alberti; who, searching for the necessary materials for temper, says, he found goats blood the best of any; but even this avails not much; for in working with chissels tempered with it, sparks of fire came much more plentifully than pieces of the stone. The sculptors were thus, however, able to make a flat or oval form; but could never attain to any thing like a figure.

* *Philos. Transact.* N° 203. or *Lowth's Abrid.* vol. ii. p. 560.

In the year 1555, Cosmo de Medicis is said to have distilled a water from certain herbs, with which his sculptor Francesco Tadda gave his tools such an admirable hardness and so fine a temper, that he performed some very exquisite works with them; particularly our Saviour's head in demi-relievo, and Cosmo's head and his duchess's. The very hair and beard, how difficult soever, are here well conducted; and there is nothing of the kind superior to it in all the works of the ancients; but the secret appears to have died with him. The French have discovered another mode of cutting porphyry, viz. with an iron saw without teeth, and *grez*, a kind of free stone pulverized, and water. The authors of this invention say that they could form the whole contour of a column hereby if they had matter to work on. Others have proposed to harden tools so as to cut porphyry, by steeping them in the juice of the plant called *bear's breech* or *brankursine*. See Birch's *Hist.* R. S. vol. i. p. 238. vol. ii. p. 73, &c. Mr Boyle says, that he caused porphyry to be cut by means of emery, steel saws, and water; and observes, that in his time the English workmen were ignorant of the manner of working porphyry, and that none of them would undertake

undertake to cut or polish it. See his Works abr. vol. i. p. 11.

Da Costa supposes, and perhaps with reason, that the method used by the ancients in cutting and engraving porphyry was extremely simple, and that it was performed without the aid of any scientific means that are now lost. He imagines, that, by unwearied diligence, and with numbers of common tools at great expence, they rudely hewed or broke the stone into the intended figure, and by continued application reduced them into more regular designs; and that they completed the work by polishing it with great labour, by the aid of particular hard sands found in Egypt. And he thinks, that in the porphyry quarries there were layers of grit or loose disunited particles, analogous to the porphyry, which they carefully sought for, and used for this work. See *Hist. Nat. of Fossils*, p. 285.

Porphyry-Shell. See Murex, Conchology *Index*.

PORPITES, the Hair-button Stone, in *Natural History*, a name given by some authors to a small species of fossil coral; which is usually of a rounded figure considerably flattened, and striated from the centre to the circumference. These are of different sizes and of different colours, as grayish, whitish, brownish, or bluish, and are usually found immersed in stone.

PORRUM, the Leek; a species of plants belonging to the genus of *Allium*. See Allium, Botany *Index*; and for an account of the method of cultivation, see Gardening.

PORT, a harbour, river, or haven, formed either by nature or art to receive and shelter shipping from the storms and waves of the open sea.

Artificial ports are those which are either formed by throwing a strong mound or rampire across the harbour's mouth to some island or rock, or erecting two long barriers, which stretch from the land on each side like arms or the horns of a crescent, and nearly inclose the haven; the former of these are called *mole-heads* and the latter *piers*.

Port, is also a name given on some occasions to the larboard or left side of the ship, as in the following instances. Thus it is said, "the ship heels to port," *i. e.* stoops or inclines to the larboard-side. "Top the yard to port?" the order to make the larboard extremity of a yard higher than the other. "Port the helm!" the order to put the helm over to the larboard-side of the vessel. In all these senses this phrase appears intended to prevent any mistakes happening from the similarity of sounds in the words *starboard* and *larboard*, particularly when they relate to the helm, where a misapprehension might be attended with very dangerous consequences.

Ports, the embrasures or openings in the side of a ship of war, wherein the artillery is ranged in battery upon the decks above and below.

The ports are formed of a sufficient extent to point and fire the cannon, without injuring the ship's side by the recoil; and as it serves no end to enlarge them beyond what is necessary for that purpose, the shipwrights have established certain dimensions, by which they are cut in proportion to the size of the cannon.

The ports are shut in at sea by a sort of hanging-doors called the *port-lids*; which are fastened by hinges to their upper edges, so as to let down when the cannon are drawn into the ship. By this means the water is prevented from entering the lower decks in a turbulent sea. The lower and upper edges of the ports are always parallel to the deck, so that the guns, when levelled in their carriages, are all equally high above the lower extremity of the ports, which is called the *portcells*.

Port, is also a strong wine brought from Port-a-port, and also called *Porto* and *Oporto*.

Port of the Voice, in *Music*, the faculty or habit of making the shakes, passages, and diminutions, in which the beauty of a song or piece of music consists.

Port-Crayon, a pencil case, which is usually four or five inches long, and contrived so as that the pencil may slide up and down. Its inside is round, and its outside is sometimes filed into eight sides or faces, on which are drawn the sector-lines; sometimes it is made round both with-side and within, and has its length divided into inches and parts of inches.

Port-Fire, a composition for setting fire to powder, &c. Port-fires are frequently used by artillery people in preference to matches; and they are distinguished into wet and dry port-fires. The composition of the former is saltpetre four, sulphur one, and mealed powder four. When these materials are thoroughly mixed and sifted, the whole is to be moistened with a little linseed oil, and rubbed between the hands till all the oil is imbibed by the composition. The preparation for dry port-fires is saltpetre four, sulphur one, mealed powder two, and antimony one. These compositions are driven into small paper cases, to be used when necessary.

Port-aux-Prune, so called by the French, is a country on the coast of Africa, to the north of the island of Madagascar. It is a rich country, and fertile in rice and pastures; it is inhabited only by the negroes, who are an industrious good sort of people, but very superstitious. There are no towns, but several villages, and they have some customs which seem to incline to Judaism.

Port-Jackson, in New Holland. See *New Holland*, N° 7, &c.

Port-Royal, a sea-port town in the island of Jamaica. It was once a place of the greatest riches and importance in the West Indies; but in 1692 it was destroyed by an earthquake, in 1702 by fire, in 1722 by an inundation of the sea, and in 1744 it suffered greatly by a hurricane. It is now reduced to three streets, a few lanes, and about 200 houses. It contains the royal navy-yard for heaving down and refitting the king's ships; the navy-hospital, and barracks for a regiment of soldiers. The fortifications, which are very extensive, being in excellent order, and having been lately strengthened with many additional works, it may be said to vie in point of strength with any fortress in the king's dominions. The harbour is one of the best in the world, and 1000 ships may ride therein, secure from every wind that can blow. It is six miles east of Spanish-town, and as much by water south-east of Kingston. W. Long. 76. 40. N. Lat. 18. 0.

Port-Royal, an island in North America, on the coast of South Carolina, which, with the neighbouring continent, forms one of the most commodious harbours in the state. It is 15 miles in length; and the town on the north shore is called *Beaufort*. W. Long. 80. 20. N. Lat. 31. 40.

Port-Royal, the name of two monasteries of Cistertian

tian nuns in the diocese of Paris; the one near Chevreuse, at the distance of five leagues from Paris, called *Port Royal of the Fields;* and the other in Paris, in the suburbs of St James.

The nuns of the former of these monasteries proving refractory were dispersed; when many ecclesiastics, and others, who were of the same sentiments as these religious, retired to Port-Royal, took apartments there, and printed many books. Hence the name of *Port-Royalists* was given to all their party, and their books were called *books of Port-Royal:* from hence we say the writers of Port-Royal, Messieurs de Port-Royal, and the translations and grammars of Port-Royal.

PORTA, or *Vena Porta*, in *Anatomy*, a large vein distributed through the liver in the manner of an artery. See ANATOMY, N° 96.

Porta-Augusta, in *Ancient Geography*, mentioned only by Ptolemy; a town of the Vaccæi in the Hither Spain; thought by some to be *Torre Quemada*, in Old Castile; by others *Los Valvases*, a village between Burgos and Torre Quemada.

PORTÆ-ROMANÆ, in *Ancient Geography*. According to Pliny, Romulus left but three, or at most four, gates of Rome: afterwards, on enlarging the Pomœria, or compass of the city, they amounted to 37.

PORTAL, in *Architecture*, a little gate where there are two gates of a different bigness; also a little square corner of a room cut off from the rest by the wainscot, and forming a short passage into the room. The same name is also sometimes given to a kind of arch of joiners work before a door.

PORTATE, or a *Cross Portate*, in *Heraldry*, a cross which does not stand upright, as crosses generally do; but lies across the escutcheon in bend, as if it were carried on a man's shoulder.

PORTCULLICE, in *Fortification*, is an assemblage of several large pieces of wood, joined across one another like a harrow, and each pointed with iron at the bottom. They are sometimes hung over the gate-way of old fortified towns, ready to let down in case of surprise, when the gates could not be shut.

PORTER, a kind of malt-liquor which differs from ale and pale beer, in its being made with high-dried malt. See ALE, BEER, and BREWING.

PORT-GLASGOW. See GLASGOW, N° 12.

PORTGREVE, or PORTGRAVE, was anciently the principal magistrate in ports and other maritime towns. The word is formed from the Saxon *port*, "a port or other town;" and *geref*, "a governor."—It is sometimes also written *port-reve*.

Camden observes, that the chief magistrate of London was anciently called *port-greve*; instead of whom, Richard I. ordained two bailiffs; and soon afterwards King John granted them a mayor for their yearly magistrate.

PORTICI, a palace of the king of Naples, six miles from that capital. It has a charming situation on the sea side, near Mount Vesuvius. It is enriched with a vast number of fine statues, and other remains of antiquity, taken out of the ruins of Herculaneum.

The museum consists of 16 rooms, in which the different articles are arranged with very great taste. The floors are paved with mosaic, taken from the recovered towns, and the walls of the court are lined with inscriptions. Besides busts, statues, medals, intaglios, lamps, and tripods, there is scarcely an article used by the ancients of which a specimen may not be seen in this museum. "But the most valuable room is the library, from the numerous manuscript rolls which it contains. What a field is here for conjecture! what room for hope! Among this inestimable collection, how many great works are there, of which even the names are now unknown! how many unbroken volumes, whose very fragments, preserved in the writings of the ancient scholiasts, convey to us moral improvement, information, and delight! perhaps, all the dramatic pieces of Menander and Philemon; perhaps, nay, certainly, the lost Decades of Livy; for it is impossible to suppose, that among so many rolls, the most admired history of the people who possessed them is not to be found: what private library in Britain is without the best histories of England? But how I tremble for their situation, as Portici is built on the lava that overwhelmed Herculaneum! How I tremble too for the indifference of the king of Naples towards this invaluable treasure, in which all the most enlightened people of Europe are deeply interested! When I first saw them, I had no idea of what they were, as they resemble wooden truncheons burnt almost to charcoal. They are so hard and brittle, that the greatest caution must be used in removing them, lest they crumble to dust; nevertheless, an ingenious friar of Genoa, named *Raggi*, undertook to unroll them; and by a most curious, though tedious process, so far succeeded, as to transcribe three Greek Treatises on Philosophy and Music; but finding (as I hear) no other encouragement than his salary, which was but little more than you pay some of your servants, the work was unhappily discontinued. Were these manuscripts in England, they would not long remain a secret to the world." See POMPEII.

Watkin's Travels through Swisserland, Italy, &c.

PORTICO, in *Architecture*, a kind of gallery on the ground; or a piazza encompassed with arches supported by columns, where people walk under covert. The roof is usually vaulted, sometimes flat. The ancients called it *lacunar*. Though the word *portico* be derived from *porta*, "gate, door;" yet it is applied to any disposition of columns which form a gallery, without any immediate relation to doors or gates. The most celebrated porticoes of antiquity were, those of Solomon's temple, which formed the atrium or court, and encompassed the sanctuary; that of Athens, built for the people to divert themselves in, and wherein the philosophers held their disputes and conversations, (see PORCH); and that of Pompey at Rome, raised merely for magnificence, consisting of several rows of columns supporting a platform of vast extent; a draught whereof, Serlio gives us in his antique buildings. Among the modern porticoes, the most celebrated is the piazza of St Peter of the Vatican.—That of Covent-Garden, London, the work of Inigo Jones, is also much admired.

PORTII. See POMPEII.

PORTLAND, a peninsula in Dorsetshire, of great strength both by nature and art, being surrounded with inaccessible rocks, except at the landing-place, where there is a strong castle, called *Portland castle*, built by King Henry VIII. There is but one church in the island: and that stands so near the sea, that it is often in danger from it. It is now chiefly noted for the building stone which is found there, and which is greatly employed

Portland. ployed in London, and other parts of England, for building the finest structures. St Paul's church, in particular, is built of this stone. W. Long. 2. 35. N. Lat. 50. 30.

The following custom at Portland is worthy of notice. "While I was looking over the quarries at Portland (says Mr Smeaton), and attentively considering the operations, observing how soon the quarrymen would cut half a ton of spawls from an unformed block, and what large pieces flew off at every stroke; how speedily their blows followed one another, and how incessantly they pursued this labour with a tool of from 18 to 20 pound weight; I was naturally led to view and consider the figure of the operative agent; and after having observed, that by far the greatest number of the quarrymen were of a very robust hardy form, in whose hands the tool I have mentioned seemed a mere play-thing, I at last broke out with surprise, and inquired of my guide, Mr Roper, where they could possibly pick up such a set of stout fellows to handle the *kevel*, which in their hands seemed nothing? for I observed, that in the space of 15 minutes, they would knock off as much waste matter from a mass of stone, as any of that occupation I had ever seen before would do in an hour. Says Roper, 'we do not go to fetch those men from a distance, they are all born upon the island, and many of them have never been farther upon the main land than to Weymouth.' I told him, I thought the air of that island must be very propitious, to furnish a breed of men so particularly formed for the business they followed. 'The air (he replied), though very sharp from our elevated situation, is certainly very healthy to working men; yet if you knew how these men are produced, you would wonder the less; for all our marriages here are productive of children.' On desiring an explanation how this happened, he proceeded: 'Our people here, as they are bred to hard labour, are very early in a condition to marry and provide for a family; they intermarry with one another, very rarely going to the main-land to seek a wife; and it has been the custom of the island, from time immemorial, that they never marry till the woman is pregnant.' But pray (said I) does not this subject you to a great number of bastards? Have not your Portlanders the same kind of fickleness in their attachments that Englishman are subject to? and, in consequence, does not this produce many inconveniences? 'None at all (replies Roper), for previous to my arrival here, there was but one child on record of the parish register that had been born a bastard in the compass of 150 years. The mode of courtship here is, that a young woman never admits of the serious addresses of a young man, but on supposition of a thorough probation. When she becomes with child, she tells her mother, the mother tells her father, her father tells his father, and he tells his son, that it is then proper time to be married.' But suppose, Mr Roper, she does not prove to be with child, what happens then? Do they live together without marriage? or, if they separate, is not this such an imputation upon her, as to prevent her getting another suitor? 'The case is thus managed (answered my friend), if the woman does not prove with child after a competent time of courtship, they conclude they are not destined by Providence for each other; they therefore separate; and as it is an established maxim, which the Portland women observe with great strictness, never to admit a plurality of lovers at one time, their honour is noway tarnished: she just as soon (after the affair is declared to be broke off) gets another suitor, as if she had been left a widow, or that nothing had ever happened, but that she had remained an immaculate virgin.' But pray, Sir, did nothing particular happen upon your men coming down from London? 'Yes (says he) our men were much struck, and mightily pleased with the facility of the Portland ladies, and it was not long before several of the women proved with child; but the men being called upon to marry them, this part of the lesson they were uninstructed in; and on their refusal, the Portland women arose to stone them out of the island; insomuch, that those few who did not choose to take their sweethearts for *better or for worse*, after so fair a trial, were in reality obliged to decamp; and on this occasion some few bastards were born: but since then matters have gone on according to the ancient custom."

PORTLAND VASE, a celebrated funeral vase which was long in possession of the Barberini family; but which was lately purchased for 1000 guineas by the duke of Portland, from whom it has derived its present name. Its height is about ten inches, and its diameter where broadest six. There are a variety of figures upon it of most exquisite workmanship, in bas relief of white opake glass, raised on a ground of deep blue glass, which appears black except when held against the light. It appears to have been the work of many years, and there are antiquarians who date its production several centuries before the Christian era; since, as has been said, sculpture was declining in excellence in the time of Alexander the Great

Respecting the purpose of this vase, and what the figures on it were meant to represent, there have been a variety of conjectures, which it is not our business to enumerate. We think with Dr Darwin * that it was not made for the ashes of any particular person deceased; and therefore that the subject of its embellishments is not a private history, but of a general nature. But we are not sure that he is right in conjecturing it to represent a part of the Eleusinian mysteries; because that conjecture depends on Warburton's explanation of the sixth book of the Æneid, which does not now command that respect which it did when it was first proposed. We shall therefore give a short account of the several figures, without noticing any of the theories or conjectures that have been made about them.

* *Loves of the Plants.*

In one compartment three exquisite figures are placed on a ruined column, the capital of which is fallen, and lies at their feet among other disjointed stones: they sit under a tree on loose piles of stone. The middle figure is a female in a reclining and dying attitude, with an inverted torch in her left hand, the elbow of which supports her as she sinks, while the right hand is raised and thrown over the drooping head. The figure on her right hand is a man, and that on the left a woman, both supporting themselves on their arms, and apparently thinking intensely. Their backs are to the dying figure, and their faces are turned to her, but without an attempt to assist her. On another compartment of the vase is a figure coming through a portal, and going down with great timidity into a darker region, where he is received by a beautiful female, who stretches forth her hand to help him: between her knees is a large and playful serpent.

pent. She sits with her feet towards an aged figure, having one foot sunk into the earth, and the other raised on a column, with his chin resting on his hand. Above the female figure is a Cupid preceding the first figure, and beckoning him to advance. This first figure holds a cloak or garment, which he seems anxious to bring with him, but which adheres to the side of the portal through which he has passed. In this compartment there are two trees, one of which bends over the female figure and the other over the aged one. On the bottom of the vase there is another figure on a larger scale than the one we have already mentioned, but not so well finished nor so elevated. This figure points with its finger to its mouth. The dress appears to be curious and cumbersome, and above them is the foliage of a tree. On the head of the figure there is a Phrygian cap: it is not easy to say whether this figure be male or female. On the handles of the vase are represented two aged heads with the ears of a quadruped, and from the middle of the forehead rises a kind of tree without leaves; these figures are in all probability mere ornaments, and have no connection with the rest of the figures, or the story represented on the vase.

PORTLANDIA, a genus of plants belonging to the pentandria class, and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

PORT-LOUIS, is a strong town of France, in the department of Morbihan, in the diocese of Vannes, with a citadel and a good harbour. It was fortified by Louis XIII. from whom it derived its name. It was a station for part of the royal navy and the East India ships belonging to France. It is seated at the mouth of the river Blavet, 27 miles west of Vannes. W. Long. 3. 18. N. Lat. 47. 40.

PORT-Mahon. See MINORCA.

PORTO. See OPORTO.

PORTO-Bello, a town of North America, situated in N. Lat. 9. 3. W. Long. 79. 45. close to the sea, on the declivity of a mountain, which surrounds the whole harbour. This harbour is so large, deep, and safe, that Columbus, who first discovered it, gave it the name of *Porto-Bello*, or the "Fine Harbour," which is now commonly used to denote the town. The number of the houses is about 130; most of them of wood, large and spacious, forming one long street along the strand, with other smaller ones crossing it. The governor of the town is always a gentleman of the army, subordinate to the president of Panama; but having under him the commandants of the forts that defend the harbour. At the east end of the town, on the road to Panama, is a place called *Guinea*, where all the negroes of both sexes, whether slaves or free, have their habitations. This place is very much crowded when the galleons are here, most of the inhabitants of the town quitting their houses entirely for the sake of letting them; while others content themselves with a small part, in order to make money of the rest. The Mulattoes and other poor families also remove either to Guinea, or to cottages already erected near it, or built on the occasion. Great numbers of artificers likewise, who flock to Porto-Bello from Panama to work at their respective callings during the fair, lodge in Guinea for cheapness. Towards the sea, in a large tract between the town and Gloria castle, barracks are erected, in most of which the ships crews keep stalls of sweet-meats, and other kinds of eatables, brought from Spain; but at the conclusion of the fair, when the ships put to sea, all these buildings are taken down, and the town returns to its former tranquillity and emptiness. In 1739, the harbour was defended by a castle and two forts; which were all demolished by Admiral Vernon, who, with six ships only, made himself master of this port. The country about Porto-Bello is overrun with mountains and impenetrable forests, except a few valleys, in which are some scattered farms. Among the mountains that surround the harbour is one distinguished by the name of *Capiro*, and by its superior loftiness is a sort of barometer to the country, by foretelling every change of weather. Its top is always covered with clouds, of a density and darkness seldom seen in those of the atmosphere. When these clouds thicken, increase their blackness, and sink below their usual station, it is a sure sign of a tempest; while, on the other hand, their clearness and ascent ascertainly indicate the approach of fair weather. These changes are very sudden and frequent here. The summit of the mountain is scarce ever clear from clouds; and when it happens, it is only, as it were, for an instant. Except in the time of the fair, all the inhabitants of Porto-Bello do not amount to 3000; half of whom are Indians, Mulattoes, or Negroes; the Spaniards of any substance not choosing to reside in a place so extremely unhealthy, and fatal even to the lives of the natives. Ulloa tells us, that the cattle brought down hither from Panama or Carthagena, lose their flesh so fast in the best pastures, as to become scarce eatable: he assures us also, that neither horses nor asses are bred here. The heat, indeed, is excessive; and the torrents of rain are so dreadful, sudden, and impetuous, that one not accustomed to them, would imagine a second deluge was coming. These torrents are also accompanied with frightful tempests of thunder and lightning, the awfulness of the scene being heightened by the repercussions from the mountains, and the shrieks and howlings of multitudes of monkeys of all kinds which inhabit the surrounding woods.

Fresh water pours down in streams from the mountains, some running without the town, and others crossing it. These waters are very light and digestive; qualities which in other countries would be very valuable, but are here pernicious, producing dysenteries, which the patient seldom survives. However, these rivulets, formed into reservoirs, serve the purposes of bathing, which is here found to be very conducive to health.

As the forests almost border on the houses of the town, tygers often make incursions into the streets during the night, carrying off fowls, dogs, and other domestic animals, and sometimes even children have fallen a prey to them. Besides the snares usually laid for them, the Negroes and Mulattoes, who fell wood in the forests of the mountains, are very dexterous in encountering them; and some, for a slender reward, even seek them in their retreats.

The town of Porto-Bello, which is thinly inhabited by reason of its noxious air, the scarcity of provisions, and the barrenness of the soil, becomes, after the arrival of the galleons, one of the most populous towns in the world. He who had seen it quite empty, and every place wearing a melancholy aspect, would be filled with astonishment to see the bustling multitudes in the time of of the fair, when every house is crowded, the squares and streets encumbered with bales of merchandise and chests of gold and silver, the harbour full of ships and vessels, loaded with provisions and goods. Formerly the fair was limited to no particular time; but as a long stay in such a sickly place extremely affected the health of the traders, his Catholic majesty transmitted an order that the fair should not last above 40 days; and that, if in that time the merchants could not agree on their rates, those of Spain should be allowed to carry their goods up the country to Peru: and accordingly, the commodore of the galleons has orders to re-embark them, and return to Carthagena; but otherwise, by virtue of a compact between the merchants of both kingdoms, and ratified by the king, no Spanish trader is to send his goods, on his own account, beyond Porto-Bello. The English were formerly allowed to send a ship annually to this fair, which turned to great account; and, while the assiento contract subsisted, either with the English or the French, one of their principal factories was at Porto-Bello.

In the summer of 1819, this town was taken by Sir Gregor Macgregor, who professed to act for the independent party in Spanish America; but in the course of a few days, he was surprised by the Spaniards, nearly his whole force taken, and he himself narrowly escaped.

Porto-Farina, a port about 12 miles from Cape Carthage, in the bay of Tunis, where formerly the large vessels belonging to the bey were fitted out, and laid up on their return from a cruise. This harbour is safe from the weather, and opens into a large lake, formed by the Mejerdah, which runs through into the sea.—The north-west wind, which blows right upon the shore, together with the soil brought down by the river, which has the same quality as the Nile of overflowing its banks, has formed a bar, so that only small vessels can now enter. It is still the arsenal where the naval stores are kept. E. Long. 10. 16. N. Lat. 37. 12.

Porto-Farraio, a handsome town of Italy in the isle of Elba, with a good citadel. It is very strong, and seated on a long, high, steep point of land, to the west of the bay of the same name, which has two forts. It belongs to the great duke of Tuscany, who always keeps a good garrison there. E. Long. 10. 37. N. Lat. 48. 55.

Porto-Longone, a small but very strong town of Italy, and in the isle of Elba, with a good harbour, and a fortress upon a rock almost inaccessible. The king of Naples has a right to put a garrison therein, though the place belongs to the prince of Piombino. It is seated on the east end of the island, eight miles south-west of Piombino. E. Long. 10. 10. N. Lat. 42. 52.

Porto-Santo, an island of the Atlantic ocean, on the coast of Africa, and the least of those called the *Madeiras*. It is about 15 miles in circumference; it produces some corn, as well as some oxen and wild hogs, with a vast number of rabbits. There are trees which produce the gum or resin called *dragon's blood;* and there is likewise a little honey and wax, which are extremely good. It has no harbour, but good mooring in the road. It belongs to the Portuguese, and is 300 miles west of the coast of Africa. W. Long. 16. 20. N. Lat. 32. 58.

Porto-Seguro, a government of South America, on the eastern coast of Brasil; bounded on the north by the government of Rio-dos-Hilios, on the east by the North sea, on the south by the government of Spiritu-Santo, and on the west by the Tupicks. It is a very fertile country, and the capital town is of the same name. It is built on the top of a rock, at the mouth of a river, on the coast of the North sea, and is inhabited by Portuguese. W. Long. 38. 50. S. Lat. 17. 0.

Porto-Vecchio, is a sea-port town of Corsica, in the Mediterranean sea, seated on a bay on the eastern coast of the island. It is 12 miles from Bonifacio, and 40 north of Sardinia. E. Long. 9. 20. N. Lat. 41. 42.

Porto-Venereo, is a town of Italy, on the coast of Genoa, at the entrance of the gulf of Spetia. It is seated on the side of a hill, at the top of which there is a fort. It has a very good harbour, and is 45 miles south-east of Genoa. E. Long. 9. 38. N. Lat. 44. 5.

PORTRAIT, or PORTRAITURE, in painting, the representation of a person, and especially of a face, done from the life. In this sense we use the term *portrait-painting*, in contradiction to *history-painting*, where a resemblance of persons is usually disregarded. Portraits, when as large as the life, are usually painted in oil-colours; sometimes they are painted in miniature with water-colours, crayons, pastils, &c. See PAINTING, p. 641.

PORTREE, is a small village, containing a church and a very few houses, with an excellent bay and a good harbour, in the isle of Skye. "The entrance of the bay (Mr Knox tells us) represents agreeable landscapes on both sides, with excellent pasture. Knox's Tour.

'The bay of Portree (says Mackenzie), off the houses, is an exceeding good harbour for a few ships of any size; it is well sheltered, the ground good, the depth from five to 14 fathoms, and nothing to fear coming in but a rock, about half a cable's length from Airderachig Point, on the starboard as you enter the anchorage, part of which is always above water.' It is the only port or harbour to a very considerable division of Skye, on the east side. From this opening to the northern extremity, a course of 20 miles, the shore is one continued line of loft rocks, where no ship can find refuge in the mildest weather, and where inevitable dangers await the mariners in rough weather.

"James V. of Scotland and several of his nobility landed here, when they made the tour of the Hebrides in 1535; from which circumstance, this fine bay has got the honourable name of *Portree*."

Mr Knox tells us, "that the country round this village, though mountainous, is well inhabited; it raises much grain and many cattle. Here the late Sir James Macdonald had marked out the lines of a town; and government, it is said, promised to assist him in the work with 500l.: but the death of that gentleman put an end to these promising appearances." We have to add, that Lord Macdonald, the present (1809) proprietor, has resumed the undertaking; and, we understand, has made some progress in building a new town, besides introducing various other important improvements in this and other parts of the island.

PORTSMOUTH, a sea-port town in Hampshire, with one of the most secure and capacious harbours in England, being defended by a numerous artillery, both on the sea and land side, and very good fortifications.

Portsmouth. A great part of the royal navy is built here; and here are some of the finest docks, yards, and magazines of naval stores, in Europe. It is seated in the isle of Portsea, being surrounded by the sea except on the north side, where there is a river which runs from one arm of it to the other. It is much resorted to on account of the royal navy, whose usual rendezvous is at Spithead, which is at the east end of the isle of Wight, and opposite to Portsmouth. There is a draw-bridge over the river, and it has always a good garrison. It is governed by a mayor, 12 aldermen, and burgesses, and sends two members to parliament. It has one church, and two chapels, one in the garrison, and one in the Common, for the use of the dock, and others, besides several meeting-houses of the dissenters. Portsmouth contained 32,166 inhabitants in 1801, and 40,567 in 1811. W. Long. 1. 1. N. Lat. 50. 47.

The town is supposed to receive its name from Port, a famous Saxon chieftain, who, A. D. 501, landed here with his two sons. It made a considerable figure in the time of the Saxons; and from the utility of its situation, was highly favoured by all our monarchs of the Norman line. It was incorporated, and became also a parliamentary borough. In the reign of Edward III. it was in a very flourishing state; but A. D. 1338, in the very same reign, was burned by the French, when that monarch, which was afterwards ratified by King Richard II. forgave the inhabitants a debt, and remitted their fee-farm for 10 years; within which space they so recovered themselves, as to equip a squadron, which sailed into the Seine, sunk two ships, and brought away a great booty. *Campbell's Political Survey.* The singular excellence of its port, and the convenience of fitting out fleets from thence in the time of a French war, induced Edward IV. to think of fortifying it, as he actually, in some measure, did; which fortifications were farther carried on by Richard III. But King Henry VII. was the first who settled a garrison therein; which was increased, and the place made still stronger, in the reign of Henry VIII. who had a great dock there, wherein was built the Henry Grace de Dieu, which was the largest ship in the navy of his time. The same monarch, remarkably attentive to the security of all maritime places, built what is now called *South Sea Castle*, for the protection of this.—The improvements made here in the reign of Queen Elizabeth were much superior to all these. King Charles II. after his restoration, directed great alterations, established new docks and yards, raised several forts, and fortified them after the modern manner; which works were augmented under his brother's reign. Notwithstanding this, King William directed likewise fresh alterations and additions; and succeeding princes, following his example, have, at a large expence, extended these fortifications, and taken in a vast deal of ground: so that it is at present, as the importance of the place deserves, the most regular fortress in Britain; and, as it cannot be effectually attacked by sea, may be justly esteemed impregnable.

PORTSMOUTH, the largest town in the state of New Hampshire in North America. It stands on the south-east side of Piscataqua river, about two miles from the sea, and contains about 600 houses, and 4400 inhabitants. The town is handsomely built, and pleasantly situated. Its public buildings are, a court-house, two churches for Congregationalists, one for Episcopalians, and one other house for public worship. Its harbour is one of the finest on the continent, having a sufficient depth of water for vessels of any burthen. It is defended against storms by the adjacent land, in such a manner, as that ships may securely ride there in any season of the year. Besides, the harbour is so well fortified by nature, that very little art will be necessary to render it impregnable. Its vicinity to the sea renders it very convenient for naval trade. A light-house, with a single light, stands at the entrance of the harbour.

Portsmouth ‖ Portugal.

PORTSOY, is a handsome sea-port town, situated on a small promontory running into the sea, on the south side of the Murray frith, in Scotland, about six miles from Cullen, and seven west from Banff. It sends out several fishing vessels, particularly for the Hebride white fishery, and exports a considerable quantity of grain. It contained 599 inhabitants in 1811. A manufacture of stocking and sewing thread is also carried on to a considerable amount for the London and Nottingham markets. In the neighbourhood is a stratum of marble, of a dark greenish colour, in which, it is said, the curious substance called ASBESTOS, or earth-flax, has been found. There is also a remarkable mineral production found here, viz. a granite of a flesh colour, and found no where else in Europe. It contains a quantity of feldspar, and shews a brilliancy like the Labrador spar. When viewed in a particular light, it shews a purple and bluish tint; and when polished, the figures upon it assume the appearance of Arabic characters. It is described by Dr Hutton, Edin. Trans. vol. i. From the asbestos a sort of incombustible cloth is made, which is purified by throwing it into the fire. W. Long. 2. 5. N. Lat. 57. 50.

PORTUGAL, the most westerly kingdom of Europe, bounded on the west and south by the Atlantic ocean, and on the east and north by Spain; extending about 310 miles in length, and 150 in breadth. See *Map* of Spain and Portugal.

1 Boundaries. By modern writers, we find this country constantly styled in Latin *Lusitania;* and it is certain, that anciently a country of Spain went by that name; but it does not by any means appear that the country called by the ancients *Lusitania* had the same boundaries with the modern kingdom of Portugal. Before Augustus Cæsar, Lusitania seems to have been bounded on the north by the ocean, and on the south by the river Tagus; by which means it comprehended all Galicia, and excluded two of the six provinces of Portugal. But in the more strict and restrained sense of the word, it was bounded on the north by the Durius, now the Douro, and on the south by the river Anas, now the Guadiana; in which sense it was not quite so long as modern Portugal, but considerably broader.

2 Etymology of the name. The commonly received opinion with regard to the etymology of the word *Portugal*, is, that a great number of Gauls landed at Porto, or Oporto, whence it received the name of *Portus Gallorum*, or *the Port of the Gauls;* and in process of time that name gradually extended over the whole country, being softened, or rather shortened, into *Portugal.* But the time when this event happened, the reason why these Gauls came thither, and what became of them afterwards, are all particulars which lie buried in oblivion. It is alleged, however, that, upon an eminence which overlooks the mouth of the river Douro, there stood an ancient town called *Cale*, strong and well peopled, but ill suited for trade; and this occasioned the construction of a lower town or ham-

Portugal. let, which was called *Portus Cale*, that is, *the haven of Cale;* and, in process of time, *Portucalia*. At length, becoming so considerable as to merit an episcopal chair, the bishops subscribed themselves, as the records of ancient councils testify, *Portucalenses*, and the name of the city was transferred to the diocese. It is true, that these bishops afterwards changed their title, and subscribed themselves *Portuenses*, that is, *bishops of Portu*. But the facts just mentioned are actually recorded in authentic histories; and as the diocese of Portucalia contained in a great measure that little country in which the sovereignty originally began, the name extended itself, together with the acquisitions of the sovereigns, and has remained in the kingdom, though the diocese itself has changed its name, and possibly on that very account.

3 Originally only a small kingdom. Portugal, though even yet but a small kingdom, was originally much smaller. The Spanish and Portuguese historians agree, that Don Alonso, King of Leon and Castile, and son to Don Ferdinand the Great, bestowed his daughter Donna Theresa in marriage upon an illustrious stranger, Don Henry and gave him with her the frontier province which he had conquered from the Moors, small indeed in extent, but excellently situated, and so pleasant and fertile, that it has sometimes been styled *Medulla Hispanica*, or *the marrow of Spain*. To this territory was added the title of *Count;* but authors are much divided about the time that this stranger came into Spain, and who he was. However, the authors of the Universal History make it pretty evident, that he was a grandson of Robert the first duke of Burgundy. The manner in which he obtained the principality above mentioned is related as follows:

The king, Don Alonso, apprehensive that his success in taking the city of Toledo would bring upon him the whole force of the Moors, sent to demand assistance from Philip I. of France, and the duke of Burgundy, whose daughter he had married. His request was granted by both princes; and a numerous body of troops was speedily collected for his service, at whose head went Raymond count of Burgundy, Henry, younger brother of Hugh duke of Burgundy, Raymond count of Tholouse, and many others. They arrived at the court of Don Alonso in the year 1087, where they were received and treated with all possible marks of esteem; and having in the course of two or three years given great proofs of their courage and conduct, the king resolved to bestow his only daughter named *Urraca*, then a mere child, being at most in her ninth year, upon Raymond count of Burgundy, and assigned them the province of Galicia for

4 Henry of Burgundy the first count of Portugal. the support of their dignity. About four years after, Don Alonso being very desirous to express his gratitude to Henry of Burgundy, gave him in marriage a natural daughter of his, born while he remained in exile at Toledo, whose name was *Donna Theresa;* and upon this marriage, he gave up in full property the country which has been already mentioned.

The new sovereign, with his consort, fixed their residence in the town of Guimaraez, pleasantly situated on the banks of the river Ave. The remains of an ancient palace belonging to their successors are still to be seen; and on account of its having been anciently the capital, the king, Don Denis, granted the inhabitants an immunity from taxes, which they still enjoy.

The Portuguese, now finding themselves independent, immediately began, like other nations, to attempt the subjection of their neighbours. Henry is said to have performed great exploits against the Moors; but the accounts of them are so indistinct, that they cannot be taken notice of here. He died in 1112; and was succeeded by his son Don Alonso, then an infant in the third year of his age. In his minority, the kingdom was governed by his mother Donna Theresa, assisted by two able ministers. During the first nine years of their administration, nothing remarkable happened; but after that period some differences took place between the queen regent (for she had assumed the title of queen after her father's death) and Urraca queen of Castile. Theresa insisted, that some part of Galicia belonged to her in virtue of her father's will; and therefore seized on Tuy, an episcopal town, and a place of some consequence. Urraca, having assembled a numerous army, went in person into Galicia; upon which Theresa was obliged to abandon Tuy, and take shelter in one of her own fortresses. The consequence, in all probability, would have been fatal to the new kingdom, had not the archbishop of Compostella, without whose assistance Urraca could do nothing, demanded leave to retire with his vassals. This offended the queen to such a degree, that she threw him into prison; which act of violence excited such a commotion among her own subjects, that the Portuguese were soon delivered from their apprehensions. Queen Theresa fell immediately after into a similar error, by throwing into prison the archbishop of Braga, who had not espoused her cause so warmly as she had expected. The bishop, however, was quickly delivered by a bull from the pope, who also threatened the kingdom with an interdict; and this was the first remarkable offence which Theresa gave her subjects.

5 Difference with Castile.

Soon after this, Queen Urraca died, and all differences were amicably settled at an interview between Theresa and Don Alonso Raymond, who succeeded to the kingdom of Castile. But, in 1126, the king of Castile being obliged to march with the whole strength of his dominions against his father-in-law the king of Navarre and Arragon, Theresa took the opportunity of again seizing upon Tuy; but the king soon returning with a superior army, she was again obliged to abandon her conquest. But the greatest misfortune which befel this princess, was a quarrel with her own son Don Alonso Enriquez. It does not appear indeed that Theresa had given him any just cause of offence; but it is certain that a civil war ensued, in which the queen's forces were totally defeated, and she herself made prisoner, in which situation she continued during the remainder of her life.

6 Don Alonso's wars with the Moors and king of Castile.

Enriquez having thus attained to the free and full possession of his dominions, made several attempts upon some places in Galicia, but without success; so that he was at last constrained to make peace with Alonso king of Castile and Leon, who had assumed the title of *Emperor of the Spains;* the more especially as his dominions happened to be at that time invaded by the Moors.—The number of infidels was so great, that the count of Portugal had little hopes of subduing them; but a plague breaking out in the Moorish army, they were obliged to retreat; after which he reduced several places belonging to that nation. But, in the mean time, the emperor Don Alonso, breaking into the Portuguese territories, destroyed every thing with fire and sword. The king of Portugal surprised and cut off a considerable part of his army; which, however, did not hinder the

 the emperor from marching directly towards him.—But, at the intercession of the pope's legate, all differences were accommodated, and a peace concluded; all places and prisoners taken on both sides being delivered up.

In the mean time, the progress of the Christian arms in Spain being reported to Abu-Ali Texefien, the miramamolin or chief monarch of the Moors in Barbary, he directed Ismar, or Ishmael, his lieutenant in Spain, to assemble all the forces in the southern provinces, and drive the Christians beyond the Douro. Ishmael immediately began to prepare for putting these orders in execution; and having added a considerable body of troops brought from Barbary to those whom he had raised in Spain, the whole army was very numerous. He was
7 Victory of Ourique. met by Don Alonso of Portugal, in the plains of Ourique, on the banks of the river Tayo; and Ishmael took all possible means to prevent the Christians from passing that river, because his own cavalry, in which the strength of his army chiefly consisted, had thus more room to act. The Portuguese forces were very inconsiderable in number in comparison of the Moors; but Ishmael, being too confident of victory, divided his army into twelve bodies, and disposed them in such a manner as might best prevent the flight, not sustain the attack, of the Christians. The consequence was, that his army was overthrown with incredible slaughter, and a vast number of prisoners taken, among whom were 1000 Christians, of the sect styled *Mozarabians*, whom, at the request of Theotonus, prior of the Holy Cross, Don Alonso set at liberty with their wives and children, and procured them settlements in his own dominions.

8 Don Alonso assumes the title of king. After this signal victory, gained in the year 1139, Don Alonso was proclaimed king by his soldiers, and ever after retained that title, renouncing all kind of subjection to the crown of Spain. Being very desirous, however, of bringing down the power of the emperor, he entered into a league with Raymond count of Barcelona and regent of the kingdom of Arragon against that prince. In consequence of this treaty, he entered Galicia with a considerable force on one side, while Don Raymond did the same on the other. Neither of these enterprises, however, succeeded. The Portuguese monarch met with a severe check in his expedition into Galicia, where he received a dangerous wound, and had some of the nobility who attended him taken prisoners. At the same time he received intelligence that the Moors had invaded his dominions, so that he was obliged to retire; which, however, was not done in sufficient time to prevent the strong fortress of Leyria from falling into their hands. This fortress they demolished, and put all the garrison to the sword; but the king caused it to be rebuilt stronger than before, and put a more numerous garrison into it; however, he undertook nothing farther this campaign. The war continued with various success till the year 1145, when the king projected an enterprise against Santaren, a strong city about 12 miles from Lisbon. In this he luckily succeeded; and by that means gained a considerable tract of country, and a strong barrier to his dominions.

After this success Don Alonso caused himself with much ceremony to be chosen and crowned king of Portugal before an assembly of the states, where he also solemnly renounced all dependence on the crown of Spain, declaring, that if any of his successors should condescend to pay tribute or to do homage to that crown, he was unworthy of enjoying the kingdom of Portugal. The next year the king undertook the recovery of Lisbon out of the hands of the Moors; and concerning this expedition there are such numbers of fables, that it is almost impossible to come at the truth. What can be gathered from these accounts is, that he undertook the siege with a small army, and was able to make but little progress in it, partly from the strength of the place, and partly from the numerous garrison by which it was defended. At length, fortunately for Don Alonso, a fleet of adventurers, French, English, Germans, and Flemings, that were going to the Holy Land, anchored at the mouth of the river Tagus, whose assistance he demanded, as not altogether foreign to their design of making war on the infidels. His request was readily granted; and, with their assistance, Lisbon was speedily reduced; which conquest so much raised the reputation of this monarch, and brought such numbers to recruit his army, that before the end of the year 1147 he had reduced 12 other considerable cities. 9 Reduces Lisbon and 12 other cities.

For many years after this, Don Alonso was successful in all his undertakings. He settled the internal government of his kingdom, procured a bull from Pope Alexander III. confirming his regal dignity, undertook many successful expeditions against the Moors, and became master of four of the six provinces which compose the present kingdom of Portugal. In all his undertakings he was assisted by the counsels of his queen Matilda, who was a woman of great capacity, and sufficient for the government of the kingdom in her husband's absence. By her he had a numerous offspring, particularly three daughters; the eldest of whom Donna Mafalda or Mathilda, was married to the king of Arragon; the second, Urraca, to Don Ferdinand king of Leon; and the third, Theresa, to Philip earl of Flanders. 10 Has his regal dignity confirmed by the pope. In 1166, however, the king thought proper, from what provocation we know not, to invade the dominions of his son-in-law Don Ferdinand; and possessed himself of Limmia and Turon, two cities of Galicia, in which he put strong garrisons. 11 His unsuccessful war with Don Ferdinand of Spain. The next year, elated with his success, he marched with a numerous army towards Badajos, which he invested; on the news of which, Don Ferdinand, who had assembled a large army at Ciudad Rodrigo, marched to its relief. Yet before he could come within sight of it, it had surrendered to the king of Portugal; upon which Don Ferdinand came to a resolution of besieging his antagonist in his newly conquered city; which Don Alonso perceiving, endeavoured to draw out his forces into the field. Though he was at that time upwards of 70 years of age, he was himself on horseback, and pushing forwards at the head of his horse to get out at the gate, he struck his leg against one of the bolts with such violence that the bone was shattered to pieces. This accident occasioned such confusion, that the Portuguese troops were easily beaten, and Don Alonso was taken prisoner. He was exceedingly mortified by this disgrace, especially as he had no great reason to expect very kind treatment from his son-in-law. However, the king of Leon behaved towards him with the greatest respect and affection. He desired him to lay aside all thoughts of business, and attend to his cure; but finding him restless and impatient, he assured him that he expected nothing more than to have things put into the same condition as before the war, and that they

might

might live in peace and friendship for the future: to which the king of Portugal most readily assented; but returned to his dominions before his cure was perfected, which was the cause of his being lame all the rest of his life. However, this did not abate his military ardour; for, notwithstanding this inconvenience, his courage transported him into the field whenever he was called by the interest of his subjects. Towards the end of his reign, an opportunity seemed to present itself of obtaining once for all an entire release from the disagreeable pretensions of the king of Leon, who, it seems, had insisted on the king of Portugal's doing homage for his kingdom. The opportunity which now presented itself was a quarrel between the king of Leon and his nephew Don Alonso king of Castile. The latter asked assistance from the king of Portugal, which was readily granted. But Don Ferdinand having received intelligence that the infant Don Sancho, (the king's eldest son) was advancing towards Ciudad Rodrigo, assembled his troops on that frontier with such diligence, that he was enabled to attack him unexpectedly, and entirely defeated him. Understanding, however, that Don Sancho was recruiting his forces with great diligence, he let him know that they might be much better employed against the infidels, who remained careless and unprepared, expecting the issue of the war. Don Sancho made a proper use of this advice; and, after making some motions to amuse the enemy, made a sudden irruption into Andalusia, penetrating as far as Triana, one of the suburbs of Seville. The Moors assembled their forces in order to attack him on his retreat; but Don Sancho having first fatigued them by the celerity of his march, at length chose a strong camp, and, having given his troops time to repose, drew them out and offered the enemy battle. The Moors accepted the challenge, but were entirely defeated; and Don Sancho returned into Portugal with spoils to an immense amount. For some years after the war was continued without any remarkable event; but, in 1184, Joseph king of Morocco, having already transported multitudes of men from Barbary, at length followed in person with a prodigious army, and carried all before him as far as the Tayo. He appeared before the city of Santaren; but having wearied and reduced his army by unsuccessful assaults on that place, he was attacked by the Portuguese forces assisted by Ferdinand of Leon, entirely defeated, and himself killed. By this victory, the Portuguese were left at liberty to improve the interior part of their country, and fortify their frontiers; and during this interval, the king died in the 76th year of his age, in the year 1185.

12 Don Sancho's success against the Moors.

13 His wise administration when king.

Don Alonso was succeeded by his son Don Sancho I. Of this prince it is remarkable, that, before he ascended the throne, he was of a restless and warlike disposition; but no sooner did he come to the possession of the kingdom, than he became a lover of peace, and began with great assiduity to repair the cities that had suffered most by the war, and to repeople the country around them. By his steady attention to this, he in a very short time quite altered the appearance of his territories, and procured to himself the glorious title of *The restorer of cities, and father of his country*. In the year 1189, a fleet, composed for the most part of English vessels, but having on board a great number of adventurers of other nations bound to the Holy Land, entered the river of Lisbon. They were very kindly received and supplied with all kinds of refreshments by Don Sancho, who took this opportunity of soliciting them to assist him in a design he had formed of attacking the city of Silves in Algarve; to which they readily yielded. Having joined a squadron of his own galleys, and marched a body of troops by land, the place was reduced, and the English, according to agreement, rewarded with the plunder. But, in a short time, the Moors from Africa having again invaded Portugal, the town was several times taken and retaken, till at last Don Sancho, being sensible of the difficulties that would attend the keeping of it, caused it to be demolished. His last enterprise was the reduction of Elvas; soon after which he died with the reputation of the best economist that ever sat on the throne of Portugal. With the character of being rather liberal than avaricious, he had amassed a treasure of more than 700,000 crowns in ready money, besides 1400 merks of silver and 100 of gold plate, which he disposed of some time before his death. He was interred by his own command with much less pomp than his father, in the cathedral of Coimbra; and when his body was taken up 400 years after by order of the king Don Emmanuel that it might be laid in a new tomb, it was found uncorrupted.

14 Differences with Castile.

The history of Portugal affords scarce any event of importance till the year 1289; when, in the reign of Don Denis, a difference commenced with Castile, which subsisted for a long time. Frequent reconciliations took place; but these were either of very short duration, or never sincere. At length, in the reign of John I. Don Juan of Castile, who had also pretensions to the crown of Portugal, invaded that kingdom at the head of the whole force of his dominions, and with the flower of the Castilian nobility entered the province of Alentejo. According to the Portuguese historians, he besieged the city of Elvas without effect; which disappointment enraged him to such a degree, that he determined next year to invade Portugal a second time, and ruin all the country before him. Accordingly, having collected an army of 30,000 men, he invaded Portugal, took and ruined several places, while King John lay inactive, with a small army, waiting for some English succours which he expected. At last he ventured an engagement with the forces which he had; and, notwithstanding the great superiority of the enemy, obtained a complete victory; after which he made an irruption into Castile, and had the good fortune to gain another battle, which fixed him firmly on the throne of Portugal. The Castilians were obliged to consent to a truce of three years, which was soon after improved into a lasting peace.

15 The Castilians entirely defeated.

16 The city of Ceuta taken from the Moors.

In 1414, King John undertook an expedition against the Moors in Barbary, where he commanded in person; but before he set out, his queen (Philippa the daughter of John duke of Lancaster) died of grief at the thoughts of his absence. The expedition, however, proved successful, and the city of Ceuta was taken from the Moors almost at the first assault; but scarcely had the king left that country, when the princes of Barbary formed a league for the recovery of it; and though they were defeated by the young princes of Portugal, whom John again sent into Barbary, yet the trouble of keeping it was so great, that some of the king's council were of opinion that the town should be demolished.

But

Portugal.

But John, having considered the arguments on both sides, determined to keep the city; and therefore enlarged and strengthened the fortifications, augmenting his forces there to 6000 foot and 2500 horse, which he hoped would be sufficient for keeping off the attacks of the Moors.

King John died in 1428, and was succeeded by his eldest son Edward. He undertook an expedition against Tangier in Barbary: but the event proved very unfortunate; the Portuguese being so shut up by the Moors, that they were obliged to offer Ceuta back again, in order to obtain leave to return to Portugal. The king's son, Don Ferdinand, was left as a hostage for the delivery of Ceuta; but was, with the utmost cruelty and injustice, left in the hands of the infidels, by the king and council of Portugal, who constantly refused to deliver up the place. Many preparations indeed were made for recovering the prince by force; but before any thing could be accomplished the king died in 1430, which put an end to all these designs. See PEDRO, *Don*.

17 Passage to the East Indies discovered.

The war with Barbary continued at intervals, but with little success on the part of the Portuguese; and till the year 1497, there is no event of any consequence recorded in the history of Portugal. This year was remarkable for the discovery of the passage to the East Indies by the Cape of Good Hope. The enterprising spirit of the Portuguese had prompted them to undertake voyages along the coast of Africa for a considerable time before; but when they undertook their first voyage of discovery, it is probable that they had nothing farther in view than to explore those parts of the coast of Africa which lay nearest to their own country. But a spirit of enterprise, when roused and put in motion, is always progressive; and that of the Portuguese, though slow and timid in its first operations, gradually acquired vigour, and prompted them to advance along the western shore of the African continent far beyond the utmost boundary of ancient navigation in that direction. Encouraged by success, it became more adventurous, despised dangers which formerly appalled it, and surmounted difficulties which it once deemed insuperable. When the Portuguese found in the torrid zone, which the ancients had pronounced to be uninhabitable, fertile countries, occupied by numerous nations; and perceived that the continent of Africa, instead of extending in breadth towards the west, according to the opinion of Ptolemy, appeared to contract itself, and to bend eastwards, more extensive prospects opened to their view, and inspired them with hopes of reaching India, by continuing to hold the same course which they had so long pursued.

Robertson's India.

After several unsuccessful attempts to accomplish what they had in view, a small squadron sailed from the Tagus, under the command of Vasco de Gama, an officer of rank, whose abilities and courage fitted him to conduct the most difficult and arduous enterprises. From unacquaintance, however, with the proper season and route of navigation in that vast ocean through which he had to steer his course, his voyage was long and dangerous. At length he doubled that promontory, which, for several years, had been the object of terror and of hope to his countrymen. From that, after a prosperous navigation along the south-east of Africa, he arrived at the city of Melinda, and had the satisfaction of discovering there, as well as at other places where he touched, people of a race very different from the rude inhabitants of the western shore of that continent, which alone the Portuguese had hitherto visited. These he found to be so far advanced in civilization and acquaintance with the various arts of life, that they carried on an active commerce, not only with the nations on their own coast, but with remote countries of Asia. Conducted by their pilots, who held a course with which experience had rendered them well acquainted, he sailed across the Indian ocean, and landed at Calecut, on the coast of Malabar, on the 22d of May 1498, ten months and two days after his departure from the port of Lisbon.

18 Circumstances which facilitated the discovery.

19 The king of the country jealous of his new visitors.

The samorin, or monarch of the country, astonished at this unexpected visit of an unknown people, whose aspect, and arms, and manners, bore no resemblance to any of the nations accustomed to frequent his harbours, and who arrived in his dominions by a route hitherto deemed impracticable, received them at first with that fond admiration which is often excited by novelty; but in a short time, from whatever motives, he formed various schemes to cut off Gama and his followers. The Portuguese admiral, however, was not to be overreached by such politics as his. From every danger to which he was exposed, either by the open attacks or secret machinations of the Indians, he extricated himself with singular prudence and dexterity, and at last sailed from Calecut with his ships, loaded not only with the commodities peculiar to that coast, but with many rich productions of the eastern parts of India. He returned to Portugal in two years after his sailing from the Tagus, but with a great loss of men; for out of 148 persons whom he took out with him, only 55 returned. The king received him with all possible testimonies of respect and kindness; created him count of Videgueira; and not only declared him admiral of the Indies, but made that office hereditary in his family.

20 The Venetians dread the ruin of their commerce.

On the first intelligence of Gama's successful voyage, the Venetians, with the quick-sighted discernment of merchants, foresaw the immediate consequence of it to be the ruin of that lucrative branch of commerce which had contributed so greatly to enrich and aggrandise their country; and they observed this with more poignant concern, as they were apprehensive that they did not possess any effectual means of preventing, or even retarding, its operation.

21 Account of the settlement of the Portuguese in India

The hopes and fears of both were well-founded. The Portuguese entered upon the new career opened to them with activity and ardour, and made exertions, both commercial and military, far beyond what could have been expected from a kingdom of such inconsiderable extent. All these were directed by an intelligent monarch, capable of forming plans of the greatest magnitude with calm systematic wisdom, and of prosecuting them with unremitting perseverance. The prudence and vigour of his measures, however, would have availed little without proper instruments to carry them into execution. Happily for Portugal, the discerning eye of Emanuel selected a succession of officers to take the supreme command in India, who, by their enterprising valour, military skill, and political sagacity, accompanied with disinterested integrity, public spirit, and love of their country, have a title to be ranked with the persons most eminent for virtue and abilities in any age or nation. Greater things

things perhaps were achieved by them than were ever accomplished in so short a time. Within 24 years only after the voyage of Gama, the Portuguese had rendered themselves masters of the city of Malacca, in which the great staple of trade carried on among the inhabitants of all those regions in Asia, which Europeans have distinguished by the general name of the *East Indies*, was then established. The conquest secured to them great influence over the interior commerce of India, while, at the same time, by their settlements at Goa and Diu, they were enabled to engross the trade of the Malabar coast, and to obstruct greatly the long established intercourse of Egypt with India by the Red sea. In every part of the east they were received with respect; in many they had acquired the absolute command. They carried on trade there without rival or controul; they prescribed to the natives the terms of their mutual intercourse; they often set what price they pleased on the goods which they purchased; and were thus enabled to import from Indostan and the regions beyond it, whatever is useful, rare, or agreeable, in greater abundance, and of more various kinds, than had been known formerly in Europe.

Not satisfied with this ascendant which they had acquired in India, the Portuguese early formed a scheme no less bold than interested, of excluding all other nations from participating of the advantages of commerce with the east; and they accomplished one half of what their ambition had planned.

22 Opposition made by the Venetians.

In consequence of this, the Venetians soon began to feel that decrease of their own Indian trade which they had foreseen and dreaded. In order to prevent the farther progress of this evil, they incited the soldan of the Mameluks to fit out a fleet in the Red sea, and to attack those unexpected invaders of a gainful monopoly, of which he and his predecessors had long enjoyed undisturbed possession. The Portuguese, however, encountered his formidable squadron with undaunted courage, entirely defeated it, and remained masters of the Indian ocean. They continued their progress in the east almost without obstruction, until they established there a commercial empire; to which, whether we consider its extent, its opulence, the slender power by which it was formed, or the splendour with which the government of it was conducted, there had hitherto been nothing comparable in the history of nations. Emanuel, who laid the foundation of this stupendous fabric, had the satisfaction to see it almost completed. Every part of Europe was supplied by the Portuguese with the productions of the east; and if we except some inconsiderable quantity of them, which the Venetians still continued to receive by the ancient channels of conveyance, our quarter of the globe had no longer any commercial intercourse with India, and the regions of Asia beyond it, but by the Cape of Good Hope.

In September 1522, King Emanuel died of an epidemical fever, and was succeeded by his son John III. The most remarkable transaction of this prince's reign

23 Inquisition introduced into Portugal.

was the introduction of the inquisition into his dominions. This happened in the year 1525, or, as some say, in 1535. A famine happening to cease in a short time after it was introduced, the priests persuaded the ignorant multitude that it was a blessing from heaven on account of the erecting such an holy tribunal. However, it was not long before the bulk of the nation perceived what kind of a blessing the inquisition was: but their discernment was too late; for by that time the inquisitors had acquired such power, that it became equally dangerous and ineffectual to attempt disclosing any of their mysteries.

In the mean time Solyman the Magnificent, the most enlightened monarch of the Ottoman race, observing the power and the opulence of the Portuguese rising, and attributing it to its proper cause, and eager to supplant them, sent orders to the bashaw of Egypt to employ his whole strength against the Christians in the East Indies. The bashaw, in obedience to these orders, sailed out from the Red sea with a greater naval force than ever the Mohammedans had employed before; having 4000 Janizaries, and 16,000 other land troops on board. Yet, by the courage and conduct of the Portuguese officers and soldiers, all this mighty armament was defeated, and their East India possessions saved from the danger which threatened them. In Africa likewise the king of Fez was baffled before the town of Safi, and fresh quarrels breaking out among the princes gave great relief to the Christians, who had long been obliged to carry on a defensive war, and had more than once been on the very brink of ruin. For a long time indeed their safety had been derived only from the quarrels of the Moors among themselves; for such was the envy and jealousy which reigned among the Portuguese, that they could never unite heartily in opposing the common enemy; and therefore, had their enemies united against them, they must certainly have been cut off. But whenever the cheriffs quarrelled with each other, one party was sure to have recourse to the Portuguese; who, by sending them a small supply, secured quiet to themselves, and had the pleasure of seeing their enemies destroy one another. Yet in the end even this had bad consequences; 24 Bad state of affairs in Barbary.
for, on one hand, it kept up a martial spirit among the Moors, and on the other it made them acquainted with the Portuguese discipline; so that after every short interval of repose they not only found them as much enemies as before, but much more formidable than ever. The consequence of all this was, that King John began to apprehend that the conquest of Barbary was impossible, and therefore to limit his desires to the keeping of those few fortresses which he had already; which, though a necessary and prudent measure, displeased the generality of his subjects.

King John exerted himself much in the settlement of Brazil in South America, which he brought into a very good state, caused several strong towns to be erected there, and took all possible methods to encourage the conversion of the natives to Christianity. He also made many regulations for the welfare and happiness of his subjects. The disputes of the nobility about precedency were frequently attended with very disagreeable consequences, which made the king resolve once for all to settle them by established rules; and the rules established by him on this occasion have subsisted ever since, and in a great measure prevent these altercations. He had other great designs in his mind, particularly with regard to the reformation, which he had pushed very far with respect to religious persons of both sexes; but, on a close examination of his affairs, he found his subjects in general to have been so much injured by his leaving their concerns to the inspection of his council, that he was thrown by the grief of it into a kind of apoplexy,

apoplexy, from which he never recovered. His death happened in June 1557; and he was succeeded by his son Don Sebastian III. an infant of three years of age.

After the death of king John, the administration remained in the hands of the queen, grandmother to Sebastian, who behaved with great prudence and circumspection. The Moors, however, supposing that under a minority they might be able to dispossess the Christians of such places as they held in Barbary, laid close siege to Masagan. But the queen-regent sent such speedy succours, and promised such rewards to those who distinguished themselves, that the Moors, though they brought 80,000 men into the field, were obliged to abandon the enterprise. This was at first magnified as a high instance of the queen's capacity and wisdom; but in a short time the natural aversion which the Portuguese had to the government of women, together with the prejudice they had against her country, as being a Castilian, appeared so plainly, and gave her so much uneasiness, that of her own accord she resigned her authority into the hands of Cardinal Don Henry the king's brother. By him Don Alexis de Moneses was appointed the king's governor, and Gonsales de Gomera with two other priests his preceptors. By means of these instructors the king's education was totally marred. His governor assiduously inculcated upon him that the chief virtue of a king was courage; that danger was never to be avoided, but always surmounted, let the occasion be what it would. His other tutors, instead of instructing him in the true religion, only inspired him with an abhorrence of professed infidels; the consequence of all which was, that he became rash, inconsiderate, and obstinate; all which qualities conspired to draw upon him the catastrophe which ruined both him and the kingdom.

25 Preposterous education of the young king Sebastian.

After the king was grown up to man's estate, his desire was to distinguish himself against the infidels. He himself chose an expedition to the East Indies; but the prime minister Alcoçova, who did not choose to attend his monarch to such a distance, substituted Africa in its stead. This expedition the king entered into in the most inconsiderate and absurd manner. He first sent over Don Antonio prior of Crato, with some hundreds of soldiers; carried his principal courtiers over with him from a hunting match, and without equipages; he then sent for the duke of Aveyro, with such troops as he could collect on the short warning he had got; and when all these were assembled, the king spent his time in hunting, and slight excursions against the enemy, without doing any thing of consequence, except exposing his person upon all occasions. At length he returned to Portugal in such tempestuous weather, that his subjects had given him up for lost; when they were agreeably surprised by his unexpected arrival in the river of Lisbon, which they celebrated with the greatest rejoicings.

26 He undertakes an expedition against Africa.

The little success which attended the king in this expedition served only to inflame him more with desire for another; so that from the time he returned he seemed to think on nothing else. He was highly delighted also with an accident which at this time furnished him with a pretence for war, though of that he stood in no great need. Muley Hamet, king of Fez and Morocco, had been dispossessed of his dominions by his uncle Muley Moloch. At the beginning of this war Don Sebastian had offered him his troops in Africa, which offer was rejected with contempt: but now being a fugitive, and having in vain applied for assistance to Philip of Spain, Muley Hamet applied to the king of Portugal; and, that he might the more easily succeed, caused the fortress of Arzila, which his father had recovered, to be restored to the Portuguese. The king was in rapture at this event, and fancied that his glory would exceed that of all his predecessors. He was advised against this expedition, however, by all his friends. King Philip of Spain having done every thing to dissuade him from it at a personal conference, sent Francisco Aldana, an old and experienced officer, to Morocco; and at his return ordered him to attend Don Sebastian, in order to give him an account of the state of affairs in that country. This he performed with the greatest fidelity, but without any effect. The queen dowager and cardinal united in their endeavours to divert him from this unfortunate enterprise; but he treated them both with so little respect, that his grandmother broke her heart; and the cardinal, to show his distaste at the measure, retired to Evora without coming either to court or council; which example was followed by many of the nobles. Many of these, however, sent very free remonstrances to the king on the impropriety of his conduct; and King Philip sent to him the duke de Medina Celi, once more to lay before him the reasons why he thought his scheme impracticable, and to put him in mind that he had no hand in pushing him upon his destruction, or of concealing from him the dangers into which he seemed determined to plunge himself and his subjects. Lastly, he received a letter on the subject from Muley Moloch himself, wherein that prince explained to him his own right to the crown of Fez, and showed that he had only dispossessed a tyrant and a murderer, who had therefore no right to his friendship or assistance. He next assured him that he had no reason to fear either the power or neighbourhood of the Portuguese; as a proof of which, and as a mark of his esteem, he was content to make him a present of ten miles of arable ground round each of the fortresses he possessed in Africa, and which indeed were no more than four, viz. Tangier, Ceuta, Masagan, and Arzila. At the same time he addressed himself to King Philip of Spain, with whom he was on good terms, desiring him to interpose with his nephew Sebastian, that things might be yet adjusted without the effusion of human blood. But the king of Portugal was deaf to all salutary advice; and therefore paid no regard to this letter, nor to the remonstrances of his uncle. On the 24th of June 1577, therefore, he set sail from the bar of Lisbon with a fleet of 50 ships and five galleys, 12 pieces of cannon, and transports and tenders, making near 1000 sail. His troops consisted of 9000 Portuguese foot; 3000 Germans; 700 Italians commanded by Sir Thomas Stukeley, an English exile, but remarkably brave; 2000 Castilians and 300 volunteers, commanded by Don Christopher de Tuvara master of the horse, a man of courage, but without either conduct or experience. He touched first at Lagos bay in the kingdom of Algarve, where he remained for four days: thence he proceeded to Cadiz; where he was magnificently feasted for a week by the duke de Medina Sidonia, who took the opportunity once more, by order of Philip, of dissuading him from proceeding further in person. But this exhortation proved as fruitless

27 Account of his forces.

Portugal. less as the rest; and the king having sailed with a strong detachment for Tangier, ordered Don Diego de Souza, his commander in chief, to follow with the remaining part of the army.

The troops landed on the coast of Africa without any bad accident, and joined at Arzila. Here the king was met by the cheriff Muley Hamet, on whose account he had undertaken the war, who delivered him his son Muley, a boy of 12 years of age, as a hostage, and brought a reinforcement of 300 Moors. The boy was sent to Masagan under a strong guard; but the father remained in the Portuguese camp. Here it was resolved in a council of war to reduce the town of Larache, but it was disputed whether the troops should proceed thither by land or sea. Don Sebastian, who espoused the former opinion, finding himself opposed by Muley Hamet, gave him such a rude answer, that he left his presence in discontent; after which the king's opinion prevailed, and the army began its march on the 29th of July. As they proceeded, the king received a letter from the duke of Alba, requesting him to attempt nothing beyond the taking of the town of Larache. Along with the latter was sent an helmet which had been worn by Charles V.

28
Movements and dispositions of the armies.

On the other hand Muley Moloch, having intelligence of this formidable invasion, took the field, though at that time so ill of a fever that he could not sit on horseback, with 40,000 foot and 60,000 horse. He conducted every thing, notwitstanding his distressed situation, with the greatest prudence. Finding some reason to suspect that part of his army were desirous of going over to his rival, he proclaimed that such as inclined to join their old master were at libery to do it. This at once put a stop to the defection, and only a very few made use of the liberty which was granted them. Standing in doubt likewise of the fidelity of a body of 3000 horse, he sent them to reconnoitre the enemy, by which act of confidence he secured them. Still, however, he feared that his officers might be corrupted by the Portuguese gold; for which reason he changed the disposition of his army entirely, so that none of his officers commanded the corps to which they had been accustomed; and therefore, having new men to deal with, had none whom they could trust.

Having taken these precautions, he advanced against the Portuguese army with such celerity, that he came in sight of them on the 3d of August. On this Don Sebastian called a council of war; in which many who out of complaisance had given their opinions for this march, were now for returning. They were separated from the enemy by a river, and the Moors were masters of the ford, so that it was impossible to force them immediately in their posts; neither was it practicable for them to wait for a more favourable opportunity, because they had no provisions. The foreign officers, on the contrary, were of opinion that fighting was now become necessary, and a retreat dangerous. This, however, was violently opposed by the cheriff, who saw plainly that they ran a great risk of being defeated and of losing all, while at the same time they were not certain of gaining any thing of consequence though they should be victorious; whereas, if they drew down towards the sea, they might entrench themselves till they were relieved by their fleet; during which interval if Muley Moloch should die, he looked upon it as certain that a great part of the army would desert to him, which would render him master not only of the kingdom, but of the fate of the Christians also. When he found that the king was bent on fighting, he only requested that the engagement might be delayed till four o'clock in the afternoon, that, in case of a defeat, they might have some chance of escaping; but even in this he could not prevail; for the king having disposed of every thing for a battle the next day, was impatient to begin the onset as soon as it was light

In the mean time Muley Moloch was so sensible of the advantages of his situation, that he was inclined to take the whole Portuguese army prisoners; but finding his disease increase, so that he had no hopes of recovery, he came to the resolution to fight, that his antagonist might not avail himself of his death. The disposition of the Christian army was very regular and correct, through the care of some old officers in Don Sebastian's service; the infantry were disposed in three lines; the battalion of volunteers made the vanguard; the Germans commanded by Colonel Amberg, and the Italians by Sir Thomas Stukeley, were on the right; the Castilian battalions on the left; the Portuguese in the centre and rear, the cavalry, consisting of about 1500 men, partly on the right under the command of the duke d'Avegro, to whom the cheriff joined himself with his horse: on the left was the royal standard, with the rest of the cavalry, under the command of the duke of Barcelos, eldest son to the duke of Braganza, Don Antonio prior of Crato, and several other persons of great rank. The king took post at first with the volunteers. Muley Moloch disposed also his troops in three lines: the first consisted of the Andalusian Moors, commanded by three officers who had distinguished themselves in the wars of Granada; the second of renegadoes; and the third of the natives of Africa. They moved in a half moon, with 10,000 horse on each wing, and the rest in the rear, with orders to extend themselves in such a manner as to encompass the Christian army. Muley Moloch, though extremely weak, was taken out of his litter, and set on horseback, that he might see how his commanders had been obeyed; and being perfectly satisfied with the situation of his troops, 29
he directed the signal of battle to be given. The Christians advanced with the greatest resolution; broke the first line of the Moorish infantry, and disordered the second. On this Muley Moloch drew his sword, and would have advanced to encourage his troops, but that his guards prevented him; on which his emotion of mind was so great, that he fell from his horse. One of his guards caught him in his arms, and conveyed him to his litter; where he immediately expired, having only time to lay his finger on his lips by way of enjoining them to conceal his death. But by this time the Moorish cavalry had wheeled quite round, and attacked the Christian army in the rear; upon which the cavalry in the left wing made such a vigorous effort that they broke the Portuguese on the right; and at this time the cheriff, in passing a rivulet, was drowned. In this emergency, the Germans, Italians, and Castilians, did wonders; but the Portuguese, according to their own historians, behaved indifferently. Attacked on all sides, however, they were unable to resist; and the whole army, except about 50 men, were killed or taken prisoners. The fate of the king is variously related. According to some,

The Portuguese army entirely defeated.

Portugal. some, he had two horses killed under him, and then mounted a third. His bravest officers were killed in his defence; after which the Moors surrounding him, seized his person, stripped him of his sword and arms, and secured him. They immediately began to quarrel about whose prisoner he was; upon which one of the generals rode in among them, crying, "What, you dogs, when God has given you so glorious a victory, would you cut one another's throats about a prisoner?" at the same time discharging a blow at Sebastian, he brought him to the ground, when the rest of the Moors soon dispatched him. Others affirm, that one Lewis de Brito meeting the king with his standard wrapped round him, Sebastian cried out, "Hold it fast, let us die upon it!" upon which charging the Moors, he was seized, rescued by Brito, who was himself taken with the standard, and carried to Fez. He affirmed, that after he was taken, he saw the king at a distance, and unpursued. Don Lewis de Lima met him afterwards making towards the river; and this is the last account we have of his being seen alive.

Muley Hamet, the brother of Muley Moloch, was proclaimed king by the Moors immediately after the battle. Next day, having ordered all the prisoners to be brought before him, the new sovereign gave orders to search for the body of Don Sebastian. The king's valet-de-chambre brought back a body, which he said was that of his master, but so disfigured with wounds, that it could not well be known; so that notwithstanding the most diligent search, this monarch's death could never be properly authenticated. This body, however, was preserved by Muley Hamet, who delivered it up as the body of Don Sebastian to King Philip of Spain. By him it was sent to Ceuta, from whence it was transported to Portugal, and buried among his ancestors in the monastery at Belem, with all possible solemnity.

By this terrible disaster, the kingdom of Portugal, from being the most eminent, sunk at once into the lowest rank of the European states. All the young nobility were cut off, or carried into slavery: the kingdom was exhausted of men, money, and reputation; so that Don Henry, who assumed the government after the death of his brother Don Sebastian, found himself in a very disagreeable situation. The transactions of his reign were quite trifling and unimportant; but after his death a great revolution took place. The crown of Portugal was claimed by three different competitors; viz. the prince of Parma, the duchess of Braganza, and Philip of Spain. Whatever might have been the merits of their respective claims, the power of Philip quickly decided the contest in his favour. He found

30
Portugal conquered by Philip of Spain.

his schemes facilitated by the treachery of the regents, who took the most scandalous methods of putting the kingdom into his hands. Under pretence of inspecting the magazines, they took out some of the powder, and mixed the rest with sand: they appointed an agent to go to France for succours, from whence they knew that they could not arrive in time; they dissolved the states as soon as they discovered that they were bent on maintaining the freedom of the nation; and, under a show of confidence, sent off to distant places such of the nobility as they suspected.

King Philip, finding every thing in his favour, commanded the duke of Alva to invade Portugal, at the head of 20,000 men. The people, perceiving that they were betrayed, exclaimed against the governors, and placed on the throne Don Antonio prior of Crato. But his forces being inexperienced, and he himself behaving in a very improper manner, he was quickly defeated by the duke of Alva, and forced to fly out of the kingdom, which he effected with great difficulty. On his flight the whole kingdom submitted, together with the garrisons of Barbary, the settlements on the western coast of Africa, of Brazil, and in the East Indies. All the Madeiras, however, except the isle of St Michael, held out for Don Antonio until they were reduced, and the French navy, which came to their assistance, entirely defeated and destroyed.

31
Terms granted to him by new subjects.

Philip made his entry into Lisbon as soon as the kingdom was totally reduced, and endeavoured to conciliate the affections of the people by confirming the terms which he had before offered to the states. These terms were, that he would take a solemn oath to maintain the privileges and liberties of the people: that the states should be assembled within the realm, and nothing proposed in any other states that related to Portugal: that the viceroy or chief governor should be a native, unless the king should give that charge to one of the royal family: that the household should be kept on the same footing: that the post of first president, and of all offices, civil, military, and judicial, should be filled with Portuguese; all dignities in the church and in the orders of knighthood confined to the same; the commerce of Ethiopia, Africa, and the Indies, reserved also to them, and to be carried on only by their merchants and vessels: that he would remit all imposts on ecclesiastical revenues: that he would make no grant of any city, town, or jurisdiction royal, to any but Portuguese: that estates resulting from forfeitures should not be united to the domain, but go to the relations of the last possessor, or be given to other Portuguese for recompense of services: that when the king came to Portugal, where he should reside as much as possible, he should not take the houses of private persons for his officers lodging, but keep to the custom of Portugal: that wherever his majesty resided, he should have an ecclesiastic, a treasurer, a chancellor, two masters of requests, with under officers, all of them Portuguese, who should dispatch every thing relating to the kingdom: that Portugal should ever continue a distinct kingdom, and its revenue be consumed within itself: that all matters of justice should be decided within the realm: that the Portuguese should be admitted to charges in the households of the king and queen of Spain: that all duties on the frontiers should be taken away: and, lastly, that Philip should give 300,000 ducats to redeem prisoners, repair cities, and relieve the miseries which the plague and other calamities had brought upon the people. All these conditions, formerly offered and rejected by the Portuguese, the king now confirmed: but whereas the duke of Ossuna, by way of security for these conditions, had promised them a law, that if the king did not adhere to them, the states should be freed from their obedience, and might defend their right by the sword, without incurring the reproach of perjury, or the guilt of treason; this he absolutely refused to ratify.

All these concessions, however, did not answer the purpose;

32 Cannot conciliate their affections.

purpose; nay, though Philip was to the last degree lavish of honours and employments, the Portuguese were still dissatisfied. This had also an effect which was not foreseen: it weakened the power, and absorbed the revenues, of the crown; and, by putting it out of the power of any of his successors to be liberal in the same proportion, it raised only a short-lived gratitude in a few, and left a number of malcontents, to which time was continually adding.

33 Is disturbed by Don Antonio.

Thus Philip, with all his policy, and endeavours to please, found his new subjects still more and more disgusted with his government, especially when they found their king treating with the utmost severity all those who had supported Don Antonio. The exiled prince, however, still styled himself *king of Portugal*. At first he retired to France, and there demanded succours for the recovery of his dominions. Here he found so much countenance, that with a fleet of near 60 sail, and a good body of troops on board, he made an attempt upon the Terceras, where his fleet was beat by the Spaniards: and a great number of prisoners being taken, all the officers and gentlemen were beheaded, and a great number of meaner people hanged. Don Antonio, notwithstanding, kept possession of some places, coined money, and performed many other acts of legal power; but was at length constrained to retire, and it was with some difficulty that he did so, and returned into France. He passed from thence into England, where he was well received; and many fitted out privateers to cruize against the Spaniards under his commission. But after King Philip had ruined the naval power of Portugal as well as Spain, by equipping the armada, Queen Elizabeth made no difficulty of owning and assisting Don Antonio, and even of sending Sir John Norris and Sir Francis Drake with a strong fleet and a great army to restore him. Upon this occasion Don Antonio sent his son Don Christopher a hostage to Muley Hamet king of Fez and Morocco, who was to lend him 200,000 ducats. But King Philip prevented this by surrendering Arzila: and this disappointment, the unseasonable enterprise upon Corunna, and the disputes that arose between Norris and Drake, rendered that expedition abortive; so that, except carrying the plague into England, it was attended with no consequences worthy of notice. He remained some time after in England; but finding himself little regarded, he withdrew once more into France, where he fell into great poverty and distress; and at length dying in the 64th year of his age, his body was buried in the church of the nuns of Ave Maria, with an inscription on his tomb, in which he is styled *king*. He left several children behind him, who, on account of his being a knight of Malta, and having made a vow of virginity at his entrance into the order, were looked upon as illegitimate. He preserved, even to the day of his death, a great interest in Portugal; and had drawn from thence, in the course of his life, immense sums of money; which had been squandered in many fruitless nogociations and attempts to disturb the possessions of King Philip in almost all parts of his dominions, and particularly in the Indies, where the Portuguese were rather more averse to the Castilian yoke, or at least testified their aversion more openly than in Europe.

But Don Antonio was not the only pretender to the crown of Portugal: for the people, partly through the love of their prince, and partly from their hatred to the Castilians, were continually feeding themselves with the hopes that Don Sebastian would appear and deliver them; and in this respect such a spirit of credulity reigned, that it was said proverbially, they would have taken a negro for Don Sebastian. This humour put the son of a tiler at Alcobaza, who had led a profligate life, and at length turned hermit, to give himself out for that prince; and having with him two companions, one of them styled himself *Don Christopher de Tavora*, and the other the *bishop of Guarda*, they began to collect money, and were in a fair way of creating much disturbance, if the cardinal arch-duke had not caused them to be apprehended; and after leading them ignominiously through the streets of Lisbon, he who took the name of *Sebastian* was sent to the galleys for life, and the pretended bishop was hanged. Not long after, Gonsalo Alvarez, the son of a mason, gave himself out for the same king; and having promised marriage to the daughter of Pedro Alonso, a rich yeoman whom he created earl of Torres Novas, he assembled a body of about 800 men, and some blood was split before he was apprehended: at length, being clearly proved to be an impostor, himself and his intended father-in-law were publicly hanged and quartered at Lisbon; which, instead of extinguishing this humour, farther increased it.

34 Impostors pretending to be Don Sebastian.

35 Account of a remarkable one.

There was, however, a person who appeared, about 20 years after the fatal defeat of Sebastian, at Venice, who created much more trouble. He assumed the name of *Don Sebastian*, and gave a very distinct account of the manner in which he had passed his time from that defeat. He affirmed, that he had preserved his life and liberty by hiding himself amongst the slain: that, after wandering in disguise for some time in Africa, he returned with two of his friends into the kingdom of Algarve: that he gave notice of this to the king Don Henry: that finding his life sought, and being unwilling to disturb the peace of the kingdom, he returned again among the Moors, and passed freely from one place to another in Barbary, in the habit of a penitent: that after this he became a hermit in Sicily; but at length resolved to go to Rome, and discover himself to the pope. On the road he was robbed by his domestics, and came almost naked to Venice, where he was known, and acknowledged by some Portuguese. Complaint being made to the senate, he was obliged to retire to Padua. But the governor of that city ordering him also to depart, he, not knowing what to do, returned again to Venice; where, at the request of the Spanish ambassador, who charged him not only with being an impostor, but also with many black and atrocious crimes, he was seized, and thrown into prison. He underwent 28 examinations before a committee of noble and impartial persons; in which he not only acquitted himself clearly of all the crimes that had been laid to his charge, but entered also into so minute a detail of the transactions that had passed between himself and the republic, that the commissioners were perfectly astonished, and showed no disposition to declare him an impostor; moved more especially by the firmness of his behaviour, his singular modesty, the sobriety of his life, his exemplary piety, and his admirable patience under his afflictions.

Portugal. tions. The noise of this was diffused throughout Europe, and the enemies of Spain endeavoured everywhere to give it credit.

The state, however, refused to discuss the great point, whether he was or was not an impostor, unless they were requested so to do by some prince or state in alliance with them. Upon this the prince of Orange sent Don Christopher, the son of the late Don Antonio, to make that demand; and at his request an examination was made with great solemnity: but no decision followed; only the senate set him at liberty, and ordered him to depart from their dominions in three days. He went therefore, by the advice of his friends, to Padua, but in the disguise of a monk, and from thence to Florence; where he was arrested by the command of the grand duke, who delivered him to the viceroy of Naples. The count de Lemos, then in possession of that dignity, died soon after, before whom he was first brought; this man asserted, he must know him to be Don Sebastian, since he had been twice sent to him from the king of Spain. He remained prisoner several years in the castle Del Ovo, where he endured incredible hardships. At length he was brought out, led with infamy through the streets of the city, and declared to be an impostor, who assumed the name of *Sebastian:* at which words, when proclaimed before him, he said gravely, *And so I am.* In the same proclamation it was affirmed, that he was in truth a Calabrian; which as soon as he heard, he said, *It is false.* He was next shipped on board a galley as a slave; then carried to St Lucar, where he was some time confined; from thence he was transferred to a castle in the heart of Castile, and never heard of more. Some persons were executed at Lisbon for their endeavours to raise an insurrection in his behalf; but it was thought strange policy, or rather a strange want of policy, in the Spaniards, to make this affair so public without proofs; and the attempt to silence this objection, by affirming him to be a magician, was justly looked upon as ridiculous.

36
Bad consequences of the Spanish administration.

The administration of affairs in Portugal, during the reign of Philip, was certainly detrimental to the nation; and yet it does not appear that this flowed so much from any ill intention in that monarch, as from errors in judgment. His prodigious preparations for the invasion of England impoverished all his European dominions; but it absolutely exhausted Portugal. The pretensions of Don Antonio, and the hopes of despoiling their Indian fleets, exposed the Portuguese to the resentment of the English; from which the king, having granted away all his domains, wanted power to defend them. Their clamours were not at all the less loud for their being in some measure without cause. The king, to pacify them, borrowed money from the nobility upon the customs, which were the only sure remedy he had still left; and this was attended with fatal consequences. The branches, thus mortgaged, became, and continue to this hour, fixed and hereditary; so that the merchant was oppressed, and the king received nothing. This expedient failing, a tax of three per cent was imposed, in the nature of ship-money, for the defence of the coasts and the commerce, which for some years was properly applied; but it then became a part of the ordinary revenue, and went into the king's exchequer without account. This made way for diverting other appropriated branches; as for instance, that for the repair of fortifications, the money being strictly levied, and the works suffered to decay and tumble down; and for the maintenance of the conquests in Africa, by which the garrisons mouldered away, and the places were lost. Upon the whole, in the space of 18 years, the nation was visibly impoverished: and yet the government of Philip was incomparably better than that of his successors; so that his death was justly regretted; and the Portuguese were taught by experience to confess, that of bad masters he was the best.

His son Philip, the second of Portugal and the third of Spain, sat 20 years upon the throne before he made a visit to Portugal, where the people put themselves to a most enormous expence to receive him; for which they received little more than the compliment, that before his entry into Lisbon, he knew not how great a king he was. He held an assembly of the states, in which his son was sworn successor. Having done all that he wanted for himself, he acquired a false idea of the riches of the nation from an immoderate and foolish display of them during his short stay at Lisbon; and having shown himself little, and done less, he returned into Spain; where he acted the part of a good king upon his death-bed, in deploring bitterly that he never thought of acting it before. The reign of Philip III. and IV. was a series of worse measures, and worse fortune: all his dominions suffered greatly: Portugal most of all. The loss of Ormus in the East, of Brazil in the West Indies, together with the shipwreck of a fleet sent to escort that from Goa, brought the nation incredibly low, and encouraged the conde duke to hope they might be entirely crushed. These are the heads only of the transactions for 40 years; to enter in any degree into the particulars, is, in other words, to point out the breaches made by the Spanish ministers on the conditions granted by King Philip; which, with respect to them, was the original contract, and unalterable constitution of Portugal while subject to the monarchs of Castile; and which, notwithstanding, they so often and so flagrantly violated, that one would have imagined they had studied to provoke the wrath of heaven, and insult the patience of men, instead of availing themselves, as they might have done, of the riches, power, and martial spirit of the Portuguese people.

37
Great losses in Asia and America.

38
The Portuguese oppressed by the Spaniards.

It was the very basis and foundation of their privileges, that the kingdom should remain separate and independent, and consequently that Lisbon should continue as much its capital as ever, the several supreme councils and courts residing there; so that the natives of this realm might not be obliged to travel in search of justice. So little, or at least so short a time, was this observed, that neither promotion nor justice was to be obtained without journeys, and Madrid was not more the capital of Castile than of Portugal. The general assembly of estates was to be held frequently, and they were held thrice in the space of 60 years; and of these twice within the first three. The king was to reside in this realm, as often and as long as possible; in compliance with which, Philip I. was there but once, Philip II. but four months, and Philp III. was never there at all. The household establishment was suppressed through all their reigns. The viceroy was to be a native of Portugal, or a prince or princess of the blood; yet when any of the royal family bore the title, the power was in reality in the hands of a Spaniard. Thus, when the prin-

cess

cess of Mantua was vice-queen, the marquis de la Puebla was to assist in council, and in all dispatches; and she was to do nothing without his advice. The council of Portugal, which was to be composed entirely of natives, was filled with Castilians, as the garrisons also were, though the contrary had been promised. The presidents of provinces, or corregidors, were to be natives; but by keeping those offices in his own hands, the king eluded this article. No city, town, or district, was to be given but to Portuguese; yet the duke of Lerma had Beja, Serpa, and other parts of the demesnes of the crown, which were formerly appendages of the princes of the blood. None but natives were capable of offices of justice, in the revenue, in the fleet, or of any post civil or military; yet these were given promiscuously to foreigners, or sold to the highest bidder; not excepting the government of castles, cities, and provinces. The natives were so far from having an equal chance in such cases, that no posts in the presidials were ever given to them, and scarce any in garrisons; and whenever it happened, in the case of a person of extraordinary merit, whose pretensions could not be rejected, he was either removed, or not allowed to exercise his charge; as fell out to the marquis of Marialva and others. The forms of proceeding, the jurisdiction, the ministers, the secretaries, were all changed, in the council of Portugal; being reduced from five to three, then two, and at last to a single person.

39 A revolution in favour of the duke of Braganza.

By reason of these and many other grievances too tedious to be mentioned here, the detestation of the Spanish government became universal; and in 1640 a revolution took place, in which John duke of Braganza was declared king, by the title of John IV. This revolution, as being determined by the almost unanimous voice of the nation, was attended with very little effusion of blood; neither were all the efforts of the king of Spain able to regain his authority. Several attempts indeed were made for this purpose. The first battle was fought in the year 1644, between a Portuguese army of 6000 foot and 1100 horse, and a Spanish army of nearly the same number. The latter were entirely defeated; which contributed greatly to establish the affairs of Portugal on a firm basis. The king carried on a defensive war during the remainder of his life; and after his death, which happened in 1655, the war was renewed with great vigour.

40 Perilous state of Portugal on his death.

This was what the Spaniards did not expect; for they expressed a very indecent kind of joy at his death, hoping that it would be followed by a dissolution of the government. It is not indeed easy to conceive a kingdom left in more perilous circumstances than Portugal was at this time:—The king Don Alonzo Enriquez, a child not more than 13 years of age, reputed of no very sound constitution either in body or mind; the regency in a woman, and that woman a Castilian; the nation involved in a war, and this respecting the title to the crown; the nobility, some of them secretly disaffected to the reigning family, and almost all of them embarked in feuds and contentions with each other; so that the queen scarce knew who to trust or how she should be obeyed. She acted, however, with great vigour and prudence. By marrying her only daughter the princess Catherine to Charles II. king of Great Britain, she procured to Portugal the protection of the English fleets, with reinforcements of some thousands of horse and foot; and at last, in 1665, terminated the war by the glorious victory of Montesclaros. This decisive action broke the power of the Spaniards, and fixed the fate of the kingdom, though not of the king of Portugal. Alonzo was a prince whose education had been neglected in his youth, who was devoted to vulgar amusements and mean company, and whom the queen for these reasons wished to deprive of the crown, that she might place it on the head of his younger brother Don Pedro. To accomplish this purpose, she attempted every method of stern authority and secret artifice; but she attempted them all in vain. The Portuguese would not consent to set aside the rights of primogeniture, and involve the kingdom in all the miseries attending a disputed succession. After the death, however, of the queen-mother, the infant entered into cabals against the king of a much more dangerous nature than any that she had carried on. Alonzo had married the princess of Nemours; but being, as was said, impotent, and likewise less handsome than his brother, that lady transferred her affection to Don Pedro, to whom she lent her assistance to hurl the king from the throne. Alonzo was compelled to sign a resignation of the kingdom; and his brother, after governing a few months without any legal authority, was in a meeting of the states unanimously proclaimed regent, and vested with all the powers of royalty. Soon after this revolution, for such it may be called, the marriage of the king and queen was declared null by the chapter of Lisbon; and the regent, by a papal dispensation, and with the consent of the states, immediately espoused the lady who had been wife to his brother. He governed, under the appellation of *regent*, 15 years, when, upon the death of the king, he mounted the throne by the title of Don Pedro II. and after a long reign, during which he conducted the affairs of the kingdom with great prudence and vigour, he died on the 9th of December 1706.

41 Don Alonzo obliged to resign the throne.

42 Don John V. a wise and resolute prince.

Don John V. succeeded his father; and though he was then little more than 17 years of age, he acted with such wisdom and resolution, adhered so steadily to the grand alliance formed against France and Spain, and showed such resources in his own mind, that though he suffered great losses during the war, he obtained such terms of peace at Utrecht, that Portugal was in all respects a gainer by the treaty. The two crowns of Spain and Portugal were not, however, reconciled thoroughly till the year 1737; and from this period they became every day more united, which gave much satisfaction to some courts, and no umbrage to any. In this situation of things, a treaty was made in 1750 with the court of Madrid, by which Nova Colonia, on the river of Plata, was yielded to his Catholic majesty, to the great regret of the Portuguese, as well on account of the value of that settlement, as because they apprehended their possession of the Brasils would by this action be rendered precarious. On the last of July the same year, this monarch, worn out by infirmities, died in the 61st year of his age, and in the 44th of his reign.

43 Don Joseph's excellent administration.

Don Joseph, prince of Brasil, succeeded him, to the universal satisfaction of his subjects, and with as great expectations as ever any monarch that mounted the throne. It was generally believed that he would make considerable alterations, in which he did not disappoint the

Portugal. the hopes of the public; and yet they were done so slowly, with such moderation, and with so many circumstances of prudence, as hindered all grounds of complaint. Amongst other new regulations, the power of the inquisition suffered some restriction; the king directing that none of their sentences should be put in execution till reviewed and approved by his privy-council. But as in the reign of his father he had consented to the treaty with Spain, he ratified it after his accession, and since carried it into execution upon this noble principle, that no considerations of interest ought ever to induce a monarch to break his word.

44 Dreadful calamities during his reign.

Within the space of the few years of this king's reign, the calamities of Portugal in general, and those of the city of Lisbon in particular, can scarcely be paralleled in history. An earthquake, a fire, a famine, an assassination-plot against their prince, executions upon executions, the scaffolds and wheels for torture reeking with the noblest blood; imprisonment after imprisonment of the greatest and most distinguished personages; the expulsion of a chief order of ecclesiastics; the invasion of their kingdom by a powerful, stronger, and exasperated nation; the numerous troops of the enemy laying waste their territory, bringing fire and sword with them, and rolling like distant thunder towards the gates of their capital; their prince ready almost to save himself by flight! The Spanish ministry had already decreed the doom of Portugal, and nothing was to be heard at the Escurial but *Delenda est Carthago*. Carthaginian, perhaps, or Jewish history, may possibly afford a scene something like this, but for the shortness of the period not so big with events, though in their final destruction superior. From that indeed, under the hand of Providence, the national humanity and generosity of Great Britain preserved the Portuguese; and it remains now to be seen, in future treaties, how that people will express their gratitude (see BRITAIN, N° 450.).

45 These calamities foolishly accounted for.

Those who are able to search deeper into human affairs, may assign the causes of such a wonderful chain of events; but no wise man will ascribe all this to so singular a cause as that which a Spaniard has done, in a famous pamphlet, printed in the year 1762 at Madrid. It is intitled, *A Spanish Prophecy;* and endeavours to show that all these calamities have befallen the Portuguese, solely on account of their connection with the heretic English. The great Ruler and Governor of the world undoubtedly acts by universal laws, regarding the whole system, and cannot, without blasphemy, be considered in the light of a partizan. The rest of the pamphlet tends to show, that his Catholic majesty carried his arms into Portugal, solely to give them liberty, and set them free from English tyranny.

Joseph dying without male issue, the succession devolved to Mary, his daughter, now queen of Portugal. She was married some time before he died, with the pope's dispensation, to his brother Don Pedro. But as the queen has long laboured under mental imbecility, the executive government of the kingdom is entrusted to her son who is styled Prince Regent.

Portugal has not been exempted from feeling the effects of Bonaparte's insatiable ambition. From the unrelenting hatred which he bears towards Great Britain, he has meditated the destruction of her commerce by every means in his power, and therefore he demanded of the Portuguese government, that all British vessels might be excluded from having any share in the trade of that country. Bonaparte demanded, that the Portuguese government should immediately pay to France 4,000,000 of crusades in specie, shut all the ports of Portugal against British commerce, imprison British subjects, and confiscate their property; give up the fleet of Portugal to France, and receive French and Spanish soldiers to protect the garrisons. It appears to have been with extreme reluctance that the prince regent agreed to such iniquitous demands, which naturally filled the British merchants with consternation and dismay, whose persons and property the Portuguese government was anxious to place beyond the reach of danger; and accordingly, the prince regent ordered their property to be shipped, without the payment of accustomed duties, requesting the military and customhouse officers to give them every assistance. On the 17th of October 1807, the Lively frigate sailed from Lisbon with a convoy of 50 sail for England, having on board nearly the whole of the English merchants and property.

Portugal. 46 Demands of Bonaparte on Portugal.

But such friendly dispositions towards the British the prince regent was very soon compelled to relinquish; for, on the 22d of October, he issued the following edict. "It having been my greatest desire to preserve within my dominions the most perfect neutrality during the present war, upon account of the acknowledged good effects that result from it to the subjects of this crown; but it being impossible to preserve it any longer, and reflecting at the same time how beneficial a general peace will be to humanity, I have judged it proper to accede to the cause of the continent, by uniting myself to his majesty the emperor of the French and king of Italy, and to his catholic majesty, in order to contribute, as far as may be in my power, to the acceleration of a maritime peace; wherefore I am pleased to order, that the ports of this kingdom may be shut against the entry of all ships of war, and merchant vessels, belonging to Great Britain; and thus it is to be understood."

A short time prior to this event, the prince regent intimated the determination of the court to abandon the kingdom and emigrate to the Brasils; but this resolution was very soon followed by the abovementioned edict. Whether we are to ascribe this change of sentiment to symptoms of domestic inquietude, or whether from the effects of some soothing opiate, administered by those who were in the interest of Bonaparte, it appears that the prince regent had not resolution to execute his project. The agitation of the metropolis was such as must have shaken his resolution; an implacable enemy was on the frontiers, and the government being supposed to be on the eve of emigrating, created uncommon consternation, and the people at large seemed ripe for an insurrection. In this situation of affairs the prince made it publicly known, that he had yet well-founded hopes to expect, that the absence of the Spanish and French ambassadors would be only temporary, and not followed by any acts of hostility on the part of those powers. In justification of the prince's conduct towards Britain on the present occasion, some have put the question, "What means did Portugal possess to resist with effect, the tyrant of the continent, who had declared, that if the house of Braganza should not break off its connection with England, it should cease to reign?"

The design first adopted by the prince regent was apparently

Portugal. parently relinquished for some time, but finally carried into execution on the 29th of November, when 15 persons belonging to the house of Braganza embarked at Lisbon, for the Brasils, under the escort of a British fleet. In consequence of this measure, the emperor of France declared that the throne was abdicated, and that the kingdom should henceforth be considered as a constituent part of the French dominions. He dissolved the regency formed by the prince, sequestered all the property belonging to the crown, and that of all the nobles who followed him into exile. General Junot, who soon after this, entered Lisbon at the head of 14,000 men, issued a proclamation to the people of Portugal, in which he promised the due administration of justice, the preservation of tranquillity, and declared that their future happiness should be attended to with the utmost punctuality. These pretensions, however, did not appear to reconcile the subjects of Portugal to their new masters; for when Junot seated himself in the prince's box at the opera, all the Portuguese then present put on their hats, and instantly withdrew. The evils attending this French invasion were such as might have been expected. The lower classes were dying of absolute want; and more than two-thirds of the mercantile houses in Lisbon were plunged into the gulf of bankruptcy.

47 Emigration of the royal family to the Brasils.

48 The French enter Lisbon.

The army of Sir Arthur Wellesley, sent by Great Britain to act against the French troops under Junot, amounted to about 20,000 men, with an equal number of Portuguese soldiers, which were to be joined by a Spanish force of 10,000 men, under the command of General Jones. The British and French had a desperate action near Vimiera on the 21st of August 1808, which terminated in the total defeat of the French forces, who were to evacuate Portugal on certain conditions, the chief of which was, that they were to be carried home with all their plunder, in vessels belonging to Great Britain. Sir Hew Dalrymple, who succeeded Sir Arthur Wellesley as commander in chief of the British forces, agreed to what is called the convention of Cintra, by which indeed the kingdom of Portugal was freed in the mean time from the ravages of an unfeeling enemy; but it has been supposed that such a convention might have been much more honourable to Britain, and the French troops compelled to an unconditional surrender. Dishonourable as this convention was deemed by some, it had the sanction of Sir Charles Cotton, the admiral of the British fleet; and the freeing the Portuguese from the oppression and tyranny of France by this means became a justification of the measure. This convention was strongly reprobated in Britain; a board of general officers was appointed by his majesty to form a court for the purpose of inquiring into the circumstances which led to it; and the result of the investigation was a decision, by a majority of the court, that the armistice and convention were necessary, and that nothing dishonourable or improper attached to any of the officers concerned in it.

49 French defeated at the battle of Vimiera.

50 Convention of Cintra.

Every thing at the Brasils proceeded in a tranquil and prosperous manner under the auspices of the new government. The highest veneration was shewn by the colonists of all descriptions for the prince regent, and prompt obedience paid to his ordinances and commercial regulations. The most enthusiastic attachment prevailed in Rio Janeiro and Bahia towards the English settlers; and the happiest consequences were expected to result from the enterprises of their new friends in South America. The consequences resulting to the Portuguese, from the convention of Cintra, were of the most beneficial nature. The whole country was not only in a state of subordination, but the effects of the energy displayed by the government began to be felt all over the kingdom. The disaffected and suspected were everywhere taken into custody; and the people were making the most active exertions for their own defence, and for the common cause.

The Portuguese government issued a proclamation calling upon the whole nation, from 15 to 60, to rise *en masse* for the defence of their country, and to oppose an insurmountable barrier against the French. This order met with more prompt obedience than a similar command experienced when issued by the emperor of Germany.

During the wars in the Peninsula which followed the general rising of the Spaniards in 1808, the Portuguese continued firm in the common cause, and their troops, which generally acted with the British, shared some of the victories gained by the latter. The peace in 1814 restored the Portuguese government to the peaceable possession of the country; but the Prince Regent has shewn no disposition to return from the Brasils. In 1817 a plot was discovered among the military at Lisbon, the the object of which was believed to be the subversion of the existing government. Some of the ringleaders were executed, and others banished.

The air of Portugal, in the southern provinces, would be excessively hot, if it were not refreshed by the sea-breezes; but in the northern, it is much cooler, and the weather more subject to rains. The spring is extremely delightful here; and the air, in general more temperate than in Spain. Lisbon has been much resorted to of late by valetudinarians and consumptive persons from Great Britain, on account of its air. The soil is very fruitful in wine, oil, lemons, oranges, pomegranates, figs, raisins, almonds, chesnuts, and other fine fruits; but there is a want of corn, owing, it is said, in a great measure to the neglect of agriculture. There is plenty of excellent honey here; and also of sea and river fish, and sea salt. The horses in Portugal are brisk lively animals, as they are in Spain, but of a slight make: but mules being surer-footed, are more used for carriage and draught. By reason of the scarcity of pasture, there are not many herds of cattle or flocks of sheep; and what they have are small and lean, though the flesh is tolerably good: their best meat is said to be that of hogs and kids. The country in many parts is mountainous: but the mountains contain all kinds of ores; particularly of silver, copper, tin, and iron, with a variety of gems, beautifully variegated marble, millstones, and many curious fossils. Not far from Lisbon is a mine of saltpetre; but none of the metal mines are here worked, the inhabitants being supplied with metals of all kinds from their foreign settlements. The principal rivers are the Minho, in Latin *Minius;* the Limia, anciently the famed Lethe, the Cavado; the Douro; the Guadiana, anciently Anas; and the Tajo, or Tagus, which is the largest river in the kingdom, carrying some gold in its sands, and falling into the sea a little below Lisbon. There are several mineral springs in the kingdom, both hot and cold, which are much frequented.

51 Air, climate, &c.

The only religion tolerated in Portugal is that of the church of Rome; yet there are many concealed Jews, and those too even among the nobility, bishops, prebends,

52 Religion.

Portugal. bends, monks, and nuns, and the very inquisitors themselves.. If a Jew pretend to be a Christian and a Roman Catholic, while he is really a Jew, by going to mass, confession, &c. or if after being converted, or pretending to be converted and pardoned, he relapses into Judaism and is discovered, the inquisition lays hold of him. In the first case, if he renounce Judaism, he is only condemned to some corporal punishment or public shame, and then ordered to be instructed in the Christian religion. In the second, he is condemned to the flames without mercy. Besides Jews and heretics, who broach or maintain any doctrines contrary to the religion of the country, the inquisition punishes all sodomites, pretenders to sorcery and the black art, apostates, blasphemers, perjured persons, impostors, and hypocrites. The burning of those condemned by the inquisition, is called an *auto da fe*, or "act of faith." There are several tribunals of the inquisition, one of which is at Goa in the East Indies; but there are none in Brasil. The number of convents in Portugal is said to be 900. The order of Jesuits hath been suppressed in this country, as they have been in others. Here is a patriarch, several archbishops and bishops: the patriarch is always a cardinal, and of the royal family. The archbishops rank with marquises, and the bishops with counts. The Portuguese have archbishops and bishops in the other quarters of the world as well as in Europe. The sums raised by the popes here, by virtue of their prerogatives, are thought to exceed the revenues of the crown, and the nuncios never fail of acquiring vast fortunes in a short time. Though there are two universities and several academies, yet while the papal power, and that of the ecclesiastics, continues at such a height, true learning is like to make but a small progress. The language of the Portuguese does not differ much from that of Spain: Latin is the groundwork of both; but the former is more remote from it, and harsher to the ear, than the latter. The Portuguese tongue is spoken on all the coast of Africa and Asia as far as China, but mixed with the languages of the several nations in those distant regions.

53 Manufactures.

With regard to manufactures, there are very few in Portugal, and those chiefly coarse silks, woollen cloths, and some linen; but their foreign trade is very considerable, especially with England, which takes a great deal of their wine, salt, foreign commodities, and fruits, in return for its woollen manufactures, with which the Portuguese furnish their colonies and subjects in Asia, Africa, and America. Their plantations in Brasil are very valuable, yielding gold, diamonds, indigo, copper, tobacco, sugar, ginger, cotton, hides, gums, drugs, dyeing woods, &c. From their plantations in Africa, they bring gold and ivory, and slaves to cultivate their sugar and tobacco plantations in Brasil. They have still several settlements in the East Indies, but far less considerable than formerly. The Azores or Western isles, Madeira, and the Cape de Verde islands, also belong to them; but a great part of the riches and merchandise brought from these distant countries becomes the property of foreigners, for the goods they furnish the Portuguese with to carry thither. The king's fifth of the gold brought from Brasil amounts commonly to about 300,000l. sterling; so that the whole annual produce of gold in Brasil may be estimated at near 2,000,000l. sterling. Lisbon is the greatest port in Europe next to London and Amsterdam. Portugal.

54 Constitution and government.

Before the late revolution, the government of Portugal was an absolute hereditary monarchy. For the administration of the civil government, there was a council of state, and several secretaries; for military affairs, a council of war; for the finances, a treasury court; and for the distribution of justice several high tribunals, with others subordinate to them, in the several districts into which the kingdom is divided. The cities have their particular magistracy. The proceedings of the courts are regulated by the Roman law, the royal edicts, the canon law, and the pope's mandates. Like the Spaniards, they transact most of their business in the mornings and evenings, and sleep at noon. The nobility are very numerous, and many of them are descended from natural sons of the royal family. They are divided into high and low. The high consists of the dukes, marquises, counts, viscounts, and barons, who are also grandees, but of different classes, being suffered to be covered in the king's presence, and having the title of *Dons*, with a pension from the royal treasury, to enable them the better to support their dignity: the king styles them *Illustrious* in his letters, and treats them as princes. A duke's sons are also grandees, and his daughters rank as marchionesses. The inferior nobility or gentry are termed *Hidalgos*, i. e. gentlemen: they cannot assume the title of *Don* without the king's license.

55 Revenues of the king, &c.

The revenues of the crown, since the discovery of the Brasil mines, are very considerable; but the real amount can only be guessed at. Some have said that it amounts, clear of all salaries and pensions, to upwards of 3,000,000l. sterling; others make it a great deal less. Besides the royal demesnes, the hereditary estates of the house of Braganza, the monopoly of Brasil snuff, the coinage, the money arising from the sale of indulgences granted by the pope, the fifth of the gold brought from Brasil, the farm of the Brasil diamonds, the masterships of the orders of knighthood, and other sources, yield very large sums. The population of Portugal in 1815, was estimated at 3,680,000; the army at 25,000, besides 33,000 militia; the navy, 8 ships of the line and 16 frigates.

56 Orders of knighthood.

There are several orders of knighthood here, viz. the order of Christ, the badge of which is a red cross within a white one, and the number of the commanderies 454. 2. The order of St James, the badge of which is a red sword in the shape of a cross. A great number of towns and commanderies belong to this order. 3. The order of Aviz, whose badge is a green cross in form of a lily, and the number of its commanderies 49. Though these three orders are religious, yet the knights are at liberty to marry. 4. The order of St John, which has also several commanderies.

The king's titles are, *King of Portugal and the Algarves, on this side and the other side the sea of Africa; Lord of Guinea, and of the navigation, conquests, and commerce, in Ethiopia, Arabia, Persia, India*, &c. The king's eldest son is styled *Prince of Brasil*. In the year 1749, Pope Benedict XIV. dignified the king with the title of *His most faithful majesty*.

Portugal has recently become the scene of an extraordinary revolution. The Portuguese had long been dissatisfied

dissatisfied with their government, and seem really to have had many serious grievances. After the removal of the court to Brasil, the mother-country had sunk to the condition of a colony, whose interests, on account of its distance from the seat of government, were often neglected or exposed to injury, from the arrogance and corruption of subordinate functionaries. The pride of the natives was hurt by the preference shewn to the English, who held many places of trust and power. Besides, the great changes the Portuguese had witnessed during the last ten years, and their free intercourse with foreigners during that period, had awakened political feelings which made them ardently wish for some alteration in their political institutions. The revolution in Spain gave increased force to these feelings, and rendered an explosion unavoidable. Accordingly, on the 24th August 1820, about five months after the completion of the Spanish revolution, a number of the leading men in Oporto, including some of the highest military officers, having previously satisfied themselves of the favourable disposition of the troops, assembled publicly, called out the military, and proclaimed the Spanish constitution, amidst the enthusiastic acclamations of the people. A provisional government was formed, and a deputation, supported by a strong body of troops, immediately set out towards Lisbon. The regency in the capital at first seemed disposed to resist; but finding that both the citizens and the army were decidedly favourable to the revolution, they yielded to the torrent, and in the name of John VI. issued a proclamation on the 2d September for assembling a cortes. This proceeding completed the revolution without one drop of blood being shed, and produced unbounded joy, both in the capital and the provinces. Some distrust, however, naturally attached to the agents of the former government; and after some negotiation these persons found it necessary to lay down their powers. The cortes has since met, and has been actively engaged in making many great and salutary reforms in the laws and interior police of the country. The constitution of this legislative assembly is pretty nearly the same with that of Spain; but in one very important point an alteration has been introduced. The deputies to the Portuguese cortes are chosen directly by the people; whereas in Spain there are three consecutive stages of election,—a mode of proceeding which offers great opportunities for corruption, and loosens the tie between the representative and the represented. The revolution in Spain was followed by a revolution in Brasil, and this led to the return of the Portuguese court to Europe. The leaders of the Portuguese revolution have conducted themselves hitherto with great firmness and moderation, correcting manifest evils, without innovating rashly; and avoiding all unnecessary rigour towards the agents of the former government.

PORTUGALLICA TERRA, earth of Portugal; the name of a fine astringent bole, dug in great plenty in the northern part of Portugal.

PORTULACA, PURSLANE; a genus of plants belonging to the dodecandria class. See BOTANY *Index*.

PORTUMNA, a town of Ireland, in the county of Galway and province of Connaught, is 74 miles from Dublin. The castle of Portumna, the seat of the earl of Clanricarde, is at this place, and near it are the ruins of an ancient castle. There is also a garrison for a troop of horse and two companies of foot. The town is seated on the river Shannon, where it falls into Lough Derg.

POSE, in *Heraldry*, denotes a lion, horse, or other beast, standing still, with all his four feet on the ground.

POSITIVE, a term of relation opposed to negative. It is also used in opposition to relative or arbitrary: thus we say, Beauty is no positive thing, but depends on the different tastes of people.

POSITIVE Degree, in *Grammar*, is the adjective in its simple signification, without any comparison.

POSITIVE Electricity. In the Franklinian system all bodies supposed to contain more than their natural quantity of electric matter are said to be *positively* electrified; and those from whom some part of their electricity is supposed to be taken away are said to be electrified *negatively*. These two electricities being first produced, one from glass, the other from amber or resin, the former was called *vitreous*, the other *resinous*, electricity.

POSPOLITE, in the former military establishment of Poland, is the name given to a kind of militia. It was the most numerous and the most useless of the Polish armies, consisting of the gentry at large, who, in case of invasion, were assembled by a regular summons from the king, with consent of the diet. Every palatinate was divided into districts, over each of which proper officers were appointed; and every person possessing free and noble tenures was bound to military service, either singly or at the head of a certain number of his retainers, according to the extent and nature of his possessions. The troops thus assembled were obliged only to serve for a limited time, and were not under the necessity of marching beyond the limits of their country. They submitted to no discipline but such as they liked themselves; and were very apt to mutiny if detained more than a fortnight in the place appointed for their meeting without marching. The mode of levying and maintaining this army was exactly similar to that practised under the feudal system. Although unfit for the purposes of repelling a foreign enemy, it was considered a powerful instrument in the hands of domestic faction: for the expedition with which it was raised under the feudal regulations facilitated the formation of those dangerous confederacies which suddenly started up on the contested election of a sovereign, or whenever the nobles were at variance with each other.

POSSE COMITATUS, in *Law*, signifies the power of the county, or the aid and assistance of all the knights, gentlemen, yeomen, labourers, servants, apprentices, &c. and all others within the county that are above the age of 15, except women, ecclesiastical persons, and such as are decrepit and infirm.

This posse comitatus is to be raised where a riot is committed, a possession kept upon a forcible entry, or any force of rescue used contrary to the king's writ, or in opposition to the execution of justice; and it is the duty of all sheriffs to assist justices of the peace in the suppression of riots, &c. and to raise the posse comitatus, or to charge any number of men for that purpose.

POSSESSION, in *Law*, is either actual, where a person actually enters into lands or tenements descended or conveyed to him; or where lands are descended to a person, and he has not yet entered into them. A long

long possession is much favoured by the law as an argument of right, even though no deed can be shown, and it is more regarded than an ancient deed without possession.

If he that is out of possession of land brings an action, he must prove an undeniable title to it; and when a person would recover any thing of another, it is not sufficient to destroy the title of the person in possession, without he can prove that his own right is better than his.

In order to make possession lawful upon an entry, the former possessor and his servants are to be removed from off the premises entered on: but a person by lease and release is in possession without making any entry upon the lands.

POSSESSION, in *Scots Law*. See LAW, Part III. N° clxii. 11. &c.

Dæmoniacal POSSESSION. (See DÆMON and DÆMONIACS). In the third volume of the Manchester Transactions, there is a paper on *popular illusions*, or medical demonology, by Dr Ferriar. He informs us in a note, that on the 13th of June 1788, George Lukins of Yatton in Somersetshire was exorcised in the Temple church at Bristol, and delivered from the possession of seven devils by the efforts of seven clergymen. An account of his deliverance was published in several of the public papers, authenticated by the Rev. Mr Easterbrook, vicar of the Temple church in Bristol.—Dr Ferriar gives us the following particulars, extracted from this account, which we shall here insert.

"Lukins was first attacked by a kind of epileptic fit, when he was going about acting Christmas plays, or mummeries: this he ascribed to a blow given by an invisible hand. He was afterwards seized by fits; during which he declared, with a roaring voice, that he was the devil, and sung different songs in a variety of keys. The fits always began and ended with a strong agitation of the right hand. He frequently uttered dreadful execrations during the fits. The whole duration of his disorder was 18 years.

"At length, viz. in June 1788, he declared that he was possessed by seven devils, and could only be freed by the prayers (*in faith*) of seven clergymen. Accordingly the requisite force was summoned, and the patient sung, swore, laughed, and barked, and treated the company with a ludicrous parody on the *Te Deum*. These astonishing symptoms resisted both hymns and prayers, till a *small faint voice* admonished the ministers to adjure. The spirits, after some murmuring, yielded to the adjuration, and the happy patient returned thanks for his wonderful cure. It is remarkable, that during this solemn mockery, the fiend swore 'by his infernal den,' that he would not quit his patient; an oath, I believe, nowhere to be found but in the Pilgrim's Progress, from which Lukins probably got it.

"Very soon after the first relation of this story was published, a person, well acquainted with Lukins, took the trouble of undeceiving the public with regard to his pretended disorder, in a plain sensible narrative of his conduct. He asserts that Lukins's first seizure was nothing else than a fit of drunkenness; that he always foretold his fits, and remained sensible during their continuance; that he frequently saw Lukins in his fits, 'in every one of which, except in singing, he performed not more than most active young people can easily do;' that he was detected in an imposture with respect to the clenching of his hands; that after money had been collected for him, he got very suddenly well; that he never had any fits while he was at St George's Hospital in London; nor when visitors were excluded from his lodgings, by desire of the author of the Narrative; and that he was particularly careful never to hurt himself by his exertions during the paroxysm.

"Is it for the credit of this philosophical age, that so bungling an imposture should deceive seven clergymen, into a public act of exorcism? This would not have passed even on the authors of the *Malleus Malificarum*; for they required signs of supernatural agency, such as the suspension of the possessed in the air, without any visible support, or the use of different languages, unknown to the demoniac in his natural state."

POSSESSIVE, in *Grammar*, a term applied to pronouns, which denote the enjoyment or possession of any thing either in particular or in common: as *meus*, "mine;" and *tuus*, "thine."

POSSESSORY ACTION, in *Scots Law*. See LAW N° clxxxiii. 18.

POSSIBILITY, in *Law*, is defined to be any thing that is altogether uncertain, or what may or may not be.

POSSIBILITY, also denotes a non-repugnance to existing, in any thing that does not any way exist.

POSSIBLE, is sometimes opposed to real existence, and is understood of a thing, which, though it actually does not exist, yet may exist; as a new star.

POSSIDONIA, in *Ancient Geography*. See POESTUM.

POST, a word derived from the Latin *positus*, "set or placed." It is used in several different meanings, but all of them referring either immediately or remotely to this primitive sense of *position*. Thus the word Post signifies, 1. A stake or piece of timber set upright; 2. A station, particularly a military station; 3. An office or employment; 4. An operation in book-keeping; 5. A conveyance for letters or dispatches; 6. A particular mode of travelling.

POST, a stake or piece of timber set upright. Posts are used both in building and in fencing ground. In brick-buildings much of the strength of the fabric depends on the nature of the posts; as it is through them, that the several parts are sustained and held together. The *corner posts* are called the *principal posts*; those formed into bressummers between principal posts for strengthening the carcase of the house are called the *prick-posts*. Posts which are to be set in the ground ought to be well seasoned and coated to preserve them from rotting; burning the downward end has been recommended as an excellent preservative, but a coating of pitch or tar, particularly the late invented coal-tar, can be most safely relied upon. For the various uses to which posts may be applied, and the form and species of them fittest to be employed in each case, see the articles ARCHITECTURE, JOINING, GARDENING, HOUSE, FENCE, &c. In architecture and sculpture, POSTS are a term used to denote certain ornaments formed after the manner of rolls or wreathings.

POST, a station, particularly a military station.—Any place where persons are set or placed upon particular occasions may be termed a *post*: but the word in this view is now chiefly restricted to military operations, and

and means any place or situation where soldiers are stationed. Thus the detachments established in front of the army are termed the *out-posts*, the stations on the wings of the army are said to be the *posts of honour*, as being the most conspicuous and most exposed. But in the operations of a campaign, a post properly signifies any spot of ground capable of lodging soldiers, or any situation, whether fortified or not, where a body of men may make a stand and engage the enemy to advantage. The great advantages of good posts, in carrying on war, as well as the mode of securing them, are only learned by experience. Barbarous nations disdain the choice of posts, or at least are contented with such as immediately fall in their way; they trust solely or chiefly to strength and courage: and hence the fate of a kingdom may be decided by the event of a battle. But enlightened and experienced officers make the choice of posts a principal object of attention. The use of them is chiefly felt in a defensive war against an invading enemy; as by carrying on a war of posts in a country where this can be done to advantage, the most formidable army may be so harassed and reduced, that all its enterprises may be rendered abortive. In the choice of a post, the general rules to be attended to are, that it be convenient for sending out parties to reconnoitre, surprise, or intercept the enemy; that if possible it have some natural defence, as a wood, a river, or a morass in front or flank, or at least that it be difficult of access, and susceptible of speedy fortification; that it be so situated as to preserve a communication with the main army, and have covered places in the rear to favour a retreat; that it command a view of all the approaches to it, so that the enemy cannot advance unperceived and rest concealed, while the detachment stationed in the post are forced to remain under arms; that it be not commanded by any neighbouring heights; and that it be proportioned in extent to the number of men who are to occupy and defend it. It is not to be expected that all these advantages will often be found united; but those posts ought to be selected which offer the greatest number of them. See War.

Post, an office or employment. This use of the word is probably derived immediately from the idea of a military station; a post being used to express such offices or employments as are supposed either to expose the holder to attack and opposition, or to require abilities and exertion to fill them. Hence the term is used only for *public* offices and employments under the government; and were strict propriety of speech always attended to, *posts* would denote those stations only in which duty must be performed. In common language, however, every *public* office or appointment, even though nominal and sinecure, goes under the name of a *post*.

Post, an operation in book-keeping. Posting in book-keeping means simply the transferring an article to the place in which it should be put, and arranging each under its proper head. It is upon this that the whole theory of book-keeping is founded. The Waste-book, which is the ground work of all subsequent operations, records every transaction exactly in the order in which it occurs. From this the several articles are posted, or transferred into the Journal, which in fact is but a kind of supplementary book to the Waste-book. From the Journal they are posted anew into the Ledger; in which a separate place is appropriated for each person with whom transactions are carried on, and frequently for every separate article about which the business is concerned. The particular mode according to which such transferences are made, may vary according to the nature of the trade carried on; the object is the same in all, to place every article so as that its operations on the general state of the business may be certainly known and distinctly traced. For a full account of the way in which this is done, see *Book-Keeping*.

Post, a conveyance for letters or dispatches.

In the early periods of society, communication between the different parts of a country is rare and difficult, individuals at a distance having little inclination or opportunity for mutual intercourse: when such communication is at any time found necessary, a special messenger must be employed. As order and civilization advance, occasions of correspondence multiply. In particular, the sovereign finds it requisite frequently to transmit orders and laws to every part of the kingdom; and for doing so he makes use of couriers or messengers, to whom he commits the charge of forwarding his dispatches. But without stations in the way, where these couriers can be certain of finding refreshment for themselves and supplies of what may be necessary for carrying them forward, the journey, however urgent and important, must always be retarded, and in many cases altogether stopped. Experience, therefore, soon pointed out the necessity of ensuring such accommodations, by erecting upon all the great roads houses or stations at convenient intervals, where the messengers might stop, as occasion required, and where too, for the greater convenience, relays of fresh horses should always be in readiness, to enable them to pursue their journey with uninterrupted dispatch. These houses or stations were with great propriety termed *posts*, and the messenger who made use of them a *post*. Though at first, it is probable, the institution was intended solely for the sovereign, and the necessities of the state; yet by degrees individuals, seeing the benefit resulting from it, made use of the opportunity to carry on their own correspondence; for which they were willing to pay an allowance to the sovereign. Thus a post-office, of some kind or other, gradually came to be established in every civilized country. Without taking notice of the different means of carrying on correspondence said to have been attempted by pigeons, dogs, and other animals, we can at least trace with certainty the invention of something like regular posts as far back as the ancient Persians. Xenophon assures us, that they were invented by Cyrus on his Scythian expedition, about 500 years before Christ; that the houses at the several stations were sumptuously built, and large enough to contain a number of men and horses; and that every courier on his arrival was obliged to communicate his dispatches to the postmaster, by whom they were immediately forwarded. From the shore of the Ægean sea to Susa the capital, there were, according Herodotus, 111 stages for posts, each a day's journey distant from the preceding.

In what manner posts were established and conducted among the Greeks does not clearly appear; but from the extended commerce carried on, and the frequent communications enjoyed among the different states, there can be no doubt that a regular conveyance, in some form or other, was established.

Though posts were well known among the Romans, yet

Post.

yet it is difficult to trace with certainty the period of their introduction. Some writers carry it back to the times of the republic; posts and post-offices, under the names of *statores* and *stationes*, having been then, it is said, established by the senate. Whether this was the case or not, Suetonius assures us that Augustus instituted posts along all the great roads of the empire. At first the dispatches were conveyed from post to post by young men who run on foot, and delivered the dispatch to others at the next stage. By and by Augustus substituted, in room of these, horses and chariots, both for the conveyance of dispatches and the convenience of travelling. His successors continued the same establishment; to the maintenance of which every subject of the empire was obliged to contribute. Post-horses are mentioned in the Theodorian code *de cursu publico*; but these were only the public horses appointed to be kept there for the use of the public messengers, who before this institution seized any that came in their way. At each post station, according to Procopius, 10 horses and as many postilions were kept, and the usual rate of their travelling was from five to eight stations a-day.

It is to be observed, however, that all these establishments of posts in ancient times were formed as much, if not more, for travelling stations, as for the mere conveyance of letters and dispatches. This latter object, it is true, was thereby secured; but the epistolary correspondence of antiquity was probably at no time so extensive as to require or maintain post-offices on the footing of modern posts, for the mere conveyance of letters. It is in later times only, when the extension of commerce and diffusion of literature give occasion to frequent communication, that these establishments are to be looked for.

The earliest institution of *posts* that occurs in modern history is about the year 807 by the emperor *Charlemagne;* who, having reduced under his dominion Italy, Germany, and a part of Spain, established three public posts at the public expence, to carry on the communication with these three provinces. The institution of posts however, like many other institutions of that emperor, dropped at his death, and for a considerable time afterwards no traces of any such establishments are to be found. We cannot indeed discover them with certainty sooner than 1464, when that restless and suspicious prince Louis XI. established posts in France, that he might be the sooner advertised of all that passed in his own or the neighbouring kingdoms. He employed in this service 230 couriers, who delivered the letters at the different stations, and in the various towns through which they passed in their course. Succeeding monarchs created at different times certain offices for the express purpose of superintending the posts; but the frequent changes to which these offices were exposed, prevented for a long time the establishment of any regular system of posts in that kingdom; insomuch that in 1619 the author of the life of the duke d'Epernon says the packet or letter office was not yet set up in France. Former establishments, it is probable, were solely for the use of the court, not for the general good of the nation. From France, the institution gradually spread through several other parts of Europe. In Germany, Lewis Hornig assures us they were first introduced by Count Taxis, who settled them at his own expence; in acknowledgement for which the emperor Matthias, in 1616, gave as a fief the office of postmaster to him and his descendants.

In England, the establishment of posts in some form or other appears as early as the reign of Edward III. but the notices concerning them are so vague, that no account can be given of them. In the reign of Edward VI. however, some species of posts must have been set up, as an act of parliament passed in 1548, fixing the rate of post-horses at one penny per mile: The post-horses here referred to were, it is probable, chiefly for travelling, and the carriage of letters or packets only an occasional service. In 1581, we find in Camden's Annals mention made of a chief postmaster for England being appointed.—How his office was managed, does not clearly appear; the limited state of the correspondence of the country probably rendered it of trifling consequence. King James I. originally erected a post-office, under the controul of one Matthew de Quester or de l'Equester, for the conveyance of letters to and from foreign parts; which office was afterwards claimed by Lord Stanhope; but was confirmed and continued to William Frizel and Tho. Witherings, by King Charles I. in 1632. Previous to this time, it would appear that private persons were in use to convey letters to and from foreign parts; all such interference with the postmaster's office is therefore expressly prohibited. King Charles, in 1635, erected a letter office for England and Scotland, under the direction of the above Thomas Witherings. The rates of postage then established were, twopence for every single letter for a distance under 80 miles; fourpence from 80 to 140 miles; sixpence above 140 miles. The allowance to the postmasters on the road for horses employed in these posts was fixed at twopence halfpenny per mile for every single horse. All private inland posts were discharged at this time; and in 1637 all private foreign posts were in like manner prohibited. The posts thus established, however, extended only to a few of the principal roads; and the times of transmission were not in every case so certain as they ought to have been.

Witherings was superseded for abuses in the execution of his offices in 1640, and they were sequestrated into the hands of Philip Burlamachy, to be exercised under the care and oversight of the king's principal secretary of state. On the breaking out of the civil war great confusions and interruptions were necessarily occasioned in the conduct of the letter-office; but it was about that time that the outline of the present more extended and regular plan seems to have been conceived by Mr Edmond Prideaux, who was afterwards appointed attorney-general to the commonwealth. He was chairman of a committee in 1642 for considering the rate of postage to be set upon inland letters; and some time after was appointed postmaster by an ordinance of both houses of parliament; in the execution of which office he first established a *weekly* conveyance of letters into *all* parts of the nation. In 1653, this revenue was farmed for 10,000l. for England, Scotland, and Ireland; and after the charge of maintaining postmasters, to the amount of 7000.l per annum was saved to the public. Prideaux's emoluments being considerable, the common council of London endeavoured to erect another post-office in opposition to his; but they were checked by a resolution of the house of commons, declaring that the office of postmaster is, and ought to be, in the sole power and

and disposal of the parliament. This office was farmed by one Maubey in 1654. In 1656 a new and regular general post-office was erected by the authority of the protector and his parliament, upon nearly the same model that has been ever since adopted, with the following rates of postage: For 80 miles distance, a single letter twopence; for a greater distance, not out of England, threepence; to Scotland, fourpence. By an act of parliament passed soon after the restoration in 1660, the regulations settled in 1656 were re-established, and a general post-office similar to the former, but with some improvements, erected. In 1663 the revenue of the post-office was found to produce 21,500l. annually. In 1685 it was made over to the king as a branch of his private income, and was then estimated at 65,000l. per annum. The year after the revolution the amount of the post-office revenue was 90,504l. 10s. 6d. At the union the produce of the English post-office was stated to be 101,101l. In 1711 the former establishments of separate post-offices for England and Scotland were abolished; and by the stat. 9. Anne, c. 10. one general post-office, and one postmaster-general, was established for the whole united kingdom; and this postmaster was empowered to erect chief letter-offices at *Edinburgh*, at *Dublin*, at *New York*, and other proper places in America and the West Indies. The rates of postage were also increased at this time as follows.—In England, for all distances under 80 miles 3d.; above 80 miles 4d. From London to Edinburgh 6d. In Scotland, under 50 miles 2d.; from 50 to 80 miles 3d.; above 80 miles 4d. In Ireland, under 40 miles 2d.; above 40 miles 4d.—By the above act all persons, except those employed by the postmaster, were strictly prohibited from conveying letters. That year the gross amount of the post-office was 111,461l. 17s. 10d. The nett amount, on a medium, of the three preceding years, was, in the printed report of the commissioners for the equivalent, stated to be for England, 62,000l. and for Scotland 2000l. In 1754 the gross revenue of the post-office for Great Britain amounted to 210,663l.; in 1764 to 281,535l.; and in 1774 to 345,421l.—The privilege of franking letters had been enjoyed by members of parliament from the first erection of the post-office; the original design of this exemption was, that they might correspond freely with their constituents on the business of the nation. By degrees the privilege came to be shamefully abused, and was carried so far, that it was not uncommon for the servants of members of parliament to procure a number of franks for the purpose of selling them; an abuse which was easily practised, as nothing more was required for a letter's passing free than the subscription of a member on the cover. To restrain these frauds, it was enacted, in 1764, that no letter should pass free unless the whole direction was of the member's writing, and his subscription annexed. Even this was found too great a latitude; and by a new regulation in 1784, no letter was permitted to go free unless the date was marked on the cover in the member's own hand writing, and the letter put into the post-office the same day. That year the rates of postage were raised in the following proportions: an addition of 1d. for a single stage; 1d. from London to Edinburgh; 1d. for any distance under, and 2d. for any distance above, 150 miles. An addition to the revenue of 120,000l. was estimated to arise from these regulations and additional rates. The rates now mentioned are those upon single letters: double letters pay double, treble letters treble, an ounce weight quadruple postage; all above are charged by the weight in the same proportion. The rates of postage have since that time been again increased.

About the year 1784, a great improvement was made in the mode of conveying the mails, upon a plan first suggested in 1782 by Mr John Palmer. Diligences and stage-coaches, he observed, were established to every town of note in the kingdom: and he proposed that government, instead of sending the mails in the old mode, by a boy on horseback, should contract with the masters of these diligences to carry the mail, along with a guard for its protection. This plan, he showed, could not fail to ensure much more expeditious conveyance, the rate of travelling in diligences being far quicker than the rate of the post; and it was easy to carry it into execution with little additional expence, as the coach owners would have a strong inducement to contract at a cheap rate for conveying the mail, on account of the additional recommendation to passengers their carriages would thereby acquire in point of security, regularity, and dispatch.

Though government heartily approved of this plan, and the public at large were satisfied of its utility; yet, like all new schemes, however beneficial, it met with a strong opposition: it was represented by a number of the oldest and ablest officers in the post-office, not only as impracticable, but dangerous to commerce and the revenue. Notwithstanding of this opposition, however, it was at last established, and gradually extended to many different parts of the kingdom; and, upon a fair comparison, it appeared that the revenue was improved, and the plan itself executed for 20,000l. per annum less than the sum first estimated by Mr Palmer.

The present establishment of the general post-office for Great Britain, consists of two postmasters-general, a secretary, surveyor, comptroller-general, and upwards of 150 assistants and clerks for the head letter office in London; the number of deputy postmasters and other officers through the kingdom is very considerable, but not easy to ascertain with accuracy, as it must frequently vary with the changes made in the establishment of country posts. The total expence of this branch of the revenue in 1778 was 149,029l, 17s. 2d.; the gross produce may be reckoned at 650,000l.

The first accounts we have of the establishment of a post-office in Scotland reach no farther back than 1635, when Charles I. erected one both for Scotland and England. The post to Scotland by that appointment was to run night and day, to go from London to Edinburgh and to return in *six* days, taking with it all letters intended for any post-town in or near the road; the rate of postage from London to Edinburgh was 8d. for a single letter. The expedition with which the post went from London to Edinburgh at this time, is indeed surprising, considering the nature of the roads; perhaps, however, though the king made the regulation that it should go and return in six days, the journey was not always performed in the specified time. During the government of Cromwell, the public post conveyed letters to Scotland as well as England; the postage from London to Scotland was only 4d. After the Restoration, when the post-office was erected for England, mention is made in the act of parliament of the conveyance of letters to Scotland; and the postage to Berwick

Post. Berwick is fixed at 3d. For some time after, however, we find no establishment by act of parliament of an internal post in Scotland. In 1662, a post between Ireland and Scotland was first established; and the privy council gave Robert Main, who was then postmaster-general for Scotland, an allowance of 200l. sterling to build a packet-boat for conveying the mail between Portpatrick and Donaghadee: the postage to Ireland was 6d. In 1669, a post was established to go between Edinburgh and Aberdeen twice a-week; and between Edinburgh and Inverness once a-week: the rate of postage was fixed, for 40 Scots miles 2d. and for every 20 miles farther an additional penny. These appear to have been the only *public* posts in Scotland at that time; but as they could not suffice for the correspondence of the country, there must have been more, either under the direction of the postmaster, or in the hands of private persons; probably there might be of both kinds. In 1690, an act for the security of the common post was passed, subjecting robbers of the mail to capital punishment. It was not till 1695 that the establishment of the post-office in Scotland received the sanction of parliament: posts were then appointed for all parts of Scotland; the rates of postage were fixed, for any place within 50 miles of Edinburgh 2d. between 50 and 100 miles 3d. all places above 100 miles 4d. By the same act, a weekly packet to Ireland was established, and 60l. sterling annually allowed for that service. Though posts were established in consequence of this act, yet such was their mode of travelling, that they hardly deserved the name. Thus, for instance, the person who set out to carry the mail from Edinburgh to Aberdeen, in place of stopping at the first intermediate stage from Edinburgh, and delivering over the mail to another to be carried forward, went on with it himself the whole journey, resting two nights by the way, first at Dundee, and next at Montrose.

In this manner the mail was conveyed thrice a-week from Edinburgh to Aberdeen; but between most parts of Scotland the post went only twice, and between some only once a-week. The post-boy generally travelled on foot. Horses were but little used in the service of the post-office.

At the Union the Scots post-office was farmed for 1194l.: in 1710, the nett amount for Scotland was reckoned to be 2000l. The epistolary correspondence of Scotland must have been small indeed, when even the rates of postage then established proved so very unproductive. This may perhaps, however, be in part accounted for, by conjecturing, that as private posts had probably prevailed pretty much before 1695, it was long before these were entirely suppressed, the people still adhering to their old conveyances, and difficulties occurring in strictly enforcing the law; the amount of the post-office revenue, therefore, at the two periods above mentioned, probably exhibits a view of only a part of the correspondence of Scotland.

In 1711, it has been already mentioned, one general post-office was established for the whole united kingdom; but the postmaster-general was authorised to erect at Edinburgh a chief letter office for Scotland.— This was accordingly done, and a postmaster-general for North Britain, with other necessary officers, appointed. All the deputy postmasters in Scotland are under his immediate direction, but he himself is under the controul of the postmaster-general for Great Britain. From this head letter-office posts were established to the different parts of Scotland. Post.

For many years the post-boys generally travelled on foot, or, if on horseback, without a change of horses. It was not till about 1750 that the mail began to be conveyed from stage to stage by different post-boys and fresh horses to the principal places in Scotland, and by foot runners to the rest. The communication between London and Edinburgh was at first but thrice a-week, and so slow, that the mail from London to Edinburgh was upon the road 85 hours, and from Edinburgh to London 131 hours. In 1757, upon a representation from the royal boroughs, regulations were fallen upon, by which the time was shortened to 82 hours in the one case, and 85 in the other. By the extension of Mr Palmer's plan to Scotland, the time has been still farther shortened to about 60 hours in each case.

The establishment of the Scots post-office consists at present of a postmaster-general, secretary, solicitor, and accountant, with a number of other clerks and assistants for the head office at Edinburgh; under its management are about 180 deputy postmasters for the different post-towns through Scotland.

The nett produce of the post-office for Scotland in 1733 was 5399l. in 1757 10,623l. in 1766 31,103l. In 1788 the gross produce was 55,836l. the expence 22,636l.; in 1793 the gross amount was about 64,000l. the nett produce about 40,000l.; in 1803 the gross produce was above 120,000l. the nett revenue about 97,000l.; in 1807 the gross produce was above 145,000l. the nett revenue towards 120,000l.

Penny-Post, a post established for the benefit of London and other parts adjacent, whereby any letter or packet under four ounces weight, is speedily and safely conveyed to and from all places within the bills of mortality, or within 10 miles of the city. It is managed by particular officers; and receiving houses are established in most of the principal streets, for the more convenient transmission of the letters. Some other large towns have instituted similar establishments.

About the year 1776, a penny-post was set up in Edinburgh by Mr Williamson, unconnected with the general post-office. It met with but indifferent encouragement for some years, doubts being entertained as to its punctuality in delivering the letters; by degrees, however, it seemed to be advancing in estimation, and was more frequently employed. Twenty years after, the general post-office, in virtue of the act of parliament prohibiting the conveyance of letters by any but those employed under the postmaster-general, took the penny-post entirely into its own hands; and Mr Williamson was allowed an annuity during life equal to what his private establishment yielded. Letters are now transmitted to the different quarters of Edinburgh, and the suburbs, three times a-day.

Post, a particular mode of travelling. A person is said to *travel post* in contradistinction to common journey travelling, when in place of going on during his whole journey in the same vehicle, and with the same horses, he stops at different stages, to provide fresh horses or carriages for the sake of greater convenience and expedition. As he thus uses the same mode of travelling that is employed for the common post, he is said to travel post, or in post, i. e. in the manner of a post.

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In tracing the origin of posts, it has already been remarked, that the more ancient establishments of this kind were fully as much for *travelling stations* as the conveyance of letters. The relays of horses provided at these public stations for the messengers of the prince, were occasionally, by special license, allowed to be used by other travellers who had sufficient interest at court. Frequent demands of this nature would suggest the expedient of having in readiness supplies of fresh horses or carriages over and above what the *public* service required, to be hired out to other travellers on payment of an adequate price. We find, therefore, that in former times the postmasters alone were in use to let out horses for riding post, the rates of which were fixed in 1548 by a statute of Edward VI. at one penny per mile. In what situation the state of the kingdom was with regard to travelling post for more than a century after this period, we cannot now certainly discover; but in the statute re-establishing the post-office in 1660, it is enacted, that none but the postmaster, his deputies, or assigns, shall furnish post-horses for travellers; with a proviso, however, that if he has them not ready in half an hour after being demanded, the traveller shall be at liberty to provide himself elsewhere.

The same prohibition is contained in the act establishing the Scots post-office in 1695, as well as in the subsequent act of Queen Anne, erecting the general office for the united kingdom. It is doubtful, however, whether it was ever strictly enforced. By an explanatory act of 26 Geo. II. the prohibition is confined to post *horses* only, and every person declared to be at liberty to furnish *carriages* of every kind for riding post. This regulation has, in fact, done away the prohibition, as hardly any person now thinks of travelling post, except in a carriage.

The rate fixed by the act 1695, in Scotland, for a horse riding post, was threepence per Scotch mile. By the act 9 Anne, c. 10. threepence a mile without, and fourpence a mile with, a guide, was the sum fixed for each horse riding post. The increase of commerce, and necessity for a speedy communication between different parts of the kingdom, have brought the mode of travelling post so much into use, that upon every great road in the kingdom post-chaises are now in readiness at proper distances; and the convenience of posting is enjoyed in Britain to a degree far superior to what is to be met with in any other country whatever.

Posting at last appeared to the legislature a proper object of taxation. In 1779 the first act was passed, imposing duties on horses hired either by themselves or to run in carriages travelling post; the duties were, one penny per mile on each horse if hired by the mile or stage, and one shilling per day if hired by the day. Every person letting out such horses was also obliged to take out a license at five shillings per annum. These duties were next year repealed, and new duties imposed, of one penny per mile on each horse hired by the mile or stage, and 1s. 6d. on each if hired by the day. A number of additional regulations were at the same time enacted for securing these duties. An addition of one halfpenny per mile, or threepence per day, for each horse riding post, was imposed in 1785, by Stat. 25 Geo. III. c. 51. The duty is secured, by obliging every letter of horses to deliver to the person hiring them a ticket, expressing the number of horses hired, and either the distance in miles to be travelled, or that the horses are hired by the day, as the case happens to be. These tickets must be delivered to the bar-keeper at the first turnpike through which the traveller passes; and the turnpike-keeper gives, if demanded, what is termed an *exchange* ticket, to be produced at the next turnpike. The stamp-office issues to the person licenced to let post-horses such a number of these tickets as is required, and these must be regularly accounted for by the person to whom they are issued. As an effectual check upon his account, the turnpike-keeper is obliged to return back to the stamp-office all the tickets he takes up from travellers. Evasions are by these means rendered difficult to be practised without running a great risk of detection. In 1787, for the more effectually levying the post-horse duties, a law was passed, authorising the commissioners of the stamp-office to let them to farm by public auction, for a sum not less than the produce in the year ending first August 1786.

In the advertisement published by the commissioners in consequence of this law, previous to the receiving proposals for farming them, the total amount of the duty for Great Britain is stated to have been, at the period above referred to 117,873l. The sum for which that duty was farmed in 1794 amounted in all to 140,030l. of which the district of North Britain was 6000l.

Soon after the tax was imposed, considerable difficulties were raised about the meaning of the term *posting*, and what mode of journey should subject travellers to duty. The old law, Stat. 9 Anne, c. 10. explained posting to be "travelling several stages, and changing horses;" but the acts imposing the posting duties expressly declare, that "every horse hired by the mile or stage shall be deemed to be hired to travel post, although the person hiring the same doth not go several stages upon a post road, or change horses;" and that "every horse hired for a day or less period of time, is chargeable with the duty of three halfpence per mile, if the distance be then ascertained; and if the distance be not then ascertained, with 1s. 6d. each horse." Horses hired for any less time than two days are by these acts to be deemed to be hired for a day. An action was brought in 1788, in the court of exchequer at Edinburgh, to determine whether several disputed cases fell under the meaning of the act, and were liable to duty, when the following decisions were given:

Saddle-horses both hired and paid by the mile, and saddle-horses hired originally for an excursion, but afterwards paid by the mile, were found liable to duty according to the number of miles paid for; carriage-horses, where the carriage is hired and paid for only at the usual rate of *outgoing* carriages, and no more, whether the person hiring it does or does not return in it, were found liable to duty only for the number of miles *out;* but if the carriage be hired and paid for, or actually paid for, though not originally hired, at the usual rate of carriages employed both to carry out and bring back the same company, the duty was found to be exigible according to the number of miles both out and home taken together. Hackney-coaches in Edinburgh, hired and paid for less than two miles, were found liable to duty for one mile.

No duty was found to be exigible on saddle-horses hired

hired for a mere excursion, and paid for accordingly, where the distance neither is nor can be ascertained; on hackney-coaches employed in the streets for less than a mile, or for an excursion or round of visits merely; and on horses or carriages hired for a journey of three days or more, and paid for accordingly, or paid for at the rate of three days, though the journey should actually be performed in two full travelling days. The general rule of these decisions was, that in every case, except unascertainable distance, or journeys exceeding two days, the mode of travelling fell under the legal definition of posting. The only point that may seem doubtful in the judgments here stated, is that where the duty is found chargeable by the number of miles both going and returning. Yet as the law expressly declares, that horses hired by the mile or stage are to be deemed *posting*, and as the number of miles for which they are hired can only be ascertained by the number paid for, it is clear, that where an addition to the outgoing charge is made on account of bringing back the person hiring the carriage, the carriage in that case is actually hired and paid for according to the number of miles both out and home, and the duty must fall to be rated accordingly. The doubtful points being now settled by the above decisions, the mode of levying the duty in Scotland has been regulated agreeably to them ever since the matter was thus determined.

POSTERIOR, a term of relation, implying something behind, or that comes after, another. In which sense it is used in opposition to *prior* and *anterior*.

The back and hips are the posterior parts of man. Aristotle has given prior and posterior analytics. A date is posterior to another when it is later or fresher.

POSTERN, in fortification, a small gate, usually made in the angle of the flank of a bastion, or in that of the curtain, or near the orillon, descending into the ditch; whereby the garrison can march in and out, unperceived by the enemy, either to relieve the works, or to make private sallies, &c.

The word is also used in general for any private or back door.

POSTHUMOUS, a child born after the death of his father, or taken out of the body of a dead mother; from whence it is frequently applied to the works of an author not published till after his decease.

POSTIL, a name anciently given to a note in the margin of the Bible, and afterwards to one in any other book posterior to the text.

POSTING, among merchants, the putting an account forward from one book to another, particularly from the journal or waste-book to the ledger. See POST and BOOK-KEEPING.

POSTLIMINIUM, among the Romans, the return of one who had gone to sojourn elsewhere, or had been banished, or taken by an enemy, to his own country or state.

POSTPONING, putting any thing after or behind another, with regard to time.

POSTSCRIPT, an article added to a letter or memoir containing something learnt or recollected after the piece was written.

POSTULATE, in mathematics, &c. is described to be such an easy and self-evident supposition, as needs no explication or illustration to render it intelligible; as that a right line may be drawn from one point to another.

POSTURE, in painting and sculpture, the situation of a figure with regard to the eye, and of the several principal members thereof with regard to one another, whereby its action is expressed. A considerable part of the art of a painter consists in adjusting the postures, or in giving the most agreeable ones to his figures, in accommodating them to the characters of the respective figures, and the part each has in the action, and in conducting and in pursuing them throughout.

Postures are either natural or artificial.

Natural postures are such as nature seems to have had a view to in the mechanism of the body, or rather such as the ordinary actions and occasions of life lead us to exhibit while young, and while the joints, muscles, ligaments, &c. are flexible.

Artificial postures, are those which some extraordinary views or studies occasion us to learn; as those of dancing, fencing, &c. Such also are those of our balance and posture masters.

A painter would be strangely puzzled with the figure of Clark (a late famous posture-master in London) in a history-piece. This man, we are told in the Phil. Trans. had such an absolute command of his muscles, &c. that he could disjoint almost his whole body; so that he imposed on the great surgeon Mullens, who looked upon him as in such a miserable condition, he would not undertake his cure. Though a well-made man, he would appear with all the deformities imaginable; hunch-backed, pot-bellied, sharp-breasted, &c. He disjointed his arms, shoulders, legs, and thighs; and rendered himself such an object of pity, that he has frequently extorted money, in quality of a cripple, from the same company in which he had the minute before been in quality of a comrade. He would make his hips stand a considerable way out from his loins, and so high as to invade the place of his back. Yet his face was the most changeable part about him, and showed more postures than all the rest. Of himself he could exhibit all the uncouth odd faces of a quakers meeting.

POTAMOGETON, POND-WEED; a genus of plants belonging to the tetrandria class; and in the natural method ranking under the 15th order, *Inundatæ*. See BOTANY *Index*.

POTAMON, or POTAMO, was a philosopher of Alexandria. He kept a middle course between the scepticism of the Pyrrhonians and the presumption of the dogmatists; but attached himself to none of the schools of philosophy of his time. He was the first projector of the Eclectic sect; for though the mode of philosophising had been pretty common before, he was the first that attempted to institute a new sect on this principle. Diogenes Laertius relates, that not long before he wrote his Lives of the Philosophers, an Eclectic sect, ἐκλεκτική τις αἵρεσις, had been introduced by Potamo of Alexandria, who selected tenets from every former sect. He then proceeds to quote a few particulars of his system from his Eclectic institutes, respecting the principles of reasoning, and certain general topics of philosophical inquiry; from which nothing further can be learned than that Potamo endeavoured to reconcile the precepts of Plato with those of other masters. *Enfield's History of Philosophy.*

Potamon, Potash.

As nothing remains concerning this philosopher besides the brief account just referred to in Laertius, an obscure passage in Suidas, and another still more obscure in Porphyry; it is probable that his attempt to institute a school upon the Eclectic plan proved unsuccessful. The time when Potamo flourished is uncertain. Suidas places him under Augustus; but it is more probable, from the account of Laertius, that he began his undertaking about the close of the second century.

POTASH, the lixivious ashes of certain vegetables, used in making glass, soap, &c. See GLASS, SOAP, &c. For an account of the properties and combinations of potash, see CHEMISTRY. Potash was till lately considered as a simple substance; but it appears from the unexpected discoveries of Mr Davy in galvanism to be a compound of a peculiar metallic substance and oxygen. Soda is also a compound of a similar nature. For an account of Mr Davy's discoveries, see ZINC. Here we treat only of the manufacture of potash.

1 Dr Shaw's method of making potash.

The method of making potash is directed by Dr Shaw as follows. Burn a quantity of billet-wood to gray ashes; and taking several pounds of these ashes, boil them in water, so as to make a very strong lixivium, or ley. Let this ley be strained through a coarse linen cloth, to keep out any black parts of the half-burnt wood that might happen to remain in the ashes; then evaporate this strained lye in an iron pan over a quick fire almost to dryness: then taking out the matter remaining at the bottom, and putting it into an iron crucible, set it in a strong fire till the matter is melted, and then immediately pour it out upon an iron plate, where it soon cools, and appears in the form of a solid lump of potash *. Much after this manner is potash made in the large way, for the service of the soap-boiler, glass-maker, fuller, &c. but according to the difference of the wood, or combustible matter employed, with the manner of turning it, and conducting the process, different kinds of potash are prepared. There are certain saline plants that yield this potash to great advantage, as particularly the plant kali; there are others that afford it in less plenty, and of an inferior quality, as bean-stalks, &c.: but in general, all vegetable subjects afford it of one kind or other, and may most of them be made to yield it tolerably perfect after the manner of the process already laid down, even the loppings, roots, and refuse parts of ordinary trees, vine clippings, &c. The fixed salts of all vegetables, excepting the kali and marine plants, when reduced to absolute purity, or entirely separated from the other principles, appear to be one and the same thing: whence it should seem, says Dr Shaw, that by a suitable management good saleable potash might be made in all places where vegetable matters abound. For if by examining Russia (A) potash, for example, we find that its superior excellence depends upon its being clear of earth, or upon its containing a large proportion of oil, or refined salt, these advantages may, by properly regulating the operation, be given to English potashes, so as perhaps to render the latter as good as the former: but where the potash of any remarkable saline vegetable is to be imitated, that of the kali, for example, the doctor recommends a prudent sprinkling of the subject with salt, or sea-water, in the burning; and by these ways, properly diversified, any principle that is naturally wanting might be artificially introduced so as to perfect the art of potash.

* See *Pearl-Ash*, and *Transactions of the Royal Irish Academy*, 1789, *art.* 1. *Class* Science.

2 Account of Mr Stephen's manufacture.

Above half a century ago, Mr Stephens, encouraged by the Society of Arts, &c. and by a parliamentary grant of 3000l. established a manufacture of potash in North America, which produced such as was so perfectly good as to answer in bleaching and other uses the purposes of *pearl-ash*; and which at the same time afforded a very large produce. But the very great heat which his process required, occasioned the destruction of a very extensive apparatus; and other circumstances concurred to disappoint the hopes and check the spirit of the proprietors. The manufacture was, however, afterwards undertaken and prosecuted by others. Mr Stephens's apparatus was as follows: Fig. 1. A is the bed of the kiln, which flies off about four feet by two from the grate, more or less according to the size; C is the ash-hole, $2\frac{1}{2}$ or 3 feet deep, Fig. 2. B represents quadrangular bars of iron, with their opposite angles placed upwards and downwards, not above an inch asunder. Fig. 3. A, B, and C, are three steepers five feet deep, and of any width from four to eight feet square, of the best white pine or cypress plank, with square joints and strong oak frames, placed each over a receiver, with a cock to let off the ley, and a vent just beneath the surface of the grating. E represents three receivers, standing each under, and projecting out, from its steeper. They must be made of the best stuff, carefully put together, and laid in tough clay, well rammed within the ground, their tops being level with the surface: they need not be so large as the steepers by six, eight, or twelve inches. Fig. 4. E represents a false bottom or lattice of boards, eight inches deep and five square, with a hole in the under edge of every partition for the ley to pass into the steeper. Fig 5. A is the vessel over the furnace in which the ley and ashes are mixed; B is a hole or funnel a few inches from the back of the furnace, with an iron socket to let the pipe through the hinder part of the arch, to reach down within two inches of the floor of the furnace. C is a cast-

Plate CCCCXXXIII. fig. 1. Fig. 2. 3 Of his apparatus. Fig. 3. Fig. 4. Fig. 5.

(A) According to Sir Peter Warren, the best woods for making Russian potash are, oak, ash, poplar, hiccory, elm, hazel, and beech. They must be cut in November, December, January, and February, split and stacked to dry. After 12 months, in warm open weather, it must be burnt on a brick hearth by a slow fire in a kiln, or close place; the ashes must be sifted through two sieves, one finer than the other, and then put up in brick troughs or wooden backs, covered with rain or river water, and must remain well mashed and incorporated five months. Brick furnaces shaped like bakers ovens must be heated with a strong fire of oak or ash, burning night and day; the prepared ashes must be gradually thrown on the fire, when they will run into metal like lead: the fire must not go out till the furnace is nigh filled with potashes. The ashes must then be broken to be taken out, but the larger the pieces the better; they must be preserved from the air in tight casks, the large pieces by themselves, and the dust by itself.

cast-iron cauldron for boiling the ley to dryness when pearl-ash is made. D is a vessel whence the liquor is let into the cauldron as it evaporates. The mortar for building the furnace should be made of loam; the arch should be 18 inches thick, and the floor should be laid with tyles on a layer of sand an inch thick, with neat joints.

4 Process without using a kiln,

Mr Stephens's process, both with and without the kiln, was as follows. Cut timber, felled at any season, into lengths of about eight feet: lay from three to ten of them lengthwise in a heap upon dry ground, and fill the vacancies between with smaller wood: the sooner it is burnt after felling, the better. Set fire to it by laying embers on the bottom logs at each end; and for burning the brush and lappings, with other smaller woods, lay them lengthwise on the ground, top to top, lapping over a little, with the butt ends outwards, and as close as a faggot; laying the larger woods on top till the heap is full four feet high; the length of the brush set against each other making the breadth of the heap. As to the choice of the timber, old hollow trees, if not dead, are best: pine, cypress, and cedar, are to be totally rejected.

As soon as the pile is burnt down, rake such ashes as lie round the outside a little in towards the middle; add no fresh fuel, nor throw on any brands. Let the ashes lie without stirring till you can just bear your hand in them; then carry them to a house, or under a shed, on a plank floor raised a little from the earth and well jointed; there wet them till brought nearly to the consistence of mortar in the first mixture of lime and sand, and ram them in a heap, in which they must lie full 20 days, or some months if you please; observing to be more sparing of water in winter, and ramming them closer, and sometimes wetting the top that it may never grow quite dry.

5 and with

Wood may also be burnt in a kiln, as fig. 1. and 2.; and then it must be cut into such lengths as may be most convenient for carriage, and best suit the size of the kiln. The mouth of the ash-hole must be close stopped by daubing the joints of the lid with loam, or throwing a bank of sand or earth against it: keep the bed of the kiln filled with wood up to the surface, but not above it, and let it burn incessantly till the ashes rise within six or eight inches of the grate. Draw them out whilst red-hot, and in that state sprinkle them with ley, from four to six caracts weight; weigh a small phial which holds about four ounces very exactly; then fill it with water and weigh that also: divide the weight of water into equal parts till you come to $\frac{1}{128}$ of the whole, which is called a *caract*, $\frac{1}{64}$ two caracts, &c. until you have a weight equal to $\frac{1}{4}$ of the whole water, which is called 32 caracts: all which small weights, together with one equal to the phial filled with water, are to be kept for weighing the ley in the said phial till they are made damp; then ram them as before in a heap, but separate from the ashes made as above. *N. B.* By kiln-burning a stronger ley may be more certainly procured than by the other way, where rain may chance to fall on the ashes before they can be removed.

The ashes thus prepared are to be put into vats or steepers, fig. 3. with a false latticed bottom, as fig. 4.; first putting coarse wheat or rye straw about a foot thick on the lattice or grating; on which put ashes to within four or five inches of the top, ramming them all the way up, especially at the sides, with a small light rammer, as tight as you can, without bursting the vat. Form on the top of the steeper a hollow bason in the ashes four or five inches deep leaving the ashes four or five inches thick on the sides, by raising a small bank round the sides, so that the liquor may not overflow the edges of the ashes at top; keep this bason constantly filled with soft water in the steeper A, until the ashes will imbibe no more, which will be in 24 hours or more, according as it is rammed; then turn the cock, and let off what shall be soaked through into the receiver or lower chamber of the steeper, and no more; for if the several runnings are not kept separate, the ley will not be brought to its due strength. Follow that steeper with fresh water on the same ashes for several other runnings, which will each come off in a few days, till the liquor has neither smell nor taste; then heave out the ashes, and charge the steeper afresh.

Upon drawing off the first running from the steeper A, fig. 3. fill the steeper B with ashes as before, and put into its hollow at the top the ley so first run off, and the smaller or half leys also, till full, and draw off as directed for the steeper A: if this weighs 18 caracts or more, pump it into the cistern F as fit for use; if it be short of that, pass it off as half ley to the steeper C, and through fresh ashes till strong enough. With kiln-ashes only, from water passing through the first steeper, it will be strong enough for the cistern, if the ashes are well prepared. If your water be hard, let it stand two or three days exposed to the air and sun in a shallow back, and it will be soft. When you use kiln-ashes with others, lay them at bottom.

The ley must be conveyed from the cistern F, as it is wanted to the vessel A fig. 5.; where with every gallon of proof ley mix three ounces of fine light wood ashes; and to the ley that is one-fourth over-proof put six ounces of ashes; and if two-fifths over-proof 12 ounces, increasing or lessening according to the strength of the ley.

For evaporating the ley and melting the salt, heat a furnace till you bring it very near a white heat, of which the side-doors being red-hot is a mark. This will take 48 hours or more if the furnace be quite cold: when thorough hot, a little fuel keeps it so. Then, through the cock of the vessel A, pass the mixture by the funnel B into the furnace, not so as to reach much beyond the middle of the floor, before it changes from dark to bright red, letting the heat prevail towards front or back as you see necessary. When the mass begins to gather about the flues or in heaps, run in no more till the furnace is cleared by driving the fire backward. You must have two funnels, one soon choking; in an hour or less will issue out a red-hot stream of melted salt, which is potash, to be broken to pieces as soon as cold, and packed in tight close casks, being in no respect inferior to the best foreign ash whatever.

The best potash is made from barilla, and comes from Spain. The plants from which it is procured are found in great plenty about Carthagena, where they are indigenous, and may be collected in a swamp called *Almojar* east of that place; the *Scyones* barilla is the best. They are found, besides all along that coast, on the borders of the Mediterranean for 60 leagues in length, and 8 in breadth. About 150,000 quintals of it are annually exported from Spain. It produces a revenue of 25,500l. 6 Spanish potash the best.

 a-year;

Potash. a-year; each quintal paying a duty of 17 reals; yet Don Bernardo de Ulloa, A. D. 1740, says it was farmed at 1822l. 4s. 3d. M. Macdonnell has brought the manufacture of potash to its present perfection in Spain; but its exportation is materially injured by the heavy tax on it. See Townshend's *Travels*, vol. iii. p. 131. See also Barilla, Kelp.

7 Dr Percival's account of making potash.

In the 70th volume of the Philosophical Transactions we have an account of a method of procuring this salt from the putrid water which runs from dunghills. The process is very easy, consisting only in simple evaporation of the fluid, and calcinating the impure salt till most of the foulness is burnt out. From 24 wine-pipes full of this muck-water were obtained 9 cwt. 1 q. 12 lb. of saleable potash, valued at 42s. per cwt: the expence of manufacturing them being only valued at 4l. 9s.

The potash thus made is of a grayish white appearance; deliquesces a little in moist air; but if kept in a dry room, near the fire, acquires a powdery surface. It is hard and of a spongy texture when broken, with many small crystals in its substance. The colour of its internal parts is dusky and variegated. To the taste it is acrid, saline, and sulphureous. It emits no smell of volatile alkali, either in a solid form, dissolved, or when added to lime-water; neither does it communicate the sapphire-colour to a solution of blue vitriol. Silver is quickly tinged black by it; a proof that it contains much phlogiston. Ten grains of this potash required 11 drops of the weak spirit of vitriol to separate it. The like quantity of salt of tartar required 24 drops: a strong effervescence occurred in both mixtures; and a sulphureous vapour exhaled from the former. A tea spoonful of the syrup of violets, diluted with an ounce of water, was changed into a bright green colour by five grains of the salt of tartar; but ten grains of this potash were necessary to produce the same hue in a similar mixture. Half an ounce of the salt dissolved entirely in half a pint of hot water; and when the liquor was cold, a large purple sediment subsided to the bottom; and it was found that this sediment amounted to about two-thirds of the whole quantity of ashes used.

Dr Percival, the author of this paper, concludes with observing, that this potash is a true fixed vegetable alkali, produced by putrefaction; that the quantity of alkali contained in it may be estimated at one-third of its weight, whereas the white Muscovy ashes are said to yield only one eighth part; that no quicklime appears to be contained in this potash, for a solution of it poured from its sediment remained clear though long exposed to the air; that it would be worth trying, whether the large purple sediment, which subsides when this potash is lixiviated, might not be applied to the manufacture of Prussian blue, or used in the manner recommended by Macquer for dyeing wool and silks; and that this manufacture will furnish the farmer with top-dressing for his garden and land, of great fertilizing powers. See *Phil. Trans.* vol. lxx. p. 345.

8 Other attempts.

These are the processes most essentially different from one another which have appeared concerning the manufacture of this useful salt. Some indeed have attempted to compose it on the supposition that alkali consisted of an earth combined in a peculiar manner with a certain acid. But the little success of all these attempts show that they have been built on a false principle. The only method of producing alkaline salts originally is from the ashes of vegetables; and the vegetable substances which yield the largest quantity of them are tartar and marine plants. From the former the purest and strongest vegetable alkali is obtained, and from the latter the mineral alkali. From other vegetables, as fern, broom, bean-stalks, &c. an alkaline salt is produced, but so impure, and in such small quantity, that no manufacture of it can be established in this country with any reasonable expectation of profit.

9 On extracting its alkaline part from rock-salt.

Dr Watson (the present bishop of Landaff) suggests, that the investigation of a method of extracting its alkaline part from rock salt would be a most serviceable discovery. We have inexhaustible mines of rock-salt in this country, which (he observes) the proprietors can afford at ten shillings a ton. A ton of rock-salt contains about half a ton of mineral alkali, which is for most purposes far preferable to potash. To those who have leisure to attempt such a discovery, he gives the following hint: whether the alkaline part of rock-salt may not be obtained by calcining it in conjunction with charcoal in open fires? His reason for this conjecture is founded upon the following experiment: upon burning sea-wreck to a black coal, and stopping the process at that point, he has obtained great plenty of common salt, but no mineral alkali from the black ashes; though we are certain, that when the black ashes are thoroughly calcined, or reduced to white ashes, mineral alkali may be obtained from them. This makes it probable, that the common salt contained in the black ashes of sea-wreck is decomposed, and changed into a mineral alkali, during the burning of the black ashes. There are reasons to suppose, that the cinder of pit-coal would answer the purpose better than charcoal. *Chem. Ess.* vol. i. p. 136, &c.

10 Dr Home's experiments on the potashes of different countries.

The potashes of different countries vary much in quality; and the experiments of Dr Home, in his Treatise on Bleaching, seem to set forth their different properties in the clearest point of view. The different kinds tried by him were,

1. *Blue pearl-ashes.*—These appear to be a pure alkaline salt, mixed with a small quantity of vitriolated tartar and earth. Half a pound of this, filtered and evaporated, yielded $5\frac{1}{2}$ ounces of pure salt.—Here, however, we must observe, that though the quantity was so far diminished by this operation, yet we are not to imagine that the whole of this diminution was owing to impurities; for all salts are destroyed in some measure by solution in water and exsiccation.

2. *White pearl-ashes* are nearly of the same quality with the former; half a pound of them giving five ounces and seven drams of pure salt, with some vitriolated tartar and earth.

3. *Russia* or *Muscovy ashes* have very much the appearance of slaked lime, and are, like it, friable betwixt the fingers. They adhere to the tongue: and their alkaline taste soon goes away, leaving in the mouth a strong taste of lime. Some small bits of charcoal are observable in their composition, and they never turn moist in the air. Half a pound of the salt lixiviated with water, and evaporated, gave only 10 drams 15 grains of very caustic salt. These consist therefore of a small quantity of alkaline salt united with a large quantity of lime.

4. *Cashub-ashes* are of the colour of iron-stone, and extremely hard, with many shining particles of charcoal in

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in them. They have a saline taste, with a considerable degree of pungency; feel gritty in the mouth when broke in pieces by the teeth, and will dissolve in water. To extract the pure salt, half a pound of the ashes were boiled in a pint of water; then that water poured off, and half a pint put on the ashes again; and so on, till the ashes tasted no more salt. This boiling took 24 hours, and the last water that came off had a strong taste of sulphur, and was blackish. A piece of silver put in the decoction was in a few minutes turned almost black; but though the decoction was evaporated considerably, it did not turn silver black more speedily than before. The whole, when totally evaporated, yielded only 10 drams of a brown salt having a strong caustic alkaline taste. Some Cashub-ashes powdered, and often washed in water, so that the salts were all carried off, were infused in water. After standing some time, there was a weak lime-water, with something of a saline taste, but no pellicle. Some of this residuum was put into a reverberatory furnace for two hours; after which it afforded good lime-water. Cashub-ashes then appear to contain an earth half vitrified, some lime, alkaline salts, and a quantity of sulphur.

5. *Marcoft ashes* are of a paler colour than the former, with some small pieces of charcoal in their composition. They have a strong saline taste; and so great pungency, that they cannot be held long in the mouth. Half a pound dissolved in water, filtered and evaporated, yielded 11 drams one scruple and two grains of alkaline residuum. The decoction blackened silver, but not so strongly as the former; and by evaporation it quickly lost that quality.

11
On manufacturing them in this country.

Our author next proceeds to consider the probability of manufacturing these ashes in this country. On which subject he has the following observations.—"The blue and white pearl-ashes we have discovered to be pure alkaline salts, without any considerable mixture of heterogeneous bodies. Their purity shows the lixive to have been strained through some close substance, such as linen or flannel. The blue ashes show by their colour that they have sustained the most fire. But both of them are so much alike, that the one may be substituted for the other; and therefore we shall consider them in one view.

"Every one knows that alkaline salts, such as these, are got from all plants except the alkalescent, and from all trees except the most resinous, which afford them in very small quantity. These plants or trees, when sound, are pulled or felled in the spring, dried, and burnt to ashes. By the affusion of warm water the salts are dissolved, and, by straining, separated from the earth along with the water. This saline liquor, which is called a *lixive*, is evaporated over a fire; and what remains is an alkaline salt of the same kind with the pearl-ashes.

"I was informed by a skilful bleacher in Ireland, that he practised a more expeditious way of extracting the salts. He bought the ashes of different vegetables from the commonalty for 9s. a bushel. From these a very strong ley was made, into which dry straw was dipped until it sucked up all the ley. This straw was afterwards dried and burnt, and gave him salts which he showed me, almost as good and pure as the pearl-ashes. This method I have several times tried; but could never burn the straw to white ashes, the salts diminishing the inflammability of the straw. It is a very expeditious method if it can be practised. But I can see no occasion for bringing the ley into a solid form, as the salts must again be dissolved in water before they can be used. The strength of the ley can easily be determined by the hydrostatical balance.

"Though I make no question, that the quantity of salt in plants of the same species, will vary in different soils and climates; yet it would be of advantage to have the proportion ascertained in general. Some trials of this kind I have made.

"Two pounds of fern which had been pulled August 16. were dried, and burnt to white ashes. These weighed 7 dr. and tasted very salt. When lixiviated, strained, and evaporated, they gave me 49 gr. of salt, about the eighth part of the ashes. If the fern had been pulled in April, it would have afforded more salt. Why then should we not prepare salts from this vegetable? There is more of it growing on our hills than would serve all our bleachfields. The Irish make great use of it.

"From 11 oz. of tobacco-ashes I had 1 oz. of salt. Two ounces of peat-ashes afforded half a drachm of salt. Nettles, I am informed, afford much salt. Furze and broom, natives of this country, are very fit for this purpose.

"But the kelp, as it grows in such plenty along our shore, and contains more salt than any other vegetable I know, would be the most proper, were it not for a mixture of some substance that renders it unfit for bleaching, at least of fine cloths, after they have obtained a tolerable degree of whiteness. It is observed by bleachers, that in these circumstances, it leaves a great yellowness in the linen. As these ashes are much used in Ireland, and as it is not uncommon to bleach coarse cloths with them in Scotland, a disquisition into their nature, and some attempts to purify them, may not be improper. There are no ashes sold so cheap as these; for the best gives but 2l. the 2000 weight (B). They may, therefore, allow of more labour to be expended on them, and come cheaper at long-run than the foreign salts.

"I dried some sea-ware, and burnt it, though I found that last operation very difficult. When I had kept it fused in the fire for two hours, it weighed $3\frac{1}{2}$ oz. I poured on the ashes an English pint and a half of cold water, that I might have as little of the sulphur as possibly. This ley, after it had stood for some hours, was poured off clear, and had but a slight tendency to a green colour. I made a second infusion with milk-warm water, and poured it off from the sediment. This had a darker colour than the former; was kept separated from it, and evaporated by itself. There was a third infusion made;

(B) "Since this treatise was written, however, the price of kelp has been advanced to 7l. or upwards the 2000 weight; so that those who would now attempt any thing of this kind, must also manufacture the kelp themselves."

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made; but having no salt taste, it was thrown away. The second infusion seemed to contain more sulphur than the first; and a piece of white linen kept in it half an hour, while it was boiling, was tinged yellow, and could not be washed white again. The earthy part remaining, weighed, when well dried, 1 oz. 2 dr. The saline decoction evaporated by degrees, and set at different times in a cellar to crystallize, afforded me 5 dr. 46 gr. The liquor, when entirely evaporated, left $4\frac{1}{2}$ dr. of a yellow salt, which appeared to be a strong alkaline. The salts which crystallized seemed to be mostly sea-salt, with a considerable quantity of sulphur, and some alkaline salt. There appeared no signs of the bittern in these salts, as their solution did not turn turbid with the oil of tartar. Nor is any of the bittern to be expected in kelp-ashes, although it probably is to be found in the recent vegetable; because the alkaline salts formed by the fire must have changed it into a neutral. The ley made warm with water, being evaporated, left 4 dr. of a black bitter salt, which, from its quantity of sulphur, appeared unfit for bleaching. These ashes, then, seem to be a composition of somewhat less than the fourth of sulphur, the same quantity of sea-salt, about a fourth of alkaline salt, and somewhat more than a fourth of earth. The alkaline salt contained in kelp ashes amounts to one penny a pound. This cheapness makes it worth our pains to bestow some labour on them.

"If the bad effects in bleaching with kelp-ashes arise from the sea-salt, as some of the most knowing bleachers think, they can be freed from it in an easy manner. Let a lixive of kelp-ashes be made with cold water, for that does not extract so much of the sulphur; it must stand but for a short time, for these salts dissolve easily; decant it, and evaporate the ley. As the boiling continues, the sea-salt will crystallize. When that is all separated, the remaining ley will contain alkaline salt with some sulphur. This operation every master of a bleachfield may learn and oversee, without taking up much of his time. A similar process is carried on by common servants in the alum-works, who have by practice learned it from others.

"I had some hopes that the sulphur might be carried off by long roasting, such as these salts undergo before they are fused in order to be turned into glass; because I had observed, that the longer time they were kept in the fire, the freer were they from this sulphureous part.

"I ordered a quantity of kelp-ashes to be kept in the furnace of a glasshouse, where the heat was just below the vitrifying point, for 24 hours. During this time they had lost almost four-fifths of their weight. They were now much freer from their sulphur, and were of a light colour; but much of the alkaline salt had been driven off with the oils. If a ley is much impregnated with this sulphureous matter, it appears to be carried off in a great measure by long boiling.

"We come now to explain the method of manufacturing the white Muscovy ashes. We have shown, by undoubted experiments, that the greatest part of these ashes consists of lime; and yet we have several acts of parliament which forbid the use of that material under severe penalties. The parliament were in the right to discharge its use, upon the disadvantageous reports which were made to them. We shall immediately see how dangerous a material it is when used improperly, or without the mixture of alkaline salts, which render it safe, and more soluble in water. But I will venture to say, that experiment will not support the prejudice entertained with regard to it, if carried any further.

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"Since bleaching, then, cannot be carried on without it (for those ashes which contain it are quite necessary in that operation), and since we import them from foreign countries, let these prejudices against it cease, and let us only consider how we may render our own lime as safe as the foreign. If we can do that, the wisdom of the legislature will be as ready to abrogate these acts as they were to make them.

"By my experiments on the white Muscovy ashes, I got about the eighth part of alkaline salts from them. This made me expect, that, by mixing in the same proportion quicklime and alkaline salts, I should be able to produce Muscovy ashes.

"To an ounce of quicklime and a dram of white pearl-ashes, I added about a gill of water, and boiled them together till the water was all evaporated. The taste of this substance was little different from lime. To recover the salts again from the lime, I dissolved it in water, strained off the liquor, and evaporated it. Instead of the dram of salts, I had but two grains of a substance which was more earthy than saline.

"To 3 drams of quicklime, and as much potashes, I added a mutchkin of water, and kept it boiling for two hours till it was evaporated. I dissolved it again in water, which being filtered and evaporated, gave me $1\frac{1}{2}$ dram of a caustic salt, that liquefied in the air when it had been but four minutes from the fire. It appears, then, that the alkaline salts are destroyed by lime, and that a great part of them can never be again recovered. From the remaining lime, after the salts were extracted, I got strong lime-water, but without a pellicle. This shows, that a quantity of alkaline salts, equal to the lime, boiled with it for two hours, are not able to fix all the soluble part of the lime.

"From these experiments we may draw some corollaries with regard to the present subject. 1st, That evaporating the water from the lime and salts by boiling, is a most unfrugal way of preparing these white ashes. 2dly, That these ashes ought to be kept close shut up in casks; for if exposed to the open air, though in a room, the alternate moisture and drought must fix their most useful parts. This I have found to be fact: for the salts that I made became less pungent by keeping; and I have observed, that the surface of the Muscovy ashes lost all pungency by being exposed to the air, while their internal parts still retained it. 3dly, That all boiling is prejudicial to these Muscovy ashes, as it fixes, and that quickly, their most subtile and probably their most serviceable parts.

"Let us now proceed to another method of making these white ashes. I imagined, that if the salts were dissolved in water, and the quicklime slaked with that, the mass would soon dry without the assistance of fire. In this way I added equal parts of both; but the composition was so strong, that it blistered my tongue if it but touched it. When the fourth part was alkaline salt, it blistered my tongue when kept to it a few seconds. I could taste the salts plainly in the composition, when they made but the thirty-second part of the whole.

"I thought, when composed with the eighteenth part of salt, it had, when fresh made, just the taste and look of the Muscovy ashes; nor could any person have distinguished them. This I once imagined was the proportion; but when I found that the saline pungency soon turned weaker by keeping, and that this composition would not afford the same quantity of salts that the Muscovy ashes did, I saw that a much greater quantity of salts was necessary. The proportion appears to be one of salts to four of lime, prepared in this last way. Three drams of ashes prepared in this way, and kept for a fortnight, gave me but 15 grains of salt; which is but the half of what the Muscovy would have afforded. I find, if the quicklime is first quenched, it does not fix the salts so much; and therefore is better and cheaper. One dram of potashes dissolved in a little water, and added to three drams of quenched lime, gave me 44 grains of a very caustic salt. I prefer this method as the best.

"The manufacturers of this salt probably pour the lixive upon the lime, as they can know by its specific gravity what quantity of salts is in the water, and so save themselves the expence of procuring the salts in a dry form.

"The manufacture of the Marcoft and Cashub ashes remains yet to be explained. We have discovered that both of them contained sulphur, earth, alkaline salts, and lime; and differ in nothing but in the Cashub's having more sulphur than the Marcoft ashes. We shall therefore consider them together.

"Whether these two species of ashes are of any use in bleaching, may be, and has already been, disputed. I find they contain no other principles, the sulphureous part excepted, than the former ashes combined together. Why then should we expect any other effects from the same ingredients in the Marcoft and Cashub ashes, than what we have from either of the pearl and Muscovy ashes mixed together? The sulphureous principle in the former must have very bad effects; as I find by experiment, that it leaves a yellowness on cloth that is very hard to be washed out. It is owing to this sulphureous principle that linen, after it has been washed with soap, and is pretty well advanced in whiteness, is apt to be discoloured by ley which is brought to boil: for, by boiling, the sulphureous part is extracted from the ashes, and the ley becomes of a deep brown colour. Daily practice, then, shows the disadvantage of this sulphureous principle. Besides, as sulphur unites itself quickly and firmly with alkaline salts, it must weaken or altogether destroy a great quantity of these in the Marcoft and Cashub ashes, and so render them of no effect in bleaching. These two reasons seem to me sufficient to exclude them from the bleachfield; especially as, by increasing the other materials, we can attain perhaps more speedily the same ends.

"However, as custom has introduced them into general practice, we shall consider how they are to be manufactured. Dr Mitchell has, in a very ingenious and useful paper, contained in the Philosophical Transactions for the year 1748, delivered an account transmitted to him by Linnæus of the method of making potashes in Sweden. This account was contained in an academical dissertation of one Lundmark upon this subject at Aboe in Sweden. The substance of this account is, 'That birch or alder is burnt by a slow fire to ashes, and made into a paste with water. This paste is plastered over a row of green pine or fir logs. Above that is laid transversely another row of the same; and that likewise is plastered over. In this way they continue building and plastering till the pile be of a considerable height. This pile is set on fire; and whenever the ashes begin to run, it is overturned, and the melted ashes are beat with flexible sticks, so that the ashes incrust the logs of wood, and become as hard as stone.' This, in the Doctor's opinion, is the method of making the potashes that come from Sweden, Russia, and Dantzic: and that there is no other difference bewixt the ashes made in those different countries, but that the Russian, containing more salt, must be made into a paste with a strong ley.

"There would appear, by my experiments, a greater difference than this betwixt the Swedish ashes, if that is the true process, and those I have examined. I had discovered the greatest part of the Muscovy ashes to be lime. I suspected it might enter into the composition of the Marcoft and Cashub; and have accordingly discovered it there. Without the same grounds, none would ever have searched for it. Whence then comes this lime? It must either enter into its composition, or arise from the materials managed according as the process directs.

"I have tried the birch ashes made into a paste with water. I have tried common charcoal made into a paste with a third part of potashes, and kept them in a strong reverberatory heat for some hours, and yet no such caustic substance appeared. I have kept earth and salts of kelp ashes fused together for 24 hours in the furnace of a glasshouse, where the heat was just below the degree of vitrification; and yet no remarkable causticity appeared afterwards in the concreted mass. But supposing that there did, will ever this account for the generation of lime? These chemists do not assert that it is a calcareous causticity. The earth of vegetables kept in fusion with their salts, is so far from turning into a quicklime, that the mass takes the opposite course, and becomes glass. Bodies that, by the laws of nature, are vitrescible, can never, so far as we know, become calcareous. In one or other of these two substances all bodies terminate that are changeable by fire; and vegetables are of the former kind. Here it may be asked, Why then, since they endure such a fire, are they not vitrified? the objection would be just, did they contain nothing else but what was found in vegatables. But if we once allow that lime is one of the materials, the difficulty is easily solved: for lime, we know, in proportion as it is mixed, hinders the vitrification of all bodies. In effect, the earthy part in these ashes is almost vitrified: and I think that I have carried the vitrification yet farther in that part; but I never was able, with the utmost heat of a reverberatory furnace, continued for six hours, to produce any thing like a thorough vitrification in these ashes. The heat of the fire used in the process would seem to be very great; and must, if it were not very difficult, reduce them to glass. The invitrescible nature of these salts, so far from being an objection, becomes a strong proof of my opinion.

"These salts have a remarkable pungency. This we have already seen is the natural effect of quicklime on salts.

"These salts are found to be the fittest for making soap, and to incorporate soonest and best with oils.

Salts,

Salts, we know, of themselves do not readily unite with oil; but when once mixed with quicklime, they have a greater tendency to union.

"Again, I find that these ashes are more easily fluxed than charcoal made into a paste with the third part salt; which is much more than the ashes contain. Now, it is observed that quicklime increases the fluxing power of alkaline salts; for the common caustic made of quicklime and alkaline salts is sooner fused than the latter alone.

"From these reasons, and the experiments that discover lime in these ashes, I am led to think, that it is not generated by the process, but mixed with the ashes when they are made into a paste. The following experiment is a convincing proof of what I have been endeavouring to make out.

"I boiled some pease straw in a strong ley of pearl-ashes burnt into a black coal, and made it into a paste with water. Another quantity of straw was boiled in a ley made of one part of quicklime and four parts of pearl salts, the ley being poured off turbid from the lime. This straw was likewise burnt when dry, and made into a paste. These two substances were put into separate crucibles, and fluxed in a reverberatory furnace. The latter appeared to resemble the Marcoft and Cashub ashes more than the former, which seemed to want their pungency."

12
Potashes and pearl-ashes obtained from neutral salts.

Though the only method of preparing the alkaline salt originally is by the combustion of vegetables, yet there are some neutral salts from which if it were possible to expel the acid, we should have it in our power to procure the finest pearl-ashes in vast quantity. These are vitriolated tartar, nitre, &c. But there are objections to all those. The vitriolated tartar, or any other salt in which the vitriolic acid enters, cannot be decomposed without converting the acid into sulphur by charcoal dust; in which case it is as difficult to get free of the sulphur as of the acid. With respect to nitre, though its acid may be expelled by fire, yet it is too high-priced, and too much used in other manufactures, to be thought of for this purpose.

POTATO. See SOLANUM, BOTANY *Index*.

Potatoes, it is generally thought, came originally from North America, where they were not reckoned good for food. They were first (we are told) introduced into Ireland in the year 1565, and from thence into England by a vessel wrecked on the western coast, called *North Meols*, in Lancashire, a place and soil even now famous for producing this vegetable in great perfection. It was 40 years after their introduction, however, before they were much cultivated about London; and then they were considered as rarities, without any conception of the utility that might arise from bringing them into common use. At this time they were distinguished from the Spanish by the name of *Virginia potatoes* or *battatas*, which is the Indian name of the Spanish sort. At a meeting of the Royal Society, March 18. 1662-3, a letter was read from Mr Buckland, a Somerset gentleman, recommending the planting of potatoes in all parts of the kingdom to prevent famine. This was referred to a committee; and, in consequence of their report, Mr Buckland had the thanks of the society, such members as had lands were intreated to plant them, and Mr Evelyn was desired to mention the proposals at the close of his Sylva.

In Sweden, notwithstanding the indefatigable industry of Linnæus, the culture of potatoes was only introduced in 1764, when a royal edict was published to encourage their general cultivation. They were known there, however, at an earlier period; for in the Memoirs of the Royal Academy of Sciences in Sweden, 1747, M. Charles Skytse proposed to distil brandy from them, in order to save corn, which in that country is very dear. He found by experience, that an acre of land set with potatoes will yield a much greater quantity of brandy than when sown with barley. For a full account of the methods of cultivating and preserving this valuable root, see AGRICULTURE *Index*.

We have already mentioned a cheap preparation by means of potatoes for the poor, see AGRICULTURE, N° 288.; we shall here introduce a receipt to make a potato harrico, which may be equally useful to those whose circumstances are not such as to make them regardless of economy. We take it from the Gentleman's Magazine, and give it in the words of a person who had made the experiment.

"Scrape the skin clean off four pounds of good raw potatoes, then wash them clean in fair water: take two pounds of beef, one of mutton, and one of pork; or, as you like best, four pounds of any of these meats; cut them into pieces of three or four ounces each, season them very well with pepper and salt and a good onion chopped very small: have ready a strong wide-mouthed stone-jar, such as hares are usually jugged in; slice thin a layer of the potatoes into the jar, then a layer of the seasoned meat over them, and so alternately layers of potatoes and meat; let your uppermost layer be potatoes, so that your jar be about three quarters full, but put no water into your jar; then close or stop the mouth of it with a large well-fitted piece of cork, covering the same with a strong piece of canvas, and tying it down with packthread, so as only a little of the steam may escape in the stewing; for a little should constantly evaporate from the side of the cork to save the jar from bursting. Then place your jar upright in a kettle of cold water on the fire, so as the mouth of the jar may be always two inches above the water in the kettle when boiling. The harrico in the jar will begin to boil some minutes sooner than the water in the kettle, and that for obvious reasons. In about an hour after the water in the kettle begins to boil, your harrico will be fully stewed. Then take out and open the jar, pour out the harrico into a deep dish, and serve it up.

"This excellent, wholesome, and economical dish supplies an agreeable dinner twice a week to a family consisting of three grown people, and three children under 14 years of age, where neither health nor good stomachs are wanting, thanks to God: and, in point of economy, we must observe, that here is the whole article of butter saved, as also the whole article of bread, or nearly so; nor does there require so large or so continued a fire, nor so much time or trouble as is necessary for the dressing of many other dishes that by no means deserve the preference to this excellent harrico.

"We have also (by way of change) made it with powdered beef, sometimes with powdered pork, sometimes with half fresh beef or mutton and half pickled pork, and found it good in all these ways, particularly with three pounds of fresh beef and one of pickled pork. We have left off sending pies and stews to the bakers. We sometimes (in a larger kettle) boil a small piece of powdered beef along-side of the jar, by continuing the boiling an hour and a half longer, and this serves us to eat cold the next day, with hot garden-stuff or a pudding."

Potato-Bread. See Bread *of Potatoes*.

Spanish Potato. See Convolvuvus, Botany *Index*.

POTENT, or Potence, in *Heraldry*, a term for a kind of cross, whose ends all terminate like the head of a crutch. It is otherwise called the *Jerusalem cross*, See Heraldry.

POTENTIA (power), that whereby a thing is capable either of acting or being acted upon.

POTENTIAL, in the schools, is used to denote and distinguish a kind of qualities, which are supposed to exist in the body *in potentia* only; by which they are capable in some measure of affecting and impressing on us the ideas of such qualities, though not actually inherent in themselves; in which sense we say, potential heat, potential cold, &c.

Potential Cautery, in *Medicine*, denotes the consuming, or reducing to an eschar, any part of the human body by a caustic alkaline or metallic salt, &c. instead of a red-hot iron, which last is called the *actual cautery*.

Potential, in *Grammar*, an epithet applied to one of the moods of verbs. The potential is the same in form with the subjunctive, and is, according to Ruddiman, implied in that mood, for which reason that grammarian rejects it; but others will have it to differ from the subjunctive in this, that it always implies in it either *possum*, *volo*, or *debeo*. It is sometimes called the *permissive mood*, because it often implies a permission or concession to do a thing. See Grammar.

POTENTILLA, Silver-weed, *Wild Tansey*, or *Cinquefoil*; a genus of plants belonging to the icosandria class; and in the natural method ranking under the 35th order, *Senticosæ*. See Botany *Index*.

POTERIUM, Garden Burnet; a genus of plants belonging to the monœcia class; and in the natural method ranking under the 54th order, *Miscellaneæ*. See Botany *Index*.

POTHOS, a genus of plants belonging to the gynandria class. See Botany *Index*.

POTION, a liquid medicine, consisting of as much as can be drunk at one draught.

POTIPHAR, or Putiphar, an officer of the court of Pharaoh king of Egypt, and general of his troops, according to our translation, Le Clerc, and the version of the vulgate; but according to the Hebrew and Septuagint, the chief of his butchers or cooks. The Hebrew text, the Septuagint, and vulgate, call him Eunuch. But it is probable it in this place means only an officer of the king's court, for he was certainly married and had children. We have no other accounts of him but what appears in scripture; and that account is too generally known to require to be enlarged on in this place. See Genesis xxxviii. xxxix, &c.

POTOSI, a city of Peru in South America, situated at the bottom of a mountain of that name, in which is the richest silver mine ever discovered. To give an idea of its richness, we shall mention its produce at different times. Exclusive of what was not registered, says Abbé Raynal, and was smuggled away, the fifth part belonging to the government from 1545 to 1564, amounted to 36,450,000 livres § per annum. But this abundance of metals soon decreased. From 1564 to 1585, the annual fifth part amounted to no more than 15,187,489 livres four sols †. From 1585 to 1624, it amounted to 12,149,994 livres 12 sols ‡. From 1624 to 1633, to 6,074,997 livres six sols ||. From this last period, the produce of these mines hath so evidently decreased, that in 1763 the fifth part, belonging to the king, did not exceed 1,364,682 livres 12 sols §. Situated in W. Long. 67. S. Lat. 22. See Peru.

§ 1,518,750l

† 632,811l. 1s.

‡ 506,249l. 15s. 6d.

|| 253,124l. 17s. 9d.

§ 56,861l. 15s. 9d.

POTSDAM, or Postdam, a town of Germany, in the circle of Upper Saxony, with a palace, belonging to the king of Prussia. It is seated in an island 10 miles in circumference, formed by the rivers Sprae and Havel. The palace is finely built, delightfully situated on a spot 12 miles west of Berlin. E. Long. 13. 42. N. Lat. 52. 34. Riesbeck in his Travels informs us, that the houses in Potsdam are still finer than those of Berlin; but like them they are inhabited only by persons of the lower and middling ranks. The population of Potsdam is stated at 26,000.

POTT, Percival, was born in London in 1713. He received the first rudiments of his education at a private school at Darne in Kent; and became an apprentice to Mr Nourse, one of the surgeons of St Bartholomew's hospital; of which hospital, in 1744-5, he was elected an assistant surgeon, and in 1749 appointed one of the principal surgeons. In 1746, he married the daughter of Robert Cruttenden, Esq. His first publication is said to have been planned in 1756, during his confinement in consequence of a compound fracture of the leg: from that time, his pen was seldom long unemployed. His practice and his reputation were now rapidly increasing: in 1764, he was elected a fellow of the Royal Society; and afterwards was complimented with honorary diplomas from the Royal Colleges of Surgeons at Edinburgh and in Ireland. In 1787, he resigned the office of surgeon to St Bartholomew's hospital, "after having served it (as he used to say), man and boy, half a century;" and on the 22d of December 1788, after an illness of eight days, he expired.

"The labours of the greatest part of his life (says Mr Earle, who published his Chirurgical works), were without relaxation; an increasing family required his utmost exertion: of late years he had a villa at Neasden; and in the autumn usually passed a month at Bath or at the sea-side. Thus, though he gathered, as he expressed it, some of the fruit of the garden which he had planted as he went along, and always lived in a generous and hospitable manner, at the same time bestowing on four sons and four daughters a liberal and necessarily expensive education, and applying large sums to their establishment during his lifetime, he left an ample provision for them at his decease. Among his papers was found, what he had often mentioned, a small box, containing a few pieces of money, being the whole which he ever received from the wreck of his father's fortune. With this was deposited an exact account of every individual fee which a long life of business had produced—abundant evidence of well spent time, and the industrious application of abilities, to which the *res angusta domi*, at the commencement, probably acted more powerfully as an incentive than as an obstacle."

POTTER, Christopher, a learned English divine, was born in 1591, and bred at Oxford. In 1633, he published

published his "Answer to a late Popish Plot," entitled *Charity mistaken*, which he wrote by special order of King Charles I. whose chaplain he was. In 1634, he was promoted to the deanery of Worcester; and, in 1640, was constituted vice-chancellor of the university of Oxford, in the execution of which office he met with some trouble from the members of the long parliament. Upon the breaking out of the civil wars, he sent all his plate to the king, declaring, "that he would rather, like Diogenes, drink in the hollow of his hand, than that his majesty should want;" and he afterwards suffered much for the royal cause. In consideration of this he was nominated to the deanery of Durham in 1646, but was prevented from being installed by his death, which happened about two months after. He was a person learned and religious, exemplary in his conversation, courteous in his carriage, of a sweet and obliging nature, and of a comely presence. He was remarkable in his charity to the poor.

POTTER, *Dr John*, archbishop of Canterbury, was the son of a linen-draper at Wakefield in Yorkshire, where he was born about the year 1674. He studied at University college, Oxford; and at 19 published *Variantes lectiones et notæ ad Plutarchi librum de audiendis poetis; et ad Basilii magni orationem ad juvenes, quomodo cum fructu legere possint Græcorum libros*, 8vo, 1693. In 1697, came out his edition of *Lycophron*, in folio; which is reckoned the best of that obscure writer: soon after, he published his antiquities of Greece, 2 vols. 8vo. These works established his literary reputation, and engaged him in a correspondence with Grævius and other learned foreigners. In 1706, he was made chaplain to the queen; in 1715, bishop of Oxford; and in 1737, he succeeded Archbishop Wake in the see of Canterbury; which high station he supported with much dignity until his death in 1747. He was a learned and exemplary churchman; but not of an amiable disposition, being but too strongly tinctured with the pride of office; nor is it to his credit that he disinherited his eldest son for marrying below his rank in life. His "Theological works, containing sermons, charges, discourses on church-government, and divinity lectures," were printed at Oxford, in 3 vols. 8vo, 1753.

POTTERY, the manufacture of earthen-ware, or the art of making earthen vessels. See *Delft-Ware*, and Porcelain.

POTTLE, an English measure containing two quarts.

POVERTY signifies indigence or want of riches, and has been the lot of a large portion of men in every age. Whether, on the whole, it has been productive of good or bad consequences, has been disputed. In a moral view, perhaps it has been, on the whole, useful, as adversity is in general more conducive to virtue than prosperity, which too often leads to luxury and vice.—Sometimes, however, poverty has had a baneful effect upon the mind, and has prompted men to commit very inhuman actions; but this in civilized communities very seldom occurs. In a political view, poverty is thought by some to be hurtful: Raynal thinks it is a check to population (see his History, vol. vi. p. 471.); and Dr Smith so far agrees with him; for though he asserts, and indeed proves, that poverty is no check to the production of children, he allows it to be very unfavourable to raising them. See Political Economy; and also Smith's Wealth of Nations, vol. i. p. 119, &c. See also Poor.

POULADUFF, two large and remarkable cavities, about a mile west of Ross, in the county of Cork, and province of Munster, in Ireland, 80 yards deep, in which the sea flows by subterraneous passages. They are called East and West *Pouladuff*.

POULES or Foulques, one of the chief nations on the banks of the Senegal. Their country extends more than 180 miles along the river, and they demand exorbitant customs from the Senegal traders with the interior of the country. They are of a copper colour, somewhat inclining to red, although their children, who reside for some years at Senegal, become much blacker. Their females are handsome, and many of them are procured by the white people of Senegal. They are, however, incapable of attachment, and their dispositions are bad, requiring to be narrowly watched to prevent their infidelity: The dread of the bastinado will often effect what attention and compliance can never bring about.

Although the Poules inhabit one of the finest spots in Africa, they are nevertheless a wretched people; they are base, cruel, thievish, and fanatic in the extreme. They are commanded by a chief of their religion, which is a contemptible mixture of Mahometanism and idolatry. This chief is called the *Almamy;* he is always chosen from among the tampsirs, who are 12 in number. The tampsirs are the interpreters of the law, and are the most learned, or rather the most fanatical among them. The almamy has the power of life and death over his subjects; yet he may be deposed by an assembly of tampsirs: it is therefore his interest to keep on good terms with them. The payment of customs is made to the almamy, and is afterwards distributed among the tampsirs; and although a part belongs to the former, he nevertheless requires a separate present for himself.

POULTICE, a sort of medicine, called also a *cataplasm*. See Cataplasma.

POULTRY, all kinds of domestic birds brought up in yards, as cocks, hens, capons, ducks, turkeys, &c.

Almost, if not all the domestic birds of the poultry kind that we maintain in our yards are of foreign extraction: but there are others to be ranked in this class that are as yet in a state of nature, and perhaps only wait till they become sufficiently scarce to be taken under the care of man to multiply their propagation. It will appear remarkable enough, if we consider how much the tame poultry which we have imported from distant climates has increased, and how much those wild birds of the poultry kind that have never yet been taken into keeping have been diminished and destroyed. They are all thinned; and many of the species, especially in the more cultivated and populous parts of the kingdom, are utterly unseen.

Under birds of the poultry kind may be ranked all those that have white flesh, and, comparatively to their heads and limbs, have bulky bodies. They are furnished with short strong bills for picking up grain, which is their chief and often their only sustenance. Their wings are short and concave; for which reason they are not able to fly far. They lay a great many eggs; and as they lead their young abroad, the very day they are hatched, in quest of food, which they are shown by the mother, and which they pick up for themselves, they generally make their nests on the ground. The toes of all these are united by a membrane as far as the first articulation, and are then divided.

Under this class we may therefore render the common cock, the peacock, the turkey, the pintada or Guinea hen, the pheasant, the bustard, the grous, the partridge, and the quail. They all bear a strong similitude to each other, being equally granivorous, fleshy, and delicate to the palate. They are among birds what beasts of pasture are among quadrupeds, peaceable tenants of the field, and shunning the thicker parts of the forest, that abound with numerous animals who carry on unceasing hostilities against them.

As nature has formed the rapacious class for war, so she seems equally to have fitted these for peace, rest, and society. Their wings are but short, so that they are ill formed for wandering from one region to another: their bills are also short, and incapable of annoying their opposers: their legs are strong indeed; but their toes are made for scratching up their food, and not for holding or tearing it. These are sufficient indications of their harmless nature; while their bodies, which are fat and fleshy, render them unwieldy travellers, and incapable of straying far from each other.

Accordingly, we find them chiefly in society: they live together: and though they may have their disputes, like all other animals, upon some occasions; yet, when kept in the same district, or fed in the same yard, they learn the art of subordination; and, in proportion as each knows his strength, he seldom tries a second time the combat where he has once been worsted.

In this manner, all of this kind seem to lead an indolent voluptuous life. As they are furnished internally with a very strong stomach, commonly called a *gizzard*, so their voraciousness scarce knows any bounds. If kept in close captivity, and separated from all their former companions, they have still the pleasure of eating left; and they soon grow fat and unwieldy in their prison. To say this more simply, many of the wilder species of birds, when cooped or caged, pine away, grow gloomy, and some refuse all sustenance whatever; none except those of the poultry kind grow fat, who seem to lose all remembrance of their former liberty, satisfied with indolence and plenty.

The following method of raising poultry has been successfully practised by Mrs d'Oyley of Sion Hill near Northallerton, and seems worthy of being noticed. We shall extract the account of it, as it was given to the Society for the Encouragement of Arts, &c. in her own words, "I keep," says she, "a large stock of poultry, which are regularly fed in a morning upon steamed potatoes chopped small, and at noon they have barley; they are in high condition, tractable, and lay a very great quantity of eggs. In the poultry-yard is a small building, similar to a pigeon cote, for the hens to lay in, with frames covered with net to slide before each nest: the house is dry, light, and well ventilated, kept free from dirt by having the nests and walls white-washed two or three times a-year, and the floor covered once a-week with fresh ashes. When I wish to procure chickens, I take the opportunity of setting many hens together, confining each to her respective nest; a boy attends morning and evening to let any off that appear restless, and to see that they return to their proper places: when they hatch, the chickens are taken away, and a second lot of eggs allowed them to set again, by which means they produce as numerous a brood as before. I put the chickens into long wicker cages, placed against a hot wall at the back of the kitchen fire, and within them have artificial mothers for the chickens to run under; they are made similar to those described by M. Reaumur, in his *Art de faire éclorre et d'élever en toutes Saisons des Oiseaux domestiques de toutes Espèces*, &c. in two volumes, printed at Paris, 1751: they are made of boards about 10 inches broad, and 15 inches long, supported by two feet in the front four inches in height, and by a board at the back two inches in height. The roof and back are lined with lambs skins dressed with the wool upon them. The roof is thickly perforated with holes for the heated air to escape; they are formed without bottoms, and have a flannel curtain in front and at the ends for the chickens to run under, which they do apparently by instinct. The cages are kept perfectly dry and clean with sand or moss. The above is a proper size for 50 or 60 new hatched chickens, but as they increase in size they of course require a larger mother. When they are a week old, and the weather fine, the boy carries them and their artificial mother to the grass-plot, nourishes and keeps them warm, by placing a long narrow tin vessel filled with hot water at the back of the mother, which will retain its heat for three hours, and is then renewed fresh from the steamer. In the evening they are driven into their cages, and resume their station at the hot wall, till they are nearly three weeks old, and able to go into a small room appropriated to that purpose. The room is furnished with frames similar to the artificial mothers, placed round the floor, and with perches conveniently arranged for them to roost upon.

"When I first attempted to bring up poultry in the above way, I lost immense numbers by too great heat and suffocation, owing to the roofs of the mothers not being sufficiently ventilated; and when that evil was remedied, I had another serious one to encounter: I found chickens brought up in this way did not thrive upon the food I gave them, and many of them died, till I thought of getting coarse barley-meal, and steaming it till quite soft: the boy feeds them with this and minced potatoes alternately; he is also employed rolling up pellets of dough, made of coarse wheat flour, which he throws to excite them to eat, thereby causing them to grow surprisingly.

"I was making the above experiments in the summer for about two months; and during that time my hens produced me upwards of 500 chickens, 400 of which I reared fit for the table or market. I used a great many made into pies for the family, and found them cheaper than butcher's meat. Were I situated in the neighbourhood of London, or any very populous place, I am confident I could make an immense profit, by rearing different kinds of poultry in the above method for the markets, and selling them on an average at the price of butcher's meat.

"A young person of 12 or 14 years of age might bring up in a season some thousands, and by adopting a fence similar to the improved sheep-fold, almost any number might be cheaply reared, and with little trouble. Hens kept as mine are, and having the same conveniences, will readily set four times a season, and by setting twice each time, they would produce at the lowest calculation eighty chickens each, which would soon make them very plentiful.

"The most convenient size of an artificial mother," continues the author, "for 40 or 50 young chickens, is about 15 inches long, 10 deep, four high in front, and two at the back; it is placed in a long wicker cage against a warm wall, the heat at about 80 degrees Fahrenheit's thermometer, till the chickens are a few days old, and used to the comfort of it; after which time they run under when they want rest, and acquire warmth by crowding together. I find it advisable to have two or three chickens among them of about a week old to teach them to peck and eat. The meat and water is given them in small troughs fixed to the outside of the cage, and a little is strewed along from the artificial mother, as a train to the main deposit. It would have given me great pleasure to have been able to send a specimen of my superior feed and management, if the season had been rather more advanced, for I think it is not possible for turkeys and chickens to weigh heavier, be whiter, or altogether better fed than mine are.

"After a certain age, they are allowed their liberty, living chiefly on steamed potatoes; and being situated tolerably secure from the depredations of men and foxes, are permitted to roost in trees near the house.

"To prevent trouble and prejudice in the first outset, I think it necessary to remark, that if the chickens do not readily run after the artificial mother for want of some educated ones to teach them, it will be proper to have the curtain in front made of rabbit or hare skin, with the fur side outwards, for the warmth and comfort to attract them; afterwards they run under the flannel ones, similar to the one I sent, which are preferable for common use, on account of cleanliness, and not being liable to get into the mouths of the chickens *".

* *Trans. of the Society*, &c. for 1807.

POUNCE, gum sandarach pounded and sifted very fine, to rub on paper, in order to preserve it from sinking, and to make it more fit to write upon.

POUNCE, is also a little heap of charcoal dust, inclosed in a piece of muslin or some other open stuff, to be passed over holes pricked in a work, in order to mark the lines or designs thereof on paper, silk, &c. placed underneath; which are to be afterwards finished with a pen and ink, a needle, or the like. This kind of pounce is much used by embroiderers, to transfer their patterns upon stuffs; by lace-makers, and sometimes also by engravers.

POUNCES, in falconry, the talons or claws of a bird of prey.

POUND, a standard weight; for the proportion and subdivisions of which, see the article WEIGHT.

POUND also denotes a money of account; so called, because the ancient pound of silver weighed a pound troy.

POUND, among lawyers, denotes a place of strength, in which to keep cattle that are distrained or put in for trespass, until they are replevied or redeemed.

POUNDAGE, a subsidy of 12d. in the pound, granted to the crown on all goods and merchandises exported or imported; and if by aliens, one penny more.

POURPRESTURE, in *Law*, is a wrongful inclosure, or incroachment upon another person's property.

POURSUIVANT, or PURSUIVANT, in *Heraldry*, the lowest order of officers at arms.—They are properly attendants on the heralds when they marshal public ceremonies. Of these in England there were formerly many; but at present there are only four, viz. bluemantle, rouge-cross, rouge-dragon, and port-cullice. In Scotland there is only one king at arms, who is styled *Lyon*; and has under him no less than six heralds, as many pursuivants, and a great many messengers at arms. See LYON.

POURVEYANCE, or PURVEYANCE, in *Law*, the providing corn, fuel, victuals, &c. for the king's household; and hence the officer who did so was termed *pourveyor*. As several offences were committed by these officers, it was enacted by stat. 12. Car. II. that no person, under colour of pourveyance, shall take any timber, cattle, corn, &c. from any subject without his free consent, or without a just appraisement and paying for the same

POUSSIN, NICHOLAS, an eminent French painter, born in 1594, at Andel, a little city in Normandy, where his father was of noble extraction, but born to a small estate. He was instructed for a few months by one Ferdinand Elle, a portrait-painter, and afterwards spent a month with L'Allemant; but finding these artists not likely to improve him suitably to his desires, he first studied the paintings of the best masters, and then hastened to finish a few pieces he was engaged in, and travelled to Italy. Here he devoted almost his whole attention to the study of antique statues and bas reliefs; which was probably the cause of his want of knowledge in, and taste for, the art of colouring. Being invited back to Paris by Louis XIII. who assigned him a pension with lodgings in the Thuilleries, he painted for Prince Justiniani an historical picture representing Herod's cruelty; an admirable composition, in which he gave such expresion to every character, as could not fail to strike the beholder with terror and pity: he then laboured for several years on the celebrated pictures of the seven sacraments of the Romish church. But none of Poussin's designs have been more generally admired than that of the death of Germanicus; which would have gained him immortal honour if he had never painted another picture. He began the labours of Hercules in the gallery of the Louvre; but the faction of Vouet's school railing at him and his performances, put him so out of humour with his own country, that he returned to Rome, where he died in 1665. He never went beyond easel-pieces, for which he had a perpetual demand, and his method was to fix the price he expected on the back of the canvas, which was readily paid.

POUSSIN, *Gaspar*. This painter, whose real name was *Dughet*, was born at Paris in 1600; and was induced to travel to Rome, not only from a love to the art of painting, but also to visit his sister, who was married to Nicholas Poussin. Sandrat says that Gaspar was employed at first only to prepare the pallet, pencils, and colours, for Nicholas; but by the precepts and example of that excellent master, gradually rose to the highest reputation, and is undoubtedly one of the best landscape painters that ever appeared. It is generally thought that no painter ever studied nature to better purpose, or represented the effects of land-storms more happily, than Gaspar; all his trees show a natural degree of agitation, every leaf being in motion; his scenes are beautifully chosen, as are the sites of his buildings. He designed human figures but very indifferently; for which reason he frequently prevailed on Nicholas to paint them for him; and they were always introduced with the utmost propriety. While he continued at Rome he dropped his own name, and assumed that of his brother-in-law and benefactor, by which only he is now known. He died in 1662.

POWDER, in *Pharmacy*, a dry medicine well broken, either in a mortar by grinding or by some chemical operation.

*Gun-*POWDER. See GUNPOWDER. See also Observations on Gunpowder in the Irish Transactions 1788, p. 97. class *Science*, by Mr Napier.

POWDER-*Chests*, certain small boxes charged with powder and a quantity of old nails or splinters of iron, and fastened occasionally on the deck and sides of a ship, in order to be discharged on an enemy who attempts to seize her by boarding. These cases are usually from 12 to 18 inches in length, and about eight or ten in breadth, having their outer or upper part terminating in an edge. They are nailed to several places of the quarter-deck and bulk head of the waist, having a train of powder, which communicates with the inner apartments of the ship, so as to be fired at pleasure to annoy the enemy. They are particularly used in merchant-ships which are furnished with close quarters to oppose the boarders.

POWDER-*Magazine*, a bomb-proof arched building, to contain powder in fortified places.

POWDER *for the Hair*. The best sort is starch well pounded and sifted, and generally prepared with some perfume.

James's POWDER. See *JAMES's Powder*. In the Philosophical Transactions for 1791, p. 217. there is a paper by Dr Pearson, containing experiments and observations on James's powder. Dr Pearson says, it was originally a patent medicine; but it is well known that it cannot be prepared by following the directions of the specification in the court of chancery. His observations and experiments, therefore, he thinks, may explain the nature and manner of preparing this medicine, and perhaps may extend the history of antimony. The result of the whole, in Dr Pearson's own words, is as follows:

1. James's powder consists of phosphoric acid, lime, and antimonial calx; with a minute quantity of calx of iron, which is considered to be an accidental substance. 2. Either these three essential ingredients are united with each other, forming a triple compound, or phosphorated lime is combined with the antimonial calx, composing a double compound in the proportion of about 57 parts of calx and 43 parts of phosphorated lime. 3. This antimonial calx is different from any other known calx of antimony in several of its chemical qualities. About three-fourths of it are soluble in marine acid, and afford Algaroth powder, and the remainder is not soluble in this menstruum, and is apparently vitrified. It also appears, that by calcining together bone-ashes, that is, phosphorated lime and antimony in a certain proportion, and afterwards exposing the mixture to a white heat, a compound was formed, consisting of antimonial calx, and phosphorated lime in the same proportion, and possessing the same kind of chemical properties as James's powder.

POWDIKE, in the fens of Norfolk and Ely. By stat. 22 Hen. VIII. c. 11. perversely to cut down and destroy the powdike in the fens of Norfolk and Ely is felony. See *Blackstone's Commentaries*, vol. iv. p. 243.

POWER, has been defined the faculty of doing or suffering any thing. Power, therefore, is two-fold, viz. considered as able to make, or able to receive, any change; the former whereof may be called *active*, and the latter *passive*, *power*: but this distinction is improper. See METAPHYSICS, N° 116.

POWER, in *Mechanics*, denotes any force, whether of a man, a horse, a spring, the wind, water, &c. which, being applied to a machine, tends to produce motion.

POWER, in *Law*, signifies in general a particular authority granted by any person to another to represent him, or to act in his stead.

POWERS, in *Arithmetic* and *Algebra*, are nothing but the products arising from the continual multiplications of a number or quantity into itself. See ALGEBRA and ARITHMETIC.

POX, *French-Pox*, or *Lues Venerea*. See MEDICINE, N° 350.

Small Pox. See INOCULATION, and MEDICINE, N° 222—226.

POYNING'S LAW, an act of parliament made in Ireland under Henry VII. whereby all the statutes of force in England were made of force in Ireland; which before that time they were not.—Nor are any now in force there made in England since that time.

The law took its name from Sir Edward Poyning, lord-lieutenant of that kingdom at the time of its making. See IRELAND, N° 46.

POZZOLANA. See PUZZOLANA.

PRACTICE, in *Arithmetic*. See there, N° 16. &c.

*Gun-*PRACTICE, in military education. In the spring, as soon as the weather permits, the exercise of the great guns begins, with an intention to show the gentlemen cadets at the royal military academy at Woolwich, and private men, the manner of laying, loading, pointing, and firing the guns. Sometimes instruments are used to find the centre line, or two points, one at the breech, the other at the muzzle, which are marked with chalk, and whereby the piece is directed to the target: then a quadrant is put into the mouth to give the gun the required elevation, which at first is guessed at, according to the distance the target is from the piece. When the piece has been fired, it is sponged to clear it from any dust or sparks of fire that might remain in the bore, and loaded: then the centre line is found as before; and if the shot went too high or too low, to the right or to the left, the elevation and trail are altered accordingly. This practice continues morning and evening for about six weeks, more or less according as there are a greater or less number of recruits. In the mean time others are shown the motions of quick-firing with field-pieces.

*Mortar-*PRACTICE, generally thus. A line of 1500 or 2000 yards is measured in an open spot of ground from the place where the mortars stand, and a flag fixed at about 300 or 500 yards: this being done, the ground where the mortars are to be placed is prepared and

Practice, Præmunire. and levelled with sand, so that they may lie at an elevation of 45 degrees; then they are loaded with a small quantity of powder at first, which is increased afterwards by an ounce every time, till they are loaded with a full charge; the times of the flights of the shells are observed, to determine the length of the fuzes. The intention of this practice is, when a mortar battery is raised in a siege, to know what quantity of powder is required to throw the shells into the works at a given distance, and to cut the fuzes of a just length, that the shell may burst as soon as it touches the ground.

PRÆMUNIRE, in *Law*, is taken either for a writ so called, or for the offence whereon the writ is granted; the one may be understood by the other.—The church of Rome, under pretence of her supremacy and the dignity of St Peter's chair, took on her to bestow most of the ecclesiastical livings of any worth in England, by mandates, before they were void; pretending therein great care to see the church provided of a successor before it needed. Whence these mandates or bulls were called *gratiæ expectativæ*, or *provisiones;* whereof see a learned discourse in *Duarenus de beneficiis*, lib. iii. cap. 1. These provisions were so common, that at last Edward I. not digesting so intolerable an encroachment, in the 35th year of his reign made a statute against papal provisions, which, according to Sir Edward Coke, is the foundation of all the subsequent statutes of præmunire: which is ranked as an offence immediately against the king, because every encouragement of the papal power is a diminution of the authority of the crown.

In the weak reign of Edward II. the pope again endeavoured to enroach, but the parliament manfully withstood him; and it was one of the articles charged against that unhappy prince, that he had given allowance to the bulls of the see of Rome. But Edw. III. was of a temper extremely different; and, to remedy these inconveniences, first, by gentle means, he and his nobility wrote an expostulation to the pope: but receiving a menacing and contemptuous answer, withal acquainting him, that the emperor (who a few years before at the diet of Nuremberg, A. D. 1323, had established a law against provisions), and also the king of France, had lately submitted to the holy see; the king replied, that if both the emperor and the French king should take the pope's part, he was ready to give battle to them both, in defence of the liberties of the crown. Hereupon more sharp and penal laws were devised against provisors, which enact severally, that the court of Rome shall present or collate to no bishopric or living in England; and that whoever disturbs any patron in the presentation to a living by virtue of a papal provision, such provisor shall pay fine and ransom to the king at his will, and be imprisoned till he renounces such provision; and the same punishment is inflicted on such as cite the king, or any of his subjects, to answer in the court of Rome. And when the holy see resented these proceedings, and Pope Urban V. attempted to revive the vassalage and annualrent to which King John had subjected his kingdom, it was unanimously agreed by all the estates of the realm in parliament assembled, 40 Edw. III. that King John's donation was null and void, being without the concurrence of parliament, and contrary to his coronation-oath; and all the temporal nobility and commons engaged, that if the pope should endeavour by process or otherwise to maintain these usurpations, they would resist and withstand him with all their power.

In the reign of Richard II. it was found necessary to sharpen and strengthen these laws, and therefore it was enacted by statutes 3 Ric. II. c. 3. and 7 Ric. II. c. 12. first, that no alien shall be capable of letting his benefice to farm; in order to compel such as had crept in, at least to reside on their preferments: and afterwards, that no alien should be capable to be presented to any ecclesiastical preferment, under the penalty of the statutes of provisors. By the statute 12 Ric. II. c. 15. all liegemen of the king accepting of a living by any foreign provision, are put out of the king's protection, and the benefice made void. To which the statute 13 Ric. II. st. 2. c. 2. adds banishment and forfeiture of lands and goods: and by c. 3. of the same statute, any person bringing over any citation or excommunication from beyond sea, on account of the execution of the foregoing statutes of provisors, shall be imprisoned; forfeit his goods and lands, and moreover suffer pain of life and member.

In the writ for the execution of all these statutes, the words *præmunire facias* being used to command a citation of the party, have denominated in common speech, not only the writ, but the offence itself of maintaining the papal power, by the name of *præmunire*. And, accordingly, the next statute we shall mention, which is generally referred to by all subsequent statutes, is usually called the *statute of præmunire*. It is the statute 16 Richard II. c. 5. which enacts, that whoever procures at Rome, or elsewhere, any translations, processes, excommunications, bulls, instruments, or other things which touch the king, against him, his crown, and realm, and all persons aiding and assisting therein, shall be put out of the king's protection, their lands and goods forfeited to the king's use, and they shall be attached by their bodies to answer to the king and his council; or process of *præmunire facias* shall be made out against them as in other cases of provisors.

By the statute 2 Henry IV. c. 3. all persons who accept any provision from the pope, to be exempt from canonical obedience to their proper ordinary, are also subjected to the penalties of præmunire. And this is the last of our ancient statutes touching this offence; the usurped civil power of the bishop of Rome being pretty well broken down by these statutes, as his usurped religious power was in about a century afterwards: the spirit of the nation being so much raised against foreigners, that about this time, in the reign of Hen. V. the alien priories, or abbeys for foreign monks, were suppressed, and their lands given to the crown. And no farther attempts were afterwards made in support of these foreign jurisdictions.

This, then, is the original meaning of the offence which we call *præmunire;* viz. introducing a foreign power into this land, and creating *imperium in imperio*, by paying that obedience to papal process which constitutionally belonged to the king alone, long before the Reformation in the reign of Henry VIII. at which time the penalties of præmunire were indeed extended to more papal abuses than before; as the kingdom then entirely renounced the authority of the see of Rome, though not at all the corrupted doctrines of the Roman church.

Præmunire. church. And therefore, by the several statutes of 24 Hen. VIII. c. 12. and 25 Hen. VIII. c. 19. & 21. to appeal to Rome from any of the king's courts, which (though illegal before) had at times been connived at; to sue to Rome for any license or dispensation, or to obey any process from thence, are made liable to the pains of præmunire. And, in order to restore to the king in effect the nomination of vacant bishoprics, and yet keep up the established forms, it is enacted by statute 25 Hen. VIII. c. 20. that if the dean and chapter refuse to elect the person named by the king, or any archbishop or bishop to confirm or consecrate him, they shall fall within the penalties of the statutes of præmunire. Also by statute 5 Eliz. c. 1. to refuse the oath of supremacy will incur the pains of præmunire; and to defend the pope's jurisdiction in this realm, is a præmunire for the first offence, and high treason for the second. So, too, by statute 13 Eliz. c. 2. to import any *agnus Dei*, crosses, beads, or other superstitious things pretended to be hallowed by the bishop of Rome, and tender the same to be used; or to receive the same with such intent, and not discover the offender; or if a justice of the peace, knowing thereof, shall not within 14 days declare it to a privy-counsellor, they all incur a præmunire. But importing or selling mass-books, or other Popish books, is by stat. 3 Jac. I. c. 5. § 25. only liable to a penalty of 40s. Lastly, to contribute to the maintenance of a Jesuit's college, or any Popish seminary whatever beyond sea, or any person in the same, or to contribute to the maintenance of any Jesuit or Popish priest in England, is by statute 37 Eliz. c. 2. made liable to the penalties of præmunire.

Thus far the penalties of præmunire seem to have kept within the proper bounds of their original institution, the depressing the power of the pope: but they being pains of no considerable consequence, it has been thought fit to apply the same to other heinous offences; some of which bear more, and some less, relation to this original offence, and some no relation at all.

Thus, 1. By the statute 1 and 2 Ph. and Mar. c. 8. to molest the possessors of abbey-lands granted by parliament to Henry VIII. and Edward VI. is a præmunire. 2. So likewise is the offence of acting as a broker or agent in any usurious contract where above 10 per cent. interest is taken, by statute 13 Eliz. c. 10. 3. To obtain any stay of proceedings, other than by arrest of judgment or writ of error, in any suit for a monopoly, is likewise a præmunire, by stat. 21 Jac. I. c. 3. 4. To obtain an exclusive patent for the sole making or importation of gunpowder or arms, or to hinder others from importing them, is also a præmunire by two statutes; the one 16 Car. I. c. 21. the other 1 Jac. II. c. 8. 5. On the abolition, by stat. 12 Car. II. c. 24. of purveyance, and the prerogative of pre-emption, or taking any victual, beasts, or goods for the king's use, at a stated price, without consent of the proprietor, the exertion of any such power for the future was declared to incur the penalties of præmunire. 6. To assert, maliciously and advisedly, by speaking or writing, that both or either house of parliament have a legislative authority without the king, is declared a præmunire by statute 13 Car. II. c. 1. 7. By the *habeas corpus* act also, 31 Car. II. c. 2. it is a præmunire, and incapable of the king's pardon, besides other heavy penalties, to send any subject of this realm a prisoner into parts beyond the seas. 8. By the statute 1 W. & M. st. 1. c. 8. persons of 18 years of age refusing to take the new oaths of allegiance as well as supremacy, upon tender by the proper magistrate, are subject to the penalties of a præmunire; and by statutes 7 & 8 W. III. c. 24. serjeants, counsellors, proctors, attorneys, and all officers of courts, practising without having taken the oaths of allegiance and supremacy, and subscribed the declaration against popery, are guilty of a præmunire whether the oaths be tendered or not. 9. By the statute 6 Ann. c. 7. to assert maliciously and directly, by preaching, teaching, or advised speaking, that the then pretended prince of Wales, or any person other than according to the acts of settlement and union, hath any right to the throne of these kingdoms, or that the king and parliament cannot make laws to limit the descent of the crown; such preaching, teaching, or advised speaking, is a præmunire: as writing, printing, or publishing the same doctrines amounted, we may remember, to high treason. 10. By statute 6 Ann. c. 23. if the assembly of peers of Scotland, convened to elect their 16 representatives in the British parliament, shall presume to treat of any other matter save only the election, they incur the penalties of a præmunire. 11. The stat. 6 Geo. I. c. 18. (enacted in the year after the infamous South Sea project had beggared half the nation) makes all unwarrantable undertakings by unlawful subscriptions, then commonly known by the name of *bubbles*, subject to the penalties of a præmunire. 12. The stat. 12 Geo. III. c. 11. subjects to the penalties of the statute of præmunire all such as knowingly and wilfully solemnize, assist, or are present at, any forbidden marriage of such of the descendants of the body of King Geo. II. as are by that act prohibited to contract matrimony without the consent of the crown.

Having thus inquired into the nature and several species of præmunire, its punishment may be gathered from the foregoing statutes, which are thus shortly summed up by Sir Edward Coke: "That, from the conviction, the defendant shall be out of the king's protection, and his lands and tenements, goods and chattels, forfeited to the king; and that his body shall remain in prison at the king's pleasure, or (as other authorities have it) during life; both which amount to the same thing, as the king by his prerogative may at any time remit the whole, or any part of the punishment, except in the cases of transgressing the statute of *habeas corpus*. These forfeitures here inflicted do not (by the way) bring this offence within our former definition of FELONY; being inflicted by particular statutes, and not by the common law." But so odious, Sir Edward Coke adds, was this offence of præmunire, that a man that was attainted of the same, might have been slain by any other man without danger of law; because it was provided by law, that any man might do to him as to the king's enemy; and any man may lawfully kill an enemy. However, the position itself, that it is at any time lawful to kill an enemy, is by no means tenable: it is only lawful, by the law of nature and nations, to kill him in the heat of battle, or for necessary self-defence. And to obviate such savage and mistaken notions, the statute 5 Eliz. c. 1. provides, that it shall not be lawful to kill any person attainted in a præmunire, any law, statute, opinion, or exposition of law to the contrary notwithstanding. But still such delinquent, though protected as a

part

part of the public from public wrongs, can bring no action for any private injury, how atrocious soever; being so far out of the protection of the law, that it will not guard his civil rights, nor remedy any grievance which he as an individual may suffer. And no man, knowing him to be guilty, can with safety give him comfort, aid, or relief.

PRÆNESTE, in *Ancient Geography*, a town of Latium, to the south-east of Rome, towards the territory of the Æqui; a place of great strength. Famous for the temple and oracle of Fortune, called *Sortes Prænestinæ* (Strabo); which Tiberius wanted to destroy, but was deterred by the awful majesty of the place. From a colony it was raised to a municipium by Tiberius (Inscriptions, Florus, A. Gellius), on the consideration of his recovery from a dangerous illness near this place. Thither the Roman emperors usually retired, on account of the agreeableness of the situation (Suetonius). It was a very ancient city, with a territory of large extent (Livy). The temple of Fortune was built in the most sumptuous manner by Sylla, and the pavement was mosaic work (Pliny). Concerning the Sortes, there is a remarkable passage in Cicero; who says that it was all a mere contrivance, in order to deceive, either for the purposes of gain or superstition. The town that has succeeded it stands low in a valley, and is called *Palestrina*, in the Campania of Rome. E. Long. 13. 30. N. Lat. 42. 0.

PRÆSIDIUM (Notitia), a town of the Cornavii in Britain. Now thought to be Warwick (Camden).—Another of Corsica (Antonine), 30 miles to the south of Aleria.—A third *Præsidium* surnamed *Julium*, in Bætica (Pliny).

PRÆTORIA AUGUSTA (Ptolemy), a town of Dacia. Now called *Brassow* by the natives, and *Cronstat* by the Germans (Baudrand): a town of Transylvania. E. Long. 25°. N. Lat. 47°.—Another of the Salassii, near the two gates or defiles of the Alps, the Grajæ and Penninæ (Pliny); a Roman colony settled by Augustus after the defeat of the Salassii by Terentius Varro, on the spot where he encamped (Strabo, Dio Cassius, Ptolemy), situated on the river Duria Major. The town is now called *Aosta* or *Aoust*, in Piedmont. E. Long. 7. 14. N. Lat. 45. 19.

PRÆTORIUM (Antonine, Notitia Imperii), a town of the Brigantes. Now *Paterington* (Camden), near the mouth of the Humber in Yorkshire. *Coventry* (Talbot).

PRAGMATIC SANCTION, in the civil law, is defined by Hottoman to be a rescript or answer of the sovereign, delivered by advice of his council, to some college, order, or body of people, upon consulting him on some case of their community. The like answer given to any particular person is called simply *rescript*.

The term *pragmatic sanction* is chiefly applied to a settlement of Charles VI, emperor of Germany, who, in the year 1722, having no sons, settled his hereditary dominions on his eldest daughter the archduchess Maria Theresa, which was confirmed by the diet of the empire, and guaranteed by Great Britain, France, the States-General, and most of the powers in Europe. The word *pragmatic* is derived from the Greek πραγμα, *negotium*, "business."—It is sometimes also called absolutely *pragmatic*, το πραγματικον.

PRAGUE, a city of Bohemia, and capital of the whole kingdom, is situated in 14° 40′ of longitude, and 50° 5′ of latitude. It stands on both sides the Moldau, over which there is a bridge 700 feet long, built of large freestone. The river, though of great breadth here, is nevertheless shallow, and not navigable. On both sides of the bridge are several statues, and among others that of St John of Nepomuck, whom King Wenzel caused to be thrown from the bridge into the river, for venturing to reprove him upon some occasion; but in 1720, he was canonized as a saint, and is at present held in such veneration in Bohemia, that all other saints seem on his account to be forgotten. Near the bridge, which stands at the upper part of the city, the number of people is very great, but the farther you go from thence the more desolate you find every place. The city is about three miles long and two broad; the number of its Christian inhabitants is said to be 70,000, and of Jews about 12,000. The principal branch of its trade consists in brewing beer. It is divided into the Old and the New Towns, and that called the *Small side*; the former lying on the east side of the Moldau, and the latter on the west. The whole is about 12 miles in circumference. The fortifications are not of great importance, as it may be flanked and raked on all sides. However, the king of Prussia was not able to make himself master of it in the late war, though he almost destroyed it with his bombs, &c. See PRUSSIA, N° 24, &c.—It has suffered greatly by sieges, and has been often taken and plundered. The university was founded by Charles IV. in the year 1347. In 1409, when John Huss was rector of the university, there were no less than 44,000 students; and when the emperor Charles V. would have retrenched their privileges, 24,000 are said to have left it in one week, and 16,000 in a short time after. The Jews have the trade of this city almost entirely in their own hands. They deal in all sorts of commodities, especially the precious stones found in the Bohemian mines, and, by receiving all old-fashioned things in payment, quite ruin the Christian handicraftsmen. In 1744, they narrowly escaped being expelled the kingdom, having been suspected of corresponding with the Prussians, when they made themselves masters of the city. The grand prior of the order of Malta, for Bohemia, Moravia, and Silesia, resides here; and the church and hospital of the Holy Ghost is the seat of the general and grand masters of the holy order of knights of the cross with the red star, residing in the above mentioned countries, and in Poland and Hungary. The houses of this city are all built of stone, and generally consist of three stories; but there are very few good buildings in it, and almost every thing looks dirty. The cathedral, which is dedicated to St Veit, is an old building, in which there are some pieces of excellent architecture and many magnificent tombs of great men. There are 100 churches and chapels, and about 40 cloisters in the place. On Ratschin-hill, in Upper Prague, most of the nobility have houses, and the emperor a very magnificent palace, and a summer house commanding one of the finest prospects in the world. Here the tribunals of the regency meet; and the halls, galleries, and other apartments, are adorned with a multitude of noble pictures. The great hall, where the coronation feast is kept, is said to be the largest of the kind in Europe next to that of Westminster. The castle stands on the above-mentioned ed mountain, called *Ratschin* or the *White Mountain*, and is very strong. From a window of this castle the emperor's counsellors were thrown in 1618; but though they fell from a great height, yet they were not killed, nor indeed much hurt. On the same mountain stands also the archiepiscopal palace. In the New Town is an arsenal, and a religious foundation for ladies, called the *Free Temporal English Foundation*, over which an abbess presides. In the Lesser Side or Town, the counts Colloredo and Wallenstein have very magnificent palaces and gardens. The stables of the latter are very grand; the racks being of steel and the mangers of marble, and a marble pillar betwixt each horse; over each horse also is placed his picture as big as life. Though the inhabitants of Prague in general are poor, and their shops but meanly furnished, yet, it is said, there are few cities where the nobility and gentry are more wealthy, and live in greater state. Here is much gaming, masquerading, feasting, and very splendid public balls, with an Italian opera, and assemblies in the houses of the quality every night. On the White Mountain, near the town, was fought the battle in which the Protestants, with the elector Palatine Frederic their king, were defeated. The lustres and drinking-glasses made here of Bohemian crystal are much esteemed, and vended all over Europe. These crystals are also polished by the Jews, and set in rings, ear-pendants, and shirt-buttons. The chief tribunal consists of twelve stadtholders, at the head of whom is the great burgrave, governor of the kingdom and city, immediately under the emperor, and the chancery of Bohemia. Though the city of Prague is very ill built, it is pleasantly situated, and some of the prospects are beautiful, and the gardens and pleasure-houses are excellent. The people, Riesbeck informs us, enjoy sensual pleasures more than those of Vienna, because they know better how to connect mental enjoyments with them. The numerous garrison kept in the place (9000 men) contributes much to its gaiety and liveliness.

PRAM, or PRAME, a kind of lighter used in Holland and the ports of the Baltic sea, to carry the cargo of a merchant ship *along side*, in order to lade or to bring it to shore to be lodged in the storehouses after being discharged out of the vessel.

PRAME, in military affairs, a kind of floating battery, being a flat-bottomed vessel, which draws little water, mounts several guns, and is very useful in covering the disembarkation of troops. They are generally made use of in transporting troops over the lakes in America.

PRASIUM, a genus of plants belonging to the didynamia class, and in the natural method ranking under the 42d order, *Verticillatæ*. See BOTANY *Index*.

PRATINAS, a Greek poet contemporary with Æschylus, born at Phlius. He was the first among the Greeks who composed satires, which were represented as farces. Of these 32 were acted, as also 18 of his tragedies, one of which only obtained the poetical prize. Some of his verses are extant, quoted by Athenæus.

PRATIQUE, or PRATTIC, in commerce, a negociation or communication of commerce which a merchant vessel obtains in the port it arrives in and the countries it discovers: hence to obtain a pratique, is to obtain liberty to frequent a port, to go ashore, to buy and sell, &c.

PRATT, CHARLES, earl of Camden, was the third son of Sir John Pratt, knight, chief-justice of the court of king's-bench under George I. by his second wife Elizabeth, daughter of the Reverend Hugh Wilson canon of Bangor, and was born in 1713, the year before his father was called to the honour of the bench. He received the first rudiments of his education at Eton, and afterwards removed to King's college Cambridge. Of his early life at both places there is little known, other than that at college he was found to be remarkably diligent and studious, and particularly so in the history and constitution of this country. By some he was thought to be a little too tenacious of the rights and privileges of the college he belonged to; but perhaps it was to this early tendency that we are indebted for those noble struggles in defence of liberty, which, whether in or out of office, he displayed through the whole course of his political life. After remaining the usual time at college, and taking his master's degree, in 1739 he entered himself a student of the Inner Temple, and was in due time admitted by the honourable society as a barrister at law. And here a circumstance developes itself in the history of this great man, which shows how much chance governs in the affairs of this world, and that the most considerable talent and indisputable integrity will sometimes require the introduction of this mistress of the ceremonies, in order to obtain that which they ought to possess from their own intrinsic qualifications.

Mr Pratt, after his being called to the bar, notwithstanding his family introduction, and his own personal character, was very near nine years in the profession, without ever getting in any degree forward. Whether this arose from a natural timidity of constitution, ill-luck, or perhaps a mixture of despondence growing out of the two circumstances, it is now difficult to tell; but the fact was so; and he was so dispirited by it, that he had some thoughts of relinquishing the profession of the law, and retiring to his college, where, in rotation, he might be sure of a church living, that would give him a small but honourable independence. With these melancholy ideas he went as usual the western circuit, to make one more experiment, and then to take his final determination. Mr Henley, afterwards Lord Northington and chancellor of England, was in the same circuit: he was Mr Pratt's most intimate friend; and he now availed himself of that friendship, and told him his situation, and his intentions of retiring to the university and going into the church. He opposed his intention with strong raillery, and got him engaged in a cause along with himself; and Mr Henley being ill, Mr Pratt took the lead, and displayed a professional knowledge and elocution that excited the admiration of his brother barristers as much as that of the whole court. He gained his cause; and besides, he acquired the reputation of an eloquent, profound, and constitutional lawyer. It was this circumstance, together with the continued good offices of his friend Henley, which led to his future greatness; for with all his abilities and all his knowledge, he might otherwise in all probability have passed his life in obscurity, unnoticed and unknown.

He became now one of the most successful pleaders at the bar, and honours and emoluments flowed thick upon him.

Pratt.

him. He was chosen to represent the borough of Downton, Wilts, after the general election in 1759; recorder of Bath 1759; and the same year was appointed attorney-general; in January 1762 he was called to the degree of serjeant at law, appointed chief-justice of the common pleas, and knighted. His lordship presided in that court with a dignity, weight, and impartiality, never exceeded by any of his predecessors; and when John Wilkes, Esq. was seized and committed to the Tower on an illegal general warrant, his lordship, with the intrepidity of a British magistrate, and the becoming fortitude of an Englishman, granted him an *habeas corpus;* and on his being brought before the court of common pleas, discharged him from his confinement in the Tower, May 6. 1763, in a speech which did him honour. His wise and spirited behaviour on this remarkable occasion, so interesting to every true-born Briton, and in the consequent judicial proceedings between the printers of The North Briton and the messengers and others, was so acceptable to the nation, that the city of London presented him with the freedom of their corporation in a gold box, and desired his picture, which was put up in Guildhall, with this inscription:

HANC ICONEM
CAROLI PRATT, EQ.
SUMMI JUDICIS, C. B.
IN HONOREM TANTI VIRI,
ANGLICÆ LIBERTATIS LEGE
ASSERTORIS,
S. P. Q. L.
IN CURIA MUNICIPALI
PONI JVSSERVNT
NONO KAL. MART. A. D. MDCCLXIV.
GULIELMO BRIDGEN, AR. PRÆ. VRB.

This portrait, painted by Reynolds, was engraved by Basire. The corporations of Dublin, Bath, Exeter, and Norwich, paid him the like compliment; and in a petition, entered in the journals of the city of Dublin, it was declared, that no man appeared to have acquitted himself in his high station with such becoming zeal for the honour and dignity of the crown, and the fulfilling his majesty's most gracious intentions for preserving the freedom and happiness of his subjects, and such invincible fortitude in administering justice and law, as the Right Honourable Sir Charles Pratt, knight, the present lord-chief-justice of his majesty's court of common pleas in England, has shown in some late judicial determinations, which must be remembered to his lordship's honour while and wherever British liberties are held sacred.

Higher honours, however, than the breath of popular applause awaited Sir Charles Pratt. On the 16th of July 1765 he was created a peer of Great Britain, by the style and title of Lord Camden, Baron Camden, in the county of Kent; and, July 30. 1766, on the resignation of Robert earl of Northington, he was appointed lord high-chancellor of Great Britain; in which capacity he, in a speech of two hours, declared, upon the first decision of the suit against the messengers who arrested Mr Wilkes, that "it was the unanimous opinion of the whole court, that general warrants, except in cases of high treason, were illegal, oppressive, and unwarrantable. He conducted himself in this high office so as to obtain the love and esteem of all parties; but when the taxation of America was in agitation, he declared himself against it, and strongly opposing it, was removed from his station in 1770.

Pratt
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Prayer.

Upon the fall of Lord North he was again taken into the administration, and on the 27th of March 1782 appointed president of the council; an office which he resigned in March 1783. On the 13th of May 1786, he was created Viscount Bayham of Bayham Abbey, Kent, and Earl Camden.

Whether we consider Earl Camden as a *statesman*, called to that high situation by his talents; as a *lawyer*, defending, supporting, and enlarging the constitution; or as a *man*, sustaining both by his firmness and unshaken integrity—in all he excites our general praise; and when we contemplate his high and exalted virtue, we must allow him to have been an honour to his country. He died on the 18th of April 1794 at his house in Hill-street, Berkeley-square, being at that time president of his majesty's most honourable privy-council, a governor of the charter-house, recorder of the city of Bath, and F. R. S.

He married Elizabeth, daughter and coheir of Nicholas Jeffery, Esq. son and heir of Sir Jeffery Jefferys of Brecknock Priory, knight, who died in December 1779, and by whom he had issue John Jefferys Pratt (now Lord Camden), born 1759, and several daughters. His seat at Camden Place, Chiselhurst, was the residence of the great William Camden; on whose death it came by several intermediate owners to Weston, Spencer, and Pratt, and was much improved by his lordship.

PRAXAGORAS, a native of Athens, at 19 years of age composed the History of the Kings of Athens, in two books; and at 22 the Life of Constantine the Great, in which, though a pagan, he speaks very advantageously of that prince. He also wrote the History of Alexander the Great. He lived under Constantius, about the year 345.

PRAXITELES, a very famous Greek sculptor, who lived 330 years before Christ, at the time of the reign of Alexander the Great. All the ancient writers mention his statues with a high commendation, especially a Venus executed by him for the city of Cnidos, which was so admirable a piece, that King Nicomedes offered to release the inhabitants from their tribute as the purchase of it; but they refused to part with it. The inhabitants of the isle of Cos requested of Praxiteles a statue of Venus; and in consequence of this application the artist gave them their choice of two; one of which represented the goddess entirely naked, and the other covered with drapery. Both of these were of exquisite workmanship. Although the former was esteemed the most beautiful, nevertheless the inhabitants of Cos had the wisdom to give the preference to the latter, from a conviction that no motive whatever could justify their introducing into their city any indecent statues or paintings, which are so likely to inflame the passions of young people, and lead them to immorality and vice. What a reproach will this be to many Christians!—He was one of the gallants of Phryne the celebrated courtesan.

PRAYER, a solemn address to God, which, when it is of any considerable length, consists of *adoration*, *confession*, *supplication*, *intercession*, and *thanksgiving*.

By *adoration* we express our sense of God's infinite perfections, his power, wisdom, goodness, and mercy; and acknowledge that our constant dependence is upon Him

Prayer.

Him by whom the universe was created and has been hitherto preserved. By *confession* is meant our acknowledgment of our manifold transgressions of the divine laws, and our consequent unworthiness of all the good things which we enjoy at present or expect to be conferred upon us hereafter. In *supplication* we intreat our omnipotent Creator and merciful Judge, not to deal with us after our iniquities, but to pardon our transgressions, and by his grace to enable us to live henceforth righteously, soberly, and godly, in this present world; and by Christians this intreaty is always made in the name and through the mediation of Jesus Christ, because to them it is known that there is none other name under heaven given unto men whereby they may be saved. To these supplications for mercy we may likewise add our prayers for the necessaries of life; because if we seek *first* the kingdom of God, and his righteousness, we are assured that such things shall be added unto us. *Intercession* signifies those petitions which we offer up for others, for friends, for enemies, for all men, especially for our lawful governors, whether supreme or subordinate. And *thanksgiving* is the expression of our gratitude to God, the giver of every good and perfect gift, for all the benefits enjoyed by us and others, for the means of grace, and for the hope of glory. Such are the component parts of a regular and solemn prayer, adapted either for the church or for the closet. But an ejaculation to God, conceived on any emergency, is likewise a prayer, whether it be uttered by the voice or suffered to remain a mere affection of the mind; because the being to whom it is addressed discerneth the thoughts of the heart.

That prayer is a duty which all men ought to perform with humility and reverence, has been generally acknowledged as well by the untaught barbarian as by the enlightened Christian; and yet to this duty objections have been made by which the understanding has been bewildered in sophistry and affronted with jargon. "If God be independent, omnipotent, and possessed of every other perfection, what pleasure, it has been asked, can he take in our acknowledgment of these perfections? If he knows all things past, present, and future, where is the propriety of our confessing our sins unto him? If he is a benevolent and merciful Being, he will pardon our sins, and grant us what is needful for us without our supplications and intreaties; and if he be likewise possessed of infinite wisdom, it is certain that no importunities of ours will prevail upon him to grant us what is improper, or for our sakes to change the equal and steady laws by which the world is governed.

"Shall burning Ætna, if a sage requires,
"Forget to thunder, and recal her fires?
"On air or sea new motions be imprest,
"O blameless Bethel! to relieve thy breast?
"When the loose mountain trembles from on high,
"Shall gravitation cease, if you go by?
"Or some old temple, nodding to its fall,
"For Chartres' head reserve the hanging wall *?"

* Essay on Man.

Such are the most plausible objections which are usually made to the practice of prayer; and though they have been set off with all the art of the metaphysical wrangler, and embellished with all the graces of the poetry of Pope, they appear to us such gross sophisms as can operate only on a very unthinking head, or on a very corrupt heart. For if God certainly exists, and there is not a mathematical theorem capable of more rigid demonstration, it is obvious that no man can think of such a being without having his mind strongly impressed with the conviction of his own constant dependence upon him; nor can he "contemplate the heavens, the work of God's hands, the moon and the stars which he has ordained," without forming the most sublime conceptions that he can of the Divine power, wisdom, and goodness, &c. But such conviction, and such conceptions, whether clothed in words or not, are to all intents and purposes what is meant by adoration; and are as well known to the Deity while they remain the silent affections of the heart, as after they are spoken in the beginning of a prayer. Our adoration, therefore, is not expressed for the purpose of giving information to God, who understandeth our thoughts afar off; but merely, when the prayer is private, because we cannot think any more than speak without words, and because the very *sound* of words that are well chosen affects the heart, and helps to fix our attention: and as the Being who sees at once the past, present, and to come, and to whom a thousand years are but as one day, stands not in need of our information; so neither was it ever supposed by a man of rational piety, that he takes pleasure on his *own* account in hearing his perfections enumerated by creatures of yesterday; for being independent, he has no passions to be gratified, and being self-sufficient, he was as happy when existing alone as at that moment "when the morning stars sang together, and all the sons of God shouted for joy." Adoration is therefore proper only as it tends to preserve in our minds just notions of the Creator and Governor of the world, and of our own constant dependence upon him; and if such notions be useful to ourselves, who have a part to act in the scale of existence, upon which our happiness depends (a proposition which no theist will controvert), adoration must be acceptable to that benevolent God, who, when creating the world, could have no other end in view than to propagate happiness. See METAPHYSICS, N° 312.

By the same mode of reasoning, it will be easy to show the duty of *confession* and *supplication*. We are not required to confess our sins unto God, because he is ignorant of them; for he is ignorant of nothing. If he were, no reason could be assigned for our divulging to our judge actions deserving of punishment. Neither are we required to cry for mercy, in order to move him in whom there is no variableness, neither shadow of turning. The Being that made the world, governs it by laws that are inflexible, because they are the best; and to suppose that he can be induced by prayers, oblations, or sacrifices, to vary this plan of government, is an impious thought, which degrades the Deity to a level with man. One of these inflexible laws is the connection established between certain dispositions of mind and human happiness. We are enjoined to pursue a particular course of conduct under the denomination of virtue, not because our virtuous actions can in any degree be of advantage to him by whom we are created, but because they necessarily generate in our own minds those dispositions which are essential to our ultimate happiness. A man of a malignant, arrogant, or sensual disposition, would have no enjoyment in that heaven, where all are actuated by a spirit of love and purity; and it is doubtless for this reason among others, that the Christian religion prohibits malice, arrogance, and sensuality, among her votaries, and requires the cultivation of the opposite virtues. But a person who has deviated far from his duty cannot think of returning, unless he be previously convinced that he has gone astray. Such conviction, whenever he obtains it, will necessarily impress upon his mind a sense of his own danger, and fill his heart with sorrow and remorse for having transgressed the laws established by the most benevolent of all Beings for the propagation of universal felicity. This conviction of error, this sense of danger, and this compunction for having transgressed, are all perceived by the Deity as soon as they take place in the mind of the sinner; and he is required to *confess* his sins, only because the act of confession tends to imprint more deeply on his mind his own unworthiness, and the necessity of returning immediately into the paths of that virtue of which all the ways are pleasantness and all the paths are peace.

In the objection, it is taken for granted, that if God be a benevolent and merciful Being, he will pardon our sins, and grant us what is needful for us, whether we supplicate him or not: but this is a gross and palpable mistake, arising from the objector's ignorance of the end of virtue and the nature of man. Until a man be sensible of his sins and his danger, he is for the reason already assigned incapable of pardon, because his disposition is incompatible with the happiness of the blessed. But whenever he acquires this conviction, it is impossible for him not to form a *mental wish* that he may be pardoned; and this wish being perceptible to the all-seeing eye of his Judge, forms the sum and substance of a supplication for mercy. If he clothe it in words, it is only for a reason similar to that which makes him adore his Creator and confess his sins in words, that just notions may be more deeply imprinted on his own mind. The same reasoning holds good with respect to those prayers which we put up for temporal blessings, for protection and support in our journey through life. We are told by high authority, that "the Lord is nigh unto all them that call upon him, to all that call upon him in truth." This, however, is not because he is attracted or delighted by their prayers and intreaties, but because those prayers and intreaties fit such as offer them for receiving those benefits which he is at all times ready to pour upon all mankind. In his essence God is equally present with the righteous and with the wicked, with those who pray, and with those who pray not; for "the eyes of the Lord are in every place, beholding the evil and the good." But as the atmosphere equally surrounds every person upon this globe, and yet in its state of greatest purity does not affect the asthmatic as it affects those who are whole; so the Divine presence, though essentially the same everywhere, yet does not protect the impious as it protects the devout, because the impious are not in a state capable of the Divine protection. The end for which God requires the exercise of prayer as a duty, is not his benefit, but ours; because it is a mean to generate in the petitioner such a disposition of mind as must render him a special object of that love and that providential care which extend over the whole creation.

That part of the objection which results from the consideration of the fixed laws of nature, and which the poet has so finely illustrated, presents, it must be confessed, considerable difficulties; but none which to us appear insurmountable. If, indeed, we suppose that in the original constitution of things, when the laws of nature were established, a determinate duration was given to the top of the mountain and the nodding temple, without any regard to foreseen consequences, it would undoubtedly be absurd and perhaps impious to expect the law of gravitation to be suspended by the prayers of a good man, who should happen to be passing at the instant decreed for the fall of these objects. But of such a constitution there is so far from being evidence, that it appears not to be consistent with the wisdom and goodness of the Author of nature. This world was undoubtedly formed for the habitation of man and of other animals. If so, we must necessarily suppose, that in the establishing of the laws of nature, God adjusted them in such a manner as he saw would best serve the accommodation of those sentient beings for whose accommodation alone they were to be established. Let it then be admitted, that all the human beings who were ever to exist upon this globe, with all their thoughts, words, and actions, were at that important moment present to the divine intellect, and it will surely not be impossible to conceive that in consequence of the foreseen danger and prayers of a good man, the determinate duration of the mountain and the tower might be either lengthened or shortened to let him escape. This idea of providence, and of the efficacy of prayer, is thus illustrated by Mr Wollaston *. "Suppose M (some man) certainly to *foreknow*, by some means or other, that, when he should come to be upon his death-bed, L would *petition* for some *particular legacy*, in a manner so earnest and humble, and with such a good disposition, as would render it proper to grant his request: and upon this, M makes his *last will*, by which he devises to L that which was to be asked, and then locks up the *will*; and all this many years before the death of M, and whilst L had yet no expectation or thought of any such thing. When the time comes, the *petition* is made and *granted*; not by making any *new* will, but by the old one already made, and without alteration: which legacy had, notwithstanding that, never been left, had the petition never been preferred. The grant may be called the effect of a future act, and depends as much upon it as if it had been made after the act. So, if it had been foreseen, that L would not *so much as ask*, and he had been therefore left out of the will, this *præterition* would have been caused by his carriage, though much later than the date of the will. In all this nothing is hard to be admitted, if M be allowed to foreknow the case. And thus the *prayers* which good men offer to the *all-knowing* God, and the *neglect of prayers* by others, may find fitting effects *already* forecasted in the course of nature."

* *Religion of Nature delineated.*

This solution of the difficulty presents indeed to the mind a prodigious scheme, in which all things to come are, as it were, comprehended under one view, and estimated and compared together. But when it is considered what a mass of wonders the universe is in other respects; what an incomprehensibly great and perfect being God is; that he cannot be ignorant of any thing, no not of the future wants and deportments of particular men; and that all things which derive their existence from him must be consistent with one another

—it

—it must surely be confessed that such an adjustment of physical causes to moral volitions is within the compass of infinite power and perfect wisdom.

To that part of a prayer which we have termed intercession, it has been objected, that "to intercede for others is to presume that we possess an interest with the Deity upon which their happiness and even the prosperity of whole communities depends." In answer to this objection, it has been observed by an ingenious and useful writer *, that "how unequal soever our knowledge of the divine economy may be to a complete solution of this difficulty, which may require a comprehension of the entire plan, and of all the ends of God's moral government, to explain it satisfactorily, we can yet understand one thing concerning it, that it is, after all, nothing more than the making of one man the instrument of happiness and misery to another; which is perfectly of a piece with the course and order that obtain, and which we must believe were intended to obtain, in human affairs. Why may we not be assisted by the *prayers* of other men, as well as we are beholden for our *support to their labour?* Why may not our happiness be made in some cases to depend upon the intercession as it certainly does in many upon the good offices of our neighbours? The happiness and misery of great numbers we see oftentimes at the disposal of one man's choice, or liable to be much affected by his conduct: what greater difficulty is there in supposing, that the prayers of an individual may avert a calamity from multitudes, or be accepted to the benefit of whole communities."

* *Mr Paley.*

These observations may perhaps be sufficient to remove the force of the objection, but much more may be said for the practice of mutual intercession. If it be one man's duty to intercede for another, it is the duty of that other to intercede for him; and if we set aside the particular relations which arise from blood, and from particular stations in society, mutual intercession must be equally the duty of all mankind. But there is nothing (we speak from our own experience, and appeal to the experience of our readers) which has so powerful a tendency to generate in the heart of any person good-will towards another as the constant practice of praying to God for his happiness. Let a man regularly pray for his enemy with all that seriousness which devotion requires, and he will not long harbour resentment against him. Let him pray for his friend with that ardour which friendship naturally inspires, and he will perceive his attachment to grow daily and daily stronger. If, then, universal benevolence, or charity, be a disposition which we ought to cultivate in ourselves, mutual intercession is undeniably a duty, because nothing contributes so effectually to the acquisition of that spirit which an apostle terms the end of the commandment.

When it is said, that by interceding for kings, and all in authority, we seem to consider the prosperity of communities as depending upon our interest with God, the objector mistakes the nature and end of these intercessions. In the prosperity of any community consists great part of the happiness of its individual members; but that prosperity depends much upon the conduct of its governors. When, therefore, individuals intercede for their governors, the ultimate object of their prayers must be conceived to be their own good. As it is equally the duty of all the members of the community to pray for their governors, such intercessions are the prayers of the whole community for itself, and of every individual for himself. So that in this view of the case, the most just, we apprehend, that can be taken of it, it is not true that supplications and intercessions for kings and all in authority are the prayers of one individual for another, but the prayers of many individuals for that body of which each of them knows himself to be a member.

Having evinced the duty of adoration, confession, supplication, and intercession, we need not surely waste our readers time with a formal and laboured vindication of thanksgiving. Gratitude for benefits received is so universally acknowledged to be a virtue, and ingratitude is so detestable a vice, that no man who lays claim to a moral character will dare to affirm that we ought not to have a just sense of the goodness of God in preserving us from the numberless dangers to which we are exposed, and "in giving us rain from heaven, and fruitful seasons, filling our hearts with food and gladness." But if we have this sense, whether we express it in words or not, we offer to God thanksgiving; because every movement of the heart is open and exposed to his all-seeing eye.

In this article we have treated of prayer in general, and as the private duty of every individual; but there ought to be *public* as well as *private* prayer, which shall be considered afterwards. (See WORSHIP). We have likewise observed, that the prayers of every Christian ought to be offered in the name and through the mediation of Jesus Christ, for which the reason will be seen in the article THEOLOGY. We shall conclude our reflections on the general duty, with observing, that nothing so forcibly restrains from ill as the remembrance of a recent address to heaven for protection and assistance. After having petitioned for power to resist temptation, there is so great an incongruity in not continuing the struggle, that we blush at the thought, and persevere lest we lose all reverence for ourselves. After fervently devoting our souls to God, we start with horror at immediate apostasy: every act of deliberate wickedness is then complicated with hypocrisy and ingratitude: it is a mockery of the Father of Mercies, the forfeiture of that peace in which we closed our address, and a renunciation of the hope which that address inspired. But if prayer and immorality be thus incompatible, surely the former should not be neglected by those who contend that moral virtue is the summit of human perfection.

PREACHING. See DECLAMATION, Art. I.—The word is derived from the Hebrew *parasch*, *exposuit*, "he expounded."

PREADAMITE, a denomination given to the inhabitants of the earth, conceived, by some people, to have lived before Adam.

Isaac de la Pereyra, in 1655, published a book to evince the reality of Preadamites, by which he gained a considerable number of proselytes to the opinion: but the answer of Demarets, professor of theology at Groningen, published the year following, put a stop to its progress; though Pereyra made a reply.

His system was this: The Jews he calls *Adamites*, and supposes them to have issued from Adam; and gives the title *Preadamites* to the Gentiles, whom he supposes to have been a long time before Adam. But this being expressly contrary to the first words of Genesis, Pereyra

Pereyra had recourse to the fabulous antiquities of the Egyptians and Chaldeans, and to some idle rabbins, who imagined that there had been another world before that described by Moses. He was apprehended by the inquisition in Flanders, and very roughly used, though in the service of the dauphin. But he appealed from their sentence to Rome; whither he went in the time of Alexander VII. and where he printed a retraction of his book of Preadamites. See PRE-EXISTENCE.

PREAMBLE, in *Law*, the beginning of an act of parliament, &c. which serves to open the intent of the act, and the mischiefs intended to be remedied by it.

PREBEND, the maintenance a prebendary receives out of the estate of a cathedral or collegiate church. Prebends are distinguished into simple and dignitary: a simple prebend has no more than the revenue for its support; but a prebend with dignity has always a jurisdiction annexed to it.

PREBENDARY, an ecclesiastic who enjoys a prebend.

The difference between a prebendary and a canon is, that the former receives his prebend in consideration of his officiating in the church, but the latter merely by his being received into the cathedral or college.

PRECARIUM, in *Scots Law*. See LAW, N° clxxxiii. 9.

PRECEDENCE, a place of honour to which a person is entitled. This is either of courtesy or of right. The former is that which is due to age, estate, &c. which is regulated by custom and civility: the latter is settled by authority; and when broken in upon, gives an action at law.

In Great Britain, the order of precedency is as follows: The king; the princes of the blood; the archbishop of Canterbury; the lord high chancellor; the archbishop of York; the lord treasurer of England; the lord president of the council; the lord privy seal; dukes; the eldest sons of dukes of the blood royal; marquises; dukes eldest sons; earls; marquises eldest sons; dukes younger sons; viscounts; earls eldest sons; marquises younger sons; bishops; barons; speaker of the house of commons; lord commissioner of the great seal; viscounts eldest sons; earls younger sons; barons eldest sons; privy counsellors not peers; chancellor of the exchequer; chancellor of the duchy; knights of the Garter not peers; lord chief justice of the king's bench; master of the rolls; lord chief justice of the common pleas; lord chief baron of the exchequer; puisne judges and barons; knights banneret, if made in the field; masters in chancery; viscounts younger sons; barons younger sons; baronets; knight banneret; knights of the Bath; knights bachelors; baronets eldest sons; knights eldest sons; baronets younger sons; knights younger sons; field and flag officers; doctors graduate; serjeants at law; esquires; gentlemen bearing coat armour; yeomen; tradesmen; artificers; labourers.—*Note*, The ladies, except those of archbishops, bishops, and judges, take place according to the degree of quality of their husbands; and unmarried ladies take place according to that of their fathers.

PRECEDENT, in *Law*, a case which has been determined, and which serves as a rule for all of the same nature.

PRECENTOR, a dignity in cathedrals, popularly called the *chanter*, or *master of the choir*.

PRECEPT, in *Law*, a command in writing sent by a chief justice or justice of the peace, for bringing a person, record, or other matter before him.

Precept of Clarè Constat, in *Scots Law*. See LAW, Part III. N° clxxx. 28.

Precept of Seisin, in *Scots Law*. See LAW, Part III. N° clxiv. 16.

PRECEPTIVE, any thing which gives or contains precepts.

Preceptive Poetry. See POETRY, N° 146, &c.

PRECESSION OF THE EQUINOXES. The most obvious of all the celestial motions is the diurnal revolution of the starry heavens. The whole appears to turn round an imaginary AXIS, which passes through two opposite points of the heavens, called the *poles*. One of these is in our sight, being very near the star α in the tail of the Little Bear. The great circle which is equidistant from both poles divides the heavens into the northern and southern hemispheres, which are equal. It is called the *equator*, and it cuts the horizon in the east and west points, and every star in it is 12 sidereal hours above and as many below the horizon, in each revolution. 1 Diurnal revolution of the starry heavens.

The sun's motions determine the length of day and night, and the vicissitudes of the seasons. By a long series of observations, the shepherds of Asia were able to mark out the sun's path in the heavens; he being always in the opposite point to that which comes to the meridian at midnight, with equal but opposite declication. Thus they could tell the stars among which the sun then was, although they could not see them. They discovered that his path was a great circle of the heavens, afterwards called the ECLIPTIC; which cuts the equator in two opposite points, dividing it, and being divided by it, into two equal parts. They farther observed, that when the sun was in either of these points of intersection, his circle of diurnal revolution coincided with the equator, and therefore the days and nights were equal. Hence the equator came to be called the EQUINOCTIAL LINE, and the points in which it cuts the ecliptic were called the EQUINOCTIAL POINTS, and the sun was then said to be in the equinoxes. One of these was called the VERNAL and the other the AUTUMNAL EQUINOX. 2 Observations of the Asiatic shepherds.

It was evidently an important problem in practical astronomy to determine the exact moment of the sun's occupying these stations; for it was natural to compute the course of the year from that moment. Accordingly this has been the leading problem in the astronomy of all nations. It is susceptible of considerable precision, without any apparatus of instruments. It is only necessary to observe the sun's declination on the noon of two or three days before and after the equinoctial day. On two consecutive days of this number, his declination must have changed from north to south, or from south to north. If his declination on one day was observed to be 21′ north, and on the next 5′ south, it follows that his declination was nothing, or that he was in the equinoctial point about 23′ after seven in the morning of the second day. Knowing the precise moments, and knowing the rate of the sun's motion in the ecliptic, it is easy to ascertain the precise point of the ecliptic in which the equator intersected it. 3 To determine the time of the sun's occupying the equinoctial points.

By a series of such observations made at Alexandria between the years 161 and 127 before Christ, Hipparchus, 4 Hipparchus's discoveries.

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chus, the father of our astronomy, found that the point of the autumnal equinox was about six degrees to the eastward of the star called SPICA VIRGINIS. Eager to determine every thing by multiplied observations, he ransacked all the Chaldean, Egyptian, and other records, to which his travels could procure him access, for observations of the same kind; but he does not mention his having found any. He found, however, some observations of Aristillus and Timochares, made about 150 years before. From these it appeared evident that the point of the autumnal equinox was then about eight degrees east of the same star. He discusses these observations with great sagacity and rigour; and, on their authority, he asserts that the equinoctial points are not fixed in the heavens, but move to the westward about a degree in 75 years or somewhat less.

5 Why called the precession of the equinoxes.

This motion is called the PRECESSION OF THE EQUINOXES, because by it the time and place of the sun's equinoctial station precedes the usual calculations: it is fully confirmed by all subsequent observations. In 1750 the autumnal equinox was observed to be 20° 21′ westward of Spica Virginis. Supposing the motion to have been uniform during this period of ages, it follows that the annual precession is about $50''\frac{1}{3}$; that is, if the celestial equator cuts the ecliptic in a particular point on any day of this year, it will on the same day of the following year cut it in a point $50''\frac{1}{3}$ to the west of it, and the sun will come to the equinox 20′ 23″ before he has completed his round of the heavens. Thus the equinoctial or tropical year, or true year of seasons, is so much shorter than the revolution of the sun or the sidereal year.

6 Importance of the discovery.

It is this discovery that has chiefly immortalized the name of Hipparchus, though it must be acknowledged that all his astronomical researches have been conducted with the same sagacity and intelligence. It was natural therefore for him to value himself highly for this discovery; for it must be admitted to be one of the most singular that has been made, that the revolution of the whole heavens should not be stable, but its axis continually changing. For it must be observed, that since the equator changes its position, and the equator is only an imaginary circle, equidistant from the two poles or extremities of the axis; these poles and this axis must equally change their positions. The equinoctial points make a complete revolution in about 25,745 years, the equator being all the while inclined to the ecliptic in nearly the same angle. Therefore the poles of this diurnal revolution must describe a circle round the poles of the ecliptic at the distance of about $23\frac{1}{2}$ degrees in 25,745 years; and in the time of Timochares, the north pole of the heavens must have been 30 degrees eastward of the place where it now is.

7 Hipparchus has been accused of plagiarism.

Hipparchus has been accused of plagiarism and insincerity in this matter. It is now very certain that the precession of the equinoxes was known to the astronomers of India many ages before the time of Hipparchus. It appears also that the Chaldeans had a pretty accurate knowledge of the year of seasons. From their saros we deduce their measure of this year to be 365 days 5 hours 49 minutes and 11 seconds, exceeding the truth only by 26″, and much more exact than the year of Hipparchus. They had also a sidereal year of 365 days 6 hours 11 minutes. Now what could occasion an attention to two years, if they did not suppose the equinoxes moveable? The Egyptians also had a knowledge of something equivalent to this; for they had discovered that the dog-star was no longer the faithful forewarner of the overflowing of the Nile; and they combined him with the star Fomelhaset * in their mystical kalendar. This knowledge is also involved in the precepts of the Chinese astronomy, of much older date than the time of Hipparchus.

* See Dupins sur le zodiaque des Egyptiens, *Mem. de l'Acad. des Inscrip.*

8 But falsely.

But all these acknowledged facts are not sufficient for depriving Hipparchus of the honour of the discovery, or fixing on him the charge of plagiarism. This motion was a thing unknown to the astronomers of the Alexandrian school, and it was pointed out to them by Hipparchus in the way in which he ascertained every other position in astronomy, namely, as the mathematical result of actual observations, and not as a thing deducible from any opinions on other subjects related to it. We see him on all other occasions, eager to confirm his own observations, and his deductions from them, by every thing he could pick up from other astronomers; and he even adduced the above-mentioned practice of the Egyptians in corroboration of his doctrine. It is more than probable then that he did not know any thing more. Had he known the Indian precession of 54″ annually, he had no temptation whatever to withhold him from using it in preference to one which he acknowledges to be inaccurate, because deduced from the very short period of 150 years, and from the observations of Timochares, in which he had no great confidence.

9 Heavenly motions accounted for by the Copernican system.

This motion of the starry heavens was long a matter of discussion, as a thing for which no physical reason could be assigned. But the establishmrnt of the Copernican system reduced it to a very simple affair; the motion which was thought to affect all the heavenly bodies, is now acknowledged to be a deception, or a false judgment from the appearances. The earth turns round its own axis while it revolves round the sun, in the same manner as we may cause a child's top to spin on the brim of a millstone, while the stone is turning slowly round its axis. If the top spin steadily, without any wavering, its axis will always point to the zenith of the heavens; but we frequently see, that while it spins briskly round its axis, the axis itself has a slow conical motion round the vertical line, so that, if produced, it would slowly describe a circle in the heavens round the zenith point. The flat surface of the top may represent the terrestrial equator, gradually turning itself round on all sides. If this top were formed like a ball, with an equatorial circle on it, it would represent the whole motion very prettily, the only difference being, that the spinning motion and this wavering motion are in the same direction; whereas the diurnal rotation and the motion of the equinoctial points are in contrary directions. Even this dissimilarity may be removed, by making the top turn on a cap, like the card of a mariner's compass.

10 And the earth's.

It is now a matter fully established, that while the earth revolves round the sun from west to east, in the plane of the ecliptic in the course of a year, it turns round its own axis from west to east in 23h 56′ 4″, which axis is inclined to this plane in an angle of nearly 23° 28′; and that this axis turns round a line perpendicular to the ecliptic in 25,745 years from east to west, keeping nearly the same inclination to the ecliptic.— By this means, its pole in the sphere of the starry heavens describes a circle round the pole of the ecliptic at the

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the distance of 23° 28′ nearly. The consequence of this must be, that the terrestrial equator, when produced to the sphere of the starry heavens, will cut the ecliptic in two opposite points, through which the sun must pass when he makes the day and night equal; and that these points must shift to the westward, at the rate of $50\frac{1}{3}$ seconds annually, which is the precession of the equinoxes. Accordingly this has been the received doctrine among astronomers for nearly three centuries, and it was thought perfectly conformable to appearances.

11 Bradley's attempts to discover the parallax of the earth's orbit.

But Dr Bradley, the most sagacious of modern astronomers, hoped to discover the parallax of the earth's orbit by observations of the actual position of the pole of the celestial revolution. Dr Hooke had attempted this before, but with very imperfect instruments. The art of observing being now prodigiously improved, Dr Bradley resumed this investigation. It will easily appear, that if the earth's axis keeps parallel to itself, its extremity must describe in the sphere of the starry heavens a figure equal and parallel to its orbit round the sun; and if the stars be so near that this figure is a visible object, the pole of diurnal revolution will be in different distinguishable points of this figure. Consequently, if the axis describes the cone already mentioned, the pole will not describe a circle round the pole of the ecliptic, but will have a looped motion along this circumference, similar to the absolute motion of one of Jupiter's satellites, describing an epicycle whose centre describes the circle round the pole of the ecliptic.

12 Difficulties in the attempt obviated by accident.

He accordingly observed such an epicyclical motion, and thought that he had now overcome the only difficulty in the Copernican system; but, on maturely considering his observations, he found this epicycle to be quite inconsistent with the consequences of the annual parallax, and it puzzled him exceedingly. One day, while taking the amusement of sailing about on the Thames, he observed, that every time the boat tacked, the direction of the wind, estimated by the direction of the vane, seemed to change. This immediately suggested to him the cause of his observed epicycle, and he found it an optical illusion, occasioned by a combination of the motion of light with the motion of his telescope while observing the polar stars. Thus he unwittingly established an incontrovertible argument for the truth of the Copernican system, and immortalized his name by his discovery of the ABERRATION of the stars.

13 His further investigation of the subject.

He now engaged in a series of observations for ascertaining all the circumstances of this discovery. In the course of these, which were continued for 28 years, he discovered another epicyclical motion of the pole of the heavens, which was equally curious and unexpected. He found that the pole described an epicycle, whose diameter was about 18″, having for its centre that point of the circle round the pole of the ecliptic in which the pole would have been found independent of this new motion. He also observed, that the period of this epicyclical motion was 18 years and seven months. It struck him, that this was precisely the period of the revolution of the nodes of the moon's orbit. He gave a brief account of these results to Lord Macclesfield, then president of the Royal Society, in 1747. Mr Machin, to whom he also communicated the observations, gave him in return a very neat mathematical hypothesis, by which the motion might be calculated.

Plate ccccxxxviii fig. 1.

Let E (fig. 1.), be the pole of the ecliptic, and SPQ a circle distant from it 23° 28′, representing the circle described by the pole of the equator during one revolution of the equinoctial points. Let P be the place of this last mentioned pole at some given time. Round P describe a circle ABCD, whose diameter AC is 18″. The real situation of the pole will be in the circumference of this circle; and its place, in this circumference, depends on the place of the moon's ascending node. Draw EPF and GPL perpendicular to it; let GL be the colure of the equinoxes, and EF the colure of the solstices. Dr Bradley's observations showed that the pole was in A when the node was in L, the vernal equinox. If the node recede to H, the winter solstice, the pole is in B. When the node is in the autumnal equinox at G, the pole is at C; and when the node is in F, the summer solstice, the pole is in D. In all intermediate situations of the moon's ascending node, the pole is in a point of the circumference ABCD, three signs or 90° more advanced.

Plate ccccxxxviii fig. 1.

14 Mathematical theory if the poles of the equator be supposed to describe a circle.

15 More exact if an ellipse be substituted for the circle.

Dr Bradley, by comparing together a great number of observations, found that the mathematical theory, and the calculation depending on it, would correspond much better with the observations, if an ellipse were substituted for the circle ABCD, making the longer axis AC 18″, and the shorter, BD, 16″. Mr d'Alembert determined, by the physical theory of gravitation, the axes to be 18″ and 13″.4.

16 These observations and this theory are facts in astronomy.

These observations, and this mathematical theory, must be considered as so many facts in astronomy, and we must deduce from them the methods of computing the places of all celestial phenomena, agreeable to the universal practice of determining every point of the heavens by its longitude, latitude, right ascension, and declination.

17 Obliquity of the ecliptic.

It is evident, in the first place, that this equation of the pole's motion makes a change in the obliquity of the ecliptic. The inclination of the equator to the ecliptic is measured by the arch of a great circle intercepted between their poles. Now, if the pole be in O instead of P, it is plain that the obliquity is measured by EO instead of EP. If EP be considered as the mean obliquity of the ecliptic, it is augmented by 9″ when the moon's ascending node is in the vernal equinox, and consequently the pole in A. It is, on the contrary, diminished 9″ when the node is in the autumnal equinox, and the pole in C; and it is equal to the mean when the node is in the colure of the solstices. This change of the inclination of the earth's axis to the plane of the ecliptic was called the NUTATION of the axis by Sir Isaac Newton; who shewed, that a change of nearly a second must obtain in a year by the action of the sun on the prominent parts of the terrestrial spheroid. But he did not attend to the change which would be made in this motion by the variation which obtains in the disturbing force of the MOON, in consequence of the different obliquity of her action on the equator, arising from the motion of her own oblique orbit. It is this change which now goes by the name NUTATION, and we owe its discovery entirely to Dr Bradley. The general change of the position of the earth's axis has been termed DEVIATION by modern astronomers.

18 Quantity of it easily ascertained.

The quantity of this change of obliquity is easily ascertained. It is evident, from what has been already said, that when the pole is in O, the arch ADCO is equal to the node's longitude from the vernal equinox, and

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and that PM is its cosine; and (on account of the smallness of AP in comparison of EP) PM may be taken for the change of the obliquity of the ecliptic. This is therefore $= 9'' \times$ cos. long. node, and is additive to the mean obliquity, while O is in the semicircle BAD, that is, while the longitude of the node is from 9 signs to 3 signs; but subtractive while the longitude of the node changes from 3 to 9 signs.

19 Change of the equinoctial points.

But the nutation changes also the longitudes and right ascensions of the stars and planets, by changing the equinoctial points, and thus occasioning an equation in the precession of the equinoctial points. It was this circumstance which made it necessary for us to consider it in this place, while expressly treating of this precession. Let us attend to this derangement of the equinoctial points.

20 Situation of the solstitial and equinoctial colures.

The great circle or meridian which passes through the poles of the ecliptic and equator is always the solstitial colure, and the equinoctial colure is at right angles to it: therefore when the pole is in P or in O, EP or EO is the solstitial colure. Let S be any fixed star or planet, and let SE be a meridian or circle of longitude; draw the circles of declination PS, OS, and the circles M′EM″, *m*E*m*′, perpendicular to PE, OE.

21 Equation of longitude from nutation of the earth's axis.

If the pole were in its mean place P, the equinoctial points would be in the ecliptic meridian M′EM″, or that meridian would pass through the intersections of the equator and ecliptic, and the angle M′ES would measure the longitude of the star S. But when the pole is in O, the ecliptic meridian *m*E*m*′ will pass through the equinoctial points. The equinoctial points must therefore be to the westward of their mean place, and the equation of the precession must be additive to that precession: and the longitude of the star S will now be measured by the angle *m* ES, which, in the case here represented, is greater than its mean longitude. The difference or the equation of longitude, arising from the nutation of the earth's axis, is the angle OEP, or $\frac{OM}{OE}$. OM is the sine of the angle CPO, which, by what has been already observed, is equal to the longitude of the node: Therefore OM is equal to $9'' \times$ long. node, and $\frac{OM}{OE}$ is equal to $\frac{9'' \times \text{sin. long. node}}{\text{sin. obliq}^y\text{. eclip.}}$. This equation is additive to the mean longitude of the star when O is in the semicircle CBA, or while the ascending node is passing backwards from the vernal to the autumnal equinox; but it is subtractive from it while O is in the semicircle ADC, or while the node is passing backwards from the autumnal to the vernal equinox; or, to express it more briefly, the equation is subtractive from the mean longitude of the star, while the ascending node is in the first six signs, and additive to it while the node is in the last six signs.

This equation of longitude is the same for all the stars, for the longitude is reckoned on the ecliptic (which is here supposed invariable); and therefore is affected only by the variation of the point from which the longitude is computed.

22 Right ascension suffers a double change.

The right ascension, being computed on the equator, suffers a double change. It is computed from, or begins at, a different point of the equator, and it terminates at a different point; because the equator having changed its position, the circles of declination also change theirs. When the pole is at P, the right ascension of S from the solstitial colure is measured by the angle SPE, contained between that colure and the star's circle of declination. But when the pole is at O, the right ascension is measured by the angle SOE, and the difference of SPE and SOE is the equation of right ascension. The angle SOE consists of two parts, GOE and GOS; GOE remains the same wherever the star S is placed, but GOS varies with the place of the star.—We must first find the variation by which GPE becomes GOE, which variation is common to all the stars. The triangles GPE, GOE, have a constant side GE, and a constant angle G; the variation PO of the side GP is extremely small, and therefore the variation of the angles may be computed by Mr Cotes's Fluxionary Theorems. See Simpson's *Fluxions*, § 253, &c. As the tangent of the side EP, opposite to the constant angle G, is to the sine of the angle EPG, opposite to the constant side EG, so is PO the variation of the side GP, adjacent to the constant angle, to the variation x of the angle GPO, opposite to the constant side EG. This gives $x = \frac{9'' \times \text{sin. long. node}}{\text{tang. obl. eclip.}}$. This is subtractive from the mean right ascension for the first six signs of the node's longitude, and additive for the last six signs. This equation is common to all the stars.

23 Other variations, &c.

The variation of the other part SOG of the angle, which depends on the different position of the hour circles PS and OS, which causes them to cut the equation in different points, where the arches of right ascension terminate, may be discovered as follows: The triangles SPG, SOG, have a constant side SG, and a constant angle G. Therefore, by the same Cotesian theorem, tan. SP : sin. SPG = PO : y, and y, or the second part of the nutation in right ascension, $= \frac{9'' \times \text{sin. diff. R. A of star and node}}{\text{cotan. declin. star}}$.

24 Nutation affects the declination of the stars.

The nutation also affects the declination of the stars: For SP, the mean codeclination, is changed into SO.—Suppose a circle described round S, with the distance SO cutting SP in f; then it is evident that the equation of declin. is $Pf =$ PO $\times$ cosine OP$f = 9'' \times$ sign r. ascen. of star—long. of node.

25 A more exact mode of calculation.

Such are the calculations in constant use in our astronomical researches, founded on Machin's Theory. When still greater accuracy is required, the elliptical theory must be substituted, by taking (as is expressed by the dotted lines) O in that point of the ellipse described on the transverse axis AC, where it is cut by OM, drawn according to Machin's Theory. All the change made here is the diminution of OM in the ratio of 18 to 13.4, and a corresponding diminution of the angle CPO. The detail of it may be seen in De la Lande's *Astronomy*, art. 2874; but is rather foreign to our present purpose of explaining the precession of the equinoxes. The calculations being in every case tedious, and liable to mistakes, on account of the changes of the signs of the different equations, the zealous promoters of astronomy have calculated and published tables of all these equations, both on the circular and elliptical hypothesis. And still more to abridge calculations, which occur in reducing every astronomical observation, when the place of a phenomenon is deduced from a comparison with known stars, there have been published tables of nutation and precession,

sion, for some hundreds of the principal stars, for every position of the moon's node and of the sun.

26 Precession of the equinoctial points, &c. It now remains to consider the precession of the equinoctial points, with its equations, arising from the nutation of the earth's axis as a physical phenomenon, and to endeavour to account for it upon those mechanical principles which have so happily explained all the other phenomena of the celestial motions.

27 Observations of Newton and others on this subject. This did not escape the penetrating eye of Sir Isaac Newton; and he quickly found it to be a consequence, and the most beautiful proof, of the universal gravitation of all matter to all matter; and there is no part of his immortal work where his sagacity and fertility of resource shine more conspicuously than in this investigation. It must be acknowledged, however, that Newton's investigation is only a shrewd guess, founded on assumptions, of which it would be extremely difficult to demonstrate either the truth or falsity, and which required the genius of a Newton to pick out in such a complication of abstruse circumstances. The subject has occupied the attention of the first mathematicians of Europe since his time; and is still considered as the most curious and difficult of all mechanical problems. The most elaborate and accurate dissertations on the precession of the equinoxes are those of Sylvabella and Walmesly, in the Philosophical Transactions, published about the year 1754; that of Thomas Simpson, published in his Miscellaneous Tracts; that of Father Frisius, in the Memoirs of the Berlin Academy, and afterwards with great improvements, in his Cosmographia; that of Euler in the Memoirs of Berlin; that of D'Alembert in a separate dissertation; and that of De la Grange on the Libration of the Moon, which obtained the prize in the Academy of Paris in 1769. We think the dissertation of Father Frisius the most perspicuous of them all, being conducted in the method of geometrical analysis; whereas most of the others proceed in the fluxionary and symbolic method, which is frequently deficient in distinct notions of the quantities under consideration, and therefore does not give us the same perspicuous conviction of the truth of the results. In a work like ours, it is impossible to do justice to the problem, without entering into a detail which would be thought extremely disproportioned to the subject by the generality of our readers. Yet those who have the necessary preparation of mathematical knowledge, and wish to understand the subject fully, will find enough here to give them a very distinct notion of it; and in the article ROTATION, they will find the fundamental theorems, which will enable them to carry on the investigation. We shall first give a short sketch of Newton's investigation, which is of the most palpable and popular kind, and is highly valuable, not only for its ingenuity, but also because it will give our unlearned readers distinct and satisfactory conceptions of the chief circumstances of the whole phenomena.

28 Sketch of Newton's investigation of it. Fig. 2. Let S (fig. 2.) be the sun, E the earth, and M the moon, moving in the orbit NMCDn, which cuts the plane of the ecliptic in the line of the nodes Nn, and has one half raised above it, as represented in the figure, the other half being hid below the ecliptic. Suppose this orbit folded down; it will coincide with the ecliptic in the circle Nm c d n. Let EX represent the axis of this orbit, perpendicular to its plane, and therefore inclined to the ecliptic. Since the moon gravitates to the sun in the direction MS, which is all above the ecliptic, it is plain that this gravitation has a tendency to draw the moon towards the ecliptic. Suppose this force to be such that it would draw the moon down from M to i in the time that she would have moved from M to t, in the tangent to her orbit. By the combination of these motions, the moon will desert her orbit, and describe the line M r, which makes the diagonal of the parallelogram; and if no farther action of the sun be supposed, she will describe another orbit M δ n', lying between the orbit MCD n and the ecliptic, and she will come to the ecliptic, and pass through it in a point n', nearer to M than n is, which was the former place of her descending node. By this change of orbit, the line EX will no longer be perpendicular to it; but there will be another line E x, which will now be perpendicular to the new orbit. Also the moon, moving from M to r, does not move as if she had come from the ascending node N, but from a point N lying beyond it; and the line of the nodes of the orbit in this new position is N′ n'. Also the angle MN′ m is less than the angle MNm.

Thus the nodes shift their places in a direction opposite to that of her motion, or move to the westward; the axis of the orbit changes its position, and the orbit itself changes its inclination to the ecliptic. These momentary changes are different in different parts of the orbit, according to the position of the line of the nodes. Sometimes the inclination of the orbit is increased, and sometimes the nodes move to the eastward. But, in general, the inclination increases from the time that the nodes are in the line of syzigee, till they get into quadrature, after which it diminishes till the nodes are again in syzigee. The nodes advance only while they are in the octants after the quadratures, and while the moon passes from quadrature to the node, and they recede in all other situations. Therefore the recess exceeds the advance in every revolution of the moon round the earth, and, on the whole, they recede.

What has been said of one moon, would be true of each of a continued ring of moons surrounding the earth, and they would thus compose a flexible ring, which would never be flat but waved, according to the difference (both in kind and degree) of the disturbing forces acting on its different parts. But suppose these moons to cohere, and to form a rigid and flat ring, nothing would remain in this ring but the excess of the contrary tendencies of its different parts. Its axis would be perpendicular to its plane, and its position in any moment will be the mean position of all the axes of the orbits of each part of the flexible ring; therefore the nodes of this rigid ring will continually recede, except when the plane of the ring passes through the sun, that is, when the nodes are in syzigee; and (says Newton) the motion of these nodes will be the same with the mean motion of the nodes of the orbit of one moon. The inclination of this ring to the ecliptic will be equal to the mean inclination of the moon's orbit during any one revolution which has the same situation of the nodes. It will therefore be least of all when the nodes are in quadrature, and will increase till they are in syzigee, and then diminish till they are again in quadrature.

Suppose this ring to contract in dimensions, the disturbing forces will diminish in the same proportion, and in this proportion will all their effects diminish. Suppose

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pose its motion of revolution to accelerate, or the time of a revolution to diminish; the linear effects of the disturbing forces being as the squares of the times of their action, and their angular effects as the times, those errors must diminish also on this account; and we can compute what those errors will be for any diameter of the ring, and for any period of its revolution. We can tell, therefore, what would be the motion of the nodes, the change of inclination, and deviation of the axis, of a ring which would touch the surface of the earth, and revolve in 24 hours; nay, we can tell what these motions would be, should this ring adhere to the earth. They must be much less than if the ring were detached; for the disturbing forces of the ring must drag along with it the whole globe of the earth. The quantity of motion which the disturbing forces would have produced in the ring alone, will now (says Newton) be produced in the whole mass; and therefore the velocity must be as much less as the quantity of matter is greater: But still all this can be computed.

Now there is such a ring on the earth: for the earth is not a sphere, but an elliptical spheroid. Sir Isaac Newton therefore engaged in a computation of the effects of the disturbing force, and has exhibited a most beautiful example of mathematical investigation. He first asserts, that the earth *must* be an elliptical spheroid, whose polar axis is to its equatorial diameter as 229 to 230. Then he demonstrates, that if the sine of the inclination of the equator be called π, and if t be the number of days (sidereal) in a year, the annual motion of a detached ring will be $360° \times \frac{3\sqrt{1-\pi^2}}{4t}$. He then shows that the effect of the disturbing force on this ring is to its effect on the matter of the same ring, distributed in the form of an elliptical stratum (but still detached) as 5 to 2; therefore the motion of the nodes will be $360° \times \frac{3\sqrt{1-\pi^2}}{10t}$, or 16′ 16″ 24‴ annually. He then proceeds to show, that the quantity of motion in the sphere is to that in an equatorial ring revolving in the same time, as the matter in the sphere to the matter in the ring, and as three times the square of a quadrantral arch to two squares of a diameter, jointly: Then he shows, that the quantity of matter in the terrestrial sphere is to that in the protuberant matter of the spheroid, as 52900 to 461 (supposing all homogeneous). From these premises it follows, that the motion of 16′ 16″ 24‴, must be diminished in the ratio of 10717 to 100, which reduces it to 9″ 07‴ annually. And this (he says) is the precession of the equinoxes, occasioned by the action of the sun; and the rest of the $50\frac{1}{7}$″ which is the observed precession, is owing to the action of the moon, nearly five times greater than that of the sun. This appeared a great difficulty; for the phenomena of the tides show that it *cannot* much exceed twice the sun's force.

29
His determination of the form and dimensions of the earth demonstrated by M'Laurin.

Nothing can exceed the ingenuity of this process. Justly does his celebrated and candid commentator, Daniel Bernoulli, say (in his Dissertation on the Tides, which shared the prize of the French Academy with M'Laurin and Euler,), that Newton saw through a veil what others could hardly discover with a microscope in the light of the meridian sun. His determination of the form and dimensions of the earth, which is the foundation of the whole process, is not offered as any thing better than a probable guess, *in re difficillima*; and it has since been demonstrated with geometrical rigour by M'Laurin.

His next principle, that the motion of the nodes of the rigid ring is equal to the mean motion of the nodes of the moon, has been most critically discussed by the first mathematicians, as a thing which could neither be proved nor refuted. Frisius has at least shown it to be a mistake, and that the motion of the nodes of the ring is double the mean motion of the nodes of a single moon: and that Newton's own principles should have produced a precession of $18\frac{1}{2}$ seconds annually, which removes the difficulty formerly mentioned.

His third assumption, that the quantity of motion of the ring must be shared with the included sphere, was acquiesced in by all his commentators, till D'Alembert and Euler, in 1749, showed that it was not the quantity of motion round an axis of rotation which remained the same, but the quantity of momentum or rotatory effort. The quantity of motion is the product of every particle by its velocity; that is, by its distance from the axis; while its momentum, or power of producing rotation, is as the square of that distance, and is to be had by taking the sum of each particle multiplied by the square of its distance from the axis. Since the earth differs so little from a perfect sphere, this makes no sensible difference in the result. It will increase Newton's precession about three-fourths of a second.

30
Examination of the phenomenon of precession on mechanical principles.

We proceed now to the examination of this phenomenon upon the fundamental principles of mechanics.

Because the mutual gravitation of the particles of matter in the solar system is in the inverse ratio of the squares of the distance, it follows, that the gravitations of the different parts of the earth to the sun or to the moon are unequal. The nearer particles gravitate more than those that are more remote.

Fig. 3.

Let PQpE (fig. 3.) be a meridional section of the terrestrial sphere, and POpq the section of the inscribed sphere. Let CS be a line in the plane of the ecliptic passing through the sun, so that the angle ECS is the sun's declination. Let NCM be a plane passing through the centre of the earth at right angles to the plane of the meridian PQpE; NCM will therefore be the plane of illumination.

In consequence of the unequal gravitation of the matter of the earth to the sun, every particle, such as B, is acted on by a disturbing force parallel to CS, and proportional to BD, the distance of the particle from the plane of illumination; and this force is to the gravitation of the central particle to the sun, as three times BD to CS, the distance of the earth from the sun.

Let ABa be a plane passing through the particle B, parallel to the plane EQ of the equator. This section of the earth will be a circle, of which Aa is a diameter, and Qq will be the diameter of its section with the inscribed sphere. These will be two concentric circles, and the ring by which the section of the spheroid exceeds the section of the sphere, will have AQ for its breadth: Pp is the axis of figure.

Let EC be represented by the symbol	a
OC or PC	b
EO their difference, $=\frac{a^2-b^2}{a+b}$	d

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CL	x
QL	$\sqrt{b^2-x^2}$
The periphery of a circle to radius 1	Π
The disturbing force at the distance 1 from the plane NCM	f
The sine of declination ECS	m
The cosine of ECS	n

It is evident, that with respect to the inscribed sphere, the disturbing forces are completely compensated, for every particle has a corresponding particle in the adjoining quadrant, which is acted on by an equal and opposite force. But this is not the case with the protuberant matter which makes up the spheroid. The segments NS sn and MT tm are more acted on than the segments NT tn and MS sm; and thus there is produced a tendency to a conversion of the whole earth, round an axis passing through the centre C, perpendicular to the plane PQ p E. We shall distinguish this motion from all others to which the spheroid may be subject, by the name Libration. The axis of this libration is always perpendicular to that diameter of the equator over which the sun is, or to that meridian in which he is.

Prob I. To determine the momentum of libration corresponding to any position of the earth respecting the sun, that is, to determine the accumulated energy of the disturbing forces on all the protuberant matter of the spheroid.

Let B and b be two particles in the ring formed by the revolution of AQ, and so situated that they are at equal distances from the plane NM; but on opposite sides of it. Draw BD, bd, perpendicular to NM, and FLG perpendicular to LT.

Then, because the momentum, or power of producing rotation, is as the force and as the distance of its line of direction from the axis of rotation, jointly, the combined momentum of the particles B and b will be $f.\text{BD.DC}-f.bd.dc$, (for the particles B and b are urged in contrary directions). But the momentum of B is $f.\text{BF.DC}+f.\text{FD.DC}$, and that of b is $f.b\text{G}.d\text{C}-f.d\text{G}.d\text{C}$; and the combined momentum is $f.\text{BF.D}d-f.\text{FD}.\overline{\text{DC}+d\text{C}}$, $=2f.\text{BF.LF}-2f.\text{LT.TC}$.

Because m and n are the sine and cosine of the angle ECS or LCT, we have $\text{LT}=m.\text{CL}$, and $\text{CT}=n.\text{CL}$, and $\text{LF}=m.\text{BL}$, and $\text{BF}=n.\text{BL}$. This gives the momentum $=2fmn\,\overline{\text{BL}^2-\text{CL}^2}$.

The breadth AQ of the protuberant ring being very small, we may suppose, without any sensible error, that all the matter of the line AQ is collected in the point Q; and, in like manner, that the matter of the whole ring is collected in the circumference of its inner circle, and that B and b now represent, not single particles, but the collected matter of lines such as AQ, which terminate at B and b. The combined momentum of two such lines will therefore be $2mnf.\text{AQ}.\overline{\text{BL}^2-\text{CL}^2}$.

Let the circumference of each parallel of latitude be divided into a great number of indefinitely small and equal parts. The number of such parts in the circumference of which Q q is the diameter, will be $\Pi.\text{QL}$. To each pair of these there belongs a momentum $2mnf.\text{AQ}.\overline{\text{BL}^2-\text{CL}^2}$. The sum of all the squares of BL, which can be taken round the circle, is one half of as many squares of the radius CL: for BL is the sine of an arch, and the sum of its square and the square of its corresponding cosine is equal to the square of the radius. Therefore the sum of all the squares of the sines, together with the sum of all the squares of the cosines, is equal to the sum of the same number of squares of the radius; and the sum of the squares of the sines is equal to the sum of the squares of the corresponding cosines: therefore the sum of the squares of the radius is double of either sum. Therefore $\int \Pi.\text{QL}.\text{BL}^2=\frac{1}{2}\Pi.\text{QL}.\text{QL}^2$. In like manner the sum of the number $\Pi.\text{QL}$ of CL^2s will be $=\Pi.\text{QL}.\text{CL}^2$. These sums, taken for the semicircle, are $\frac{1}{4}\Pi.\text{QL}.\text{QL}^2$, and $\frac{1}{2}\Pi.\text{QL}.\text{CL}^2$, or $\Pi.\text{QL}.\frac{1}{4}\text{QL}^2$, and $\Pi.\text{QL}.\frac{1}{2}\text{CL}^2$: therefore the momentum of the whole ring will be $2mnf.\text{AQ}.\text{QL}.\Pi(\frac{1}{4}\text{QL}^2-\frac{1}{2}\text{CL}^2)$: for the momentum of the ring is the combined momentum of a number of pairs, and this number is $\frac{1}{4}\Pi.\text{QL}$.

By the ellipse we have $\text{OC}:\text{QL}=\text{EO}:\text{AQ}$, and $\text{AQ}=\text{QL}\frac{\text{EO}}{\text{OC}}, =\text{QL}\frac{d}{b}$; therefore the momentum of the rings is $2mnf\frac{d}{b}\text{QL}^2\Pi(\frac{1}{4}\text{QL}^2-\frac{1}{2}\text{CL}^2), =mnf\frac{d}{b}\text{QL}^2\Pi(\frac{1}{2}\text{QL}^2-\text{CL}^2)$: but $\text{QL}^2=b^2-x^2$; therefore $\frac{1}{2}\text{QL}^2-\text{CL}^2=\frac{1}{2}b^2-\frac{1}{2}x^2-x^2, =\frac{1}{2}b^2-\frac{3}{2}x^2, =\frac{b^2-3x^2}{2}$; therefore the momentum of the ring is $mnf\frac{d}{b}\Pi(b^2-x^2)\left(\frac{b^2-3x^2}{2}\right)=mnf\frac{d}{b}\Pi\left(\frac{b^4-4b^2x^2+3x^4}{2}\right), =mnf\frac{d}{2b}\Pi(b^4-4b^2x^2+3x^4)$. If we now suppose another parallel extremely near to A a, as represented by the dotted line, the distance L l between them being $\dot{x}$, we shall have the fluxion of the momentum of the spheroid $mnf\frac{d}{2b}\Pi(b^4\dot{x}-4b^2x^2\dot{x}+3x^4\dot{x})$, of which the fluent is $mnf\frac{d}{2b}\Pi\left(b^4x-4b^2\frac{x^3}{3}+\frac{3x^5}{5}\right)$. This expresses the momentum of the zone EA a Q, contained between the equator and the parallel of latitude A a. Now let x become $=b$, and we shall obtain the momentum of the hemispheroid $=mnf\frac{d}{2b}\Pi(b^5-\frac{4}{3}b^5+\frac{3}{5}b^5)$, and that of the spheroid $=mnf\frac{d}{b}\Pi(b^5-\frac{4}{3}b^5+\frac{3}{5}b^5)=\frac{4}{15}mnfd\Pi b^4$.

This formula does not express any motion, but only a pressure tending to produce motion, and particularly tending to produce a libration by its action on the cohering matter of the earth, which is affected as a number of levers. It is similar to the common mechanical formula $w.d$, where w means a weight, and d its distance from the fulcrum of the lever.

It is worthy of remark, that the momentum of this protuberant matter is just one fifth of what it would be if it were all collected at the point O of the equator: for the matter in the spheroid is to that in the inscribed sphere as a^2 to b^2, and the contents of the inscribed sphere is $\frac{2}{3}\Pi b^3$. Therefore $a^2 : a^2-b^2=\frac{2}{3}\Pi b^3 : \frac{2}{3}\Pi b^3\frac{a^2-b^2}{a^2}$, which is the quantity of protuberant matter.

We

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We may, without sensible error, suppose $\frac{a^2-b^2}{a}=2d$; then the protuberant matter will be $\frac{4}{3}\Pi b^2 d$. If all this were placed at O, the momentum would be $\frac{4}{3}\Pi d b^2 f$.OH.HC, $=\frac{4}{3} m n f d b^4$, because OH.HC$=mnb^2$; now $\frac{4}{3}$ is 5 times $\frac{4}{15}$.

Also, because the sum of all the rectangles OH.HC round the equator is half of as many squares of OC, it follows that the momentum of the protuberant matter placed in a ring round the equator of the sphere or spheroid is one half of what it would be if collected in the point O or E; whence it follows that the momentum of the protuberant matter in its natural place is two-fifths of what it would be if it were disposed in an equatorial ring. It was in this manner that Sir Isaac Newton was enabled to compare the effect of the sun's action on the protuberant matter of the earth, with his effect on a rigid ring of moons. The preceding investigation of the momentum is nearly the same with his, and appears to us greatly preferable in point of perspicuity to the fluxionary solutions given by later authors. These indeed have the appearance of greater accuracy, because they do not suppose all the protuberant matter to be condensed on the surface of the inscribed sphere: nor were we under the necessity of doing this, only it would have led to very complicated expressions had we supposed the matter in each line AQ collected in its centre of oscillation or gyration. We made a compensation for the error introduced by this, which may amount to $\frac{1}{115}$ of the whole, and should not be neglected, by taking d as equal to $\frac{a^2-b^2}{2a}$ instead of $\frac{a^2-b^2}{a+b}$. The consequence is, that our formula is the same with that of the later authors.

Thus far Sir Isaac Newton proceeded with mathematical rigour; but in the application he made two assumptions, or, as he calls them, hypotheses, which have been found to be unwarranted. The first was, that when the ring of protuberant matter is connected with the inscribed sphere, and subjected to the action of the disturbing force, the same quantity of motion is produced in the whole mass as in the ring alone. The second was, that the motion of the nodes of a rigid ring of moons is the same with the mean motion of the nodes of a solitary moon. But we are now able to demonstrate, that it is not the quantity of motion, but of momentum, which remains the same, and that the nodes of a rigid ring move twice as fast as those of a single particle. We proceed therefore to

31 Effects of the libratory momentum of the earth's protuberant matter.

Prob. 2. To determine the deviation of the axis, and the retrograde motion of the nodes which result from this libratory momentum of the earth's protuberant matter.

But here we must refer our readers to some fundamental propositions of rotatory motions which are demonstrated in the article ROTATION.

If a rigid body is turning round an axis A, passing through its centre of gravity with the angular velocity a, and receives an impulse which alone would cause it to turn round an axis B, also passing through its centre of gravity, with the angular velocity b, the body will now turn round a third axis C, passing through its centre of gravity, and lying in the plane of the axes A and B, and the sine of the inclination of this third axis to the axis A will be to the sine of inclination to the axis B as the velocity b to the velocity a.

When a rigid body is made to turn round any axis by the action of an external force, the quantity of momentum produced (that is, the sum of the products of every particle by its velocity and by its distance from the axis) is equal to the momentum or similar product of the moving force or forces. 32

If an oblate spheroid, whose equatorial diameter is a and polar diameter b, be made to librate round an equatorial diameter, and the velocity of that point of the equator which is farthest from the axis of libration be v, the momentum of the spheroid is $\frac{4}{15}\Pi a^2 b^2 v$. 33

The two last are to be found in every elementary book of mechanics.

Let ANan (fig. 4.) be the plane of the earth's equator, cutting the ecliptic CNKn in the line of the nodes or equinoctial points N n. Let OAS be the section of the earth by a meridian passing through the sun, so that the line OCS is in the ecliptic, and CA is an arch of an hour-circle or meridian, measuring the sun's declination. The sun not being in the plane of the equator, there is, by prop. 1. a force tending to produce a libration round an axis ZOz at right angles to the diameter Aa of that meridian in which the sun is situated, and the momentum of all the disturbing forces is $\frac{4}{15} m n f d \Pi b^4$. The product of any force by the moment $\dot{t}$ of its action expresses the momentary increment of velocity; therefore the momentary velocity, or the velocity of libration generated in the time $\dot{t}$, is $\frac{4}{15} m n f d \Pi b^4 \dot{t}$. This is the absolute velocity of a point at the distance 1 from the axis, or it is the space which would be uniformly described in the moment $\dot{t}$, with the velocity which the point has acquired at the end of that moment. It is double the space actually described by the libration during that moment; because this has been an uniformly accelerated motion, in consequence of the continued and uniform action of the momentum during this time. This must be carefully attended to, and the neglect of it has occasioned very faulty solutions of this problem.

Let v be the velocity produced in the point A, the most remote from the axis of libration. The momentum excited or produced in the spheroid is $\frac{4}{15}\Pi a^2 b^2 v$ (as above), and this must be equal to the momentum of the moving force, or to $\frac{4}{15} m n f d \Pi b^4 \dot{t}$; therefore we obtain $v=\frac{\frac{4}{15} m n f d \Pi b^4 \dot{t}}{\frac{4}{15}\Pi a^2 b^2}$, that is, $v=m n f d \dot{t}\cdot\frac{b^2}{a^2}$ or very nearly $m n f d \dot{t}$, because $\frac{b^2}{a^2}=1$ very nearly. Also, because the product of the velocity and time gives the space uniformly described in that time, the space described by A in its libration round Zz is $m n f d \dot{t}^2$, and the angular velocity is $\frac{m n f d \dot{t}}{a}$.

Let $\dot{r}$ be the momentary angle of diurnal rotation. The arch A r, described by the point A of the equator in this moment $\dot{t}$ will therefore be $a\dot{r}$, that is, $a\times\dot{r}$, and the velocity of the point A is $\frac{a\dot{r}}{\dot{t}}$, and the angular velocity of rotation is $\frac{\dot{r}}{\dot{t}}$.

Here then is a body (fig. 5.) turning round an axis OP, Precession. OP, perpendicular to the plane of the equator $z\,o\,z$, and therefore situated in the plane ZPz; and it turns round this axis with the angular velocity $\frac{\dot{r}}{t}$. It has received an impulse, by which alone it would librate round the axis Zz, with the angular velocity $\frac{m\,n\,f\,d\,\dot{t}}{a}$. It will therefore turn round neither axis (N° 31.), but round a third axis OP′, passing through O, and lying in the plane ZPz, in which the other two are situated, and the sine P′Π of its inclination to the axis of libration Zz will be to the sine Pp of its inclination to the axis OP of rotation as $\frac{\dot{r}}{t}$ to $\frac{m\,n\,f\,d\,\dot{t}}{a}$.

Fig 4. Now A, in fig. 4. is the summit of the equator both of libration and rotation; $m\,n\,f\,d\,\dot{t}^2$ is the space described by its libration in the time $\dot{t}$; and $a\,\dot{r}$ is the space or arch A r (fig. 4.) described in the same time by its rotation: therefore, taking A r to A c (perpendicular to the plane of the equator of rotation, and lying in the equator of libration,) as $a\,\dot{r}$ to $m\,n\,f\,d\,\dot{t}^2$, and completing the parallelogram A $r\,m\,c$, A m will be the compound motion of A (N° 31.), and $a\,\dot{r} : m\,n\,f\,d\,\dot{t}^2 = 1 : \frac{m\,n\,f\,d\,\dot{t}^2}{a\,\dot{r}}$, which will be the tangent of the angle m A r, or of the change of position of the equator. But the axes of rotation are perpendicular to their equator; and therefore the angle of deviation w is equal to this angle r A m. This appears from fig. 5.; for Π P″ : P′p = OP : P′p, = OP : tan. POP; and it is evident that $a\,\dot{r} : m\,n\,f\,d\,\dot{t}^2 = \frac{\dot{r}}{t} m\,n\,f\,d\frac{\dot{t}}{a}$, as is required by the composition of rotations.

In consequence of this change of position, the plane of the equator no longer cuts the plane of the ecliptic in the line N n. The plane of the new equator cuts the former equator in the line AO, and the part AN of the former equator lies between the ecliptic and the new equator AN′, while the part A n of the former equator is above the new one A n'; therefore the new node N′, from which the point A was moving, is removed to the westward, or farther from A; and the new node n', to which A is approaching, is also moved westward, or nearer to A; and this happens in every position of A. The nodes, therefore, or equinoctial points, continually shift to the westward, or in a contrary direction to the rotation of the earth; and the axis of rotation always deviates to the east side of the meridian which passes through the sun.

This account of the motions is extremely different from what a person should naturally expect. If the earth were placed in the summer solstice, with respect to us who inhabit its northern hemisphere, and had no rotation round its axis, the equator would begin to approach the ecliptic, and the axis would become more upright; and this would go on with a motion continually accelerating, till the equator coincided with the ecliptic. It would not stop here, but go as far on the other side, till its motion were extinguished by the opposing forces; and it would return to its former position, and again begin to approach the ecliptic, playing up and down like the arm of a balance. On this account this motion is very properly termed *libration;* but this very slow libration, compounded with the incomparably swifter motion of diurnal rotation, produces a third motion extremely different from both. At first the north pole of the earth inclines forward toward the sun; after a long course of years it will incline to the left hand, as viewed from the sun, and be much more inclined to the ecliptic, and the plane of the equator will pass through the sun. Then the south pole will come into view, and the north pole will begin to decline from the sun; and this will go on (the inclination of the equator diminishing all the while) till, after a course of years, the north pole will be turned quite away from the sun, and the inclination of the equator will be restored to its original quantity. After this the phenomena will have another period similar to the former, but the axis will now deviate to the right hand. And thus, although both the earth and sun should not move from their places, the inhabitants of the earth would have a complete succession of the seasons accomplished in a period of many centuries. This would be prettily illustrated by an iron ring poised very nicely on a cap like the card of a mariner's compass, having its centre of gravity coinciding with the point of the cap, so that it may whirl round in any position. As this is extremely difficult to execute, the cap may be pierced a little deeper, which will cause the ring to maintain a horizontal position with a very small force. When the ring is whirling very steadily, and pretty briskly, in the direction of the hours of a watch-dial, hold a strong magnet above the middle of the nearer semicircle (above the 6 hour point) at the distance of three or four inches. We shall immediately observe the ring rise from the 9 hour point, and sink at the 3 hour point, and gradually acquire a motion of precession and nutation, such as has been described.

If the earth be now put in motion round the sun, or the sun round the earth, motions of libration and deviation will still obtain, and the succession of their different phases, if we may so call them, will be perfectly analogous to the above statement. But the quantity of deviation, and change of inclination, will now be prodigiously diminished, because the rapid change of the sun's position quickly diminishes the disturbing forces, annihilates them by bringing the sun into the plane of the equator and brings opposite forces into action.

We see in general that the deviation of the axis is always at right angles to the plane passing through the sun, and that the axis, instead of being raised from the ecliptic, or brought nearer to it, as the libration would occasion, deviates sidewise; and the equator, instead of being raised or depressed round its east and west points, is twisted sidewise round the north and south points; or at least things have this appearance; but we must now attend to this circumstance more minutely.

The composition of rotation shows us that this change of the axis of diurnal rotation is by no means a translation of the former axis (which we may suppose to be the axis of figure) into a new position, in which it again becomes the axis of diurnal motion; nor does the equator of figure, that is, the most prominent section of the terrestrial spheroid, change its position, and in this new position continue to be the equator of rotation. This was indeed supposed by Sir Isaac Newton;

ton; and this supposition naturally resulted from the train of reasoning which he adopted. It was strictly true of a single moon, or of the imaginary orbit attached to it; and therefore Newton supposed that the whole earth did in this manner deviate from its former position, still, however, turning round its axis of figure. In this he has been followed by Walmesly, Simpson, and most of his commentators. D'Alembert was the first who entertained any suspicion that this might not be certain; and both he and Euler at last showed that the new axis of rotation was really a new line in the body of the earth, and that its axis and equator of figure did not remain the axis and equator of rotation. They ascertained the position of the real axis by means of a most intricate analysis, which obscured the connection of the different positions of the axis with each other, and gave us only a kind of momentary information. Father Frisius turned his thoughts to this problem, and fortunately discovered the composition of rotations as a general principle of mechanical philosophy. Few things of this kind have escaped the penetrating eye of Sir Isaac Newton. Even *this* principle had been glanced at by him. He affirms it in express terms with respect to a body that is perfectly spherical (cor. 22. prop. 66. B. I.). But it was reserved for Frisius to demonstrate it to be true of bodies of any figure, and thus to enrich mechanical science with a principle which gives simple and elegant solutions of the most difficult problems.

But here a very formidable objection naturally offers itself. If the axis of the diurnal motion of the heavens is not the axis of the earth's spheroidal figure, but an imaginary line in it, round which even the axis of figure must revolve; and if this axis of diurnal rotation has so greatly changed its position, that it now points at a star at least 12 degrees distant from the pole observed by Timochares, how comes it that the equator has the very same situation on the surface of the earth that it had in ancient times? No sensible change has been observed in the latitude of places.

Fig. 6.

The answer is very simple and satisfactory: Suppose that in 12 hours the axis of rotation has changed from the position PR (fig. 6.) to $p\,r$, so that the north pole, instead of being at P, which we may suppose to be a particular mountain, is now at p. In this 12 hours the mountain P, by its rotation round $p\,r$, has acquired the position π. At the end of the next 12 hours, the axis of rotation has got the position $\pi\varrho$, and the axis of figure has got the position $p\,r$, and the mountain P is now at p. Thus, on the noon of the following day, the axis of figure PR is in the situation which the real axis of rotation occupied at the intervening midnight. This goes on continually, and the axis of figure follows the position of the axis of rotation, and is never further removed from it than the deviation of 12 hours, which does not exceed $\frac{1}{100}$th part of one second, a quantity altogether imperceptible. Therefore the axis of figure will always sensibly coincide with the axis of rotation, and no change can be produced in the latitudes of places on the surface of the earth.

34
Application of this reasoning to nutation and precession.

We have hitherto considered this problem in the most general manner; let us now apply the knowledge we have gotten of the deviation of the axis or of the momentary action of the disturbing force to the explanation of the phenomena: that is, let us see what precession and what nutation will be accumulated after any given time of action.

For this purpose we must ascertain the precise deviation which the disturbing forces are competent to produce. This we can do by comparing the momentum of libration with the gravitation of the earth to the sun, and this with the force which would retain a body on the equator while the earth turns round its axis.

The gravitation of the earth to the sun is in the proportion of the sun's quantity of matter M directly, and to the square of the distance A inversely, and may therefore be expressed by the symbol $\frac{M}{A^2}$. The disturbing force at the distance 1 from the plane of illumination is to the gravitation of the earth's centre to the sun as 3 to A, (A being measured on the same scale which measures the distance from the plane of illumination). Therefore $\frac{3\,M}{A^4}$ will be the disturbing force f of our formula.

Let p be the centrifugal force of a particle at the distance 1 from the axis of rotation; and let t and T be the times of rotation and of annual revolution, viz. sidereal day and year. Then $p : \frac{M}{A^2} = \frac{1}{t^3} : \frac{A}{T^2}$. Hence we derive $\frac{3\,M}{A^3} = 3\,p\,\frac{t^2}{T^2}$. But since $\dot{r}$ was the angular velocity of rotation, and consequently $1 \times \dot{r}$ the space described, and $\frac{1 \times \dot{r}}{\dot{t}}$ the velocity; and since the centrifugal force is as the square of the velocity divided by the radius (this being the measure of the generated velocity, which is the proper measure of any accelerating force), we have $p = \frac{1^2 \times \dot{r}^2}{1^2 \times \dot{t}^2}, = \frac{\dot{r}^2}{\dot{t}^2}$, and $f = \frac{3\,\dot{r}^2}{\dot{t}^2} \times \frac{t^2}{T^2}$. Now the formula $f\,m\,n\,d\,\frac{\dot{t}^2}{a}$ expressed the sine of the angle. This being extremely small, the sine may be considered as equal to the arc which measures the angle. Now, substitute for it the value now found, viz. $\frac{3\,\dot{r}^2}{\dot{t}^2} \times \frac{t^2}{T^2}$, and we obtain an angle of deviation $\dot{w} = \dot{r}\,\frac{3\,t^2}{T^2}\,m\,n\,\frac{d}{a}$, and this is the simplest form in which it can appear. But it is convenient, for other reasons, to express it a little differently: d is nearly equal to $\frac{a^2 - b^2}{2\,a^2}$ therefore $\dot{w} = \dot{r} \times \frac{3}{2}\,\frac{t^2}{T^2}\,m\,n\,\frac{a^2 - b^2}{a^2}$, and this is the form in which we shall now employ it.

The small angle $\dot{r}\,\frac{3\,t^2}{2T^2}\,m\,n\,\frac{a^2 - b^2}{a^2}$ is the angle in which the new equator cuts the former one. It is different at different times, as appears from the variable part $m\,n$, the product of the sine and cosine of the sun's declination. It will be a maximum when the declination is in the solstice, for $m\,n$ increases all the way to 45°, and the declination never exceeds $23\frac{1}{2}$. It increases, therefore, from the equinox to the solstice, and then diminishes.

Let

Precession. Fig. 7.

Let ESL (fig. 7.) be the ecliptic, EAC the equator, BAD the new position which it acquires by the momentary action of the sun, cutting the former in the angle BAE $=\dot{r}\frac{3}{2}\frac{t^2}{T^2}mn\frac{a^2-b^2}{a^2}$. Let S be the sun's place in the ecliptic, and AS the sun's declination, the meridian AS being perpendicular to the equator. Let $\frac{a^2-b^2}{a^2}$ be k. The angle BAE is then $=\dot{r}\frac{3t^2}{2T^2}kmn$. In the spherical triangle BAE we have sin. B : sin. AE = sin. A : sin. BE, or = AB : BE, because very small angles and arches are as their sines. Therefore BE, which is the momentary precession of the equinoctial point E, is equal to $A\frac{\text{sin. AE}}{\text{sin. B}}, =\dot{r}\times\frac{3t^2}{2T^2}kmn, \frac{\text{sin. R. ascen.}}{\text{sin. obl. ecl.}}$

35 Various modes of application. The equator EAC, by taking the position BAD, recedes from the ecliptic in the colure of the solstices CL, and CD is the change of obliquity or the nutation. For let CL be the solstitial colure of BAD, and cl the solstitial colure of EAC. Then we have sin. B : sin. E = sin. LD : sin. lc; and therefore the difference of the arches LD and lc will be the measure of the difference of the angles B and E. But when BE is indefinitely small, CD may be taken for the difference of LD and lc, they being ultimately in the ratio of equality. Therefore CD measures the change of the obliquity of the ecliptic, or the nutation of the axis with respect to the ecliptic.

The real deviation of the axis is the same with the change in the position of the equator, P p being the measure of the angle EAB. But this not being always made in a plane perpendicular to the ecliptic, the change of obliquity generally differs from the change in the position of the axis. Thus when the sun is in the solstice, the momentary change of the position of the equator is the greatest possible; but being made at right angles to the plane in which the obliquity of the ecliptic is computed, it makes no change whatever in the obliquity, but the greatest possible change in the precession.

36 In order to find CD the change of obliquity, observe that in the triangle CAD, R : sin. AC, or R : cos. AE = sin. A : sin. CD, = A : CD (because A and CD are exceedingly small). Therefore the change of obliquity (which is the thing commonly meant by nutation) CD = A × cos. AE, $=\dot{r}\frac{3t^2}{2T^2}kmn$, cos. AE $=\dot{r}\frac{3t^2}{2T^2}k\times$ sin. declin. × cos. declin. × cos. R. ascens.

37 But it is more convenient for the purposes of astronomical computation to make use of the sun's longitude SE. Therefore make

The sun's longitude ES	- - =	z
Sine of sun's long.	- - - =	x
Cosine	- - - $\sqrt{1-x^2}$ =	y
Sine obliq. eclipt.	- - - 23½ =	p
Cosine obliq.	- - - =	q

38 In the spherical triangle EAS, right-angled at A (because AS is the sun's declination perpendicular to the equator), we have R : sin. ES = sin. E : sin. AS, and sin. AS $=px$. Also R : cos. AS = cos. AE : cos. ES, and cos. ES or $y=$ cos. AS × cos. AE. Therefore $pxy=$ sin. AS × cos. AS × cos. AE, $=mn\times$ cos. AE. Therefore the momentary nutation CD $=\dot{r}\times\frac{3t^2}{2T^2}kpxy$.

We must recollect that this angle is a certain fraction of the momentary diurnal rotation. It is more convenient to consider it as a fraction of the sun's annual motion, that so we may directly compare his motion on the ecliptic with the precession and nutation corresponding to his situation in the heavens. This change is easily made, by augmenting the fraction in the ratio of the sun's angular motion to the motion of rotation, or multiplying the fraction by $\frac{T}{t}$; therefore the momentary nutation will be $\dot{r}\frac{3t}{2T}kpxy$. In this value $\frac{3tkp}{2T}$ is a constant quality, and the momentary nutation is proportional to xy, or to the product of the sine and cosine of the sun's longitude, or to the sine of twice the sun's longitude; for xy is equal to half the sine of twice z. 39

If therefore we multiply this fraction by the sun's momentary angular motion, which we may suppose, with abundant accuracy, proportional to $\dot{z}$, we obtain the fluxion of the nutation, the fluent of which will express the whole nutation while the sun describes the arch z of the ecliptic, beginning at the vernal equinox. Therefore in place of y put $\sqrt{1-x^2}$, and in place of $\dot{z}$ put $\frac{\dot{x}}{\sqrt{1-x^2}}$, and we have the fluxion of the nutation for the moment when the sun's longitude is z, and the fluent will be the whole nutation. The fluxion resulting from this process is $\frac{3tkp}{2T}x\dot{x}$, of which the fluent is $\frac{3tkp}{4T}x^2$. This is the whole change produced on the obliquity of the ecliptic while the sun moves along the arch z ecliptic, reckoned from the vernal equinox. When this arch is 90°, x^2 is 1, and therefore $\frac{3tkp}{4T}$ is the nutation produced while the sun moves from the equinox to the solstice. 40

The momentary change of the axis and plane of the equator (which is the measure of the changing force) is $\frac{3tk}{2T}mn$.

41 The real and momentary changes greatest at the solstices, and at the equinoxes nothing.

The momentary change of the obliquity of the ecliptic is $\frac{3tkp}{2T}x\dot{x}$

The whole change of obliquity is $\frac{3tkp}{4T}x^2$.

Hence we see that the force and the real momentary change of position are greatest at the solstices, and diminish to nothing in the equinoxes.

The momentary change of obliquity is greatest at the octants, being proportional to $x\dot{x}$ or to xy.

The whole accumulated change of obliquity is greatest at the solstices, the obliquity itself being then smallest.

We must in like manner find the accumulated quantity

Fig. 1.

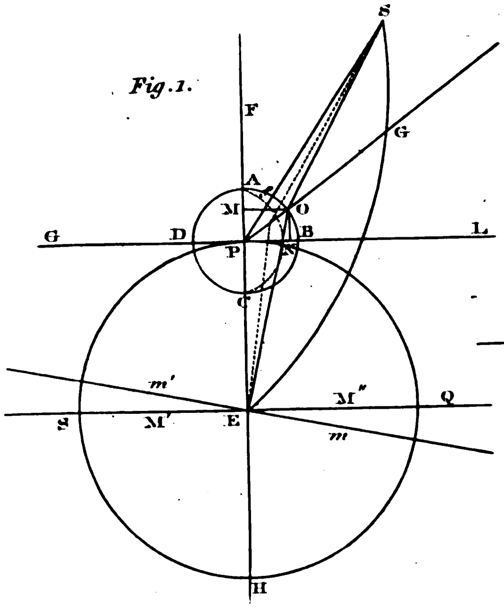


Fig. 2.

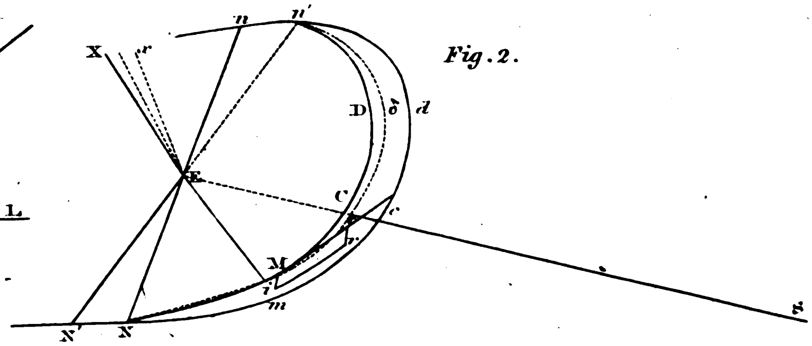


Fig. 3.

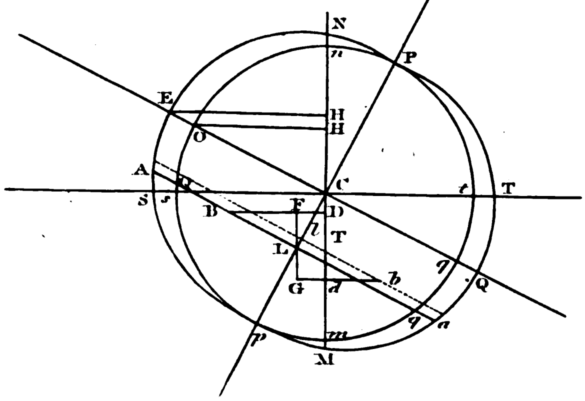


Fig. 4.

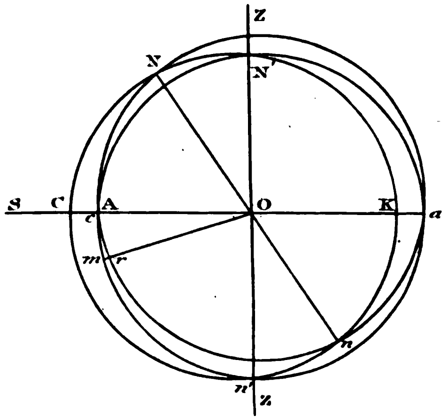


Fig. 5.

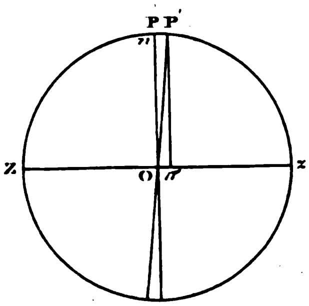


Fig. 6.

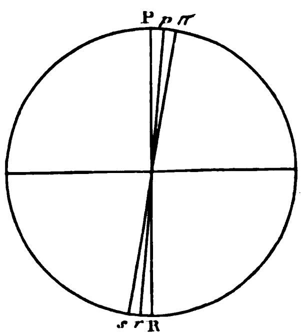


Fig. 7.

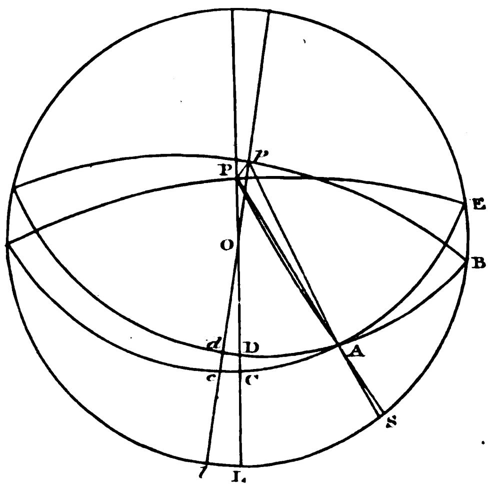
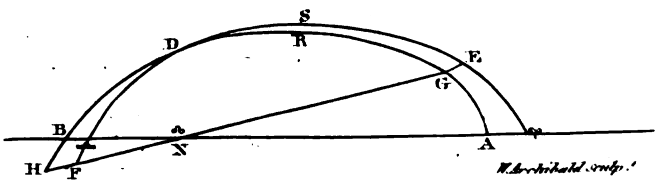


Fig. 8.



W. Archibald sculp.

Precession.

tity of the precession after a given time, that is, the arch BE for a finite time.

42 Quantity of precession in a given time.

We have ER : CD = sin. EA : sin. CA (or cos. EA) = tan. EA : 1, and EB : ER = 1 : sin. B. Therefore EB : CD = tan. EA : sin. B. But tan. EA = cos. E $\times$ tan. ES, = cos. E $\times \frac{\text{sin. long.}}{\text{cos. long.}} = \frac{qx}{\sqrt{1-x^2}}$.

Therefore EB : CD = $\frac{qx}{\sqrt{1-x^2}}p$, and CD = EB : $\frac{\text{sin. obliq. eclip.}}{\text{tan. long.} \odot}$. If we now substitute for CD its value found in N° 40. viz. $\frac{3tkp}{2T}x\dot{x}$, we obtain EB = $\frac{3t}{2T} \times \frac{kqx^2\dot{x}}{\sqrt{1-x^2}}$, the fluxion of the precession of the equinoxes occasioned by the action of the sun. The fluent of the variable part $\frac{x^2\dot{x}}{\sqrt{1-x^2}} = x\dot{y}$, of which the fluent is evidently a segment of a circle whose arch is z and sine x, that is, $= \frac{z - x\sqrt{1-x^2}}{2}$, and the whole precession, while the sun describes the arch z, is $\frac{3t}{2T} \times \frac{kq}{2}\left(z - x\sqrt{1-x^2}\right)$. This is the precession of the equinoxes while the sun moves from the vernal equinox along the arch z of the ecliptic.

In this expression, which consists of two parts, $\frac{3tkq}{4T}z$, and $\frac{3tkq}{4T}\left(-x\sqrt{1-x^2}\right)$, the first is incomparably greater than the second, which never exceeds 1″, and is always compensated in the succeeding quadrant. The precession occasioned by the sun will be $\frac{3tkq}{4T}z$, and from this expression we see that the precession increases uniformly, or at least increases at the same rate with the sun's longitude z, because the quantity $\frac{3tkq}{4T}$ is constant.

43 Mode of using the formulæ.

In order to make use of these formulæ, which are now reduced to very great simplicity, it is necessary to determine the values of the two constant quantities $\frac{3tkp}{4T}$, $\frac{3tkq}{4T}$, which we shall call N and P, as factors of the nutation and precession. Now t is one sidereal day, and T is $366\frac{1}{4}$. k is $\frac{a^2-b^2}{a^2}$, which according to Sir Isaac Newton is $\frac{231^2-230^2}{231^2} = \frac{1}{115}$; p and q are the sine and cosine of 23° 28′, viz. 0.39822 and 0.91729.

These data give $N = \frac{1}{141030}$ and $P = \frac{1}{61224}$, of which the logarithms are 4.85069 and 5.21308, viz. the arithmetical complements of 5.14931 and 4.78692.

44 Example of the utility of the investigation.

Let us, for an example of the use of this investigation, compute the precession of the equinoxes when the sun has moved from the vernal equinox to the summer solstice, so that z is 90°, or 324000″.

Log 324000′ = z	5.51055
Log P	5.21308
Log 5″.292	0.72363

The precession therefore in a quarter of a year is 5.292 seconds; and, since it increases uniformly, it is 21″.168 annually.

45 Assumptions on which the computation proceeds.

We must now recollect the assumptions on which this computation proceeds. The earth is supposed to be homogeneous, and the ratio of its equatorial diameter to its polar axis is supposed to be that of 231 to 230. If the earth be more or less protuberant at the equator, the precession will be greater or less in the ratio of this protuberance. The measures which have been taken of the degrees of the meridian are very inconsistent among themselves; and although a comparison of them all indicates a smaller protuberancy, nearly $\frac{1}{314}$ instead of $\frac{1}{231}$, their differences are too great to leave much confidence in this method. But if this figure be thought more probable, the precession will be reduced to about 17″ annually. But even though the figure of the earth were accurately determined, we have no authority to say that it is homogeneous. If it be denser towards the centre, the momentum of the protuberant matter will not be so great as if it were equally dense with the inferior parts, and the precession will be diminished on this account. Did we know the proportion of the matter in the moon to that in the sun, we could easily determine the proportion of the whole observed annual precession of $50\frac{1}{3}$″ which is produced by the sun's action. But we have no unexceptionable data for determining this; and we are rather obliged to infer it from the effect which she produces in disturbing the regularity of the precession, as will be considered immediately. So far, therefore, as we have yet proceeded in this investigation, the result is very uncertain. We have only ascertained unquestionably the law which is observed in the solar precession. It is probable, however, that this precession is not very different from 20″ annually; for the phenomena of the tides show the disturbing force of the sun to be very nearly $\frac{2}{5}$ of the disturbing force of the moon. Now 20″ is $\frac{2}{5}$ of 50″.

46 Effect of the moon's action on the protuberant matter of the earth.

But let us now proceed to consider the effect of the moon's action on the protuberant matter of the earth; and as we are ignorant of her quantity of matter, and consequently of her influence in similar circumstances with the sun, we shall suppose that the disturbing force of the moon is to that of the sun as m to 1. Then (*cæteris paribus*) the precession will be to the solar precession π in the ratio of the force and of the time of its action jointly. Let t and T therefore represent a periodical month and year, and the lunar precession will be $= \frac{m\pi t}{T}$. This precession must be reckoned on the plane of the lunar orbit, in the same manner as the solar precession is reckoned on the ecliptic. We must also observe, that $\frac{m\pi t}{T}$ represents the lunar precession only on the supposition that the earth's equator is inclined to the lunar orbit in an angle of $23\frac{1}{2}$ degrees. This is indeed the mean inclination; but it is sometimes increased to above 28°, and sometimes reduced to 18°. Now in the value of the solar precession the cosine of the obliquity was employed. Therefore whatever is the

Precession.

the angle E contained between the equator and the lunar orbit, the precession will be $= \frac{m \pi t}{T} \cdot \frac{\text{Cos. E}}{\text{Cos. } 23\frac{1}{2}^{\circ}}$, and it must be reckoned on the lunar orbit.

47 Fig. 8.

Now let ♈ B (fig. 8.) be the immoveable plane of the ecliptic, ♈ ED♎F the equator in its first situation, before it has been deranged by the action of the moon, AGRDBH the equator in its new position, after the momentary action of the moon. Let EGNFH be the moon's orbit, of which N is the ascending node, and the angle N=5° 8′ 46″.

Let N♈ the long. of the node be	z
Sine N♈	x
Cosine N♈	y
Sine ♈ $= 23\frac{1}{2}$	a
Cosine ♈	b
Sine N = 5.8.46	c
Cosine N	d
Circumference to radius 1, = 6.28	e
Force of the moon	m
Solar precession (supposed $= 14\frac{1}{2}''$ by observation)	π
Revolution of ☽ $= 27^{d}\frac{1}{3}$	t
Revolution of ☉ $= 366\frac{1}{4}$	T
Revolution of N = 18 years 7 months	n

48 Lunar precession in a month reduced to the ecliptic.

In order to reduce the lunar precession to the ecliptic, we must recollect that the equator will have the same inclination at the end of every half revolution of the sun or of the moon, that is, when they pass through the equator, because the sum of all the momentary changes of its position begins again each revolution. Therefore if we neglect the motion of the node during one month, which is only $1\frac{1}{2}$ degrees, and can produce but an insensible change, it is plain that the moon produces, in one half revolution, that is, while she moves from H to G, the greatest difference that she can in the position of the equator. The point D, therefore, half-way from G to H, is that in which the moveable equator cuts the primitive equator, and DE and DF are each 90°. But S being the solstitial point, ♈S is also 90°. Therefore DS=♈E. Therefore, in the triangle DGE, we have sin. ED : sin. G=sin. EG : sin. D, =EG : D. Therefore D=EG × sin. G, =EG × sin. E. nearly. Again, in the triangle ♈DA we have sin. A : sin. ♈D (or cos. ♈E) = sin. D : sin. ♈A, =D : ♈A. Therefore

$$\text{♈A} = \frac{\text{D} \cdot \text{cos. ♈E}}{\text{sin. A}}, = \frac{\text{EG} \cdot \text{sin. E} \cdot \text{cos. ♈E},}{\text{sin. } 23\frac{1}{2}}, = \frac{m \pi t}{T} \frac{\text{sin. E} \cdot \text{cos. E} \cdot \text{cos. ♈E}}{\text{sin. ♈} \cdot \text{cos. ♈}}.$$

49 This is the lunar precession produced in the course of one month, estimated on the ecliptic, not constant like the solar precession, but varying with the inclination or the angle E or F, which varies both by a change in the angle N, and also by a change in the position of N on the ecliptic.

50 Nutation in the same time,

We must find in like manner the nutation SR produced in the same time, reckoned on the colure of the solstices RL. We have R : sin. DS=D : RS, and RS=D · sin. DS, =D · sin. ♈E. But D=EG · sin. E. Therefore $\text{RS} = \text{EG} \cdot \text{sin. E} \cdot \text{sin. ♈E}, = \frac{m \pi t \text{ cos. E}}{T \cdot \text{cos. ♈}} \times \text{sin. E} \times \text{sin. ♈E}$. In this expression we must substitute the angle N, which may be considered as constant during the month, and the longitude ♈N, which is also nearly constant, by observing that sin. E : sin. ♈N=sin. N : sin. ♈E. Therefore $\text{RS} = \frac{m \pi t}{T} \times \frac{\text{sin. N} \cdot \text{sin. ♈N} \cdot \text{cos. E}}{\text{cos. ♈}}$.

But we must exterminate the angle E, because it changes by the change of the position of N. Now, in the triangle ♈EN we have cos. E=cos. ♈N · sin. N · sin. ♈ — cos. N · cos. ♈, $= yca - db$. And because the angle E is necessarily obtuse, the perpendicular will fall without the triangle, the cosine of E will be negative, and we shall have cos. E$= bd - acy$. Therefore the nutation for one month will be $= \frac{m \pi t}{T} \times \frac{cx\,(bd - acy)}{b}$, the node being supposed all the while in N.

51 may be considered as momentary parts of the moon's action.

These two expressions of the monthly precession and nutation may be considered as momentary parts of the moon's action, corresponding to a certain position of the node and inclination of the equator, or as the fluxions of the whole variable precession and nutation, while the node continually changes its place, and in the space of 18 years makes a complete tour of the heavens.

52 Precession and nutation compared.

We must, therefore, take the motion of the node as the fluent of comparison, or we must compare the fluxions of the node's motion with the fluxions of the precession and nutation; therefore, let the longitude of the node be z, and its monthly change $= \dot{z}$; we shall then have $t : n = \dot{z} : e$, and $t = \frac{n \dot{z}}{e}, = \frac{n \dot{x}}{e\sqrt{1 - x^2}}$. Let T be = 1, in order that n may be 18.6, and substitute for t its value in the fluxion of the nutation, by putting $\sqrt{1-x^2}$ in place of y. By this substitution we obtain $m \pi n \frac{c}{eb} \left(\frac{dbx\dot{x}}{\sqrt{1-x^2}} - acx\dot{x} \right)$. The fluent of this is $m \pi n \frac{c}{eb} \left(-db\sqrt{1-x^2} - \frac{acx^2}{2} \right)$. (*Vide* Simpson's Fluxions, § 77.). But when x is $=0$, the nutation must be $=0$, because it is from the position in the equinoctial points that all our deviations are reckoned, and it is from this point that the period of the lunar action recommences. But if we make $x = 0$ in this expression, the term $-\frac{acx^2}{2}$ vanishes, and the term $-db\sqrt{1-x^2}$ becomes $= -db$; therefore our fluent has a constant part $+db$; and the complete fluent is $m \pi n \frac{c}{eb} \left(db - db\sqrt{1-x^2} - \frac{acx^2}{2} \right)$. Now this is equal to $m \pi n \frac{c}{eb}(db \times$ versed sine, $z - \frac{1}{4}ac \times$ versed sine $2z)$: For the versed sine of z is equal to $(1 - \text{cos. } z)$; and the square of the sine of an arch is $\frac{1}{2}$ the versed sine of twice that arch.

This, then, is the whole nutation while the moon's ascending node moves from the vernal equinox to the longitude ♈N=z. It is the expression of a certain number of seconds, because π, one of its factors, is the solar precession in seconds; and all the other factors are numbers, or fractions of the radius 1; even e is expressed in terms of the radius 1. 53

The fluxion of the precession, or the monthly precession, 54

Precession.

sion, is to that of the nutation as the cotangent of ♈ E is to the sine of ♈. This also appears by considering fig. 7. Pp measures the angle A, or change of position of the equator; but the precession itself, reckoned on the ecliptic, is measured by Po, and the nutation by po; and the fluxion of the precession is equal to the fluxion of nutation $\times \frac{\text{cot. ♈ E}}{\text{sine ♈}}$, but cot. ♈ E$=\frac{ad+bcy}{cx}$; therefore $\frac{\text{cot. ♈ E}}{\text{sine ♈}}=\frac{ad+bc\sqrt{1-x^2}}{cx}$: This, multiplied into the fluxion of the nutation, gives $\frac{m\pi n}{abe}\Big(\frac{abd^2}{\sqrt{1-xx}}+(b^2-a^2)\,dc-abc^2.\sqrt{1-xx}\Big)\dot{z}$ for the monthly precession. The fluent of this $\frac{m\pi n}{abe}\Big(ad^2bz+(b^2-a^2)\,dcx-\frac{1}{2}abc^2z-\frac{1}{2}abc^2x\sqrt{1-x^2}\Big)$, or it is equal to $\frac{m\pi n}{abe}\Big((d^2-\frac{1}{2}c^2)\,abz+(b^2-a^2)\,dcz-\frac{1}{4}abc^2 \text{ sine } 2z\Big)$.

55 Let us now express this in numbers? When the node has made a half revolution, we have $z=180°$, whose versed sine is 2, and the versed sine of $2z$, or 360°, is $=0$; therefore, after half a revolution of the node, the nutation (N° 52.) becomes $\frac{m\pi nc}{eb}2bd$. If, in this expression, we suppose $m=2\frac{1}{7}$, and $\pi=14\frac{1}{2}''$, we shall find the nutation to be $19\frac{1}{3}''$.

56 Now the observed nutation is about 18″. This requires m to be $2\frac{1}{10}$, and $\pi=16\frac{1}{4}''$. But it is evident that no astronomer can pretend to warrant the accuracy of his observations of the nutation within 1″.

To find the lunar precession during half a revolution of the node, observe that then z becomes $=\frac{e}{2}$, and the sine of z and of $2z$ vanish, d^2 becomes $1-c^2$, and the precession becomes $\frac{m\pi n}{2}(d^2-\frac{1}{2}c^2)$, $=\frac{m\pi n}{2}(1-\frac{3}{2}c^2)$, and the precession in 18 years is $m\pi n\,\overline{1-\frac{3}{2}c^2}$.

57 We see, by comparing the nutation and precession for nine years, that they are as $\frac{4cd}{e}$ to $1-\frac{3}{2}c^2$, nearly as 1 to $17\frac{1}{7}$. This gives 313″ of precession, corresponding to 18″, the observed nutation, which is about 35″ of precession annually produced by the moon.

58 Gives the disturbing force and matter of the moon.

And thus we see, that the inequality produced by the moon in the precession of the equinoxes, and, more particularly, the nutation occasioned by the variable obliquity of her orbit, enables us to judge of her share in the whole phenomenon; and therefore informs us of her disturbing force, and therefore of her quantity of matter. This phenomenon, and those of the tides, are the only facts which enable us to judge of this matter: and this is one of the circumstances which has caused this problem to occupy so much attention. Dr Bradley, by a nice comparison of his observations with the mathematical theory, as it is called, furnished him by Mr Machin, found that the equation of precession computed by that theory was too great, and that the theory would agree better with the observations, if an ellipse were substituted for Mr Machin's little circle. He thought that the shorter axis of this ellipse, lying in the colure of the solstices, should not exceed 16″. Nothing can more clearly show the astonishing accuracy of Bradley's observations than this remark: for it results from the theory, that the pole must really describe an ellipse, having its shorter axis in the solstitial colure, and the ratio of the axis must be that of 18 to 16.8; for the mean precession during a half revolution of the node is $\frac{m\pi n}{2}(d^2-\frac{c^2}{2})$; and therefore, for the longitude z, it will be $\frac{zm\pi n}{e}(d^2-\frac{c^2}{2})$; when this is taken from the true precession for that longitude (N° 54.), it leaves the equation of precession $\frac{m\pi n}{abe}\Big((b^2-a^2)\,dc \text{ sine } z-\frac{1}{4}abc \text{ sine } 2z\Big)$; therefore, when the node is in the solstice, and the equation greatest, we have it$=\frac{m\pi ncd}{abe}(b^2-a^2)$. We here neglect the second term as insignificant.

Precession. Preciæ.

59 Greatest equation of precession.

This greatest equation of precession is to $\frac{2m\pi ncd}{c}$, the nutation of 18″, as b^2-a^2 to $2ab$; that is, as radius to the tangent of twice the obliquity of the ecliptic. This gives the greatest equation of precession 16″.8, not differing half a second from Bradley's observations.

Thus have we attempted to give some account of this curious and important phenomenon. It is curious, because it affects the whole celestial motions in a very intricate manner, and received no explanation from the more obvious application of mechanical principles, which so happily accounted for all the other appearances. It is one of the most illustrious proofs of Sir Isaac Newton's sagacity and penetration, which catched at a very remote analogy between this phenomenon and the libration of the moon's orbit. It is highly important to the progress of practical and useful astronomy, because it has enabled us to compute tables of such accuracy, that they can be used with confidence for determining the longitude of a ship at sea. This alone fixes its importance: but it is still more important to the philosopher, affording the most incontestable proof of the universal and mutual gravitation of all matter to all matter. It left nothing in the solar system unexplained from the theory of gravity but the acceleration of the moon's mean motion; and this has at last been added to the list of our acquisitions by M. de la Place.

Quæ toties animos veterum torsere Sophorum,
Quæque scholas frustra rauco certamine vexant,
Obvia conspicimus, nube pellente Mathesi,
Jam dubios nulla caligine prægravat error
Queis superûm penetrare domos, atque ardua cœli
Scandere sublimis genii concessit acumen.
Nec fas est propius mortali attingere divos.

Halley.

PRECIÆ, (*precius*, "early"), the name of the 21st order in Linnæus's fragments of a natural method; consisting of primrose, an early flowering plant, and a few

few genera which agree with it in habit and structure, though not always in the character or circumstance expressed in the title. See BOTANY, *Natural Orders*.

PRECIPITANT, in *Chemistry*, is applied to any liquor, which, when poured on a solution, separates what is dissolved, and makes it precipitate, or fall to the bottom of the vessel.

PRECIPITATE, in *Chemistry*, a substance which having been dissolved in a proper menstruum, is again separated from its solvent, and thrown down to the bottom of the vessel by pouring some other liquor upon it.

PRECIPITATION, the process by which a precipitate is formed.

PRECOGNITION, in *Scots Law*. See LAW, Part III. N° CLXXXVI. 43.

PRECORDIA, in *Anatomy*, a general name for the parts situated about the heart, in the forepart of the thorax; as the diaphragm, pericardium, and even the heart itself, with the spleen, lungs, &c.

PREDECESSOR, properly signifies a person who has preceded or gone before another in the same office or employment; in which sense it is distinguished from ancestor.

1 The doctrine stated.

PREDESTINATION, the decree of God whereby he hath from all eternity unchangeably appointed whatsoever comes to pass; and hath more especially fore-ordained certain individuals of the human race to everlasting happiness, and hath passed by the rest, and fore-ordained them to everlasting misery. The former of these are called the *elect*, and the latter are called the *reprobate*.

2 Not peculiar to Christianity.

This doctrine is the subject of one of the most perplexing controversies that has occurred among mankind. But it is not altogether peculiar to the Christian faith. The opinion, that whatever occurs in the world at large, or in the lot of private individuals, is the result of a previous and unalterable arrangement by that Supreme Power which presides over nature, has always been a favourite opinion among the vulgar, and has been believed by many speculative men. Thus, in that beautiful scene in the sixth book of the Iliad, Hector, taking leave of his wife and his child, speaks thus:

> Andromache! my soul's far better part,
> Why with untimely sorrows heaves thy heart?
> No hostile hand can antedate my doom,
> Till fate condemns me to the silent tomb.
> Fix'd is the term to all the race of earth,
> And such the hard condition of our birth.
> No force can then resist, no flight can save;
> All sink alike, the fearful and the brave. l. 624.

The ancient Stoics, Zeno and Chrysippus, whom the Jewish Essenes seem to have followed, asserted the existence of a Deity, that, acting wisely, but necessarily, contrived the general system of the world; from which, by a series of causes, whatever is now done in it unavoidably results. This series, or concatenation of causes, they held to be necessary in every part; and that God himself is so much the servant of necessity, and of his own decrees, that he could not have made the smallest object in the world otherwise than it now is, much less is he able to alter any thing.

According to the words of Seneca, *Eadem necessitas et Deos alligat. Irrevocabilis divina pariter atque humana cursus vehit. Ille ipse omnium conditor ac rector scripsit quidem fata sed sequitur. Semper paret, semel jussit.*" "The same chain of necessity constrains both gods and men. Its unalterable course regulates divine as well as human things. Even he who wrote the Fates, the Maker and Governor of all things, submits to them. He did but once command, but he always obeys." The stoical fate, however, differs from the Christian predestination in several points. They regarded the divine nature and will as a necessary part of a necessary chain of causes; whereas the Christians consider the Deity as the Lord and Ruler of the Universe, omnipotent and free, appointing all things according to his pleasure. Being doubtful of the immortality of the soul, the Stoics could have no idea of the doctrine of election and reprobation; nor did they ever doubt their own freedom of will, or power of doing good as well as evil, as we shall presently see the Christian predestinarians have done.

Mahomet introduced into his Koran the doctrine of an absolute predestination of the course of human affairs. He represented life and death, prosperity and adversity, and every event that befals a man in this world, as the result of a previous determination of the one God who rules over all; and he found this opinion the best engine for inspiring his followers with that contempt of danger, which, united to their zeal, has extended the empire of their faith over the fairest portion of the habitable globe.

3 When first agitated in the church.

The controversy concerning predestination first made its appearance in the Christian church about the beginning of the fifth century *. Pelagius a British, and Cœlestius an Irish monk, both lived at Rome during that period, and possessed great celebrity on account of their piety and learning. They taught that the opinion is false, which asserts, that human nature is necessarily corrupted by a depravity derived from our first parents.—They contended, that men are born at present in a state as pure as that in which Adam was originally created; and that they are not less qualified than he was for fulfilling all righteousness, and for reaching the most sublime eminence of piety and virtue: that the external grace of God, which is given unto all, and attends the preaching of the gospel, is necessary to call forth the attention and exertions of men; but that we do not want the assistance of any internal grace to purify the heart, and to give it the first impulse towards what is good. Having fled into Africa on account of the Goths, who at that time invaded Italy, A. D. 410, Cœlestius remained at Carthage as a presbyter; but Pelagius went into the East, where he settled, and prospered under the patronage of John bishop of Jerusalem, to whom his sentiments were agreeable.

4 Augustine, a predestinarian.

On the contrary, the celebrated Augustine, bishop of Hippo, strenuously asserted the depravity of human nature since the fall of the first man, the necessity of a special interposition of divine grace to enable us to do any one good action; and consequently, that none could obtain salvaaction excepting those whom God has thought fit to elect, and upon whom he bestows this grace. The dispute was carried on with great zeal. Zozimus bishop of Rome decided at first in favour of Pelagius and Cœlestius, whose followers were called *Pelagians*; but he afterwards altered his opinion; and by the activity of Augustine, the council of Ephesus was called, at

* Mosheim. Instit. Hist. Eccl.

Predestination.

at which the opinion of his antagonists was formally condemned.

In the course of the same century, these opinions assumed a variety of forms and modifications. One party, called *Predestinarians*, carried Augustine's doctrine fully farther than he himself had ventured to do in express words; and asserted, that God had not only predestinated the wicked to *punishment*, but also that he had decreed that they should commit those very *sins* on account of which they are hereafter to be punished.—Another party moderated the doctrine of Pelagius, and were called *Semipelagians*. Their peculiar opinion is expressed in a different manner by different writers; but all the accounts sufficiently agree. Thus, some represent them as maintaining that inward grace is not necessary to the first beginning of repentance, but only to our progress in virtue. Others say, that they acknowledged the power of grace, but said that faith depends upon ourselves, and good works upon God; and it is agreed upon all hands, that these Semipelagians held that predestination is made upon the foresight of good works. The assistance of Augustine, though then far advanced in life, was called in to combat these tenets, and he wrote several treatises upon the subject. In all these he strenuously maintained, that the predestination of the elect was independent of any foresight of their good works, but was according to the good pleasure of God only; and that perseverance comes from God, and not from man. Thereafter the doctrine of Augustine, or St Austin as he is often called, became general. He was the oracle of the schoolmen. They never ventured to differ from him in sentiment; they only pretended to dispute about the true sense of his writings.

5
and all the earliest reformers, but more especially Calvin.

The whole of the earliest reformers maintained these opinions of Augustine. They assumed under Luther a more regular and systematic form than they had ever formerly exhibited. But as the Lutherans afterwards abandoned them, they are now known by the name of *Calvinistic Doctrines*, from John Calvin of Geneva. He asserted, that the everlasting condition of mankind in a future world was determined from all eternity by the unchangeable decree of the Deity, arising from his sole good pleasure or free will. Being a man of great ability, industry, and eloquence, Geneva, where he taught, and which was a free state, soon became the resort of all the men of letters belonging to the reformed churches, and was a kind of seminary from which misssionaries issued to propagate the Protestant doctrines through Europe. Their success was such, that, excepting a part of Germany, the principles of all the reformed churches are professedly Calvinistic or Predestinarian.

6
Rise of the Arminians.

The opponents of the doctrine of predestination among the Protestants usually receive the appellation of *Arminians* or *Remonstrants*. They derive the first of these appellations from James Arminius, who was A. D. 1602, appointed* professor of theology at Leyden. He was violently opposed by Gomer his colleague, and died A. D. 1609. After his death, the controversy was conducted with great eagerness on both sides. The Calvinists, however, gradually prevailed. A synod was called at Dort, A. D. 1618, to which the most celebrated divines of different countries were invited. There, in a great measure, by the authority and influence of Maurice prince of Orange, the Arminians were condemned as heretics; for by this time ambitious and powerful men found themselves politically interested in this religious contest. The Arminians presented to this synod a remonstrance, containing a statement of their faith upon the subjects in dispute; and from this they derived the appellation of *Remonstrants*. This statement contained the following five articles: 1. That God from all eternity predestinated those to everlasting salvation whom he foresaw would believe in Christ unto the end of their lives; and predestinated obstinate unbelievers to everlasting punishment. 2. Jesus Christ died for the whole human race, and for every individual of it, but believers alone reap the benefit of his death. 3. No man can produce faith in his mind by his own free will, but it is necessary that man, who is by nature wicked and unfit for acting or thinking aright, should be regenerated by the grace of the Holy Spirit, imparted by God for Christ's sake. 4. This divine grace constitutes the source, the progress, and the fulfilment, of all that is good in man; but it is not irresistible in its operation. 5. Believers, by the assistance of the Holy Spirit, are abundantly fitted for every good work; but whether it is possible for those who have once been truly such to fall away, and to perish finally, is not clear, and must be better inquired into by searching the sacred scriptures.

* *Relatio Historica de Origine et Progressu Controversiarum in Fœderato Belgio de Prædestinatione Philippi à Limborch.*

In opposition to these, a counter-remonstrance was presented, containing the opinions of the Calvinists, which was approved of by the synod. The substance of it was afterwards adopted, and in nearly the same expressions, into the Confession of Faith compiled by the assembly of divines which met at Westminster, A. D. 1643, and which every clergyman and probationer for the ministry in Scotland is at present required to subscribe previous to his admission. To give as clear and as fair an idea as possible of the Calvinistic doctrine upon this head, we transcribe the following passage from that Confession: "God from all eternity did, by the most wise and holy counsel of his own will, freely and unchangeably ordain whatsoever comes to pass; yet so, as thereby neither is God the author of sin, nor is violence offered to the will of the creatures, nor is the liberty or contingency of second causes taken away, but rather established. Although God knows whatsoever may or can come to pass upon all supposed conditions; yet hath he not decreed any thing because he foresaw it as future, or that which would come to pass upon such conditions. By the decree of God, for the manifestation of his glory, some men and angels are predestinated unto everlasting life, and others are fore-ordained to everlasting death. These angels and men, thus predestinated and fore-ordained, are particularly and unchangeably designed; and their number is so certain and definite, that it cannot be either increased or diminished. Those of mankind that are predestinated unto life, God, before the foundation of the world was laid, according to his eternal and immutable purpose, and the secret counsel and good pleasure of his will, hath chosen, in Christ, unto everlasting glory, out of his mere free grace and love, without any foresight of faith, or good works, or perseverance in either of them, or any other thing in the creature, as conditions or causes moving him thereunto; and all to the praise of his glorious grace. As God hath appointed the elect unto glory,

7
Calvinistic doctrine of predestination.

Predestination. ry, so hath he, by the eternal and most free purpose of his will, fore-ordained all the means thereunto. Wherefore, they who are elected, being fallen in Adam, are redeemed by Christ, are effectually called unto faith in Christ, by his spirit working in due season; are justified, adopted, sanctified, and kept, by his power through faith unto salvation. Neither are any other redeemed by Christ effectually called, justified, adopted, sanctified, and saved, but the elect only. The rest of mankind, God was pleased, according to the unsearchable counsel of his own will, whereby he extendeth or withholdeth mercy as he pleaseth for the glory of his sovereign power over his creatures, to pass by, and to ordain them to dishonour and wrath for their sin, to the praise of his glorious justice."

8 Supralapsarians and Sublapsarians.

There are two kinds of Calvinists or Predestinarians, viz. the *Supralapsarians*, who maintained that God did originally and expressly decree the fall of Adam, as a foundation for the display of his justice and mercy; while those who maintain that God only *permitted* the fall of Adam, are called *Sublapsarians*, their system of decrees concerning election and reprobation, being as it were, subsequent to that event. But as Dr Priestley justly remarks, if we admit the divine precience, there is not, in fact, any difference between the two schemes; and accordingly that distinction is now seldom mentioned.

9 Disputes in the church of Rome on the subject.

Nor was the church of Rome less agitated by the contest about predestination than the first Protestants were. The council of Trent was much perplexed how to settle the matter without giving offence to the Dominicans, who were much attached to the doctrine of Augustine, and possessed great influence in the council. After much dispute, the great object came to be, how to contrive such a decree as might give offence to nobody, although it should decide nothing. Upon the whole, however, they seem to have favoured the Semi-pelagian scheme. Among other things, it was determined, that good works are of themselves meritorious to eternal life; but it is added, by way of softening, that it is through the goodness of God, that he makes his own gifts to be merits in us. Catarin revived at that council an opinion of some of the schoolmen, that God chose a small number of persons, such as the blessed virgin, the apostles, &c. whom he was determined to save without any foresight of their good works; and that he also wills that all the rest should be saved, providing for them all necessary means, but they are at liberty to use them or not. This is called the *Baxterian* scheme in England, from one of its promoters there. But at all events, the council of Trent seems to have been extremely anxious that any opinions entertained among them concerning predestination might have as little influence as possible upon practical morality. "Let no man (say they), while he remains in this mortal state, presume that he is among the number of the elect, and that therefore he cannot sin, or sin without repentance; for it cannot be known who are elected without a special revelation from God." Sect. 6. c. 13.

The Jesuits at first followed the opinion of Augustine; but they afterwards forsook it. *Molina*, one of their order, was the author of what is called the *middle scheme*, or the doctrine of *a grace sufficient for all men*, but subject to the freedom of the human will. *Jansenius*, a doctor of Louvain, opposed the Jesuits, with great vigour, and supported the doctrine of Augustine. He wrote in a very artful manner. He declared, that he did not presume to state his own sentiments upon the subject. He pretended only to explain and publish the sentiments of that great father of the church St Augustine. But the Jesuits, in consequence of that inviolable submission to the authority of the pope, which they always maintained, had sufficient interest at Rome to procure the opinion of Jansenius to be condemned there: but with this addition subjoined, that nothing was thereby intended to be done in prejudice of the doctrine of St Augustine. This produced an absurd dispute about the pope's infallibility in matters of fact. The Jansenists affirmed, that the pope had made a mistake in condemning the opinion of Jansenius as different from those of Augustine; whereas in truth they are the same, and the one cannot be condemned without the other. But the Jesuits affirmed, that the pope is no less infallible in points of fact than he is in questions of faith; and he having decided, that the opinions of Jansenius are different from those of St Augustine, every good catholic is bound to believe accordingly that they are different. These disputes have never been fully settled, and still divide the Roman catholic churches. Some of the ablest supporters of predestination have appeared among the Jansenists, and particularly among the gentlemen of Port-Royal.

10 English and Scotch reformers predestinarians.

With regard to Great Britain, the earliest English reformers were in general Sublapsarians, although some of them were Supralapsarians. But the rigid Predestinarians have been gradually declining in number in that church, although they still subscribe the 39 articles of their faith, which are unquestionably Calvinistic. The celebrated Scotch reformer John Knox having been educated at Geneva, established in this country the doctrine of predestination in its strictest form: and it has probably been adhered to with more closeness in Scotland than in any country in Europe.

Of late years, however, the dispute concerning predestination has assumed a form considerably different from that which it formerly possessed. Instead of being considered as a point to be determined almost entirely by the sacred scriptures, in the hands of a number of able writers, it has in a great measure resolved itself into a question of natural religion, under the head of the philosophical liberty or necessity of the will (A); or, whether all human actions are or are not necessarily determined

(A) Dr Priestley, the most celebrated Necessarian of the age, has written a whole section of his *Illustrations*, with a view to show, that between "the two schemes of Calvinistic predestination and philosophical necessity, there is no sort of resemblance, except that the future happiness or misery of all men is certainly foreknown and appointed by God. In all other respects (says he) they are most essentially different; and even where they agree in the *end*, the difference in the *manner* by which that end is accomplished is so very great, that the *influence* of the two termined by motives arising from the character which God has impressed on our minds, and the train of circumstances amidst which his providence has placed us? We have already discussed this point (see METAPHYSICS) by giving a candid statement of the arguments on both sides of the question. We shall treat the subject of predestination in the same manner, avoiding as far as possible any recapitulation of what has been advanced under the head of *NECESSITY and Liberty*.

11 Points at issue between the predestinarians and their opponents.

From what has been already said, it will appear that the points chiefly at issue between the parties are the following: First, With what views and purposes did God create the world and frame his decrees concerning mankind? Did he contrive a great unalterable scheme of creation and providence only for the sake of manifesting his own glory and perfections? Or did he first consider the free motions of those rational agents whom he intended to create, and frame his decrees upon the consideration of what they might choose or do in all the various circumstances in which he intended to place them?—The second and following questions are branches of this leading one. Did Christ die for a particular portion of the human race, who shall therefore certainly be saved? or was his death intended as a benefit to all, from which none are excluded excepting those who willingly reject it? Is the divine grace certainly and irresistibly efficacious in all those minds to which it is given? or does its effect depend upon the good use which men may or may not make of it? Can any good action be done without it? Do those who have once received it certainly persevere and obtain eternal salvation? or is it possible for any of them to fall away and perish finally?

12 Arguments for the doctrine

We shall begin by stating the argument on the side of the predestinarians, and in the language which they commonly use. But it is necessary to make this previous remark, that the general * objections to their doctrine are, that it is hostile to all our ideas of the justice of God, representing him as a partial being, rewarding without merit, and punishing without sin; that it renders him the author of evil, destroys moral distinctions, makes useless every effort on our part, makes every prayer absurd, and even the preaching of the gospel vain; seeing that all things are immutably fixed, and none can believe or be saved excepting the elect, and they must certainly and at all events be safe. Against all this they reason thus.

* *Calvini Respons. contra Pigbaium, ad 2dum lib.*

The great and everlasting Author of all things existed from eternity alone, independent and essentially perfect. As there was no other, he could only consider himself and his own glory. He must therefore have designed all things in and for himself. To make him stay his determinations till he should see what free creatures would do, is to make him decree with uncertainty, and dependently upon them, which falls short of infinite perfection. He existed alone, and his counsels could have no object excepting himself; he could only then consider the display of his own attributes and perfection. In doing this, as the end is more important than the means, Divine Wisdom must begin its designs with that which is to come last in the execution of them; but the conclusion of all things at the last judgement will be the complete manifestation of the wisdom, the goodness, and justice of God: we must therefore suppose, that in the order of things, he decreed that first, although with him, in the order of time, there is no first nor second, but all is from eternity. When this great design was laid, the means were next designed. Creation, and its inhabitants of every order, form the means by which the author and disposer of all things accomplishes his will. But creatures in his sight are nothing, and are figuratively said to be less than nothing. We may entertain proud and elevated conceptions of our own dignity if we please; but if we in our designs regard not the dust on which we tread, or the lives of ants and insects, the omnipotent Lord of all, from whom we are more infinitely distant, must regard us as at least equally inconsiderable, and only valuable as we serve the accomplishment of his great and mysterious purposes, which cannot be us or our aggrandisement, but himself and his own glory.

13 as necessary to explain the Divine attributes.

It is only by this view of the divine conduct that some of the attributes of God can be explained, or their existence rendered possible. In the scriptures he claims the attribute of *prescience* as his distinguishing prerogative;

two systems on the minds of those that adopt and act upon them is the reverse of one another. The Calvinistic doctrine of predestination, according to a very authentic statement of the doctrine*, is, that "God, for his own glory, hath *foreordained whatsoever comes to pass*." The scheme of philosophical necessity, as stated by an intimate friend and warm admirer of Dr Priestley's, is, "That *every thing* is *predetermined* by the Divine Being; that whatever has been, must have been; and that whatever will be, must be; that *all events* are *pre-ordained* by infinite wisdom and unlimited goodness; that the will, in all its determinations, is governed by the state of mind; that this state of mind is in every instance determined by the Deity; and that there is a continued chain of causes and effects, of motives and actions, inseparably connected, and originating from the condition in which we are brought into existence by the Author of our being." The *author* or *compiler* of the same book affirms, "That all motion indeed originates in the Deity; that the Deity is self-moved; that he possesses the singular attribute underived of moving himself." But it is added, in the very same paragraph from which this last sentence is quoted, that "the very argument we employ to prove one underived source of motion and existence, is a gross solecism in logic; and that the ascription of this power to the Divine Being is in fact nothing else than the less of two palpable *absurdities*, or rather *impossibilities*, if these could admit of degrees †."

* *Shorter Catechism of the Assembly of Divines at Westminster.*

The piety of these assertions will be obvious, we are persuaded, to every one of our readers; but to some it is possible that their consistency may not be apparent. We would advise all such "to peruse once and again Dr Priestley's Illustrations," which we have the best authority to say, will remove from their minds all libertarian prejudices, convince them "that the hypothesis of necessity is incontrovertibly true," and show them that all the defenders of that hypothesis are in perfect harmony with themselves and with one another!

† *Essay on Philosophical Necessity by Alexander Crombie, A. M.*

Predestination. gative; but there can be no prescience of future contingencies; for it involves a contradiction to say, that things which are not certainly to be should be certainly foreseen. If they are certainly foreseen, they *must* certainly be, and can therefore be no longer contingent. An uncertain foresight is also an imperfect act, as it may be a mistake, and is therefore inconsistent with divine perfection. On the other side the difficulty is easily explained. When God decrees that an event shall take place, its existence thenceforth becomes certain, and as such is certainly foreseen. For it is an obvious absurdity to say, that a thing happens freely, that is to say, that it may be or may not be, and yet that it is certainly foreseen by God. He cannot foresee things but as he decrees them, and consequently gives them a future certainty of existence; and therefore any prescience antecedent to his decree must be rejected as impossible. Conditional decrees are farther absurd, inasmuch as they subject the purposes of God to the will and the actions of his creatures. Does he will or wish that all mankind should be saved, and shall they not all be saved? Infinite perfection can wish nothing but what it can execute: and if it is fit to wish, it is also fit to execute its wishes. We are indeed certainly informed by the scriptures, that all shall not be saved; and we therefore as certainly conclude, that God never intended that they should be so; *for the counsel of the Lord standeth fast, and the thoughts of his heart, to all generations.*

14 Christ died only for the elect.

We conclude, upon the same principles, that although the blessings resulting from the death of Christ are offered to all, yet that intentionally and actually he only died for those whom the Father had chosen and given to him to be saved by him. That Christ should have *died in vain* is represented by the apostle Paul as a great absurdity (Gal. ii. 21.): but if he died for all, he must have died in vain with regard to the greater part of mankind who are not to be saved by him. In so far as some inferior blessings are concerned, which through him are communicated, if not to all men, at least to all Christians, he may perhaps justly be said to have died for all: but with regard to eternal salvation, his design, to avoid rendering it fruitless, could go no farther than the secret purpose and election of God. This is implied in these words, *all that are given me of my Father, thine they were, and thou gavest them me.* To these his intercession is limited; *I pray not for the world, but for those that thou hast given me, for they are thine, and all thine are mine, and mine are thine* (Jo. xvii. 9, 10.). Universal words are indeed used with regard to the death of Christ: but the reason is obvious, the Jewish religion was confined to the family and descendants of Abraham. In contradiction to this, the gospel is said to be preached to *every creature*, and *to all the world;* because it is not limited to any one race or nation, and because the apostle received a general commission to teach it unto all who should be willing to receive it. These extensive expressions can only be understood in this manner, because in their strict acceptation they have never been verified. Nor can their meaning be carried farther without an imputation upon the justice of God: for if he has received a sufficient satisfaction for the sins of the whole world, it is not just that all should not be saved by it, or at least have the offer of salvation made to them, that they may accept of it if they please.

But to return to the divine purposes and attributes in general: it is in vain to assert that God is partial and unjust while he prefers without merit, and predestinates to punishment those who have not yet offended. The same error misleads men here that has so often seduced them from the true path of scientific research. Instead of submitting to the patient and humble observation of nature, they boldly form some plausible hypothesis of their own, and vainly attempt to reconcile every appearance to their favourite system. This mode of procedure never has proved, and never will prove, successful in any branch of true philosophy. We are not entitled to frame to ourselves certain notions of the justice of God, and from these to decide that thus he must act, and in no other manner. He takes no counsel from us concerning his conduct, and we have no right to rejudge his judgments. What he regards as just or unjust between himself and his creatures, is a question of fact not to be known by ingenious conjectures, but by the cautious observation of the manner in which he acts in the course of his providence, and by attending to what he has declared concerning himself in the sacred scriptures. If from these it shall appear that he does prefer where there is no merit, and reject where there is no crime; it will be in vain thereafter to assert that such conduct is unjust: the fact will be on our side of the question, and we shall leave those to account for it, who insist that their limited reason is capable of comprehending all the mysterious ways of an Infinite Being.

15 Great inequalities in the ordinary course of providence.

In the course of providence, then, we see the greatest inequalities take place, and such as appear altogether contradictory to our ideas of justice. We see the sins of the fathers punished in the persons of the children, who often derive debilitated bodies from the intemperance of their parents, and corrupted manners from the example of their vices. God frequently afflicts good men in this life for a great length of time, as in the case of Job, only for the manifestation of his own glory, that their faith and patience may be made manifest. Some sins are punished with other sins, and often with a course of severe miseries in the persons of those who never committed them. We may transfer this from time to eternity; for if God may do for a little time what is inconsistent with our notions, and with our rules of justice, he may do it for a longer duration: since it is as impossible that he can be unjust for a day as for all eternity: and the same inequality of management appears in the great as in the private affairs of this world. During many ages almost the whole human race were lost in the darkness of idolatry: even since the Christian religion came into the world, how few nations have received it; and of these few, the number is still smaller of those who have enjoyed it in tolerable purity. If we consider how many great nations remain under the delusion contrived by Mahomet; if we reflect upon the idolatry of the Indies and of China, and the superstition of the Greek church, and of the church of Rome—we shall find that very few nations have possessed the most ordinary means of grace. Even the blessings of civilization, of science, and of liberty, are so rarely scattered over the face of the earth, that it is to be regarded as a melancholy truth, that with a very few favoured exceptions the whole human race have hitherto been sunk in the depth of barbarism, ignorance, slavery, and idolatry. When the Arminians think fit to assert, then,

then, that the doctrine of absolute decrees is contrary to their ideas of the impartiality and justice of God, we can only answer that we are sorry for them if they have formed ideas of the character of God which are contrary to the truth. We presume not * like them to call his attributes before the tribunal of our understandings; we only observe the ways of his providence, and declare that thus stands the fact. If he leave whole nations in darkness and corruption, and freely chooses others to communicate the knowledge of himself to them, we need not be surprised if he act in the same manner with individuals. For surely the rejecting immense empires for so many ages is much more unaccountable than the selection of a few individuals, and the leaving others in ignorance and depravity. It is in vain to allege that he extends his mercy to those who make the best use of the dim light which they have. This does not remove the difficulty of a choice and a preference; as it cannot be denied that their condition is very deplorable, and that the condition of others is much more hopeful: so that the mysterious doctrine of election and reprobation is an unquestionable truth under the government of God, seeing that great numbers of men are born in such circumstances that it is morally impossible they should not perish in them; whereas others are more happily situated and enlightened.

* *Calvini Tract. de Æterna Dei Prædest.*

16
The language of Scripture predestinarian.

Nor are we left to common observation upon this point. The language of the sacred scriptures is positive and clear. The whole reasoning in the ninth chapter to the Romans resolves all the acts of God's justice and mercy, his *hardening* as well as his *pardoning*, into an absolute freedom and an unsearchable depth. More pointed expressions for this purpose can scarcely be conceived than those actually made use of. *For the children being not yet born, neither having done any good or evil, that the purpose of God according to election might stand, not of works, but of him that calleth, it was said, The elder shall serve the younger. As it is written, Jacob have I loved, but Esau have I hated. What shall we say then? Is there unrighteousness with God? God forbid. For he saith to Moses, I will have mercy on whom I will have mercy, and I will have compassion on whom I will have compassion. So then it is not of him that willeth, nor of him that runneth, but of God that showeth mercy; for the scripture saith unto Pharaoh, Even for this same purpose have I raised thee up, that I might show my power in thee, and that my name might be declared throughout all the earth. Therefore hath he mercy on whom he will have mercy, and whom he will he hardeneth.*

17
An objection answered.

If any man shall still be sufficiently bold to declare that all this is contrary to what he is pleased to consider as just and impartial, we can only reply to him in the words of the celebrated John Calvin of Geneva†. *Tibi molestum est ac odiosum, Deum plus posse et facere, quam mens tua capiat; æquali autem tuo interdum concedes, ut suo judicio fruatur. Et tu in tanto furore, Dei mentionem ullam facere audes?* "Is it painful to thee that the power and the works of God exceed thy limited capacity? Thou sometimes sufferest thine equal to judge of his own conduct for himself, and darest thou in thy folly to censure the ways of God?" Or rather we may reply in those words of the apostle Paul which immediately follow the passage already quoted. *Thou wilt say then to me, Why doth he yet find fault? for who hath resisted his will? Nay but, O man, who art thou that repliest against God? Shall the thing formed say to him that formed it, Why hast thou made me thus? Hath not the potter power over the clay; of the same lump to make one vessel unto honour, and another unto dishonour?* Let these passages, and even the whole of the chapter now alluded to, be explained in any manner that is judged proper, still their import with regard to the present argument will remain the same. If God loved Jacob so as to choose his posterity to be his people, and rejected or hated Esau and his posterity, and this without regard to them or their future conduct, but merely in consequence of the purpose and design of his election; if by the same purpose the Gentiles were to be grafted upon that stock from which the once favoured Jews were cut off, it will follow, not only that the great and mysterious decree of final election is unsearchably free and absolute, but also that all the means of grace are granted or withheld in the same unlimited and free manner according to the sovereign will and good pleasure of God, independent of any foresight of merit on our part. The words of our Saviour express this: *I thank thee, O Father, Lord of heaven and earth, because thou hast hid these things from the wise and prudent, and hast revealed them unto babes:* The reason of which is given in the following words, *Even so, Father, for so it seemed good in thy sight*, (Mat. xi. 26.). The passage immediately preceding this, shews clearly that the means of grace are not bestowed upon those who, it is foreseen, will make a good use of them; nor denied to those who will make a bad use of them. *Wo unto thee Chorazin, wo unto thee Bethsaida: for if the mighty works which were done in you had been done in Tyre and Sidon, they would have repented long ago in sackcloth and ashes.* But the passages in scripture are innumerable, which declare that the whole character and destiny of every man is the result of the counsel and uncontrouled determination of God. The expression is often repeated in the book of Exodus; God *hardened the heart of Pharaoh, so that he would not let his people go*, (Exod. iv. 21.), &c. It is said, that *God has made the wicked man for the day of evil*, (Prov. xvi. 4.). On the other hand, it is said, *as many believed the gospel as were appointed to eternal life*, (Acts. i. 48.). Some are said to be *written in the book of life, of the Lamb slain from the foundation of the world* (Rev. xiii. 8.). Every prayer that is used, or directed to be used, in scripture, is for a grace that opens our eyes, that turns the heart, that makes us to go, that leads us not into temptation, but delivers us from evil. All these expressions denote that we desire more than a power or capacity to act, such as is given to all men. Indeed we do not, and we cannot, pray earnestly for that which we know all men as well as ourselves possess at all times.

† *Ubi supra.*

18
Sure efficacy of grace.

The *grace of God* is the medium by which his sovereign will and absolute degrees are accomplished. Accordingly, it is set forth in scripture by such expressions as clearly denote its sure efficacy; and that it does not depend upon us to use it or not at our pleasure. It is said to be a creation; *we are created unto good works, and we become new creatures:* It is called a regeneration, or a *new birth;* it is called a quickening and a resurrection, as our former state is compared to a feebleness, a blindness, and a death. God is said *to work in us both to will and to do: His people shall be willing in the day of his power: He will write his laws in their* hearts,

hearts, and make them to walk in them. In a passage already quoted, the human race are compared to a mass of *clay* in the hands of the *potter*, who of the same lump makes at his pleasure *vessels of honour and dishonour*. These passages, and this last more particularly, prove that there is an absolute and a conquering power in divine grace; and that the love of God constrains us, as St Paul expresses himself. Our Saviour compares the union and influence that he communicates to believers to the union of an head with the members, and of a root with the branches, which imparts an internal, a vital, and an efficacious influence. The outward means may indeed be rejected, but this overcoming grace never returns empty: these outward means coming from God, the resisting of them is said to be the *resisting* of God, the *grieving* or *quenching of his spirit;* and in that sense we may resist the grace or favour of God; but we can never withstand him when he intends to overcome us; *For the foundation of God standeth sure, having this seal, The Lord knoweth them that are his,* (2 Tim. ii. 19.). *Having predestinated us unto the adoption of children by Jesus Christ himself, according to the good pleasure of his will,* (Eph. i. 5.).

19
Perseverance of the saints.

That the saints shall certainly persevere unto the end is a necessary consequence of absolute decrees and of efficacious grace: all depends on God. He *of his own will begat us;* and with him *there is no variableness nor shadow of turning: whom he loves, he loves to the end:* and he has promised that he will never leave nor forsake those to whom he becomes a God. Our Lord hath said, *I give unto them eternal life, and they shall never perish; neither shall any pluck them out of my hand,* (Jo. x. 28.). Hence we must conclude, that *the purpose and calling of God is without repentance,* (Heb. xiii. 5.). And therefore, although good men may fall into great sins, yet of all those who are given by the Father to the Son to be saved by him, none are lost: The conclusion from the whole is, that God did in himself, and for his own glory, *foreknow* a determinate number in whom he would be both sanctified and glorified. These he *predestinated* to be holy, conformable to the image of his Son: they are to be *called*, not by a general calling in the sense of these words, *many are called, but few are chosen;* but to be *called according to his purpose.* He *justified* them upon their obeying that calling, and in the conclusion he will *glorify* them; for nothing can separate us from the love of God in Christ, (Rom. ix. 19.). And he is not less absolute in his decree of reprobation than he is in his election: for *ungodly men* are said to be *of old ordained to condemnation, and to be given up by God unto vile affections, and to be given over by him to a reprobate mind.*

20
Arguments against the doctrine from the attributes of God

Thus far we have defended the doctrine of predestination: we proceed next to state the arguments usually adduced in favour of the Arminian system.

God is just, holy, and merciful. In speaking of himself in scripture, he is pleased to make appeals to the human understanding, and to call upon men to reason with him concerning his ways. The meaning of this is, that men may examine his actions and his attributes with that measure of intelligence which they possess, and they will be forced to approve of them; nay, he proposes himself to us as a pattern for our imitation. We are required to be holy as he is holy, and merciful as he is merciful; which is a proof that he accounts us not incapable of forming just notions at least of these attributes. What then can we think of a justice that shall condemn us for a fact that we never committed? that designs first of all to be glorified by our being eternally miserable, and which afterwards decrees that we shall commit sins to justify this previous decree of our reprobation? For if God originally designs and determines all things, and if all his decrees are certainly effected, it is inconceivable how there should be a justice in punishing that which he himself, by an antecedent and irreversible decree, appointed to be done. Or, setting justice aside, is it possible that a being of infinite holiness, and who is *of purer eyes than to behold iniquity*, would by an antecedent decree fix our committing so many sins, in such a manner that it is not possible to avoid them? He represents himself in the scriptures as *gracious, merciful, slow to anger, and abundant in goodness and truth.* It is often said, that *he desires that no man should perish, but that all should come to the knowledge of the truth:* this is even said with the solemnity of an oath, *As I live, saith the Lord, I take no pleasure in the death of sinners.* What sense can these words bear if we believe that God did by an absolute decree doom so many of them to everlasting misery? If all things that happen arise out of the absolute decree of God as their first cause, then we must believe that God takes pleasure both in his own decrees and in the execution of them, consequently that *he doth take pleasure in the death of sinners;* and this in express contradiction to the most positive language of scripture. Besides all this, what are we to think of the truth of God, and of the sincerity of those offers of grace and mercy, with the exhortations and expostulations upon them that occur so frequently in scripture, if we can imagine that by antecedent acts he determined that all these should be ineffectual? In one word, are we to regard our existence as a blessing, and to look up with gratitude to that paternal goodness which has placed us in a *land* of hope, which formed our nature, weak indeed and exposed to many imperfections, but capable of rising by virtuous efforts and by a patient continuance in well-doing to excellence and to high and immortal felicity? or, are we to curse the hour in which we were born under the dominion of a master, who is not only severe, but absurd, and even adds insult to cruelty; who, after placing us in a goodly habitation, binds us hand and foot, locks the door, blocks up the windows, sets fire to the fabric, and then very mercifully calls upon us to come forth lest we perish?

It is not true that rational beings are nothing in the sight of their Maker. Compared to his Almighty strength and uncreated existence, our powers do indeed diminish into weakness, and our years into a moment: yet although our interests may be unimportant in themselves, the attributes of God with which they are connected are far from being so. There was no necessity for his calling us into existence; but the instant he bestowed upon us that gift, and conferred upon us faculties capable of rising to happiness by the contemplation of himself and of his works, he became our parent, and granted to us a right to look up to him for protection and mercy, and to hope that our existence and our faculties were not bestowed in vain. Nor will he

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trample upon the just and reasonable hopes of the meanest of his creatures. He is watchful over our interests; he hath sent his Son to die for us; his providence has been exerted for no other purpose but to promote our welfare; and there is joy in heaven even over one sinner that repenteth. Let it be allowed, that the universe was formed for no other purpose but to promote the glory of God; that glory can surely be little promoted by the exertion of undistinguishing and blind acts of power, in the arbitrary appointment to eternal reprobation of millions of unresisting and undeserving wretches*. Is it not more honourable to the Deity to conceive of him as the parent, guide, governor, and judge of free beings, formed after the likeness of himself, with powers of reason and self-determination, than to conceive of him as the former and conductor of a system of conscious machinery, or the mover and controuler of an universe of puppets, many of whom he is pleased to make completely miserable? The most important and fundamental point of religion considered as a speculative science, consists in our forming high and just ideas of God and of his attributes, that from them we may understand the maxims of true and perfect morality. But were we to attempt to form our own natures upon the idea of the divine character that is given us by the doctrine of absolute decrees, we would certainly become imperious, partial and cruel; at least we should not readily learn the virtues of kindness, mercy, and compassion.

* *Correspondence between Price and Priestley.*

21 The difficulty of prescience solved.

It is true that, setting aside predestination, it is not easy to show how future contingencies should be certainly foreseen; but it is obvious that such foresight involves no contradiction, (see METAPHYSICS, N° 308); and if the actions of men be free, we know from the train of prophecies, which in the sacred scriptures appear to have been made in one age and fulfilled in another, that contingencies are foreseen by that infinite Being who inhabiteth eternity, and to whom a thousand years are but as one day. The prophecies concerning the death and sufferings of Christ were fulfilled by the free acts of the Jewish priests and people: These men sinned in accomplishing that event, which proves that they acted with their natural liberty. From these and all the other prophecies both in the Old and New Testament, it must be confessed that future contingencies were certainly foreknown, but where to found that certainty cannot be easily resolved. We doubt not, however, that we may safely refer it to the infinite perfection of the Divine mind. And it ought to be observed that this difficulty is of a very different nature from that to which our antagonists are reduced on their side of the argument. They are compelled to confess that they cannot reconcile their doctrine with the justice of God, an attribute the nature of which we clearly understand, and which is held forth to our imitation; whereas we are only at a loss how to explain the mode in which the divine prescience is exerted; an attribute which God claims as peculiarly his own, and which it is not to be expected that we should be able in the smallest degree to comprehend. We can go farther than this. Heaven hath given to man two revelations of itself. The one consists in the knowledge which we procure by the right use of our rational faculties; and the other is bestowed by means of the sacred scriptures. Without intending to derogate from the authority of inspiration, it is fair to assert, that we are *more certain* that God is the author and bestower of our reason, than that he is the author of the scriptures; at least it is certain that the last cannot contradict the first, because God cannot contradict himself. By the primary revelation from heaven then, that is, by our reason, we are informed that God is true, and just, and good. If an angel from heaven should preach a doctrine contrary to this, we are entitled to say with the apostle, *let him be accursed*. If our antagonists then should succeed in the proving that the doctrine of absolute decrees, which represents the Deity as cruel and unjust, is contained in scripture, the consequence would be, not that we would believe it, for that is impossible, but that we should be reduced to the necessity of rejecting the authority of the scriptures, because they contradict the previous sure revelation of God, our reason. We believe that the doctrines contained in the scriptures are certainly true, because they were taught by those who wrought miracles and foretold future events in proof of their being inspired by the God of truth. But miracles and prophecy are *direct* evidences of nothing but the *power* and *wisdom* of their Author; and unless we know by other evidence, that this powerful and wise Being is likewise the father of truth and justice, we cannot be sure that the scriptures, notwithstanding their source, are any thing better than a tissue of falsehoods. The very arguments therefore by which predestination is supported, tend to sap the foundation of that revelation from which its advocates pretend to draw them. The case is very different when no doctrine is asserted that is not contradictory to our reason, but only above it. For example, when we are told that God can create rational beings, that he attends without distraction to the minutest affairs that pass in a thousand worlds, that he knows all things, the past, the present, and the future, we do not presume that we comprehend how he can do all this: but there is nothing in it that contradicts our reason; we ourselves possess a certain degree of power, can attend at once to a certain number of objects, can in some cases form very sure conjectures about futurity, and we resolve all the rest into the infinite nature and perfections of God.

22 Scripture cannot contradict the clear dictates of reason.

It is farther to be observed, that prescience does not make effects certain because they are foreseen; but they are foreseen because they are to be: so that the certainty of the prescience is not the cause, but the consequence of the certainty of the event. The Roman republic has fallen; but our knowledge or ignorance of that event does not render it more or less true and certain. That it was to fall, was as surely true before it happened as it is now; and had we known it beforehand, as many men of sense probably did, it would neither have fallen sooner nor later on that account. This shows that the knowledge which an intelligent being has of a past or future event need not have any influence upon the circumstances that produce that event.

23 Conditional prescience.

On some occasions the scripture takes notice of a conditional prescience*. God answered David, that Saul would come to Keilah, and that the men of Keilah would deliver him up; yet both the one and the other rested upon the condition of his staying there; and he going from thence, neither of them ever happened. Such also was the † prophecy of Jonah, at the failure of

* 1 Sam. xxiii 11, 12.

† Chap. iii.

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of which he was so absurdly offended: and such was Christ's saying, That those of Tyre and Sidon, Sodom and Gomorrah, would have turned to him, if they had seen the miracles that he wrought in the towns of Galilee. Since, then, this prescience may be so certain that it can never err or mislead the exertions of providence, and since by this, both the attributes of God are vindicated, and the due freedom of man is asserted, all difficulties seem to be thus easily removed.

24 Christ died for the whole world.

With regard to the purpose of Christ's death, he is said to be the *propitiation for the sins of the whole world;* and the wicked are said *to deny the Lord that bought them.* His death, as to its extent, is set in opposition to the sins of *Adam;* so that as by the offence of one judgment came upon all men to condemnation, so by the righteousness of one the free gift came upon all men to justification of life, (Rom. v. 18.). The *all* on the one side must be as extensive as the *all* on the other: so, since *all* are concerned in Adam's sin, *all* must likewise be concerned in the death of Christ. To this we may add, that *all* men are commanded and required to believe that Christ died for their sins; but no man can be obliged to believe what is not true: he must therefore have died for *all.* The following passages express clearly the universality of the object of Christ's death. *If any man sin, we have an advocate with the Father, Jesus Christ the righteous: and he is the propitiation for our sins: and not for ours only, but also for the sins of the whole world* (1 Jo. ii. 1, 2.). *The love of Christ constraineth us; because we thus judge, that if one died for all, then were all dead: and that he died for all, that they which live should not henceforth live unto themselves,* (2 Cor. v. 14.). *God so loved the world that he gave his only begotten Son, that whosoever believeth in him might not perish, but might have everlasting life.* (Jo. iii. 16.).

25 Freedom essential to moral agents.

But a proper attention to the nature of man will set the justice of our argument in a still stronger point of view. It is obvious, that such an inward freedom as renders a man the master of his own conduct, and able to do or not do what he pleases, is so necessary to the morality of our actions, that without it they are neither good nor evil, neither capable of rewards nor punishments. Madmen, or men asleep, are not to be charged with the good or evil of what they do; therefore at least some small degree of liberty must be left us, otherwise why are we praised or blamed for our conduct? All virtue and religion, all discipline and industry, arise out of this as their first principle, that there is a power in us to govern our own thoughts and actions, and to raise and improve our faculties. If this be denied, all efforts, all education, all attention bestowed upon ourselves or others, become fruitless and vain. If a man account himself under an inevitable decree, as he will have little remorse for the evil he does while he imputes it to that inevitable force that constrains him, so he will naturally conclude that it is to no purpose for him to struggle with impossibilities. Men are sufficiently inclined to throw all censure off from themselves, and to indulge in indolence; and upon the doctrine of absolute predestination who can blame them, seeing that their efforts can be of no value?

Matter is inactive of itself, and only moves in consequence of its being acted upon by some other being. Man is possessed of a power to begin motion, and to determine it in any direction that he may judge proper. This power and this intelligence constitute his liberty, and form that image of God that is stamped upon his nature. Whether man possesses this power of acting originally and of himself, or whether he is incapable of forming any resolution, or making any effort, without being acted upon by a foreign cause, is not a point to be reasoned on or disputed about: it is a question of fact, which, as far as it can possibly be known, every man has it in his power to determine by the evidence of his own consciousness.

26 Liberty or necessity a question of fact.

We do aver, then, that every man is conscious that he is a free agent, and that it is not possible for the most staunch predestinarian that has ever yet appeared seriously and practically to convince himself of the contrary. It is not possible for a man in his senses to believe, that in all those crimes which men charge *themselves* with, and reproach *themselves* for, God is the agent; and that, properly speaking, they are no more agents than a sword is when employed to commit murder. We do indeed, on some occasions, feel ourselves hurried on so impetuously by violent passions, that we seem for an instant to have lost our freedom; but on cool reflection we find, that we both might and ought to have restrained that heat in its first commencement. We feel that we can divert our thoughts, and overcome ourselves in most instances, if we set seriously about it. We feel that knowledge, reflection, and proper society, improve the temper and disposition; and that ignorance, negligence, and the society of the worthless and abandoned, corrupt and degrade the mind. From all this we conclude, that man is free, and not under inevitable fate, or irresistible motions to good or evil. This conclusion is confirmed by the whole style of scripture, which upon any other supposition becomes a solemn and unworthy mockery. It is full of persuasions, exhortations, reproofs, expostulations, encouragements, and terrors. But to what purpose is it to speak to dead men, to persuade the blind to see, or the lame to run? If we are under impotence till the irresistible grace comes, and if, when it comes, nothing can withstand it, what occasion is there for these solemn discourses which can have no effect? They cannot render us inexcusable, unless it were in our power to be improved by them; and to imagine that God gives light and blessings, which can do no good, to those whom he before intended to damn, only to make them more inexcusable, and for the purpose of aggravating their condemnation, gives so strange an idea of his character as it is not fit to express in the language that naturally arises out of it.

27 Some of the acts of God depend on the conduct of his creatures.

Our antagonists seem to have formed ideas of the divine perfection and sovereignty that are altogether false. There is no imperfection implied in the supposition that some of the acts of God may depend upon the conduct of his creatures. Perfection consists in forming the wisest designs, and in executing them by the most suitable means. The Author of Nature conducts the planets in their orbits with immutable precision according to fixed rules: but it would be absurd to pretend to manage free agents, or their affairs, in the same manner by mathematical or mechanical principles. The providence that is exerted over material objects is fixed and steady in its operations, because it is fit that material objects which cannot move of themselves should be moved in a regular manner: but free and intelligent beings enjoy a wider range, and ought not to be confined to a prescribed train of exertions; it may

Predestination. may therefore be necessary that the providence which superintends them should accommodate itself to circumstances. This, however, is not injurious to the divine sovereignty; for God himself is the author of that freedom of agency which he is pleased to watch over. He is not less the Lord of the universe; and surely his wisdom and benevolence are more conspicuous when he brings good out of evil, and renders the perverse wanderings of the human heart subservient to purposes of mercy, than when he hurls into the immensity of space the most enormous mass of dead and passive matter subjected to unerring laws.

28
The inequalities of Providence accounted for.

As for the inequalities of moral situation that are to be observed in the world, and the giving to some nations and persons the means of improvement, and the denying them to others, the Scriptures do indeed ascribe these wholly to the riches and freedom of God's grace. And we confess, that the ways of Providence are often dark and mysterious. In this world there are many things which are hard to be understood, and many which appear altogether unaccountable: we see the wicked man prospering in his wickedness, though it impose misery upon thousands; we see truth hiding its head, and the world governed by fraud and absurdity. Still, however, we can venture to assert, that God bestows upon all what is necessary to enable them to fulfil the obligations expected from the state in which they are placed; and it is elsewhere shown, that physical evil is among men the parent of moral good. (See PROVIDENCE). God winketh at the times of ignorance; much is required of them to whom much is given; and it shall be more tolerable in the day of judgment for the inhabitants of Sodom and Gomorrah than for the enlightened cities of Galilee. Thus God will be just when he judges; none will meet with condemnation excepting those who are inexcusable. For although he grants more to some than may be absolutely necessary, yet he grants less to none; and where he grants little, he will suit his judgments to the little which he gave. There is no injustice in this. If it was the intention of the great Creator, that his creation should contain within its ample bosom every possible variety of intelligent natures, it was necessary that there should be somewhere such a being as man; and, in forming all possible varieties of human minds and situations, it was necessary that every particular individual should exist. Hence a man may as well complain that he was not formed one of the flaming seraphims that surround the throne of the Eternal, as that he is not placed in other circumstances in life than those which he now occupies; for if little is given, little will be required from him. Thus the designs of Providence go on according to the goodness and mercy of God. None can complain, though some have more cause for joy than others. What happens to individuals may happen to nations in a body; some may have higher privileges, and be placed in happier circumstances than others; but none can complain of the wise and just disposer of all, who has given enough, although we may have good reason to complain of ourselves, for not using what was sufficient.

As to the case of those who are not blessed with the light of the gospel, we may consider, that if they have fewer and less advantages than others, their nature and capacities must likewise be inferior; to which their future state may be proportioned. God is not obliged to make all men equally perfect in the next world any more than in this; and if their capacity be rendered less than that of an ordinary *Christian*, a lower degree of happiness may fill it. However, we need not be extremely solicitous about their state, much less cast any ungrateful imputations on the Governor of the world for not having dealt so bountifully with them as he has with ourselves; since we know that Christ died for the whole race of mankind; that every one will at length be 'accepted according to that he has, and not according to that he has not; and that to whomsoever much is given, of him shall much be required' (B).

29
Scriptural expressions explained.

Upon these principles, we can easily explain all the passages in the New Testament concerning the *purpose*, the *election*, the *foreknowledge*, and the *predestination* of God. They relate to the design of calling the Gentile world to the knowledge of the Messias: This was kept secret, though hints had been given of it by several of the prophets, so that it was a mystery; but it was revealed when the apostles, in consequence of Christ's commission, *to go and teach all nations*, went about preaching the gospel to the Gentiles. This was a stumbling block to the Jews, and it was the chief subject of dispute betwixt them and the apostles at the time when the Epistles were written; so that it was necessary for them to clear up this point very fully, and to mention it frequently. But in the beginning of Christianity there was no need of amusing men with high and unsearchable speculations concerning the decrees of God; the apostles therefore take up the point in dispute, the calling of the Gentiles, in a general manner. They show, that Abraham at first, and Isaac and Jacob afterwards, were chosen by a discriminating favour, that they and their posterity should be in covenant with God; but that, nevertheless, it always was the intention of Providence to call in the Gentiles, though it was not executed till these later times.

With this key we can explain coherently the whole of St Paul's discourses upon this subject, without asserting antecedent and special decrees as to particular persons. Things that happen under a permissive and directing Providence, may, by a largeness of expression, be ascribed to the will and counsel of God; for a permissive will is really a will, though it is not the agent or cause of the effect. The *hardening of Pharaoh's heart* may be ascribed to God, though it is said, that his *heart hardened itself*, because he took advantage of the respites which God granted him from the plagues, to encourage himself to longer resistance. Besides this, he was a cruel and bloody tyrant, and deserved such judgments for his other sins; so that he may be considered as at that time

(B) See Bishop Law's *Considerations on the Theory of Religion*, where this question is treated in a very masterly manner. The work, though less known than it ought to be, has great merit, and of the author we have given a biographical sketch.

Predestination time under final condemnation, and only preserved from the first plagues, to afford a striking instance of the avenging justice of God. That this is the meaning of the passage, appears extremely probable from the manner in which Exod. ix. 16. is rendered in the Vatican and Aldus's edit. of the LXX. Instead of saying, as in our translation, "And in very deed for this cause have I *raised thee up*, for to show in thee my power, &c." God is represented in that version as saying, "And in very deed for this cause have I *kept thee alive till now*, for to show," &c. *Whom he will he hardeneth*, is an expression that can only be applied to such persons as this tyrant was. It is obvious that the words of our Saviour concerning those *whom his Father had given him*, are only meant of a dispensation of Providence, and not of a decree; since he adds, And *I have lost none of them except the son of perdition*: for it cannot be said that *Judas Iscariot* was in the decree, and yet was lost. And in the same passage in which God is said *to work in us both to will and to do*, we are required *to work out our own salvation with fear and trembling*. The word *ordained* to eternal life also signifies fitted and disposed to eternal life. The question, *Who made thee to differ?* (1 Cor. iv. 7.) refers to those extraordinary gifts which, in different degrees and measures, were bestowed upon the first Christians, in which they were unquestionably passive.

30 Grace not irresistible. If the decrees of God are not absolute, neither can his grace be so efficacious as absolutely and necessarily to determine our conduct, else why are we required *not to grieve God's spirit?* why is it said, *ye do always resist the Holy Ghost; as your fathers did, so do ye? How often would I have gathered you under my wings, and ye would not? What could I have done in my vineyard that has not been done in it?* These expressions indicate a power in us, by which we not only can, but often do, resist the motions of grace. But if the determining efficacy of grace be not acknowledged, it will be much harder to believe that we are efficaciously determined to sin. This supposition is so contrary both to the holiness of God, and to the whole style of the sacred writings, that it is unnecessary to accumulate proofs of it. *O Israel, thou hast destroyed thyself, but in me is thy help: ye will not come unto me that ye may have life: Why will you die, O house of Israel?*

31 The greatest saint on earth may fall. As for perseverance, we may remark, that the many promises made in the sacred scriptures to them that *overcome*, that continue *stedfast and faithful to the death*, do certainly insinuate that a man may fall from a good state. The words of the apostle to the Hebrews are very clear and pointed: *For it is impossible for those who were once enlightened, and have tasted of the heavenly gift, and were made partakers of the Holy Ghost, and have tasted the good word of God, and the powers of the world to come, if they shall fall away, to renew them again unto repentance* (Heb. vi. 4.) It is also said, *The just shall live by faith: but if he draw* (c) *back, my soul shall have no pleasure in him*, (Heb. x. 38.). And it is said by the prophet, *When the righteous turneth away from his righteousness, and committeth iniquity, all his righteousness that he hath done shall not be mentioned; in his sin that he hath sinned shall he die*, (Ezek. viii. 24.). These passages, with many others, give us every reason to believe that a good man may fall from a good state, as well as that a wicked man may turn from a bad one.

We conclude the whole by observing, that the only difficulty which attends the question arises from the mysterious, and apparently partial and unequal, course of the divine government in our present state; but there is an important day approaching, when God will condescend to remove these obscurities, and to vindicate the ways of his providence to man. On that great day, we are well assured, that the question will be decided in our favour; for we know that judgment will be given, not according to any absolute decree, but according to the deeds which we ourselves shall have freely done in the body, whether they have been good, or whether they have been evil. 32 All difficulties solved at the day of judgment.

Thus have we stated, we hope with fairness and impartiality, a summary of the arguments on both sides of this long-agitated question. We need hardly add, that it is a question involved in considerable difficulties.—Milton, who was an eminent philosopher and divine, as well as the first of poets, when he wished to exhibit the fallen angels themselves as perplexed by questions above their comprehension, set them to dispute about predestination.

> They reason'd high, of knowledge, will, and fate,
> Fix'd fate, free-will, fore-knowledge absolute;
> And found no end, in wand'ring mazes lost.
>
> *Paradise Lost.*

The weak side of the Calvinistic doctrine consists in the impossibility of reconciling the absolute and unconditional decree of reprobation with our ideas of the justice and goodness of God The weak side of the rminian scheme consists in the difficulty of accounting for the certainty of the divine fore-knowledge, upon the supposition of a contingency of events, or an absolute freedom of will in man. 33 The weak side of each doctrine.

To elude the former of these difficulties, some of the late writers upon philosophical necessity, and Dr Priestly is among the number, have given up the doctrine of reprobation, and asserted, that this world is only a state of preparation for another, in which all men, of every description and character, shall attain to final and everlasting happiness, when God *shall be all, and in all*.—On the other side, some of the supporters of free agency, and Montesquieu * is among the number, have been disposed to deny the divine attribute of prescience.

* *Lettres Pers.*

Whatever may be thought of the practical tendency of the two opinions, there is one remark which we think ourselves bound in justice to make, although it appears to us to be somewhat singular. It is this, that from the earliest ages down to our own days, if we consider the character of the ancient Stoics, the Jewish Essenes, the modern Calvinists, and Jansenists, when compared with that of their antagonists the Epicureans, the Sadducees, Arminians, and the Jesuits, we shall find that they

(c) In our translation we read, "if *any man* draw back," &c.; but the words *any man* are not in the original; and if they do not make nonsense of the text, they must at least be acknowledged to obscure its meaning.

Predestination ‖ Pre-existence.

they have excelled in no small degree in the practice of the most rigid and respectable virtues, and have been the highest honour of their own ages, and the best models for imitation to every age succeeding. At the same time, it must be confessed, that their virtues have in general been rendered unamiable by a tinge of gloomy and severe austerity.

So far as the speculative foundation of their principles is considered, however, neither party seems liable to censure in a moral point of view. Each of them wishes to support, though in a different manner from the other, the honour of the divine character. The Calvinists begin their argument with the notion of infinite perfection, independency, and absolute sovereignty, and thence deduce their opinions; making every difficulty yield to these first and leading ideas. Their opponents are more jealous of the respect due to the divine attributes of justice, truth, holiness, and mercy, and deduce their sentiments from the idea which they have formed of these. Each party lays down general maxims that are admitted by the other, and both argue plausibly from their first principles. Dr Burnet, whom we have here followed very closely, justly observes *, that "these are great grounds for mutual charity and forbearance."

34 Mutual forbearance recommended.

* *Exposition of the 39 Articles.*

PREDETERMINATION, in *Philosophy* and *Theology*, is that concurrence of God which makes men act, and determines them in all their actions, both good and evil, and is called by the schoolmen *physical predetermination* or *premotion*. See METAPHYSICS, Part III. chap. v. and PREDESTINATION.

PREDIAL slaves. See *Predial SLAVES*.

PREDIAL Tithes, are those that are paid of things arising and growing from the ground only; as corn, hay, fruit, &c.

PREDICABLE, among logicians, denotes a general quality which may be predicated or asserted of several things: thus, animal is predicable of mankind, beasts, birds, fishes, &c.

PREDICAMENT, among logicians, the same with category. See CATEGORY and PHILOSOPHY.

PREDICATE, in *Logic*, that which, in a proposition, is affirmed or denied of the subject. In these propositions, *snow is white, ink is not white;* whiteness is the predicate which is affirmed of snow, and denied of ink.

PRE-EMPTION, a privilege anciently allowed the king's purveyor, of having the choice and first buying of corn and other provisions for the king's house: but taken away by the statute 19 Car. II.

PREENING, in *Natural History*, the action of birds cleaning, composing, and dressing their feathers, to enable them to glide more easily through the air. For this purpose they have two peculiar glands on their rump, which secrete an unctuous matter into a bag that is perforated, out of which the bird occasionally draws it with its bill.

PRE EXISTENCE, a priority of being, or the being of one thing before another. Thus a cause, if not in time, is yet in nature pre-existent to its effect. Thus God is pre-existent to the universe. Thus a human father is pre-existent to his son. The Peripatetics, though they maintained the eternity of the world, were likewise dogmatical in their opinion, that the universe was formed, actuated, and governed, by a sovereign intelligence. See *Aristotle on the Soul*, and our articles CREATION and EARTH. See also the *Philosophical Essays of Dr Isaac Watts*, and the *Principles of natural and revealed Religion*, by the Chevalier Ramsay, where the subject of the world's eternity is discussed. Mr Hume's speculations also, on this abstruse and arduous subject, had a greater tendency to dissipate its gloom than that philosopher himself could imagine.

1 The Peripatetics maintained the eternity of the world.

Pre-existence.

The pre-existence of the human soul to its corporeal vehicle had been from time immemorial a prevailing opinion among the Asiatic sages, and from them was perhaps transferred by Pythagoras to the philosophy of the Greeks; but his metempsychosis, or transmigration of souls, is too trivial either to be seriously proposed or refuted. Nevertheless, from the sentiments of Socrates concerning the immortality of the soul, delivered in his last interview with his friends, it is obvious that the tenet of pre-existence was a doctrine of the Platonic school. If at any period of life, say these philosophers, you should examine a boy, of how many ideas, of what a number of principles, of what an extent of knowledge will you find him possessed: these without doubt could neither be self derived nor recently acquired. With what avidity and promptitude does he attain the knowledge of arts and sciences, which appear entirely new to him! these rapid and successful advances in knowledge can only be the effects of reminiscence, or of a fainter and more indistinct species of recollection. But in all the other operations of memory, we find retrospective impressions attending every object or idea which emerges to her view; nor does she ever suggest any thought, word, or action, without informing us, in a manner equally clear and evident that those impressions had been made upon our senses, mind, or intellect, on some former occasion. Whoever contemplates her progress, will easily discover, that association is her most faithful and efficacious auxiliary; and that by joining impression with impression, idea with idea, circumstance with circumstance, in the order of time, of place, of similarity or dissimilarity, she is capacitated to accumulate her treasures and enlarge her province even to an indefinite extent. But when intuitive principles, or simple conclusions, are elicited from the puerile understanding by a train of easy questions properly arranged, where is the retrospective act of memory, by which the boy recognises those truths as having formerly been perceived in his mind? Where are the crowds of the concomitant, antecedent, or subsequent ideas, with which those recollections ought naturally to have been attended? In a word, where is the sense of personal identity, which seems absolutely inseparable from every act of memory? This hypothesis, therefore, will not support pre-existence.

2 Pre-existence of the soul taught by Asiatic sages.

3 Socratic arguments for pre-existence refuted.

After the Christian religion had been considerably diffused, and warmly combated by its philosophical antagonists, the same doctrine was resumed and taught at Alexandria, by Platonic proselytes, not only as a topic constituent of their master's philosophy, but as an answer to those formidable objections which had been deduced from the doctrine of original sin, and from the vices which stain, and from the calamities which disturb, human life: hence they strenuously asserted, that all the human race were either introduced to being prior to Adam, or pre-existent in his person; that they were not, therefore, represented by our first parents, but actually concurred in their crime, and participated their ruin.

4 Pre-existence taught by Christian Platonists.

The

Pre-existence.

* See *Pre-adamites.*

5 But no solution of original sin.

The followers of Origen, and such as entertained the notion of Pre-adamites *, might argue from the doctrine of pre-existence with some degree of plausibility. For the human beings introduced by them to the theatre of probation had already attained the capacity or dignity of moral agents; as their crime therefore was voluntary, their punishment might be just. But those who believe the whole human race created in Adam to be only pre-existent in their germs or stamina, were even deprived of this miserable subterfuge; for in these homunculi we can neither suppose the moral nor rational constitution unfolded. Since, therefore, their degeneracy was not spontaneous, neither could their sufferings be equitable. Should it be said that the evil of original sin was penal, as it extended to our first parents alone, and merely consequential as felt by their posterity, it will be admitted that the distinction between penal and consequential evil may be intelligible in human affairs, where other laws, assortments, and combinations than those which are simply and purely moral, take place. But that a moral government, at one of the most cardinal periods of its administration, should admit gratuitous or consequential evil, seems to us irreconcileable with the attributes and conduct of a wise and just legislator. Consequential evil taken as such, is misery sustained without demerit; and cannot result from the procedure of wisdom, benignity, and justice; but must flow from necessity, from ignorance, from cruelty, or from caprice, as its only possible sources. But even upon the supposition of those who pretend that man was mature in all his faculties before the commission of original sin, the objections against it will still remain in full force: for it is admitted by all except the Samian sage, that the consciousness of personal identity which was felt in pre-existence, is obliterated in a subsequent state of being.

Now it may be demanded, whether agents thus resuscitated for punishment have not the same right to murmur and complain as if they had been perfectly innocent, and only created for that dreadful catastrophe? It is upon this principle alone that the effects of punishment can be either exemplary or disciplinary; for how is it possible, that the punishment of beings unconscious of a crime should ever be reconciled either to the justice or beneficence of that intention with which their sufferings are inflicted? Or how can others be supposed to become wise and virtuous by the example of those who are neither acquainted with the origin nor the tendency of their miseries, but have every reason to think themselves afflicted merely for the sake of afflicting? To us it seems clear, that the nature and *rationale* of original sin lie inscrutably retired in the bosom of Providence; nor can we, without unpardonable presumption and arrogance, form the most simple conclusion, or attempt the minutest discovery, either different from or extraneous to the clear and obvious sense of revelation. This sense indeed may with propriety be extracted from the whole, or from one passage collated with another; but independent of it, as reason has no premisses, she can form no deductions. The boldness and temerity of philosophy, not satisfied with contemplating pre-existence as merely relative to human nature, has dared to try how far it was compatible with the glorious Persons of the sacred Trinity. The Arians, who allowed the subordinate divinity of our Saviour, believed him pre-existent to all time, and before all worlds; but the Socinians, who esteemed his nature as well as his person merely human, insisted, that before his incarnation he was only pre-existent in the divine idea, not in nature or person. But when it is considered, that children do not begin to deduce instructions from nature and experience, at a period so late as we are apt to imagine; when it is admitted, that their progress, though insensible, may be much more rapid than we apprehend; when the opportunities of sense, the ardour of curiosity, the avidity of memory, and the activity of understanding, are remarked—we need not have recourse to a pre-existent state for our account of the knowledge which young minds discover. It may likewise be added, that moral agents can only be improved and cultivated by moral discipline. Such effects therefore of any state, whether happy or miserable, as are merely mechanical, may be noxious or salutary to the patient, but can never enter into any moral economy as parts of its own administration. Pre-existence, therefore, whether rewarded or punished, without the continued impression of personal identity, affords no solution of original sin.

Pre-existence ¶ Prejudice.

PREFACE, something introductory to a book, to inform the reader of the design, method, &c. observed therein, and generally whatever is necessary to the understanding of a book.

PREFECT, in ancient Rome, one of the chief magistrates who governed in the absence of the kings, consuls, and emperors.

This power was greatest under the emperors. His chief care was the government of the city, taking cognizance of all crimes committed therein and within 100 miles. He judged capitally and finally, and even presided in the senate. He had the superintendence of the provisions, building, and navigation.

The prefect of modern Rome differs little from the ancient *præfectus*, his authority only extending to 40 miles round the city.

Prefect of the Prætorium, the leader of the pretorian bands destined for the emperor's guard, consisting, according to Dion, of 10,000 men. This officer, according to Suetonius, was instituted by Augustus, and usually taken from among the knights.

By the favour of the emperors his power grew very considerable; to reduce which, Constantine divided the prefecture of the prætorium into four prefectures, and each of these he subdivided again into civil and military departments, though the name was only reserved to him who was invested with the civil authority, and that of *comes belli* given him who commanded the cohorts.

PREGADI, in *History*, a denomination given to the senate of Venice, in which resides the whole authority of the republic. At its first institution, it was composed of 60 senators, to whom 60 more have been added. See VENICE.

PREGNANCY, the state of a woman who has conceived, or is with child. See MIDWIFERY.

PREHNITE, a mineral first brought by Colonel Prehn from the Cape of Good Hope, whose name it bears. See MINERALOGY *Index*.

I Definition.

PREJUDICE, or PREJUDGMENT, from *præ* and *judicium*, means a judgment formed beforehand, without examination; the preposition *præ* expressing an anticipation, not so much of time as of knowledge and due attention: and hence the schoolmen have called it *anticipation* and *a preconceived opinion*.

Prejudice.

2 Origin of prejudice.

Prejudice arises from the associating principle, which we have explained at large in another article (see METAPHYSICS, Part I. chap. 5.), and it is a weakness from which no human mind can be wholly free. Some are indeed much more than others under its influence; but there is no man who does not occasionally act upon principles, the propriety of which he never investigated; or who does not hold speculative opinions, into the truth of which he never seriously inquired. Our parents and tutors, yea, our very nurses, determine a multitude of our sentiments: our friends, our neighbours, the custom of the country where we dwell, and the established opinions of mankind, form our belief; the great, the pious, the learned, and the ancient, the king, the priest, and the philosopher, are characters of mighty efficacy to persuade us to regulate our conduct by their practice, and to receive as truth whatever they may dictate.

The case cannot indeed be otherwise. The occasions of acting are so frequent, and the principles of action are so various, that were a man to investigate accurately the value of every single motive which presents itself to his mind, and to balance them fairly against each other, the time of acting would in most instances pass away long before he could determine what ought to be done; and life would be wasted in useless speculation. The great laws of religion and morality, which ought to be the general and leading principles of action, no man of science will take upon trust; but in the course of a busy life a thousand circumstances will occur in which we must act with such rapidity, that, after being satisfied of the lawfulness of what we are about to do, we must, for the prudence of it, confide entirely in the general customs of our country, or in the practice of other individuals placed in circumstances similar to ours. In all such cases, though we may act properly, we act from *prejudice*.

3 Its extensive dominion.

But the dominion of prejudice is not confined to the actions of the man of business: it extends over the speculations of the philosopher himself, one half of whose knowledge rests upon no other foundation. All human sciences are related to each other (see PHILOSOPHY, N° 2.), and there is hardly one of them in which a man can become eminent unless he has some general acquaintance with the whole circle; but no man could ever yet investigate for himself all those propositions which constitute the circle of the sciences, or even comprehend the evidence upon which they rest, though he admits them perhaps as truths incontrovertible. He must therefore receive many of them upon the authority of others, or, which the same thing, admit them by *prejudice*.

To this reasoning it may be objected, that when a man admits as true abstract propositions, which, though not self-evident, he cannot demonstrate, he admits them not by prejudice, but upon testimony, which has been elsewhere shown to be a sufficient foundation for human belief (see METAPHYSICS, N° 138.). The objection is plausible, but it is not solid; for testimony *commands* belief only concerning *events* which, falling under the cognizance of the senses, preclude all possibility of mistake; whereas abstract propositions, not self-evident, can be proved true only by a *process of reasoning* or by a *series of experiments*; and in conducting both these, the most vigorous mind is liable to mistake. When Sir Isaac Newton told the world that it was the fall of an apple which first suggested to him the general law of gravitation, he bore testimony to a fact concerning which he could not be mistaken; and we receive his testimony for the reasons assigned in the article referred to. When he lays down the method of obtaining the fluxion or momentum of the rectangle or product of two indeterminate quantities, which is the main point in his doctrine of fluxions, he labours to establish that method on the basis of demonstration; and whoever makes use of it in practice, without understanding that demonstration, receives the whole doctrine of the modern geometrical analysis, not as a matter of *fact* upon the credit of Sir Isaac's *testimony*, but as a system of abstract *truth* on the credit of his *understanding*: in other words, he is a fluxionist by *prejudice*.

In vain will it be said, that in mathematical demonstration there is no room for mistake; and that therefore the man who implicitly adopts the method of fluxions may be considered as relying upon the *veracity* of its author, who had no inducement to deceive him, and whose comprehension was confessedly greater than his. In fluxionary mathematics, which treat of matters of which it is extremely difficult, if not impossible, to have adequate and steady conceptions, the most comprehensive mind is liable to mistake; and it is well known that the celebrated bishop of Cloyne wrote his *Analist* to prove that the incomparable author of the method of fluxions had committed *two mistakes* in his fundamental proposition, which balancing one another, produced a true conclusion by false reasoning. One or other of these great men, of whom the least was an eminent mathematician, must have been bewildered in his reasoning, and have fallen into error; and therefore whoever follows either of them implicitly without perceiving the error of the other, is unquestionably under the influence of prejudice. This is the case with the writer of the present article. He perceives not the error of Bishop Berkeley's reasoning, and yet he admits the doctrine of fluxions on the authority of Sir Isaac's demonstration. That demonstration, however, he pretends not to understand; and therefore he admits the doctrine through *prejudice*.

4 Impossible to eradicate all prejudices from the mind.

We have made these observations, to point out the absurdity of the fashionable cry against the harbouring of any prejudices. To eradicate all prejudices from the human mind is impossible; and if it were possible, it would be very unwise: for we see that prejudice may exist on the side of truth as well as on that of falsehood; and that principles professed and believed by any individual may be useful and true, though he was brought to them not by a train of fair and candid reasoning, but through the medium of prepossession or authority. Indeed such is our nature, and such are the laws of association, that many of our best principles, and our obligation to perform many of the most amiable of our duties in common life, must evidently be acquired in this way. From endearing associations and authoritative instruction, we acquire a knowledge of our duty to our parents, and a facility in performing it, together with the first principles of religion, without a single effort of our own reason. Even when reason has begun to assert its power, and shows us the propriety of such duties, we are wonderfully assisted in performing them by the amiable prejudices which we had before acquired, and

and which now appear to be natural to us. He who has never had the advantage of such associations, and who acquires a knowledge of the duties suggested by them after he has come to the years of discretion, and chiefly by the efforts of his own reason, will seldom *cæteris paribus*, perform these duties with an energy and delight equal to that of the person who has. This remark appears to be confirmed by experience; for it is often found that the children of the great, who have been given out to nurse in their infancy, and who have seldom been in the company of their parents till their reasoning faculties have been far advanced, are much less dutiful and affectionate than those in the middle or lower stations of life, who have scarcely ever been out of their parents company.

5
which would not be wise if it were possible.

Would it then be wise, even if it were practicable, to dissolve all those associations which tend so powerfully to increase the mutual affections of parents and children? We cannot think that it would; as we believe it might be easily shown that public spirit springs out of private affection. Plato indeed held an opinion very different from ours; for in order to extend that affection which is usually lavished at home to the whole state, he proposed that children should be educated at the public expence, and never be permitted to know the authors of their being. But this is only one of the many visionary projects of that great man, of which daily experience shows the absurdity. In modern times, we are certain that less dependence is to be had upon the *patriotism* of the man who, for the love which he pretends to his country, can overlook or forget his own partial connections in it, than on him who, at the same time that he wishes his country well, is feelingly alive to all the endearments of kindred affection.

Such affection may be called *partial*, and very probably has its foundation in that which is the source of all our prejudices: but if it be properly trained in early life, it will gradually extend from our nearest relations to the persons with whom we associate, and to the place which not only gave us birth, but also furnished our youthful and most innocent enjoyments. It is thus that the *amor patriæ* is generated (see PASSION and PATRIOTISM), which in minds unseduced by false principles is exceedingly strong; and, though a partial affection, is of the most general utility. It is this prejudice which reconciles the Laplander to his freezing snows, and the African to his burning sun; which attaches the native of the Highlands or of Wales as much to his mountains and rocks, as the apparently happier inhabitant of the southern counties of England is to the more fertile and delightful spot where he drew his first breath. And we find in fact, that when a native of Kent and a Scotch Highlander have in some distant corner of the world gained a competent fortune without being corrupted by luxury, they return, the one to his hop-gardens, and the other to his mountains. Were this prejudice, for such it surely is, wholly eradicated from the human mind, it is obvious that large tracts of country which are now full of inhabitants would be totally deserted; and that the hungry barbarians, to make room for themselves, would exterminate the proprietors of more favourable climes. From an affection to our friends and to our country, we naturally contract an affection for that mode of government under which we live; and unless it be particularly oppressive to ourselves or any order of citizens, we come as naturally to prefer it to all other modes, whether it deserve that preference or not. This no doubt is prejudice, but it is a beneficial prejudice; for were the multitude, who are wholly incapable of estimating the excellencies and defects of the various modes of government, to become dissatisfied with their own, and rise in a mass to change it for the better, the most horrible consequences might justly be dreaded. Of this truth the present state of Europe affords too melancholy and convincing a proof. The man therefore who, under the pretence of enlightening the public mind and extirpating prejudices, paints to the illiterate vulgar in aggravated colours the abuse of that government which has hitherto protected them from the ferocity of each other, is one of the greatest criminals if his views be selfish, and one of the worst reasoners if they be disinterested, that human imagination can easily conceive.

6
Good effects of some prejudices.

[illegible]

With the selfish patriot we have at present no concern; but we may with propriety ask the disinterested lover of truth, whether he thinks it possible, that in a large community, of which nine-tenths of the members are necessarily incapable of taking comprehensive views of things, or feeling the force of political reasonings, any form of government can be acceptable to the people at large, which does not gain their affections through the medium of prejudice? It has been shown by Mr Hume with great strength of argument, that government is founded on *opinion*, which is of two kinds, viz. opinion of interest, and opinion of right. By opinion of interest, he understands the sense of the general advantage which is reaped from government, together with the persuasion that the particular government which is established is equally advantageous with any other that could easily be settled. The opinion entertained of the *right* of any government is always founded in its antiquity; and hence arises the passionate regard which under ancient monarchies the people have for the true heir of their royal family. These opinions, as held by the philosopher conversant with the history of nations, are founded upon reasoning more or less conclusive; but it is obvious, that in the minds of the multitude they can have no other foundation than prejudice. An illiterate clown or mechanic does not *see how* one form of government promotes the general interest more than another; but he may *believe* that it does, upon no other evidence than the declamation of a demagogue, who, for selfish purposes, contrives to flatter his pride. The same is the case with respect to the rights of hereditary monarchy. The anatomist finds nothing more in the greatest monarch than in the meanest peasant, and the moralist may perhaps frequently find less; but the true philosopher acknowledges his right to the sovereignty: and though he be weak in understanding, or infirm in years, would, for the sake of public peace, and the stability of government, maintain him in his throne against every competitor of the most shining talents. The vulgar, however, who would act with this philosopher, are influenced by no such views, but merely by their prejudices in favour of birth and family; and therefore it is ridiculous to think of changing the public mind with respect to any form of government by pure reasoning. In France a total change in the minds of the people has indeed been effected, and from the most violent prejudices in favour of royalty, they have now become more violently prejudiced

diced in favour of republicanism. Bad as their government unquestionably was, the change that has now taken place is not the effect of calm reasoning and accurate inquiry (for of that the bulk of mankind appears to be incapable), nor are their prejudices less violent than they were before. They are changed indeed; but no one will deny that prejudice, and that of the most violent kind, leads them on at present; nor can any one assert that their new prejudices have rendered them more happy, or their country more flourishing, than their former ones, which made them cry *Vive le Roi* under the tyrannic government of Louis XIV.

The influence of prejudice is not more powerful in fixing the political opinions of men, than in dictating their religious creed. Every child of a religious father receives his faith by inheritance long before he be capable of judging whether it be agreeable or disagreeable to the word of God and the light of reason. This experience shows to be the fact; and sound philosophy declares that it cannot be otherwise. Parents are appointed to judge for their children in their younger years, and to instruct them in what they should believe, and what they should practise in the civil and religious life. This is a dictate of nature, and doubtless would have been so in a state of perfect innocence. It is impossible that children should be capable of judging for themselves before their minds are furnished with a competent number of ideas, and before they are acquainted with any *principles* and *rules* of just reasoning; and therefore they can do nothing better than run to their parents, and receive their directions what they should believe and what they should practise.

8
Absurdity of keeping children ignorant of religion from the dread of prejudice.

This mode of tutoring the infant mind, and giving to our instructions the force of prejudice, before reason can operate with much effect, will, we know, be highly displeasing to many who challenge to themselves alone the epithet of liberal. With them it will be cramping the genius and perverting the judgment: but we cannot help thinking, that such an objection, if it should be made, would be the offspring of ignorance; for it requires but very little knowledge of human nature to be able to see, that if children be not restrained by authority, and if we do not insinuate a love of good principles into their minds, bad ones will insinuate themselves, and a little time will give *them* the force of inveterate prejudice, which all the future efforts of reason and philosophy will find it difficult to eradicate. The idea of keeping a child ignorant of the being of a God, and the grand duties of morality and religion, till he shall come to years of discretion, and then allowing him to reason them out for himself, is an absurd chimera; it is an experiment which never has been tried, which to us it appears impossible to try, and which, if it could be tried, could not possibly produce any good effect. For suppose we had a youth just arrived at years of discretion, totally ignorant of all these things, and unbiassed to any system of opinions, or rather possessed of no opinions at all—it would, in the first place, we suspect, be absolutely necessary to direct his thoughts into a particular train, and for some person to lead him on from one idea to another, till he should arrive at some conclusion: but in all this there is the influence of authority, association, and of prejudice.

9
Origin of bigotry.

It being therefore absolutely necessary that sentiments of religion be instilled into the minds of children before they be capable of discovering by the use of their reason whether those sentiments be just or not, it need not excite wonder, nor is it any reflection upon religion, that most men adhere with bigotry to the creed of their fathers, and support that creed by arguments which could carry conviction to no minds but their own. The love and veneration which they bear to the memory of those from whom they imbibed their earliest opinions, do not permit them to perceive either the falsehood of those opinions, or their little importance, supposing them true. Hence the many frivolous disputes which have been carried on among Christians; and hence the zeal with which some of them maintain tenets which are at once contrary to scripture, to reason, and to common sense. A due reflection, however, on the source of all prejudices ought to moderate this zeal; for no man is wholly free from that bias which he is so ready to condemn in others: and indeed a man *totally free from prejudice*, would be a more unhappy being than the most violent bigot on earth. In science, he would admit nothing which he could not himself demonstrate; in business, he would be perpetually at a stand for want of motives to influence his conduct: he could have no attachment to a particular country; and therefore must be without patriotism, and without the solaces of friendship; and his religion, we are afraid, would be cold and lifeless.

10
An objection answered.

What, it will be said, are the authors of a work which professes to enlighten the public mind by laying before it a general view of science and literature, become at last the advocates of *prejudice*, which is the *bane* of *science*, and the *prop* of *superstition*? No, we are advocates for no prejudice which is either inimical to science or friendly to absurdity; but we do not think that the moralist would act wisely who should desert his proper business to make himself master of the higher mathematics, merely that he might not be obliged to trust occasionally to the demonstrations of others. The writers of this article is not skilled in trade; but it is not his opinion that the merchant would soon grow rich, who should never make a bargain till he had previously calculated with mathematical exactness all the probabilities of his gain or loss. That to dissolve all the associations which are the source of partial attachments of kindred, affection, and private friendship, would tend to promote the public happiness, we cannot possibly believe. And we think, that the experience of the present eventful day abundantly confirms Mr Hume's opinion, that far from endeavouring to extirpate the people's prejudices in favour of birth or family, we should cherish such sentiments, as being absolutely requisite to preserve a due subordination in society. That men would be better Christians if they were to receive no religious instruction till they should be able by their own reason to judge of its truth, daily observation does not warrant us to conclude; for we see those who have seldom heard of God when children, "live without him in the world" when they are men.

Pernicious prejudices we have traced to their source elsewhere, and shown how they may be best prevented by proper attention in the education of children. (See METAPHYSICS, N° 98.). We shall only add here, that the earlier such attention is paid, the more effectual it will be found; and that it is much easier to keep prejudices out of the mind than to remove them after

Prejudice.

they have been admitted. This however must be sometimes attempted; and where prejudices are strong, several methods have been recommended for rendering the attempt successful. The following are taken mostly from Dr Watts's Improvement of the Mind.

11 Proper methods of removing prejudices.

1. Never attack the prejudice *directly*, but lead the person who is under its influence step by step to the truth. Perhaps your neighbour is under the influence of *superstition and bigotry in the simplicity of his soul;* you must not immediately run upon him with violence, and show him the absurdity or folly of his own opinions, though you might be able to set them in a glaring light; but you must rather begin at a distance, and establish his assent to some familiar and easy propositions, which have a tendency to refute his mistakes, and to confirm the truth; and then silently observe what impression this makes upon him, and proceed by slow degrees as he is able to bear, and you must carry on the work perhaps at distant seasons of conversation. The tender or diseased eye cannot bear a deluge of light at once.

Overhastiness and vehemence in arguing is oftentimes the effect of *pride;* it blunts the poignancy of the argument, breaks its force, and disappoints the end. If you were to convince a person of the falsehood of the *doctrine of transubstantiation*, and you take up the consecrated bread before him and say, "You may see, and taste, and feel, *this is nothing but bread;* therefore whilst you assert that God commands you to believe *it is not bread*, you most wickedly accuse God of commanding you to tell a lie." This sort of language would only raise the indignation of the person against you, instead of making any impressions upon him. He will not so much as think at all on the argument you have brought, but he rages at you as a *profane wretch*, setting up your own sense and reason above sacred authority; so that though what you affirm is a truth of great evidence, yet you lose the benefit of your whole argument by an ill management, and the unreasonable use of it.

2. Where the prejudices of mankind cannot be conquered at once, but will rise up in arms against the evidence of truth, there we must make some allowances, and yield to them for the present, as far as we can safely do it without real injury to truth; and if we would have any success in our endeavours to convince the world, we must practise this complaisance for the benefit of mankind. Take a student who has deeply imbibed the principles of the *Peripatetics*, and imagines certain immaterial beings, called *substantial forms*, to inhabit every herb, flower, mineral, metal, fire, water, &c. and to be the spring of all its properties and operations; or take a Platonist, who believes an *anima mundi*, "an universal soul of the world," to pervade all bodies, to act in and by them according to their nature, and indeed to give them their nature and their special powers; perhaps it may be very hard to convince these persons by arguments, and constrain them to yield up those fancies. Well then, let the one believe his *universal soul*, and the other go on with his notion of *substantial forms*, and at the same time teach them how by certain original laws of motion, and the various sizes, shapes, and situations of the parts of matter, allowing a continued divine concourse in and with all, the several appearances in nature may be solved, and the variety of effects produced, according to the corpuscular philosophy, improved by *Descartes*, *Mr Boyle*, and *Sir Isaac Newton;* and when they have attained a degree of skill in this science, they will see these airy notions of theirs, these imaginary powers, to be so useless and unnecessary, that they will drop them of their own accord. The *Peripatetic forms* will vanish from the mind like a dream, and the *Platonic soul of the world will expire.*

We may give another instance of the same practice, where there is a prejudicate fondness of particular words and phrases. Suppose a man is educated in an *unhappy form of speech*, whereby he explains some *great doctrine of the gospel*, and by the means of this phrase he has imbibed a very false idea of that doctrine; yet he is so bigotted to his form of words, that he imagines if those words are omitted the form is lost. Now, if we cannot possibly persuade him to part with his improper terms, we will indulge them a little, and try to explain them in a scriptural sense, rather than let him go on in his mistaken ideas. A person who has been bred a *Papist*, knows but little of religion, yet he resolves never to part from the *Roman Catholic faith*, and is obstinately bent against a change. Now it cannot be unlawful to teach such an one the true Christian, i. e. the *Protestant religion* out of the *Epistle to the Romans*, and show him that the same doctrine is contained in the *Catholic Epistles of St Peter, James, and Jude;* and thus let him live and die a good Christian in the belief of the religion taught him out of the New Testament, while he imagines he is a *Roman Catholic* still, because he finds the doctrine he is taught in the *Catholic* Epistles and in that to the *Romans*. Sometimes we may make use of the very prejudices under which a person labours, in order to convince him of some particular truth, and argue with him upon his own professed principles as though they were true. Suppose a *Jew* lies sick of a fever, and is forbidden flesh by his physician; but hearing that rabbits were provided for the dinner of the family, desired earnestly to eat of them; and suppose he became impatient, because his physician did not permit him, and he insisted upon it that it could do him no hurt—surely rather than let him persist in that fancy and that desire, to the danger of his life, we might tell him that these animals were strangled, a sort of food forbidden by the Jewish law, though we ourselves might believe that law to be abolished.

Where we find any person obstinately persisting in a mistake in opposition to all reason, especially if the mistake be very injurious or pernicious, and we know this person will hearken to the sentiment or authority of some favourite name; it is needful sometimes to urge the *opinion and authority* of that favourite person, since that is likely to be regarded much more than *reason*. We are almost ashamed indeed to speak of using any *influence of authority* in reasoning or argument; but in some cases it is better that poor, silly, perverse, obstinate creatures, should be persuaded to judge and act right, by a veneration for the sense of others, than to be left to wander in pernicious errors, and continue deaf to all argument, and blind to all evidence. They are but children of a larger size; and since they persist all their lives in their minority, and reject all true reasoning, surely we may try to persuade them to practise what is for their own interest by such childish reasons as they will hearken to. We may overawe them from pursuing

pursuing their own ruin by the terrors of a solemn shadow, or allure them by a sugar plum to their own happiness. But after all, we must conclude, that wheresoever it can be done, it is best to *remove and root out those prejudices* which obstruct the entrance of truth into the mind, rather than to palliate, humour, or indulge them; and sometimes this must necessarily be done, before you can make a person part with some beloved error, and lead him into better sentiments.

12 Mutual forbearance recommended.

On the whole, we would recommend more mutual forbearance and less acrimony than is commonly found among writers on disputed subjects, as the only means by which our differences in religion, politics, and science, ever can be healed, and truth certainly discovered. If men were less violent in defending their particular opinions, they would always gain a more patient hearing, they would be less suspected of, and less liable to, prejudice, and of course more apt either to convince or to be convinced. They would likewise by so doing show, in the most unequivocal manner, their attention to sound philosophy, and above all to genuine Christianity; which, though it is far from encouraging scepticism, or a temporizing spirit, recommends in the strongest terms, among all its professors, *universal charity and mutual forbearance*. See PROBABILITY, TRUTH, and SUPERSTITION.

PRELATE, an ecclesiastic raised to some eminent and superior dignity in the church; as bishops, archbishops, patriarchs, &c.

PRELIMINARY, in general, denotes something to be examined and determined before an affair can be treated of to the purpose.

PRELUDE, in *Music*, is usually a flourish or irregular air, which a musician plays off-hand, to try if his instrument be in tune, and to lead him into the piece to be played.

PREMISES, in *Logic*, an appellation given to the two first propositions of a syllogism. See LOGIC.

PREMISES, in *Law*, properly signifies the land, &c. mentioned in the beginning of a deed.

PREMIUM, or PRÆMIUM, properly signifies a reward or recompense: but it is chiefly used in a mercantile sense for the sum of money given to an insurer, whether of ships, houses, lives, &c. See INSURANCE.

PREMNA, a genus of plants belonging to the didynamia class. See BOTANY *Index*.

PREMONSTRANTES, or PRÆMONSTRATENSES, a religious order of regular canons instituted in 1120, by S. Norbert; and thence also called *Norbertines*.

The first monastery of this order was built by Norbert in the Isle of France, three leagues to the west of Laon; which he called *Præmonstre*, *Præmonstratum*, and hence the order itself derived its name; though as to the occasion of that name, the writers of that order are divided. At first the religious of this order were so very poor, that they had only a single ass, which served to carry the wood they cut down every morning, and sent to Laon in order to purchase bread. But they soon received so many donations, and built so many monasteries, that in 30 years after the foundation of the order, they had above 100 abbeys in France and Germany: and in process of time the order so increased, that it had monasteries in all parts of Christendom, amounting to 1000 abbeys, 300 provostships, a vast number of priories, and 500 nunneries. But they are now greatly diminished. The rule they followed was that of St Augustine, with some slight alterations, and an addition of certain severe laws, whose authority did not long survive their founder.

The order was approved by Honorius II. in 1126, and again by several succeeding popes. At first the abstinence from flesh was rigidly observed. In 1245 Innocent IV. complained of its being neglected to a general chapter. In 1288, their general, William, procured leave of Pope Nicholas IV. for those of the order to eat flesh on journeys. In 1460, Pius II. granted them a general permission to eat meat, excepting from Septuagesima to Easter. The dress of the religious of this order is white, with a scapulary before the cassock. Out of doors they wear a white cloak and white hat; within, a little camail; and at church, a surplice, &c.

In the first monasteries built by Norbert, there was one for men and another for women, only separated by a wall. In 1137, by a decree of a general chapter, this practice was prohibited, and the women removed out of those already built, to a greater distance from those of the men.

The Præmonstratenses, or monks of Premontre, vulgarly called *white canons*, came first into England, A. D. 1146. Their first monastery, called *New-house*, was erected in Lincolnshire, by Peter de Saulia, and dedicated to St Martial. In the reign of Edward I. this order had 27 monasteries in England.

PRENANTHES, a genus of plants belonging to the syngenesia class; and in the natural method ranking under the 49th order, *Compositæ*. See BOTANY *Index*.

PRENOMEN, PRÆNOMEN, among the ancient Romans, a name prefixed to their family name, and answering to our Christian name: such as Caius, Lucius, Marcus, &c.

PRENOTION, PRÆNOTIO, or *Præcognitio*, is a notice or piece of knowledge preceding some other in respect of time. Such is the knowledge of the antecedent, which must precede that of the conclusion. It is used by Lord Bacon for breaking off an endless search, which he observes to be one of the principal parts of the art of memory. For when one endeavours to call any thing to mind, without some previous notion or perception of what is sought for, the mind exerts itself and strives in an endless manner: but if it hath any short notion before-hand, the infinity of the search is presently cut off, and the mind hunts nearer home, as in an enclosure. Thus verse is easier remembered than prose; because if we stick at any word in a verse, we have a previous notion that it is such a word as must stand in a verse. Hence also, order is a manifest help to memory; for here is a previous notion, that the thing sought for must be agreeable to order. Bacon's *Works Abr*. vol. i. p. 136. and vol. ii. p. 473.

PEEPARATION, in a general sense, the act of disposing things in such a manner as to render any foreseen event more advantageous or less hurtful according to its nature.

PREPARATION of Dissonances, in *Music*, is their disposition in harmony in such a manner, that, by something congenial to what precedes, they may be rendered less harsh to the ear than they would be without that precaution: according to this definition, every discord ought to be prepared. But when, in order to

prepare

Preparation.

prepare a dissonance, it is exacted that the sound which forms it should before have formed a consonance, then there is fundamentally but one single dissonance which is prepared, viz. the seventh. Nor is even this preparation necessary in the chord which contains the sensible note, because then the dissonance being characteristical, both in its chord and in its mode, the ear has sufficient reason to expect it: it accordingly does expect it, and recognise it: nor is either deceived with respect to its chord nor its natural progress. But when the seventh is heard upon a fundamental sound which is not essential to the mode, it ought then to be prepared, in order to prevent all ambiguity; to prevent the ear, whilst listening to this note, from losing its train: and as this chord of the seventh may be inverted and combined in several different manners, from this arise likewise a number of different ways by which it may seem to be prepared, which, in the main, always issue however in the same thing.

In making use of dissonances, three things are to be considered; viz. the chord which precedes the dissonance, that in which it is found, and that which is immediately subsequent to it. Preparation only respects the two first; for the third, see RESOLUTION.

When we would regularly prepare a discord in order to arrive at its chord, we must choose such a career of the fundamental bass, that the sound which forms the dissonance may be a protraction into the perfect time of the same note which formed a consonance formerly struck in the imperfect in the preceding chord; this is what we call *sincopation*. See SINCOPATION.

From this preparation two advantages result; viz. 1. That there is necessarily an harmonical connection between the two chords, since that connection is formed by the dissonance itself; and, 2. That this dissonance, as it is nothing else but the continuation of the same sound which had formed a consonance, becomes much less harsh to the ear than it would have been with any sound recently struck. Now this is all that we expect to gain by preparation. See CADENCE, DISCORD, and HARMONY.

By what has been just said, it will appear that there is no other part peculiarly destined for preparing the dissonance, except that in which it is heard; so that if the treble shall exhibit a dissonance, that must be sincopated; but if the dissonance is in the bass, the bass must be sincopated. Though there is nothing here but what is quite simple, yet have masters of music miserably embroiled the whole matter.

Some dissonances may be found which are never prepared: such is the sixth superadded: some which are very unfrequently prepared; such is the diminished seventh.

PREPARATIONS, in *Pharmacy*, the medicines when mixed together in such a manner as to be fit for the use of the patient. See PHARMACY, under MATERIA MEDICA.

PREPARATIONS, in *Anatomy*, the parts of animal bodies prepared and preserved for anatomical uses.

Edin. Med. Essays, vol. ii. p. 8.

The manner of preserving anatomical preparations, is either by drying them thoroughly in the air, or putting them into a proper liquor.

In drying parts which are thick, when the weather is warm, care must be taken to prevent putrefaction, fly-blows, insects, &c. This is easily done by the use of a solution of corrosive sublimate in spirit of wine, in the proportion of two drams of sublimate to a pound of spirit: the part should be moistened with this liquor as it dries, and by this method the body of a child may be kept safe even in summer. Dried preparations are apt to crack and moulder away in keeping; to prevent this, their surface should be covered with a thick varnish, repeated as often as occasion requires.

Though several parts prepared dry are useful, yet others must be so managed as to be always flexible, and nearer a natural state. The difficulty has been to find a proper liquor for this purpose. Dr Monro says, the best he knows is a well rectified colourless spirit of wine, to which is added a small quantity of the spirit of vitriol or nitre. When these are properly mixed, they neither change their colour nor the consistence of the parts, except where there are serous or mucous liquors contained in them. The brain, even of a young child, in this mixture grows so firm as to admit of gentle handling, as do also the vitreous and crystalline humours of the eye. The liquor of the sebaceous glands and the semen are coagulated by this spirituous mixture; and it heightens the red colour of the injection of the blood-vessels, so that after the part has been in it a little time, several vessels appear which were before invisible. If you will compare these effects with what Ruysch has said of his balsam, you will find the liquor above mentioned to come very near to it.

The proportion of the two spirits must be changed according to the part prepared. For the brain and humours of the eye, you must put two drams of spirit of nitre to one pound of spirit of wine. In preserving other parts which are harder, 30 or 40 drops of the acid will be sufficient; a larger quantity will make bones flexible, and even dissolve them. The part thus preserved should always be kept covered with the liquor: therefore great care should be taken to stop the mouth of the glass with a waxed cork and a bladder tied over it, to prevent the evaporation of the spirit; some of which, notwithstanding all this care, will fly off; therefore fresh must be added as there is occasion. When the spirits change to a dark tincture, which will sometimes happen, they should be poured off, and fresh put in their room; but with somewhat less acid that at first.

The glasses which contain the preparations should be of the finest sort, and pretty thick; for through such the parts may be seen very distinctly, and of a true colour, and the object will be so magnified as to show vessels in the glass which out of it were not be seen.

As the glass when filled with the liquor has a certain focus, it is necessary to keep the preparation at a proper distance from the sides of it, which is easily done by little sticks suitably placed, or by suspending it by a thread in a proper situation. The operator should be cautious of putting his finger in this liquor oftener than is absolutely necessary; because it brings on a numbness on the skin, which makes the fingers unfit for any nice operation. The best remedy for this is to wash them in water mixed with a few drops of oil of tartar per deliquium.

Dr Christ. Jac. Trew prefers the rectified spirit of grain for preserving anatomical preparations to spirit of wine, or to compositions of alcohol, amber, camphor, &c. because these soon change into a brown colour, whereas the spirit from malt preserves its limpid appearance. When any part is to be preserved wet, wash it with water till it is no more tinctured. The water is next to be washed away with spirits, and then the preparation is to be put among spirits in a glass, the mouth of which is to be closely covered with a glass head, over which a wet bladder and leaf-tin are to be tied. *Com. Lit. Norimb.* 1731, *semest.* 1. *specim.* 9. See also *Pole's Anatomical Instructor*, and *American Transactions*, vol. ii. p. 366.

PREPENSED, in *Law*, denotes fore-thought. In which sense we say *prepensed malice*, &c. If, when a man is slain upon a sudden quarrel, there were malice prepensed formerly between them, it makes it murder; and, as it is called in some statutes, *prepensed murther*.

PREPOSITION, in *Grammar*, one of the parts of speech, being an indeclinable particle which yet serves to govern the nouns that follow it; such as *per*, *pro*, *propter*; and through, for, with, &c.

F. Buffier allows it to be only a modificative of a part of speech, serving to circumstantiate a noun.

PREPUCE, in *Anatomy*, the foreskin, being a prolongation of the cutis of the penis, covering the glans. See PENIS, ANATOMY *Index*.

PREROGATIVE, an exclusive or peculiar privilege.

Royal PREROGATIVE, that special pre-eminence which the king hath over and above all other persons, and out of the ordinary course of the common law, in right of his regal dignity. It signifies in its etymology (from *præ* and *rogo*) something that is required or demanded before, or in preference to, all others. And hence it follows, that it must be in its nature singular and eccentrical; that it can only be applied to those rights and capacities which the king enjoys alone in contradistinction to others, and not to those which he enjoys in common with any of his subjects: for if once any one prerogative of the crown could be held in common with the subject, it would cease to be prerogative any longer. And therefore Finch lays it down as a maxim, that the prerogative is that law in case of the king, which is law in no case of the subject.

Prerogatives are either *direct* or *incidental*. The *direct* are such positive substantial parts of the royal character and authority, as are rooted in, and spring from, the king's political person, considered merely by itself, without reference to any other extrinsic circumstance; as, the right of sending ambassadors, of creating peers, and of making war or peace. But such prerogatives as are *incidental* bear always a relation to something else, distinct from the king's person; and are indeed only exceptions, in favour of the crown, to those general rules that are established for the rest of the community: such as, that no costs shall be recovered against the king; that the king can never be a joint tenant; and that his debt shall be preferred before a debt to any of his subjects.

These substantive or direct prerogatives may again be divided into three kinds: being such as regard, first, the king's royal *character* or *dignity*; secondly, his royal *authority* or *power*; and, lastly, his royal *income*. These are necessary, to secure reverence to his person, obedience to his commands, and an affluent supply for the ordinary expences of government; without all of which it is impossible to maintain the executive power in due independence and vigour. Yet, in every branch of this large and extensive dominion, our free constitution has interposed such seasonable checks and restrictions, as may curb it from trampling on those liberties which it was meant to secure and establish. The enormous weight of prerogative, if left to itself, (as in arbitrary governments it is), spreads havock and destruction among all the inferior movements: but, when balanced and bridled (as with us) by its proper counterpoise, timely and judiciously applied, its operations are then equable and regular; it invigorates the whole machine, and enables every part to answer the end of its construction.

I. Of the royal *dignity*. Under every monarchical establishment, it is necessary to distinguish the prince from his subjects, not only by the outward pomp and decorations of majesty, but also by ascribing to him certain qualities as inherent in his royal capacity, distinct from, and superior to, those of any other individual in the nation. For though a philosophical mind will (says Sir William Blackstone) consider the royal person merely as one man appointed by mutual consent to preside over many others, and will pay him that reverence and duty which the principles of society demand; yet the mass of mankind will be apt to grow insolent and refractory, if taught to consider their prince as a man of no greater perfection than themselves. The law therefore ascribes to the king, in his high political character, not only large powers and emoluments, which form his prerogative and revenue, but likewise certain attributes of a great and transcendent nature; by which the people are led to consider him in the light of a superior being, and to pay him that awful respect which may enable him with greater ease to carry on the business of government. This is what we understand by the royal dignity; the several branches of which we shall now proceed to enumerate.

1. And, first, the law ascribes to the king the attribute of *sovereignty*, or pre-eminency. See SOVEREIGNTY.

2. "The law also (according to Sir William Blackstone) ascribes to the king, in his political capacity, absolute *perfection*. 'The king can do no wrong.' Which ancient and fundamental maxim (says he) is not to be understood as if every thing transacted by the government was of course just and lawful; but means only two things. First, that whatever is exceptionable in the conduct of public affairs, is not to be imputed to the king, nor is he answerable for it personally to his people: for this doctrine would totally destroy that constitutional independence of the crown, which is necessary for the balance of power, in our free and active, and therefore compounded, constitution. And, secondly, it means that the prerogative of the crown extends not to do any injury; it is created for the benefit of the people, and therefore cannot be exerted to their prejudice.

Preroga-tive.

prejudice.—"The king, moreover, (he observes), is not only incapable of *doing* wrong, but even of *thinking* wrong; he can never mean to do an improper thing: in him is no folly or weakness. And, therefore, if the crown should be induced to grant any franchise or privilege to a subject contrary to reason, or in anywise prejudicial to the commonwealth or a private person, the law will not suppose the king to have meant either an unwise or an injurious action, but declares that the king was deceived in his grant; and thereupon such grant is rendered void, merely upon the foundation of fraud and deception, either by or upon those agents whom the crown has thought proper to employ. For the law will not cast an imputation on that magistrate whom it entrusts with the executive power, as if he was capable of intentionally disregarding his trust: but attributes to mere imposition (to which the most perfect of sublunary beings must still continue liable) those little inadvertencies, which, if charged on the will of the prince, might lessen him in the eyes of his subjects."

But this doctrine has been exposed as ridiculous and absurd, by Lord Abingdon, in his *Dedication to the collective Body of the People of England.* "Let us see (says he) how these maxims and their comments agree with the constitution, with nature, with reason, with common sense, with experience, with fact, with precedent, and with Sir William Blackstone himself; and whether by the application of these rules of evidence thereto, it will not be found, that (from the want of attention to that important line of distinction which the constitution has drawn between the *king* of England and the *crown* of England) what was attributed to the *monarchy* has not been given to the *monarch*, what meant for the *kingship* conveyed to the *king*, what designed for the *thing* transferred to the *person*, what intended for *theory* applied to *practice;* and so in consequence, that whilst the premises (of the perfection of the monarchy) be true, the conclusion (that the king can do no wrong) be not false.

"And, first, in reference to the constitution: to which if this matter be applied (meaning what it expresses, and if it do not it is unworthy of notice), it is subversive of a principle in the constitution, upon which the preservation of the constitution depends; I mean the principle of *resistance;* a principle which, whilst no man will now venture to gainsay, Sir William Blackstone himself admits, '*is justifiable to the person of the prince;* when the being of the state is endangered, and the public voice proclaims such resistance necessary;' and thus, by such admission, both disproves the maxim, and oversets his own comment thereupon; for to say that 'the king can do no wrong,' and that 'he is incapable even of thinking wrong,' and then to admit that 'resistance to his person is justifiable,' are such jarring contradictions in themselves, that, until reconciled, the necessity of argument is suspended.

"With respect then, in the next place, to the agreement of this maxim, and its comment, with nature, with reason, and with common sense, I should have thought myself sufficiently justified in appealing to every man's own reflection for decision, if I had not been made to understand that nature, reason, and common sense, had had nothing to do with either. Sir William Blackstone says, 'That though a philosophical mind will consider the royal person merely as one man appointed by mutual consent to preside over others, and will pay him that reverence and duty which the principles of society demand, yet the mass of mankind will be apt to grow insolent and refractory if taught to consider their prince as a man of no greater perfection than themselves; and therefore the law ascribes to the king, in his high political character, certain attributes of a great and transcendent nature, by which the people are led to consider him in the light of a superior being, and to pay him that awful respect which may enable him with greater ease to carry on the business of government.' So that, in order to govern with greater ease (which by the bye is mere assertion without any proof), it is necessary to deceive the mass of mankind, by making them believe not only what a philosophical mind cannot believe, but what it is impossible for any mind to believe; and therefore, in the investigation of this subject, according to Sir William, neither nature, reason, nor common sense, can have any concern.——

"It remains to examine in how much this maxim and its comment agree with experience, with fact, with precedent, and with Sir William Blackstone himself. And here it is matter of most curious speculation, to observe a maxim laid down, and which is intendod for a rule of government, not only without a single case in support of it, but with a string of cases, that may be carried back to Egbert the first monarch of England, in direct opposition to the doctrine. Who is the man, that, reading the past history of this country, will show us any king that has done no wrong? Who is the reader that will not find that all the wrongs and injuries which the free constitution of this country has hitherto suffered, have been solely derived from the arbitrary measures of our kings? And yet the mass of mankind are to look upon the king as a superior being; and the maxim, that 'the king can do no wrong,' is to remain as an article of belief. But, without pushing this inquiry any farther, let us see what encouragement Sir William Blackstone himself has given for our credulity. After stating the maxim, and presenting us with a most lively picture, 'of our sovereign lord thus *all perfect* and *immortal*,' what does he make this all-perfection and immortality in the end to come to? His words are these: 'For when King Charles's deluded brother attempted to *enslave* the nation,' (*no wrong this, to be sure*), 'he found it was beyond his power: the people both *could*, and *did*, resist him; and in consequence of such resistance, obliged him to quit his enterprise and his throne together *.'"

* Comm. vol. iv. p. 433.

The sum of all is this: That the crown of England and the king of England are distinguishable, and not synonymous terms: that allegiance is due *to the crown*, and through the crown *to the king:* that the attributes of the crown are sovereignty, perfection, and perpetuity; but that it does not therefore follow that the king can do no wrong. It is indeed to be admitted, that in high respect for the crown, high respect is also due to the wearer of that crown; that is, to the king: but the crown is to be preferred to the king, for the first veneration is due to the constitution. It is likewise *to be supposed* that the king *will* do no wrong: and as, to prevent this, a privy council is appointed by the constitution to assist the king in the execution of the government; so if any wrong be done, 'these men, as

2 Montesquieu

Montesquieu expresses it, 'may be examined and punished (A).'

"But if any future king shall think to screen these evil counsellors from the just vengeance of the people, by becoming *his own minister;* and in so doing, shall take for his sanction *the attribute of perfection*, shall trust to the deception of his being *a superior being*, and cloak himself under the maxim that *the king can do no wrong;* I say, in such a case, let the appeal already made to the constitution, to nature, to reason, to common sense, to experience, to fact, to precedent, and to Sir William Blackstone himself, suffice; and preclude the necessity of any further remarks from me (B)."

To proceed now to other particulars: The law determines, that in the king can be no negligence or LACHES; and therefore no delay will bar his right. *Nullum tempus occurrit regi*, is the standing maxim upon all occasions: for the law intends that the king is always busied for the public good, and therefore has not leisure to assert his right within the times limited to subjects. In the king also can be no stain or corruption of blood: for if the heir to the crown were attainted of treason or felony, and afterwards the crown should descend to him, this would purge the attainder *ipso facto*. And therefore, when Henry VII. who as earl of Richmond stood attainted, came to the crown, it was not thought necessary to pass an act of parliament to reverse this attainder; because, as Lord Bacon in his history of that prince informs us, it was agreed that the assumption of the crown had at once purged all attainders. Neither can the king, in judgment of law, as king, ever be a minor or under age; and therefore his royal grants and assents to acts of parliament are good, though he has not in his natural capacity attained the legal age of 21. By a statute, indeed, 28 Hen. VIII. c. 17. power was given to future kings to rescind and revoke all acts of parliament that should be made while they were under the age of 24: but this was repealed by the statute 1 Edw. VI. c. 11. so far as related to that prince, and both statutes are declared to be determined by 24 Geo. II. c. 24. It hath also been usually thought prudent, when the heir apparent has been very young, to appoint a protector, guardian, or regent, for a limited time: but the very necessity of such extraordinary provision is sufficient to demonstrate the truth of that maxim of common law, that in the king is no minority; and therefore he hath no legal guardian. See REGENT.

Blackst. Comment.

3. A third attribute of the king's majesty is his *perpetuity*. The law ascribes to him, in his political capacity, an absolute immortality. The king never dies. Henry, Edward, or George, may die; but the king survives them all. For, immediately upon the decease of the reigning prince in his natural capacity, his kingship or imperial dignity, by act of law, without any *interregnum* or interval, is vested at once in his heir; who is *eo instanti*, king to all intents and purposes. And so tender is the law of supposing even a possibility of his death, that his natural dissolution is generally called his *demise; dimissio regis vel coronæ:* an expression which signifies merely a transfer of property; for, as is observed in Plowden, when we say the demise of the crown, we mean only, that, in consequence of the disunion of the king's body-natural from his body-politic, the kingdom is transferred or demised to his successor, and so the royal dignity remains perpetual. Thus, too, when Edward IV. in the tenth year of his reign, was driven from his throne for a few months by the house of Lancaster, this temporary transfer of his dignity was denominated his *demise;* and all process was held to be discontinued, as upon a natural death of the king.

II. We are next to consider those branches of the royal prerogative which invest this our sovereign lord with a number of *authorities* and *powers;* in the exertion whereof consists the executive part of government. This is wisely placed in a single hand by the British constitution, for the sake of unanimity, strength, and despatch. Were it placed in many hands, it would be subject to many wills: many wills, if disunited and drawing different ways, create weakness in a government; and to unite those several wills, and reduce them to one, is a work of more time and delay than the exigencies of state will afford. The king of England is therefore not only the chief, but properly the sole, magistrate of the nation; all others acting by commission from, and in due subordination to, him: in like manner as, upon the great revolution in the Roman state, all the powers of the ancient magistracy of the commonwealth were concentered in the new emperor; so that, as Gravina expresses it, *in ejus unius persona veteris rei publicæ vis atque majestas per cumulatas magistratuum potestates exprimebatur.*

(A) Except the parliament, which is the great council of the nation, the judges, and the peers, who, being the hereditary counsellors of the crown, have not only a right, but are bound *in foro conscientiæ* to advise the king for the public good, the constitution knows of no other counsel than the privy council. Any other counsel, like Clifford, Arlington, Buckingham, Ashley, Lauderdale, and, as the initial letters of these names express, is a CABAL, and as such should be suppressed. Nat. Bacon, speaking of the loss of power in the grand council of lords, says, "The sense of state once contracted into a privy-council, is soon recontracted into a cabinet-council, and last of all into a *favourite* or two; which many times brings damage to the public, and both *themselves* and *kings* into extreme *precipices;* partly for want of maturity, but principally through the providence of God overruling irregular courses to the hurt of such as walk in them." *Pol. Dis.* part ii. p. 201.

(B) For experience, fact, and precedent, see the reigns of King John, Henry III. Edward II. Richard II. Charles I. and James II. See also *Mirror of Justice;* where it is said, "that this grand assembly (meaning the now parliament, or then Wittena-gemotte) is to confer the government of God's people, how they may be kept from sin, live in quiet, and have right done them, according to the customs and laws; and more especially *of wrong done by the king*, queen, or their children: to which Nat. Bacon adds this note: "At this time *the king might do wrong*, &c. and so say Bracton and Fleta of the *kings* in their time." *Disc.* part i. p. 37. Lond. 1739.

Prerogative.

In the exertion of lawful prerogative the king is held to be absolute; that is, so far absolute, that there is no legal authority that can either delay or resist him. He may reject what bills, may make what treaties, may coin what money, may create what peers, may pardon what offences, he pleases: unless where the constitution hath expressly, or by evident consequence, laid down some exception or boundary; declaring, that thus far the prerogative shall go and no farther. For otherwise the power of the crown would indeed be but a name and a shadow, insufficient for the ends of government, if, where its jurisdiction is clearly established and allowed, any man or body of men were permitted to disobey it, in the ordinary course of law: we do not now speak of those *extraordinary* recourses to the first principles, which are necessary when the contracts of society are in danger of dissolution, and the law proves too weak a defence against the violence of fraud or oppression. And yet the want of attending to this obvious distinction has occasioned these doctrines, of absolute power in the prince and of national resistance by the people, to be much misunderstood and perverted, by the advocates for slavery on the one hand, and the demagogues of faction on the other. The former, observing the absolute sovereignty and transcendent dominion of the crown laid down (as it certainly is) most strongly and emphatically in our law-books as well as our homilies, have denied that any case can be excepted from so general and positive a rule; forgetting how impossible it is, in any practical system of laws, to point out beforehand those eccentrical remedies, which the sudden emergence of national distress may dictate, and which that alone can justify. On the other hand, over-zealous republicans, feeling the absurdity of unlimited passive obedience, have fancifully (or sometimes factiously) gone over to the other extreme: and, because resistance is justifiable to the person of the prince when the being of the state is endangered, and the public voice proclaims such resistance necessary, they have therefore allowed to every individual the right of determining this expedience, and of employing private force to resist even private oppression. A doctrine productive of anarchy, and (in consequence) equally fatal to civil liberty as tyranny itself. For civil liberty, rightly understood, consists in protecting the rights of individuals by the united force of society: society cannot be maintained, and of course can exert no protection, without obedience to some sovereign power; and obedience is an empty name, if every individual has a right to decide how far he himself shall obey.

Blackst. Comment.

In the exertion, therefore, of those prerogatives which the law has given him, the king is irresistible and absolute, according to the forms of the constitution. And yet, if the consequence of that exertion be manifestly to the grievance or dishonour of the kingdom, the parliament will call his advisers to a just and severe account. For prerogative consisting (as Mr Locke has well defined it) in the discretionary power of acting for the public good where the positive laws are silent, if that discretionary power be abused to the public detriment, such prerogative is exerted in an unconstitutional manner. Thus the king may make a treaty with a foreign state, which shall irrevocably bind the nation; and yet, when such treaties have been judged pernicious, impeachments have pursued those ministers by whose agency or advice they were concluded.

Prerogative.

The prerogatives of the crown (in the sense under which we are now considering them) respect either this nation's intercourse with foreign nations, or its own domestic government and civil polity.

With regard to *foreign concerns*, the king is the delegate or representative of his people. It is impossible that the individuals of a state, in their collective capacity, can transact the affairs of that state with another community equally numerous as themselves. Unanimity must be wanting to their measures, and strength to the execution of their counsels. In the king, therefore, as in a centre, all the rays of his people are united, and form by that union a consistency, splendour, and power, that make him feared and respected by foreign potentates; who would scruple to enter into any engagement, that must afterwards be revised and ratified by a popular assembly. What is done by the royal authority, with regard to foreign powers, is the act of the whole nation: what is done without the king's concurrence, is the act only of private men. And so far is this point carried by our law, that it hath been held, that should all the subjects of England make war with a king in league with the king of England, without the royal assent, such war is no breach of the league. And, by the statute 2 Hen. V. c. 6. any subject committing acts of hostility upon any nation in league with the king, was declared to be guilty of high treason: and, though that act was repealed by the statute 20 Hen. VI. c. 11. so far as relates to the making this offence high treason, yet still it remains a very great offence against the law of nations, and punishable by our laws, either capitally or otherwise, according to the circumstances of the case.

1. The king, therefore, considered as the representative of his people, has the sole power of sending ambassadors to foreign states, and receiving ambassadors at home.

2. It is also the king's prerogative to make treaties, leagues, and alliances, with foreign states and princes. For it is, by the law of nations, essential to the goodness of a league, that it be made by the sovereign power; and then it is binding upon the whole community: and in Britain the sovereign power, *quoad hoc*, is vested in the person of the king. Whatever contracts, therefore, he engages in, no other power in the kingdom can legally delay, resist, or annul. And yet, lest this plenitude of authority should be abused to the detriment of the public, the constitution (as was hinted before) hath here interposed a check, by the means of parliamentary impeachment, for the punishment of such ministers as from criminal motives advise or conclude any treaty, which shall afterwards be judged to derogate from the honour and interest of the nation.

3. Upon the same principle the king has also the sole prerogative of making war and peace. For it is held by all the writers on the law of nature and nations, that the right of making war, which by nature subsisted in every individual, is given up by all private persons that enter into society, and is vested in the sovereign power: and this right is given up, not only by individuals, but even by the entire body of people that are under the dominion of a sovereign. It would indeed be extremely improper,

improper, that any number of subjects should have the power of binding the supreme magistrate, and putting him against his will in a state of war. Whatever hostilities, therefore, may be committed by private citizens, the state ought not to be affected thereby; unless that should justify their proceedings, and thereby become partner in the guilt. And the reason which is given by Grotius, why, according to the law of nations, a denunciation of war ought always to precede the actual commencement of hostilities, is not so much that the enemy may be put upon his guard (which is matter rather of magnanimity than right), but that it may be certainly clear that the war is not undertaken by private persons, but by the will of the whole community; whose right of willing is in this case transferred to the supreme magistrate by the fundamental laws of society. So that, in order to make a war completely effectual, it is necessary with us in Britain that it be publicly declared and duly proclaimed by the king's authority; and then, all parts of both the contending nations, from the highest to the lowest, are bound by it. And wherever the right resides of beginning a national war, there also must reside the right of ending it, or the power of making peace. And the same check of parliamentary impeachment, for improper or inglorious conduct, in beginning, conducting, or concluding a national war, is in general sufficient to restrain the ministers of the crown from a wanton or injurious exertion of this great prerogative.

4. But, as the delay of making war may sometimes be detrimental to individuals who have suffered by depredations from foreign potentates, our laws have in some respects armed the subject with powers to impel the prerogative; by directing the ministers of the crown to issue letters of marque and reprisal upon due demand: the prerogative of granting which is nearly related to, and plainly derived from, that other of making war; this being indeed only an incomplete state of hostilities, and generally ending in a formal denunciation of war. These letters are grantable, by the law of nations, whenever the subjects of one state are oppressed and injured by those of another, and justice is denied by that state to which the oppressor belongs. In this case, letters of marque and reprisal (words in themselves synonymous, and signifying a taking in return) may be obtained, in order to seize the bodies or goods of the subjects of the offending state, until satisfaction be made, wherever they happen to be found. And indeed this custom of reprisals seems dictated by nature herself; for which reason we find in the most ancient times very notable instances of it. But here the necessity is obvious of calling in the sovereign power, to determine when reprisals may be made; else every private sufferer would be a judge in his own cause. In pursuance of which principle, it is with us declared by the statute 4 Hen. V. c. 7. that if any subjects of the realm are oppressed in time of truce by any foreigners, the king will grant marque in due form to all that feel themselves grieved. See MARQUE.

5. Upon exactly the same reason stands the prerogative of granting safe-conducts; without which, by the law of nations, no member of one society has a right to intrude into another. And therefore Puffendorf very justly resolves, that it is left in the power of all states to take such measures about the admission of strangers as they think convenient; those being ever excepted who are driven on the coasts by necessity, or by any cause that deserves pity or compassion. Great tenderness is shown by our laws, not only to foreigners in distress (see WRECK), but with regard also to the admission of strangers who come spontaneously: for so long as their nation continues at peace with ours, and they themselves behave peaceably, they are under the king's protection; though liable to be sent home whenever the king sees occasion. But no subject of a nation at war with us can, by the law of nations, come into the realm, nor can travel himself upon the high seas, or send his goods and merchandise from one place to another, without danger of being seized by our subjects, unless he has letters of safe-conduct; which, by divers ancient statutes, must be granted under the king's great seal and inrolled in chancery, or else they are of no effect; the king being supposed the best judge of such emergencies, as may deserve exception from the general law of arms. But passports under the king's sign manual, or licenses from his ambassadors abroad, are now more usually obtained, and are allowed to be of equal validity.

These are the principal prerogatives of the king respecting this nation's intercourse with foreign nations; in all of which he is considered as the delegate or representative of his people. But in domestic affairs, he is considered in a great variety of characters, and from thence there arises an abundant number of other prerogatives.

1. He is a constituent part of the supreme legislative power; and, as such, has the prerogative of rejecting such provisions in parliament as he judges improper to be passed. The expediency of which constitution has before been evinced at large under the article PARLIAMENT. We shall only farther remark, that the king is not bound by any act of parliament, unless he be named therein by special and particular words. The most general words that can be devised (any person or persons, bodies politic, or corporate, &c.) affect not him in the least, if they may tend to restrain or diminish any of his rights or interests. For it would be of most mischievous consequence to the public, if the strength of the executive power were liable to be curtailed, without its own express consent, by constructions and implications of the subject. Yet, where an act of parliament is expressly made for the preservation of public rights and the suppression of public wrongs, and does not interfere with the established rights of the crown, it is said to be binding as well upon the king as upon the subject: and, likewise, the king may take the benefit of any particular act, though he be not especially named.

2. The king is considered, in the next place, as the generalissimo, or the first in military command, within the kingdom. The great end of society is to protect the weakness of individuals by the united strength of the community; and the principal use of government is to direct that united strength in the best and most effectual manner, to answer the end proposed. Monarchical government is allowed to be the fittest of any for this purpose: it follows therefore, from the very end of its institution, that in a monarchy the military power must be trusted in the hands of the prince.

In this capacity, therefore, of general of the kingdom, the king has the sole power of raising and regulating fleets and armies. The manner in which they are raised and regulated is explained under the article *Mi-*

Prerogative.

LITARY *State*. We are now only to consider the prerogative of enlisting and governing them: which indeed was disputed and claimed, contrary to all reason and precedent, by the long parliament of King Chas. I.; but, upon the restoration of his son, was solemnly declared by the statute 13 Charles II. c. 6. to be in the king alone: for that the sole supreme government and command of the militia within all his majesty's realms and dominions, and of all forces by sea and land, and of all forts and places of strength, ever was and is the undoubted right of his majesty, and his royal predecessors, kings and queens of England; and that both or either house of parliament cannot, nor ought to, pretend to the same.

This statute, it is obvious to observe, extends not only to fleets and armies, but also to forts and other places of strength within the realm; the sole prerogative, as well of erecting, as manning and governing of which, belongs to the king in his capacity of general of the kingdom; and all lands were formerly subject to a tax, for building of castles wherever the king thought proper. This was one of the three things, from contributing to the performance of which no lands were exempted, and therefore called by the Anglo-Saxons the *trinoda necessitas; sc. pontis reparatio, arcis constructio, et expeditio contra hostem.* And this they were called upon to do so often, that, as Sir Edward Coke from M. Paris assures us, there was in the time of Henry II. 1115 castles subsisting in England. The inconveniencies of which, when granted out to private subjects, the lordly barons of those times, were severely felt by the whole kingdom; for, as William of Newburgh remarks in the reign of King Stephen, *erant in Anglia quodammodo tot reges, vel potius tyranni, quot domini castellorum;* but it was felt by none more sensibly than by two succeeding princes, King John and King Henry III. And therefore, the greatest part of them being demolished in the barons wars, the kings of after times have been very cautious of suffering them to be rebuilt in a fortified manner: and Sir Edward Coke lays it down, that no subject can build a castle, or house of strength imbattled, or other fortress defensible, without the license of the king; for the danger which might ensue, if every man at his pleasure might do it.

It is partly upon the same, and partly upon a fiscal foundation, to secure his marine revenue, that the king has the prerogative of appointing *ports* and *havens*, or such places only, for persons and merchandise to pass into and out of the realm, as he in his wisdom sees proper. By the feodal law, all navigable rivers and havens were computed among the regalia, and were subject to the sovereign of the state. And in England it hath always been held, that the king is lord of the whole shore, and particularly is the guardian of the ports and havens, which are the inlets and gates of the realm; and therefore, so early as the reign of King John, we find ships seized by the king's officers for putting in at a place that was not a legal port. These legal ports were undoubtedly at first assigned by the crown; since to each of them a court of portmote is incident, the jurisdiction of which must flow from the royal authority: the *great ports* of the sea are also referred to, as well known and established, by statute 4 Hen. IV. c. 20. which prohibits the landing elsewhere under pain of confiscation: and the statute 1 Eliz. c. 11. recites, that the franchise of lading and discharging had been frequently granted by the crown.

But though the king had a power of granting the franchise of havens and ports, yet he had not the power of resumption, or of narrowing and confining their limits when once established; but any person had a right to load or discharge his merchandise in any part of the haven: whereby the revenue of the custom was much impaired and diminished, by fraudulent landings in obscure and private corners. This occasioned the statutes of 1 Eliz. c. 11. and 13 and 14 Car. II. c. 11. § 14. which enable the crown by commission, to ascertain the limits of all ports, and to assign proper wharfs and quays in each port, for the exclusive landing and loading of merchandise.

The erection of beacons, light-houses, and sea-marks, is also a branch of the royal prerogative: whereof the first was anciently used in order to alarm the country in case of the approach of an enemy; and all of them are signally useful in guiding and preserving vessels at sea by night as well as by day. See BEACON.

3. Another capacity in which the king is considered in domestic affairs, is as the fountain of justice and general conservator of the peace of the kingdom. See the article *fountain of* JUSTICE.

4. The king is likewise the fountain of honour, of office, and of privilege: and this in a different sense from that wherein he is styled the *fountain of justice;* for here he is really the parent of them. See the articles *Fountain of* JUSTICE and *Fountain of* HONOUR.

5. Another light, in which the laws of England consider the king with regard to domestic concerns, is as the arbiter of commerce. By commerce, we at present mean domestic commerce only; for the king's prerogative with regard to which, see *Regulation of* WEIGHTS *and Measures*, MONEY, &c.

6. The king is, lastly, considered by the laws of England as the head and supreme governor of the national church.

To enter into the reasons upon which this prerogative is founded is matter rather of divinity than of law. We shall therefore only observe, that by statute 26 Hen. VIII. c. 1. (reciting that the king's majesty justly and rightfully is and ought to be the supreme head of the church of England; and so had been recognised by the clergy of that kingdom in their convocation) it is enacted, that the king shall be reputed the only supreme head on earth of the church of England; and shall have, annexed to the imperial crown of this realm, as well the title and style thereof, as all jurisdictions, authorities, and commodities, to the said dignity of supreme head of the church appertaining. And another statute to the same purport was made, 1 Eliz. c. 1.

In virtue of this authority the king convenes, prorogues, restrains, regulates, and dissolves, all ecclesiastical synods or convocations. This was an inherent prerogative of the crown long before the time of Henry VIII. as appears by the statute 8 Hen. VI. c. 1. and the many authors, both lawyers and historians, vouched by Sir Edward Coke. So that the statute 25 Hen. VIII. c. 19. which restrains the convocation from making or putting in execution any canons repugnant to the king's prerogative, or the laws, customs, and statutes of the realm, was merely declaratory of the old common law: that part of it only being new, which makes the king's royal assent actually necessary to the validity of every canon. The convocation or ecclesiastical synod, in England, differs considerably in its constitution from the synods of other Christian kingdoms: these consisting wholly of bishops; whereas in England the convocation is the miniature of a parliament, wherein the archbishop presides with regal state; the upper house of bishops represents the house of lords; and the lower house, composed of representatives of the several dioceses at large, and of each particular chapter therein, resembles the house of commons with its knights of the shire and burgesses. This constitution is said to be owing to the policy of Edward I. who thereby at one and the same time let in the inferior clergy to the privileges of forming ecclesiastical canons (which before they had not), and also introduced a method of taxing ecclesiastical benefices, by consent of convocation.

From this prerogative also, of being the head of the church, arises the king's right of nomination to vacant bishoprics, and certain other ecclesiastical preferments.

As head of the church, the king is likewise the *dernier resort* in all ecclesiastical causes; an appeal lying ultimately to him in chancery from the sentence of every ecclesiastical judge: which right was restored to the crown by statute 25 Hen. VIII. c. 9.

III. The king's fiscal prerogatives, or such as regard his revenue. See the article REVENUE.

PREROGATIVE-Court, an English court established for the trial of all testamentary causes, where the deceased hath left *bona notabilia* within two different dioceses. In which case the probate of wills belongs to the archbishop of the province, by way of special prerogative. And all causes relating to the wills, administrations, or legacies of such persons, are originally cognizable herein, before a judge appointed by the archbishop, called the *judge of the prerogative court;* from whom an appeal lies by statute 25 Hen. VIII. c. 19. to the king in chancery, instead of the pope as formerly.

PRESAGE, in *Antiquity*, denotes an augury, or sign of some future event; which was chiefly taken from the flight of birds, the entrails of victims, &c. See AUGURY and ARUSPICES.

PRESBURG, the capital of the kingdom of Lower Hungary, called by the inhabitants *Posony* and *Presporen*, situated on the Danube, about 46 miles east from Vienna, and 75 from Buda. The castle, in which the regalia are kept, stands on a hill above the town. Here the states assemble; and in the cathedral, dedicated to St Martin, the king is crowned. The town is not very large, or well built; but is very ancient, pleasantly situated, and enjoys a good air. The population is computed at 27,000. Its fortifications are only a double wall and ditch. In the lower suburbs is a hill, where the king, after his coronation, goes on horseback, and brandishes St Stephen's sword towards the four cardinal points, intimating, that he will defend his country against all its enemies. Besides the cathedral, there are several other Popish and one Lutheran church, with a Jesuits college, three convents, and two hospitals. It gives name to a county, and is the residence of the archbishop of Gran, who is primate, chief secretary, and chancellor of the kingdom, *legatus natus* of the Papal see, and prince of the holy Roman empire. E. Long. 17. 30. N. Lat. 48. 20.

PRESBYTÆ, persons whose eyes are too flat to refract the rays sufficiently, so that unless the object is at some distance, the rays coming from it will pass through the retina before their union, consequently vision is confused; old people are usually the subjects of this disease. In order to remedy, or at least to palliate, this defect, the person should first use glasses which do not magnify, and from them pass gradually to more convex spectacles, which shorten the focus.

PRESBYTER, in the primitive Christian church, an elder, one of the second order of ecclesiastics; the other two being bishops and deacons. See the article BISHOP and DEACON.

Presbyter, or elder, is a word borrowed from the Greek translation of the Old Testament, where it commonly signifies ruler or governor; it being a note of office and dignity, not of age; and in this sense bishops are sometimes called *presbyters* in the New Testament. The presbyters might baptize, preach, consecrate, and administer the eucharist in the bishop's absence, or in his presence if he authorised and deputed them; and the bishops did scarce any thing in the government of the church without their advice, consent, and amicable concurrence.

The grand dispute between the followers of the Geneva and Roman discipline, is about the sameness and difference of presbyters and bishops at the time of the apostles. See EPISCOPACY, INDEPENDENTS, and the following article.

1 Discriminating principle of the Presbyterians.

PRESBYTERIANS, Protestants so called from their maintaining that the government of the church appointed in the New Testament was by Presbyteries, that is, by associations of ministers, and ruling elders, possessed all of equal powers, without any superiority among them either in office or in order.

The Presbyterians believe, that the authority of their ministers to preach the gospel, to administer the sacraments of baptism and the Lord's supper, and to feed the flock of Christ, is derived from the Holy Ghost by the imposition of the hands of the presbytery; and they oppose the independent scheme of the common rights of Christians by the same arguments which are used for that purpose by the Episcopalians, (see EPISCOPACY). They affirm, however, that there is no order in the church as established by Christ and his apostles superior to that of presbyters; that all ministers being ambassadors of Christ, are equal by their commission; that *presbyter* and *bishop*, though different words, are of the same import; and that prelacy was gradually established upon the primitive practice of making the *moderator* or speaker of the presbytery a permanent officer.

2 Scriptural arguments against Episcopacy.

These positions they maintain against the Episcopalians by the following scriptural arguments. They observe, that the apostles planted churches by ordaining bishops and deacons in every city; that the ministers which in one verse are called bishops, are in the next perhaps denominated presbyters; that we nowhere read in the New Testament of bishops, presbyters, and deacons, in any one church; and that therefore we are under the necessity of concluding *bishop* and *presbyter* to be two names for the same church officer. This is apparent from Peter's exhortation to the *elders* or *presbyters* who were among the Jewish Christians. "The *elders* (presbyters) which are among you I exhort, who am also an *elder*, and a witness of the sufferings of Christ, and also a partaker of the glory that shall be revealed:

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vealed: Feed the flock of God which is among you, taking the *oversight* thereof (ἐπισκοποῦντες, acting as *bishops* thereof), not by constraint, but willingly; not for filthy lucre, but of a ready mind; neither as being LORDS over God's heritage, but being ensamples to the flocks*." From this passage it is evident, that the presbyters not only fed the flock of God, but also governed that flock with episcopal powers; and that the apostle himself, as a church officer, was nothing more than a presbyter or elder. The identity of the office of bishop and presbyter is still more apparent from Heb. xiii. 7. 17. and 1 Thess. v. 12.; for the bishops are there represented as governing the flock, speaking to them the word of God, watching for their souls, and discharging various offices, which it is impossible for any man to perform to more than one congregation.

* 1 Peter v. 1, 2, 3.

3 Reasons for supposing bishops and presbyters of the same order.

From the last cited text it is evident, that the bishops (προϊσταμένους) of the Thessalonian churches had the pastoral care of no more souls than they could hold personal communion with in God's worship; for they were such as all the people were to *know*, *esteem*, and *love*, as those that not only were *over them*, but also "closely laboured among them, and admonished them." But diocesan bishops, whom ordinarily the hundredth part of their flock never hear nor see, cannot be those bishops by whom that flock is admonished, nor can they be, what Peter requires the bishops of the Jewish converts to be, *ensamples to the flock*. It is the opinion of Dr Hammond, who was a very learned divine, and a zealot for episcopacy, that the *elders* whom the apostle James desires † the sick to call for, were of the highest permanent order of ecclesiastical officers; but it is self-evident that those elders cannot have been diocesan bishops, otherwise the sick must have been often without the reach of the remedy proposed to them.

† Chap. v. 14.

There is nothing in Scripture upon which the Episcopalian is more ready to rest his cause than the alleged episcopacy of Timothy and Titus; of whom the former is said to have been bishop of Ephesus, and the latter bishop of Crete; yet the Presbyterian thinks it as clear as the noon-day sun, that the presbyters of Ephesus were supreme governors under Christ of the Ephesian churches, at the very time that Timothy is pretended to have been their proper diocesan.

In Acts xx. 17, &c. we read, that "from Miletus Paul sent to Ephesus, and called the elders (presbyters) of the church. And when they were come to him, he said unto them, Ye know, from the first day that I came into Asia, after what manner I have been with you, at all seasons. And now I know that ye all, among whom I have gone preaching the kingdom of God, shall see my face no more. Wherefore, I take you to record this day, that I am pure from the blood of all men. For I have not shunned to declare unto you all the counsel of God. Take heed therefore unto yourselves, and to all the flock over which the Holy Ghost hath made you overseers (ἐπισκόπους, *bishops*,) to feed the church of God, which he hath purchased with his own blood. For I know this, that after my departure shall grievous wolves enter in among you, not sparing the flock. Also of your ownselves shall men arise, speaking perverse things, to draw away disciples after them. Therefore watch, and remember, that by the space of three years, I ceased not to warn every one night and day with tears. And now, brethren, I recommend you to God, and to the word of his grace," &c.

4 The pastors of Ephesus of equal authority.

From this passage, it is evident that there was in the city of Ephesus a plurality of pastors of equal authority without any superior pastor or bishop over them; for the apostle directs his discourse to them all in common, and gives them equal power over the whole flock. Dr Hammond indeed imagines, that the elders whom Paul called to Miletus were the *bishops of Asia*, and that he sent for them to Ephesus, because that city was the metropolis of the province. But were this opinion well-founded, it is not conceivable that the sacred writer would have called them the elders of the church of *Ephesus*, but the elders of the *church in general*, or the elders of the *churches in Asia*. Besides, it is to be remembered, that the apostle was in such haste to be at Jerusalem, that the sacred historian measures his time by *days;* whereas it must have required several months to call together the bishops or elders of all the cities of Asia; and he might certainly have gone to meet them at Ephesus in less time than would be requisite for their meeting in that city and proceeding thence to him at Miletus. They must therefore have been either the joint pastors of one congregation, or the pastors of different congregations in one city; and as it was thus in Ephesus, so was it in Philippi; for we find the apostle addressing his epistle "to all the saints in Christ Jesus which are at Philippi, with the bishops and deacons." From the passage before us it is likewise plain, that the presbyters of Ephesus had not only the *name* but the whole *power* of bishops given to them by the Holy Ghost; for they are enjoined to do the whole work of bishops—ποιμαίνειν τὴν ἐκκλησίαν τοῦ Θεοῦ.—which signifies, to *rule* as well as *feed* the church of God. Whence we see, that the apostle makes the power of *governing* inseparable from that of *preaching* and *watching;* and that according to him, all who are preachers of God's word, and watchmen of souls, are necessarily rulers or governors of the church, without being accountable for their management to any prelate, but only to their Lord Christ from whom their power is derived.

5 Timothy no bishop.

It appears, therefore, that the apostle Paul left in the church of Ephesus, which he had planted, no other successors to himself than *presbyter-bishops*, or Presbyterian ministers, and that he did not devolve his power upon any prelate. Timothy, whom the Episcopalians allege to have been the first bishop of Ephesus, was present when this settlement was made*; and it is surely not to be supposed, that, had he been their bishop, the apostle would have devolved the whole episcopal power upon the presbyters before his face. If ever there was a season fitter than another for pointing out the duty of this supposed bishop to his diocese, and his presbyters duty to him, it was surely when Paul was taking his final leave of them, and discoursing so pathetically concerning the duty of *overseers*, the coming of ravenous wolves, and the consequent hazard of the flock. In this farewel discourse, he tells them that "he had not shunned to declare unto them all the counsel of God." But with what truth could this have been said, if obedience to a diocesan bishop had been any part of their duty either at the time of the apostle's speaking or at any future period? He foresaw that ravenous wolves would enter in among them, and that even some of themselves should arise

* Acts xx. 5.

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6 But an evangelist. But if Timothy was not bishop of Ephesus, what, it may be asked, was his office in that city? for that he resided there for some time, and was by the apostle invested with authority to ordain and rebuke presbyters, are facts about which all parties are agreed, and which indeed cannot be controverted by any reader of Paul's epistles. To this the Presbyterian replies with confidence, that the power which Timothy exercised in the church of Ephesus was that of an evangelist *, and not a fixed prelate. But, according to Eusebius, the work of an evangelist was, "to lay the foundations of the faith in barbarous nations, and to constitute among them pastors; after which he passed on to other countries." Accordingly we find, that Timothy was resident for a time at Philippi and Corinth † as well as at Ephesus, and that he had as much authority over those churches as over that of which he is said to have been the fixed bishop. "Now, if Timotheus come, see that he may be with you without fear, for he worketh the work of the Lord, as I also do. Let no man therefore despise him." This text might lead us to suppose, that Timothy was bishop of Corinth as well as of Ephesus; for it is stronger than that upon which his episcopacy of the latter church is chiefly built. The apostle says, "I besought thee ‡ to abide still at Ephesus, when I went into Macedonia, that thou mightest charge some that they teach no other doctrine." But had Timothy been the fixed bishop of that city, there would surely have been no necessity for *beseeching* him to abide with his flock. It is to be observed, too, that the first epistle to Timothy, which alone was written to him during his residence at Ephesus, was of a date prior to Paul's meeting with the elders of that church at Miletus; for in the epistle he hopes to come to him shortly, whereas he tells the elders at Miletus, that they should see his face no more. This being the case, it is evident that Timothy was left by the apostle at Ephesus only to supply his place during his temporary absence at Macedonia, and that he could not possibly have been constituted fixed bishop of that church, since the episcopal powers were afterwards committed to the presbyters by the Holy Ghost in his presence.

* 2 Tim. iv. 5.

† Phil. ii. 19. 1 Cor. iv. 17. xvi. 10, 11.

‡ 1 Tim. i. 3.

7 Presbyterate the highest permanent office in the church. The identity of the office of bishop and presbyter being thus clearly established, it follows, that the presbyterate is the highest permanent office in the church, and that every faithful pastor of a flock is successor to the apostles in every thing in which they were to have any successors. In the apostolic office there were indeed some things peculiar and extraordinary, such as their immediate call by Christ, their infallibility, their being witnesses of our Lord's resurrection, and their unlimited jurisdiction over the whole world. These powers and privileges could not be conveyed by imposition of hands to any successors, whether called presbyters or bishops; but as rulers or office-bearers in particular churches, we have the confession of "the very chiefest apostles," Peter and John, that they were nothing more than presbysters or parish ministers. This being the case, the dispute, which in the early part of the passing century was so warmly agitated concerning the validity of Presbyterian ordination, may be soon decided; for if the ceremony of ordination be at all essential, it is obvious that such a ceremony performed by presbyters must be valid, as there is no higher order of ecclesiastics in the church by whom it can be performed. Accordingly we find that Timothy himself, though said to be a bishop, was ordained by the laying on of the hands of a presbytery. At that ordination indeed St Paul presided, but he could preside only as *primus in paribus*; for we have seen that, as permanent officers in the church of Christ, the apostles themselves were no more than presbyters. If the apostles hands were imposed for any other purpose, it must have been to communicate those *charismata* or miraculous gifts of the Holy Spirit, which were then so frequent; but which no modern presbyter or bishop will pretend to give, unless his understanding be clouded by the grossest ignorance, or perverted by the most frantic enthusiasm.

8 Rise of Episcopacy. But if the office of bishop and presbyter was originally the same, how, it will be asked, came diocesan episcopacy to prevail so universally as it is confessed to have done before the conversion of Constantine and the civil establishment of Christianity in the Roman empire? To give a satisfactory answer to this question is certainly the most arduous task which the advocate for presbytery has to perform: but it is a task not insurmountable.

From many passages in the New Testament *, it is evident, that when the apostles planted churches in different cities, they generally settled more than one pastor in the same church, to feed and govern it with joint authority. The propriety of this constitution is obvious. In those days, when the disciples of Christ were persecuted for their religion, and often obliged to meet in the "night for fear of the Jews," they could not with any degree of prudence assemble in large numbers; and therefore, had there been no more than one pastor in a city, the Christian converts, though, when assembled, they might have amounted to but a small congregation, could not all have enjoyed the benefit of public worship on the same day; at least it is obvious that they could not possibly have assembled for this purpose so often as their want of instruction, and the duty of "breaking of bread and of prayer," required them to meet. It was therefore with great wisdom that the apostles ordained several presbyters in the same church; but as these presbyters would have occasion to meet frequently, and to deliberate on the state of the flock which it was their duty to feed, and over which they had all equal authority, they would be under the necessity of electing one of their own number to be president or *moderator* of the presbytery, that order might be preserved, and all things done with decency. At first there is reason to believe that those presidents held their office no longer than while the presbyteries sat in which they were elected. Among the apostles themselves there was no fixed president. Peter indeed appears to have been most frequently admitted to that honour; but there is one very memorable occasion on record †, when James the Lord's brother presided in an assembly of apostles, elders, and brethren, held at Jerusalem, to determine the question

* Acts xi. 29. xiii. 1, 2, 3. xv. Tit. i. 5.

† Acts xv.

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tion concerning the necessity of circumcising the Gentiles, and commanding them to keep the law of Moses.

Upon this model were the primitive presbyteries formed. They consisted of several presbyters possessed of equal powers, who at their meetings appointed one of their own number to discharge the office of moderator or temporary president; but to this president they gave no prelatical powers or negative voice over the deliberations of his brethren; for, as Jerome informs us, the church was then governed *communi presbyterorum concilio*, "by a common council of presbyters." It appears, however, that when an apostle, an apostolical man, or an evangelist, fixed his residence in any city, and took upon himself the pastoral care of part of the flock, his co-presbyters, from respect to his singular gifts, made him their constant and fixed moderator. Hence Timothy, during his abode at Ephesus, was moderator of the presbytery; and hence too Mark the evangelist, who resided many years in Alexandria, has been called the first bishop of that church, though he appears to have been nothing more than permanent moderator. We advance this upon the authority of Jerome, one of the most learned fathers of the Christian church, who informs us, that upon the death of the evangelist, the presbyters of Alexandria, for more than 200 years, chose their bishops from their own number, and placed them in the episcopal chair, without dreaming that they ought to be raised to a higher order by a new consecration;—*Presbyteri unum ex se electum in excelsiori gradu collocatum, episcopum nominabant.* As this practice of making the moderator of the presbytery of Alexandria a permanent officer, was thought a good expedient to guard the infant churches against schisms and divisions, those churches gradually adopted it. For, as Jerome tells us, *Postquam unusquisque eos quos baptizaverat, suos putabat esse, non Christi, in toto orbe decretum est, ut unus de presbyteris electus, superponeretur cæteris, ad quem omnis ecclesiæ cura pertineret, et schismatum semina tollerentur.*

9 According to Jerome.

The advantages which, in displaying his talents and authority, the perpetual president or speaker of any assembly has over his colleagues in office, are so obvious, that when the practice of electing their moderators for life became universal among the presbyteries of the primitive church, it is easy to conceive how ambitious men might so magnify the difficulties and importance of their station, as to introduce the custom of filling it by a new consecration of the bishop elect. But when this was done, diocesan episcopacy, with all its powers and prerogatives, would follow as a thing of course, until "by little and little (as Jerome expresses himself) the whole pastoral care of the flock was devolved upon one man."

Our limits will not permit us to trace more minutely the rise and progress of this ecclesiastical usurpation, as the Presbyterian calls it; but the reader who wishes for fuller information, after studying the remains of the four first centuries of the Christian church, may consult *An Inquiry into the Constitution, Discipline, and Worship of the Primitive Church*, said to have been written by Sir Peter King, afterwards lord chancellor of England. As an impartial lover of truth, he will do well to consult also a book entitled, *An original Draught of the Primitive Church*, which was published as an answer to the Inquiry; and he may read with much advantage to himself *A Letter from a parochial bishop to a prelatical gentleman*, with *An apology for the Church of Scotland*, both written by Mr Willison some time minister in Dundee, and both evincing considerable learning and great ingenuity in their pious author.

10 The church of Scotland.

Of the churches at present formed upon this model, we believe, that without incurring the imputation of national prejudice, we may safely affirm the church of Scotland to be by much the most respectable. Her mode of worship is simple and solemn; her established faith agreeable to the confessions of most other Protestant churches; her judicatories are calculated to maintain the rights of the people; and her pastors are confessedly men of liberal and enlightened minds. On these accounts it appears to us, that we cannot more properly conclude this article than with a short view of her constitution, as being that in which our Presbyterian readers are undoubtedly most interested.

No one is ignorant, that from the first dawn of reformation among us, till the era of the revolution, there was a perpetual struggle between the court and the people for the establishment of an Episcopal or a Presbyterian form of church government: The former model of ecclesiastical polity was patronised by the house of Stuart on account of the support which it gave to the prerogatives of the crown; the latter was the favourite of the majority of the people, perhaps not so much on account of its superior claim to apostolical institution, as because the laity are mixed with the clergy in church judicatories, and the two orders, which under episcopacy are kept so distinct, incorporated, as it were, into one body. In the Scottish church, every regulation of public worship, every act of discipline, and every ecclesiastical censure, which in other churches flows from the authority of a diocesan bishop, or from a convocation of the clergy, is the joint work of a certain number of clergymen and laymen acting together with equal authority, and deciding every question by a plurality of voices. The laymen who thus form an essential part of the ecclesiastical courts of Scotland, are called *ruling elders;* and hold the same office, as well as the same name, with those brethren * who joined with the apostles and elders at Jerusalem in determining the important question concerning the necessity of imposing upon the Gentile converts the ritual observances of the law of Moses. These lay-elders Paul enjoined Timothy † to account worthy of double honour, if they should rule well, and discharge the duties for which they were separated from the multitude of their brethren. In the church of Scotland every parish has two or three of these lay-elders, who are grave and serious persons, chosen from among the heads of families, of known orthodoxy and steady adherence to the worship, discipline, and government of the church. Being solemnly engaged to use their utmost endeavours for the suppression of vice and the cherishing of piety and virtue, and to exercise discipline faithfully and diligently, the minister, in the presence of the congregation, sets them apart to their office by solemn prayer; and concludes the ceremony, which is sometimes called ordination, with exhorting both elders and people to their respective duties.

11 Its government by clergy and laymen.

* Acts xv. † 1 Tim. v. 17.

12 The kirk-session.

The kirk-session, which is the lowest ecclesiastical judicatory, consists of the minister and those elders of the congregation. The minister is *ex officio* moderator, but has no negative voice over the decision of the session; nor indeed has he a right to vote at all, unless when the voices of the elders are equal and opposite. He

may

Presbyterians

may indeed enter his protest against their sentence, if he think it improper, and appeal to the judgment of the presbytery; but this privilege belongs equally to every elder, as well as to every person who may believe himself aggrieved by the proceedings of the session. The deacons, whose proper office it is to take care of the poor, may be present in every session, and offer their counsel on all questions that come before it; but except in what relates to the distribution of alms, they have no decisive vote with the minister and elders.

13 The presbytery.

The next judicatory is the *presbytery*, which consists of all the pastors within a certain district, and one ruling elder from each parish, commissioned by his brethren to represent, in conjunction with the minister, the session of that parish. The presbytery treats of such matters as concern the particular churches within its limits; as the examination, admission, ordination, and censuring of ministers; the licensing of probationers, rebuking of gross or contumacious sinners, the directing of the sentence of excommunication, the deciding upon references and appeals from kirk-sessions, resolving cases of conscience, explaining difficulties in doctrine or discipline; and censuring, according to the word of God, any heresy or erroneous doctrine which hath either been publicly or privately maintained within the bounds of its jurisdiction. Partial as we may be thought to our own church, we frankly acknowledge that we cannot altogether approve of that part of her constitution which gives an equal vote, in questions of heresy, to an illiterate mechanic and his enlightened pastor. We are persuaded that it has been the source of much trouble to many a pious clergyman; who, from the laudable desire of explaining the scriptures and declaring to his flock all the counsel of God, has employed a variety of expressions of the same import, to illustrate those articles of faith which may be obscurely expressed in the established standards. The fact however is, that, in presbyteries, the only prerogatives which the pastors have over the ruling elders, are the power of ordination by imposition of hands, and the privilege of having the moderator chosen from their body.

14 The provincial synod.

From the judgment of the presbytery there lies an appeal to the provincial synod, which ordinarily meets twice in the year, and exercises over the presbyteries within the province a jurisdiction similar to that which is vested in each presbytery over the several kirk-sessions within the bounds. Of these synods there are in the church of Scotland fifteen, which are composed of the members of the several presbyteries within the respective provinces which give names to the synods.

15 The general assembly.

The highest authority in the church of Scotland is the general assembly, which consists of a certain number of ministers and ruling elders delegated from each presbytery, and of commissioners from the universities and royal boroughs. A presbytery in which there are fewer than twelve parishes, sends to the general assembly two ministers and one ruling elder: if it contain between 12 and 18 ministers, it sends three of these, and one ruling elder: if it contains between 18 and 24 ministers, it sends four ministers and two ruling elders: and of 24 ministers, when it contains so many, it sends five with two ruling elders. Every royal borough sends one ruling elder, and Edinburgh two: whose election must be attested by the kirk-sessions of their respective boroughs. Every university sends one commissioner from its own body. The commissioners are chosen annually six weeks before the meeting of the assembly; and the ruling elders are often men of the first eminence in the kingdom for rank and talents. In this assembly, which meets once a-year, the king presides by his commissioner, who is always a nobleman; but he has no voice in their deliberations. The order of their proceedings is regular, though sometimes the number of members creates a confusion, which the moderator, who is chosen from among the ministers, to be, as it were, the speaker of the house, has not sufficient authority to prevent. Appeals are brought from all the other ecclesiastical courts in Scotland to the general assembly; and in questions purely religious no appeal lies from its determinations.—In the subordination of these assemblies, parochial, presbyterial, provincial, and national, the less unto the greater, consists the external order, strength, and stedfastness of the church of Scotland.

Presbyterians || Prescription.

PRESCIENCE, in *Theology*, prevision or foreknowledge; that knowledge which God has of things to come.—The doctrine of predestination is founded on the prescience of God, and on the supposition of all futurity's being present to him. See PREDESTINATION.

PRESCRIPTION, in *Law*, is a title acquired by use and time, and allowed by law; as when a man claims any thing, because he, his ancestors, or they whose estate he hath, have had or used it all the time whereof no memory is to the contrary: or it is where for continuance of time, *ultra memorium hominis*, a particular person hath a particular right against another.

There is a difference between prescription, custom, and usage. *Prescription* hath respect to a certain person, who *by intendment* may have continuance *for ever;* as for instance, he and all they *whose estate he hath* in such a thing; this is a prescription: but *custom* is *local*, and always applied to a *certain* place; as, *time out of mind there has been such a custom in such a place*, &c. And *prescription* belongeth to *one* or a *few* only; but *custom* is common to *all*. *Usage* differs from both, for it may be either to *persons* or *places;* as to *inhabitants of a town to have a way*, &c.

A custom and prescription are in the *right;* usage is in the *possession;* and a prescription that is good for the matter and substance, may be bad by the manner of setting it forth: but where that which is claimed *as a custom*, in or for many, will be good, *that* regularly will be so when claimed by *prescription* for one. *Prescription* is to be *time out of mind;* though it is not the length of time that begets the right of prescription, nothing being done by time, although every thing is done in time; *but it is a presumption in law, that a thing cannot continue so long quiet, if it was against right, or injurious to another.*

PRESCRIPTION, in *Scots Law*. See LAW, p. 675. and 702.

PRESCRIPTION, in *Theology*, was a kind of argument pleaded by Tertullian and others in the 3d century against erroneous doctors. This mode of arguing has been despised by some, both because it has been used by Papists, and because they think that truth has no need of such a support. But surely in disputed points, if it can be shown that any particular doctrine of Christianity was held in the earliest ages, even approaching the apostolic, it must have very considerable weight; and indeed that it has so, appears from the universal appeals of

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of all parties to those early times in support of their particular opinions. Besides, the thing is in itself natural; for if a man finds a variety of opinions in the world upon important passages in scripture, where shall he be so apt to get the true sense as from cotemporary writers or others who lived very near the apostolic age? and if such a man shall find any doctrine or interpretation to have been universally believed in the first ages, or as Vincentius Lirinensis words it, *semper ubique et ab omnibus*, he will unquestionably be disposed to think such early and universal consent, or such prescription, of very considerable weight in determining his opinion.

PRESCRIPTIONS, EXTEMPORANEOUS.

Introduction.

1 Nature of a medical prescription.

A Prescription, in a medical sense, signifies much the same with what in common language is called a *receipt*, being "a form of direction for the preparation and administration of some compound medicine." These *medical receipts* are commonly called *formulæ* by physicians; and the term *prescription* is applied to what is written by a physician on seeing his patient, instructing the apothecary what medicines are to be prepared, how they are to be composed, and how administered to the patient. In this sense, a prescription may contain two or more *formulæ*.

These prescriptions are almost always written in Latin, and are expressed in a peculiar style, which, though well known to physicians and apothecaries, may require the illustration of an example. The following is a specimen of a modern prescription, as it would be written by an Edinburgh and a London physician, according to the nomenclature of their respective college Pharmacopœias.

Edinburgh Prescription.

For Mr ——.

2 Examples.

℞ Pulv. Rad. Rhei palmati gr. xxv.
Tartritis Potassæ ʒij.
Tincturæ Sennæ compositæ,
Syrupi Rosæ centifoliæ āā ʒij.
Aquæ Menthæ piperitæ ℥iss.
M. f. *Potio summo mane sumenda.*
Jan. 31. 1809.

London Prescription.

℞ Pulv. Rhei gr. xxv.
Kali Tartarisati ʒij.
Tincturæ Senæ
Syrupi Rosæ āā ʒij.
Aquæ Menthæ piperitidis ℥iss.
M. &c.

3 Parts of a prescription.

From the above examples, it will be seen that a prescription, properly so called, contains several circumstances beside the *formulæ* or *receipts*, as the name of the *patient*, for whom the prescription is written; the signature of the *physician*, as G. F. for George Fordyce, &c. and the *date of prescribing;* none of which should be omitted, as the prescriptions are carefully preserved by the apothecary, for future reference.

4 Parts of a formula.

It may be proper to explain some circumstances respecting the *formula* given in the above prescription. The ℞ with which it commences signifies *recipe* or *take;* and is prefixed to all medical receipts. Then follow the several ingredients of which the medicine is to be composed, with the quantities of each. These quantities are usually marked by peculiar characters or symbols, which will be examined hereafter; and the numbers employed are usually the Roman numerals. After the ingredients have been enumerated, and their quantities specified, there follows the title of the medicine, as *Potio* in the present instance, signifying *potion* or *purging draught*, with M. f. prefixed to it, which stand for *misce fiat*, or *misce ut fiat*, mix to make; and lastly the direction how the medicine is to be taken or administered; *summo mane sumenda;* to be taken early in the morning. In England, these directions are always written in Latin, but in Scotland it is, we believe, more common to write them in English. We shall consider the propriety of this latter mode in a future part of this article.

The ingredients of which a formula is composed have been, by writers on medical prescriptions, arranged under four heads: 1. The *basis* of the formula, which in the present instance is the rhubarb, constituting the principal ingredient, on whose action, modified where necessary, the chief success of the medicine, in fulfilling the required indication, is to depend. 2. The *adjuvant* or auxiliary, added to the basis, for the purpose of increasing its power, expediting its action, or rendering it more easily soluble in the juices of the stomach; in the above formula the *tartrate of potash* is the principal adjuvant. 3. The *corrector*, added to the basis, when we wish to moderate or delay its action, to correct some unpleasant or injurious property of it, such as its odour, taste, acrimony, &c. or to prevent it from acting on the body in a different manner from that which the indication requires: thus, in the present formula, the warm *tincture of senna* is added, rather to correct the griping quality of the rhubarb, than to increase its action, and the *syrup of roses* to correct the unpleasant taste of the medicine; and *the essential oil* in the peppermint-water contributes to both these purposes: these, therefore, are to be considered as the correctors. 4. The *constituent*, or that ingredient which serves to reduce the rest into the form which is considered as most convenient for the exhibition of the medicine; in the present case the *peppermint-water* is the constituent, serving to reduce the medicine to the form of a potion or draught.

5 Division of formulæ.

Medical *formulæ* are either *officinal*, or *extemporaneous;* the former being such as are directed by authority of some public medical college to be kept in the shops of apothecaries, and the preparation of which is described in their *pharmacopœias* or dispensatories; the latter such as are prescribed by the physician or surgeon as occasion may require.

6 Division of the subject.

Having explained the nature of a prescription, and enumerated the several circumstances which are usually comprised in it, we propose, in the present article, to consider the importance of acquiring the habit of writing prescriptions with ease, elegance, and scientific accuracy;

Importance of the Subject.

cy; the previous information required by a physician, to enable him to prescribe properly in the several cases which come under his care; the general rules which we deem it necessary to lay down for attaining the art of prescribing with neatness and accuracy; and lastly, we propose to give a brief historical view of the progress of pharmacy from the revival of literature to the present time, with a critical examination of some of the best writings on this subject.

7
Advantages of composition.

I. Before considering the importance of learning the *art* of prescribing, it may be proper to explain why such an art is required, or to point out the advantages to be expected from the composition of several simples in the same medicine. There are indeed a few drugs, which cannot be more efficacious in the generality of cases than when in their most simple state. Thus, crude *opium* in a pill, *cinchona bark* or *ipecacuan* in powder, mixed with some ordinary liquid, afford the most effectual, as well as the most simple remedies. The same may be remarked of *mustard seeds*, *white pepper*, and *garlic* swallowed whole, and so of a few others. In general, however, it is much more convenient, and in many cases it is absolutely necessary, to have recourse to composition. Many remedies cannot be taken or applied in their simple state, especially such as are used externally; while others are rendered more certain, safe, or expeditious, by being combined with others. Thus *opium* and *tartrate of antimony and potash* are both *diaphoretics*, or sweating medicines; but when combined, their effect in this way, is considerably increased. (See Kirby's Tables, *formula* 27. and 28.). So of *jalap* and *calomel* as purgatives (Ibid. *form.* 49.). Opium with many patients produces headach; but if *citric acid* (lemon juice) be added, this unpleasant symptom seldom takes place. (Tables, *formula* 137.). Chemical medicines are for the most part compound from their very nature; but even such of these as are contained in the catalogues of the *materia medica* can seldom be employed except in composition. Mercury in its native state is nearly inert, and yet how many valuable and powerful remedies are formed by its union with other bodies. *Sulphuric acid* and *alcohol* form *æther*, but æther cannot be swallowed except in combination. Thus we see, that independently of neatness and convenience, which, though they ought to have their weight, are secondary considerations, there are many positive arguments to prove the utility of composition: and if composition be of use, it must surely be of some consequence to know the scientific principles on which this is to be founded.

8
Importance of the subject.

The importance of acquiring a readiness at writing a neat and scientific prescription, seems not to be generally understood. Indeed few parts of a medical education have been more neglected than this department of pharmacy, especially in Britain. In many of the continental medical schools, there is a professor appointed to give lectures on the art of writing prescriptions, while in our colleges this subject is at most confined to a single lecture from the professor of materia medica, and the student is left to learn the art as he can, by copying the prescriptions of the physicians whose clinical practice he has an opportunity of witnessing, or by attendance in an apothecary's shop.

9
General courses of medicine insufficient for practice.

When a gentleman has passed through the usual course of education at a medical school, and has received a diploma, it is supposed that he is fully qualified to enter on his career with confidence, and proceed with success. Let us for a moment consider what are his usual qualifications. He has, we shall suppose, acquired a tolerably acurate knowledge of the structure and functions of the human body; he has been made acquainted with the nature, properties, and, so far as known, the mode of action of the various simple and compound bodies, which, as medicines, food, and poisons, exert an influence on the animal economy; he has been instructed in the general nature of disease, the various symptoms or appearances by which its presence is indicated, and the general means to be employed for their removal. He has more particularly taken a view of many of the maladies to which the human frame is subject; has seen them exerting their influence on patients, and has frequently witnessed the effects of remedies in expelling them from the system, or in alleviating the distress which they occasioned. Here, it will be said, is a complete physician, and such, to a superficial observer, he may appear. With all this knowledge, however, (and without all this no man is qualified for the active duties of the profession) many gentlemen are still deficient in a most important point, the capacity of applying this knowledge to actual practice. A physician may be able to distinguish a disease at a glance; he may be prompt and accurate in forming his indications of cure, and may be well acquainted with the general nature of the remedies by which these indications are to be fulfilled, and still, if he be not master of the form and method in which these are to be exhibited; if he be not familiar with the practice of writing prescriptions, he will often be placed in a most unpleasant predicament, and will not unfrequently expose himself to the ridicule of those who are far his inferiors in knowledge and abilities, by writing prescriptions which, though they contain the essential means of cure, yet wanting the mode and fashion of the day, will be read with a smile, or perhaps be imperfectly understood, by the apothecary or the druggist to whom they are presented.

10
Necessity of acquiring a habit of writing prescriptions.

This, however, is an inconvenience which, as it may not be attended with serious effects, is trifling in comparison of some which he will encounter.

From a want of habit in prescribing, or from a want of some medical or chemical information, which we shall presently explain, he will be often liable to jumble together substances which, though when single, they are possessed of similar medical properties, may, when combined, exert an action greater or less than he had intended to produce, or even altogether of an opposite nature.

11
Illustration.

By way of illustration let us suppose a young practitioner, at his first outset, called to a patient labouring under *tetanus*, or that disease of which a locked jaw is one of the most obvious symptoms. The patient is in the most distressing situation, and it is expected that every renewal of the spasm will end in those convulsions which most frequently bring on the fatal termination of this formidable disease. How is he to act? The remedies to be employed are evidently antispasmodics, and of these he has heard opium and mercury highly recommended in this disease. Which of these is he to employ, or is he to make a trial of both? He determines to give opium: in what form is he to order its administration? That of pill is the most obvious; but perhaps the patient cannot, in the ordinary state of his health, swallow pills, and every effort of the muscles of deglutition, increases

Importance of the Subject.

the disease. He must then prescribe it in a liquid form. Shall he order it in the form of laudanum to be given by the attendants, or shall he prescribe draughts or a mixture, with a certain proportion of *tinctura opii?* What is the dose of the opium? He knows that a person affected with this disease can bear a large dose. Is he to give this large dose at once, or is he gradually to increase it? In a short time the patient can perhaps no longer swallow even liquids. Can he administer opium in any other form? He has heard of opiate clysters. What is the best formula for them? Is the same quantity of opium as when taken by the mouth, sufficient for a clyster? Again, if the patient cannot swallow, how is he to be supported? By nutritive injections. How is the physician to prescribe a nutritive injection? Should it be large or small in quantity? and is there any mode of making the bowels retain it for a sufficient time, to draw from it the proper nourishment? We might carry this illustration, simple as it is, to a much greater length; but we forbear, that we may not be thought tedious. We need say little to persuade those who are at all acquainted with the practice of physic, that it is the duty of every physician who values the comfort and safety of his patient, or who has any regard for his own reputation and respectability, to spare no pains in enabling himself to write a prescription with facility, perspicuity, and neatness.

12 Attendance in a shop necessary, but not alone sufficient.

To those who, previous to their attending medical lectures, have been for some time in an apothecary's shop, instructions for the writing of prescriptions may be thought useless or impertinent. In the daily habit of perusing and copying formulæ from the hands of various physicians, it may be thought "custom hath made it in them a property of easiness." Certainly, with respect to form and method, doses and proportions, they can require but little information. But after all, this knowledge is merely imitative; they have learned to write prescriptions as a parrot learns to speak, and unless they have added considerable chemical knowledge to their practical information, they can only copy what they have seen, and will often find themselves very much at a loss.

This is considering the matter in the fairest point of view, taking it for granted that they have been under a master who had abilities, leisure, and inclination to give them all the necessary information; to point out to them how particular formulæ were suited to particular indications; to shew them why one is preferable to another, and how they should distinguish a scientific from an empirical prescription.

How seldom this is the case, and how easy it is for a young man to be several years in an apothecary's shop, and learn but little, we leave to the judgment of others to decide. We trust it would not be difficult to show, that many of the formulæ which they have witnessed, may be simplified or improved; that many of them are unscientific, and not a few absurd.

We would, however, by no means be understood to consider attendance on a shop as an unnecessary part of a medical education; far from it. We are of opinion that every one who intends to practise medicine, whether it be as surgeon, apothecary, or physician, should for some time accustom himself to the preparing of medicines, and the keeping of an apothecary's day-book: and we conceive that a young practitioner without this experience, will commence practice under considerable disadvantages. By perusing, copying, and preparing the formulæ of various practitioners, the student certainly acquires a readiness at prescription, which he cannot so easily and imperceptibly attain in any other way. To those who have had little opportunity of profiting in this way, and their number is by no means small, the instruction intended to be conveyed in the following observations will be peculiarly adapted; and probably such as have passed some time behind a compter, will learn something which had before escaped their notice, or will at least be convinced that the subject admits of considerable improvement by the application of recent chemical discoveries.

It may be thought, that such as have, during their residence at college, given diligent attention to hospital practice, will there have received all the information on the subject of prescription which is necessary to qualify them for private practice. But those who are familiar with both will readily agree, that what is sufficient for the one, is by no means calculated for the other. The unexperienced physician, accustomed to the hospital routine, thinks it sufficient if he prescribe the proper quantities of the proper medicines in the most simple form. Is an emetic required? He will order gr. xv. or ℈i of powdered ipecacuanha. Is a gentle diaphoretic indicated? He would prescribe ℥ij of *mistura salina* to be taken every four hours. Were his future practice to be confined to any infirmary, to the negroes of a West India plantation, or the crew of a man of war, this might be sufficient; but if he aim at extensive or genteel practice, he will find it necessary to take a much wider range.

II. The subject of extemporaneous prescription may be considered as constituting the finishing part of a physician's education; so far, at least, as we can say, that the study of a profession, for the perfect attainment of which the father of medicine has declared life too short, may admit of a completion. This is truly the practical part of a physician's duty; it is this for which all his previous studies are intended to prepare him. Having acquired a knowledge of diseases and their remedies, he is, when entering on the active duties of his profession, to apply that knowledge to the best advantage, so as to cure or relieve his patient in the easiest, safest, and most expeditious manner. It is not merely the mechanical business of penning a medical receipt, which he might copy from his memory or his *vade mecum*, that we are here considering as the practical duty of a physician. It is the adapting of the means which he possesses to the peculiar case that is under his care; the modifying his prescription according to the circumstances of the patient; the age, sex, temperament, peculiarity of constitution, season, climate, and many other circumstances; the choice of remedies, and the necessary variation of them; it is these which constitute the duty of a practical physician, so far as relates to the business of prescription.

Before a physician can attempt to prescribe for his patient, it is requisite that he possess much previous information.

In the first place, he must be well acquainted with the nature and seat of the disease, the cure or alleviation of which he is about to attempt; with the symptoms which usually appear in similar cases, and the variations which are likely to take place, with the causes, so far as known,

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known, which predispose to the disease, or which remotely or immediately have a tendency to produce it; with the probable termination of such a case, and the general indications of cure. This knowledge presupposes an acquaintance with anatomy, physiology, and pathology, without a competent share of which a physician can no more effect a cure of a disease, than an algebraist can accomplish the solution of an equation, while he is ignorant of its terms.

17 Materia Medica.

The prescriber must also be familiar with the Materia Medica and pharmacy, from which he learns the natural history, the chemical and medical properties of the various simple substances employed in medicine; their usual doses and their officinal compounds, as contained in the pharmacopœia of the country in which he resides; as it is these articles that are to form the ingredients of which the medicines he prescribes are to be composed. As without considerable practical experience few men are able to retain all the requisite information respecting each article of the Materia Medica, it would be of great advantage to the young prescriber to have by him a tabular sketch, which might, within a small compass, contain the information more immediately necessary for writing a prescription. Nothing is found to assist the memory, or to facilitate the attainment of knowledge, more than these tabular views; and so much is the learned world convinced of this, that such views are daily becoming more fashionable, and are now applied to almost every branch of science. It was with the intention of assisting the young practitioner in writing prescriptions, that Dr Kirby, a few years ago, published his tables of the Materia Medica, containing a concise view of the most material circumstances respecting the various simple and compound medicines admitted into the catalogues of the London, Edinburgh, and Dublin Pharmacopœias. In this volume the articles are arranged under 18 classes; the titles and order of which are much the same with those given in our article MATERIA MEDICA; and of each article are given the systematic name, the synonymous pharmaceutical name, the country in which it is produced, or from which it is brought; the part employed in medicine; the form in which it is commonly administered, and the usual doses of the simple, and of the several officinal compounds. In the original draught of these tables, the circumstances above mentioned were arranged in columns; but it was found, that the difficulty and consequent expence of printing the work in that form would be so great, as nearly to counterbalance the advantage which might be derived from it. We are, however, of opinion that the arrangement in columns is better adapted to strike the eye, and we shall here give a specimen of such an arrangement, taken from one of the shortest classes in the above work (A).

Previous Requisites. 18 Utility of tabular view.

TABLE OF EXPECTORANTS.

SIMPLES.					OFFICINAL PREPARATIONS.		
I. VEGETABLES.	COUNTRY.	PART.	FORM.	DOSE.		DOSE.	CASES.
5. CEPHAELIS IPECACUANHA. *Ipecacuanha.* Ed. Lond. Dub.	E. Indies & Brazil.	Root.	Powder.	gr. j. every 3 or 4 hours.	Vinum Ipecacuanhæ. Ed. Lond. Dub.	Dr. 1. or 2.	*Peripneumonia and asthma.*
6. NICOTIANA TABACUM. Ed. *Nicotiana.* Lond. Dub.	America.	Leaves.	Smoke and extract.	- -	- - - - - - - - - - - -	- -	Consumption.
8. SCILLA MARITIMA. Ed. *Scilla.* Lond. Dub.	South of Europe.	Root fresh or dried.	Conserve, powder, pill, &c.	Grs. 1 to 2.	a. Acetum Scillæ Maritimæ. Ed. *Acetum Scillæ.* Lond. Dub. b. Syrupus Scillæ Maritimæ. Ed. c. Oxymel Scillæ. Lond. Dub. d. Conserva Scillæ. Lond. e. Tinctura Scillæ. Lond. f. Pilulæ Scilliticæ. Ed. *Pilulæ Scillæ.* Lond. Dub.	D. 2 to 4. In composition. Gts. 30 to 40. Gts. 10 to dr. 1. Gr. 10 to 15	Peripneumonia, asthma.
3. ALLIUM SATIVUM. Ed. *Allium.* Lond. Dub.	Do.	Fresh root.	Substance.	Dr. 1 to 2.	Syrupus Allii. Dub.	About a table spoonful.	
4. AMMONIACUM. Ed. Lond. Dub.	India.	Gumresin.	Pill, mixture.	Grs. 10 to 20.	Lac Ammoniaci. Lond.	Oz. 1 to 2.	
5. ARUM MACULATUM. Ed. *Arum.* Lond.	Britain.	Fresh root.			Conserva Ari. Lond.	Dr ¾ to 1.	
6. COLCHICUM AUTUMNALE. Ed. *Colchicum.* Lond.	Britain.	Fresh root.			a. Syrupus Colchici autumnalis. Ed. b. Oxymel Colchici. Lond. Dub.	Dr 2 to 1 oz. Do.	

(A) The simples in the first columns of the above table have numbers prefixed to them. To explain why these do not follow each other in a regular series, it is necessary to mention, that the articles marked 5, 6, 8, 11, and 12, are, in the tables of Materia Medica from which this specimen is altered, inserted in a former class, viz. emetics.

Table continued.

SIMPLES.					OFFICINAL PREPARATIONS.		
I. VEGETABLES.	COUNTRY.	PART.	FORM.	DOSE.		DOSE.	CASES.
17. FERULA ASAFOETIDA. Ed. *Asa fœtida.* Lond. Dub.	Persia.	Gumresin.	Pill, mixture.	Grs. 10 to 15.	Lac Asæ fœtidæ. Lond.	1 oz. to 2.	Hooping cough.
18. HYSSOPUS OFFICINALIS. *Hyssopus.* Dub.	Britain.	Herb.	Tea.				
19. MARRUBIUM VULGARE. Lond.	Do.	Leaves.	Domestic syrup.				
20. MYRRHA. Ed. Lond. Dub.	Arabia	Gumresin.	Powder or pill.	10 grs. to 1 dr.			
21. PIMPINELLA ANISUM. Ed. *Anisum.* Lond. Dub.	Asia.	Seeds.	Infusion, oil.		Oleum Volatile Pimpinellæ Anisi. Ed. *Ol. Essentiale Anisi.* Lond. Dub.	Gt. 2 to 6.	Croup and pneumonia.
22. POLYGALA SENEGA. Ed. *Seneka.* Lond. Dub.	America.	Root.	Decoction.	- -	Decoctum Polygalæ Senegæ. Ed.	1 oz. to $1\frac{1}{2}$ oz.	
23. STYRAX BENZÖIN. Ed *Benzoinum.* Dub. *Benzoe.* Lond.	Sumatra.	Balsam.	Pill.		a. Acidum Benzoicum. Ed. *Sal Benzoini.* Dub. *Flores Benzoes.* Lond.	Grs. 1 to 2.	
					b. Tinctura Benzoes Composita. Lond.	Gt. 15 to 30.	Catarrh.
24. ALCOHOL. Ed. Spt. Vinosus Rectificatus. Lond. Dub.					Æther Sulphuricus. Ed. Dub. *Æther Vitriolicus.* Lond.	Vapour inhaled.	Asthma.
II. MINERAL PRODUCTIONS.							
11. SULPHURETUM ANTIMONII. Ed. Dub. *Antimonium.* Lond	Britain.	- -	- -	-	a. Tartris Antimonii. Ed. *Tartarum Antimoniatum.* Dub. *Antimonium Tartarisatum.* Lond.	Gr. $\frac{1}{3}$ to $\frac{1}{2}$ repeated.	
					b. Vinum Tartritis Antimonii. Ed. *Vinum Antimonii Tartarisati.* Lond.	Dr. 1 to 2. Dr. $\frac{1}{2}$ to 1.	
					c. Sulphuretum Antimonii Precipitatum. Ed. *Sulphur Antimonii Precipitatum.* Lond. *Sulph. Ant. Fuscum.* Dub.	Gr. 3—5.	
25. SULPHUR SUBLIMATUM. Ed. Dub. *Flores Sulphuris.* Lond.					a. Sulphur Sublimatum Lotum. Ed. Dub. *Flores Sulphuris.* Lond.	Gr. 15 o dr. $\frac{1}{2}$.	Asthma.
					b. Trochisci Sulphuris. Lond.	Ad libitum.	
					c. Oleum Sulphuratum. Ed. Lond. Dub.	Gt. 10—20.	
12. Zincum. Ed. Lond. Dub.	- -	- -	- -	- -	Sulphas Zinci. Ed. Dub. *Zincum Vitriolatum.* Lond.	Gr. $\frac{1}{2}$ to 1 three times a day.	Consumption and hooping cough.

19 Explanation.

The above table contains eight columns. In the first are written the scientific and corresponding pharmaceutical names of the several simple substances, distributed into departments, according as they are taken from the vegetable or the mineral kingdom, and arranged alphabetically; in the second is written the name of the country where the article is found, or from which it is procured; in the third the part of the simple usually employed in medicine; in the fourth the form in which it is usually administered; in the fifth the dose of the simple. In the sixth column are arranged all the officinal preparations of each simple which properly belong to the class of expectorants, and named according to the nomenclature of the Edinburgh Pharmacopœia, with the corresponding synonymous names of the other two colleges; in the seventh are given the usual doses of these compound medicines, and in the eighth are noted the diseases to which the simple or its compound is more peculiarly adapted.

20 Use.

The use of such tables is pretty obvious. Having before him all the remedies that are suited to answer any particular indication, as in the present instance, that of promoting expectoration, the prescriber can select such articles as are best suited to the particular case in hand, or

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21 Therapeutics. It is next required of a prescriber, that he be thoroughly acquainted with therapeutics, a part of the institutions or principles of medicine which instructs him in the nature and effects of the various classes of medicines as suited to different indications of cure.

22 Chemistry. An extensive acquaintance with the elementary parts of chemistry is also necessary, as the subject of extemporaneous prescription forms a part of pharmacy, which is essentially a chemical art. It is therefore as impossible for a physician to be a scientific prescriber without a competent share of chemical knowledge, as for the captain of a ship to be a scientific sailor, without a knowledge of astronomy and navigation. It is certainly possible for a physician to write a prescription without having studied chemistry, and for a sailor to conduct a vessel to the West Indies without being acquainted with the mathematical principles of navigation: but these men are both empirics; they have a certain mechanical way of proceeding, which they have learned by long experience, and much more severe labour than it would have cost them to acquire a knowledge of the scientific principles of the arts which they profess.

23 Rational prescription depends chiefly on chemical principles. It is of the utmost importance that a physician should be able to assign a reason for every article which he inserts in his prescriptions; that he should, as correctly as possible, know what part each will act in the composition of the medicine, and what effect the whole compound will produce on his patient; in short, that he should not prescribe a certain formula merely because he has seen it prescribed by others in similar cases, but should form his prescription on scientific principles, and from the result of reason and reflection. In the present improved state of chemistry this is more peculiarly necessary, and it is also become much more easy. Not many years ago physicians had scarcely a clue to guide them in their prescriptions, except that of experience; they saw certain results take place, and certain effects produced, but why these results took place, or how these effects were brought about, they were almost entirely ignorant. The reasoning employed by old writers on pharmacy concerning the preparation and operation of compound medicines, is to a modern chemist highly entertaining. We shall not swell this article by specimens of such reasonings, but shall refer those who wish to amuse themselves in this way, to Strother's *Lectures on the Rationale of Medicine; Quincy's Complete Dispensatory:* Fuller's *Pharmacopœia Extemporanea*, and the *Pharmaceutical* works of Dr Willis.

24 Chemical affinity. When a physician sits down to write a prescription, he should imagine the preparation going on under his eye, and should know whether or not the materials which he is ordering will act chemically on each other; and if they do, what changes will be produced. It very frequently happens that from the union of two or more substances there arises a compound possessed of very different properties, and which is likely to produce very different effects from any of the component articles. The result will sometimes be advantageous, sometimes inert, and sometimes injurious. It is the business of the prescriber to be acquainted with the advantages and disadvantages of these combinations, that he may avail himself of the former, and avoid the latter. This desirable object is to be attained only by a correct and extensive knowledge of chemical affinity. This will teach what substances are capable of combining together, or of decomposing what are already united; and will inform us whether we can derive any advantage from their action.

25 Common errors in this point. For want of this chemical knowledge many of the formulæ prescribed by some of our best practical writers, are much less simple and scientific than they might be made by an attention to chemical principles. The famous tonic remedy, commonly called *Griffith's myrrh mixture*, so much, and we believe, so justly extolled in cases of general debility, was originally composed in the following manner.

26 Griffith's myrrh mixture.

℞ Myrrhæ dr. j. *Solve terendo in mortario cum*
Aquæ Alexeteriæ simp. unc. vi. ss.
—— cujuslibet Spirituosæ dr. vi. vel unc. j.
Dein adde
Salis Absynthii, dr. ss.
—— Martis, gr. xii.
Syrupi simplicis, dr. ij. m *.

From the gravity with which the author speaks of this composition, and the various proportions he allows of the salt of wormwood and the salt of steel, together with the different methods of mixing the ingredients, it is pretty clear that he had no idea that any of them were superfluous or unnecessary, nor probably was he aware that the two salts act on each other, and undergo a mutual decomposition. It seems therefore to be quite an empirical prescription. Analysing it according to our present chemical knowledge, we know that the principal part of it consists of an emulsion of myrrh, containing in suspension a quantity of carbonate of iron, and having dissolved in it a small quantity of sulphate of potash, and perhaps a little subcarbonate of potash. Now, as there is no reason to believe that the two last are of any consequence in the medicine, it would surely be much more scientific to form a medicine of myrrh and carbonate of iron, with the addition of such cordials and syrups as may add to its tonic power, and render it palatable. A medicine of this kind is the following.

℞ Pulv. Myrrh. dr. i.
Carbonat. Ferri præcip. dr. $\frac{1}{2}$,
Syrup. Citri Aurant. unc. $\frac{1}{2}$. *Simul terc, et adde*
Aquæ Menth. piper. unc. 6.
Tinctur. Cinchon. compos. unc. i. M †.

27 In Dr Strother's 19th lecture there is noticed a medicine which was then considered as a valuable nostrum in the cure of smallpox. The principal ingredients are, spirit of salt (*muriatic acid*), and salt of hartshorn (*impure carbonate of ammonia*). A tyro in modern chemistry need not be told that this medicine contains muriate of ammonia, produced by the combination of the acid with the alkali. If, therefore, such a medicine is useful in smallpox, it would surely be much less laborious, and much more scientific, to employ the muriate of ammonia, commonly called *sal ammoniac*, which we have prepared to our hands.

28 As the secondary salts form a class of bodies which constitutes a considerable part of the materia medica, it is proper for the physician to be intimately acquainted with their nature and chemical properties. Here he will again find the advantage of systematic tables, containing

* *Griffith on Hectic Fevers.*

† *Kirby's Tables, Formal.* 106.

taining the principal circumstances respecting the composition and decomposition of such of these salts as are employed in medicine. A table of this kind is printed in Dr Kirby's Tables, and we shall here give a similar view, only divided, for the sake of convenience, into two tables, the first containing the composition of the salts, and the second the substances employed in medicine, by which they may be decomposed.

TABLE I.

Salt.	Solubility.	Composition. Base.	Acid.	Water.
1. Supersulpate of Alumina and Potash.	At 60° 20. 212°, 1.	Cryst. 12. Dry 63, 75.	17.66 36.25	70.24 0.
2. Sulphate of Magnesia.	60°, 1. .75	17.	29.35	53.65
3. Sulphate of Potash.	60°, 16 212° 4.5	54.8	45.2	0.
4. Sulphate of Soda.	60°, 2.6 212° .8 Efflorescent.	Cryst. 18.48 Dry 44.	23 52 56.	58. 0.
5. Sulphate of Copper.	60°, 4. 212°, 2.	32.	33.	35.
6. Green Sulphate of Iron.	60°, 2. 212°, .75	28.	26.	46.
7. Sulphate of Zinc.	60°, 2.5	20.	40.	40.
8. Subsulphate of Mercury.	60°, 2000	87.	10.	3.
9. Nitrate of Potash.	60°, 7. 212°, 1.	51.8	44.	4.2
10. Nitrate of Silver.	60°, 1.			
11. Muriate of Barytes.	60°, 5.	Cryst. 57.	32.	11.
12. Muriate of Lime.	Deliquescent. 60°, 5.	Red hot, 50.	42.	8.
13 Muriate of Soda.	60°, 2 8	Dried 53.	38.88	8.12
14. Muriate of Ammonia.	60°, 3. 212°, 1.	Sublimed. 25.	42.75	32.25
15. Mild Muriate of Mercury, or Calomel.	Insoluble.	88.5	11.5	
16. Corrosive Muriate of Mercury.	60°, 20. 212°, 2.	82.	18.	0.
17. Muriate of Antimony.	Deliquescent.			
18. Phosphate of Lime.	Insoluble.	49.	51.	0.
19. Phosphate of Soda.	60°, 4. 212°, 2.	19.	15.	66.
20. Carbonate of Barytes.	Insoluble.	22.	78.	0.
21. Carbonate of Lime.	Insoluble.	55.	[illegible]	0.

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Salt.	Solubility.	Composition.		
		Base.	Acid.	Water.
22. Carbonate of Magnesia.	Insoluble.	45.	34.	21.
23. Carbonate of Potash.	60°, 4. 212°, 1.5	40.	43.	17.
24. Subcarbonate of Potash.	Deliquescent.	Dry 64.	30.	6.
25. Carbonate of Soda.	Efflorescent.	Cryst. 21.58 Dried 59.85.	14.42 40.05	64. 0.
26. Carbonate of Ammonia.	60°, 2.			
27. Carbonate of Iron.	Insoluble.			
28. Carbonate of Zinc.	Insoluble.			
29. Acetate of Potash.	Deliquescent.			
30. Acetate of Lead. Ph. Ed.	60°, 4.	58.	26.	16.
31. Subborate of Soda.	60°, 18. 212°, 6.	17.	39.	44.
32. Supertartrate of Potash.	60°, 60. 212°, 13.	33.	67.	0.
33. Tartrate of Potash.	60°, 4. Deliquescent.			
34. Tartrate of Potash and Soda.	60°, 5. Efflorescent.	Tart. Pot. 54.	Tart. of Soda. 46.	0.
35. Tartrate of Antimony and Potash, or Emetic Tartar.	60°, 15. 212°, 3.	Ox. of Ant. 38. Potash 16.	34.	12.

29 Explana-

In this first part of the table of secondary salts there are five columns, in the first of which are set down the names of most of the secondary salts employed in medicine, according to the most approved chemical nomenclature. The second column shews the degree of attraction which subsists between each salt and water, namely, how many parts of water at the temperatures of 60° and 212° of Fahrenheit are required to dissolve one part of the salt, in the state in which it is usually employed, and whether the salt be deliquescent or efflorescent. The three remaining columns point out, as far as has been ascertained, the proportional quantities of the component parts of each salt, the third column shewing how many parts in the 100 consist of base; the fourth how many of acid, and the fifth how many of water of composition. In some cases two proportions are given, and it is expressed in the third column under what state of the salt these proportions exist.

TABLE II.

Decomposition by Single Affinity.	Salt.	Decomposition by Double Affinity.
Barytes. Potash. Soda. Lime. Magnesia. Ammonia. Tannin. Gallic Acid. Oxalic Acid. Tartaric Acid.	Supersulphate of Alumina and Potash.	Nitrate of Potash. ——— Silver. Muriate of Barytes. ——— Lime. ——— Soda. ——— Ammonia. Carbonate of Barytes. ——— Lime. ——— Magnesia. ——— Potash. ——— Soda. ——— Ammonia. Acetate of Lead. Subborate of Soda.

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Decomposition by Single Affinity.	Salt.	Decomposition by Double Affinity.
Barytes. Potash. Soda. Lime. Ammonia.	Sulphate of Magnesia.	Nitrate of Silver. Muriate of Barytes. ——— Lime. Corrosive Muriate of Mercury. Red Muriate of Iron. Carbonate of Lime. ——— Potash. ——— Soda. ——— Ammonia. Acetate of Mercury. ——— Lead. Subborate of Soda. Tartrate of Potash.
Barytes.	Sulphate of Potash.	Nitrate of Silver. Muriate of Barytes. ——— Lime. ——— Soda. ——— Ammonia. Corrosive Muriate of Mercury. Phosphate of Soda. Carbonate of Barytes. Acetate of Mercury. ——— Lead. Tartrate of Potash, partially.
Barytes. Potash.	Sulphate of Soda.	Nitrate of Potash. ——— Silver. Muriate of Barytes. ——— Lime. Corrosive Muriate of Mercury. Acetate of Mercury. ——— Lead. Tartrate of Potash.
Barytes. Potash. Soda. Lime. Magnesia. Ammonia. Tartaric Acid. Muriatic Acid. Zinc. Iron. Tin.	Sulphate of Copper.	Subsulphate of Mercury. Nitrate of Potash. ——— Silver. Muriate of Barytes. ——— Lime. ——— Soda. ——— Ammonia. Corrosive Muriate of Mercury. Phosphate of Soda. Carbonate of Potash. ——— Soda. Acetate of Mercury. ——— Lead. Subborate of Soda.
Barytes. Potash. Soda. Lime. Magnesia. Ammonia.	Green Sulphate of Iron.	Nitrate of Silver. Muriate of Barytes. ——— Lime. Corrosive Muriate of Mercury. Acetate of Mercury. ——— Lead. Subborate of Soda.
Same as the last.	Sulphate of Zinc.	Nitrate of Silver. Muriate of Barytes. Acetate of Lead.

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Decomposition by Single Affinity.	Salt.	Decomposition by Double Affinity.
Barytes. Sulphuric Acid. Heat.	Nitrate of Potash.	Supersulphate of Alumina and Potash. Sulphate of Magnesia. ——— Soda. Muriate of Barytes. ——— Lime.
Barytes. Potash. Soda. Lime. Magnesia. Ammonia. Zinc. Muriatic Acid. Tin. Phosphoric Acid. Copper. Mercury.	Nitrate of Silver.	All the Sulphates employed in Medicine. Muriate of Barytes. ——— Lime. ——— Soda. ——— Ammonia. Corrosive Muriate of Mercury. Red Muriate of Iron. ——— Antimony. Phosphate of Soda. All the Carbonates employed in Medicine. Subborate of Soda.
Sulphuric Acid.	Muriate of Barytes.	All Sulphates more or less. Nitrate of Silver. Phosphate of Soda. Carbonate of Potash. ——— Soda. ——— Ammonia. Subborate of Soda.
Barytes. Potash. Magnesia. Sulphuric Acid. Nitric Acid. Boracic Acid. Phosphoric Acid.	Muriate of Lime.	All Sulphates. Nitrate of Silver. Phosphate of Soda. Carbonate of Ammonia.
Barytes. Potash. Sulphuric Acid. Nitric Acid.	Muriate of Soda.	Supersulphate of Alumina and Potash. Sulphate of Potash. ——— Copper. Nitrate of Silver. Acetate of Mercury. ——— Lead.
Barytes. Potash. Soda. Lime. Sulphuric Acid. Nitric Acid.	Muriate of Ammonia.	Supersulphate of Alumina and Potash. Sulphate of Potash. ——— Copper. Nitrate of Silver. Carbonate of Barytes. ——— Potash. ——— Soda. Acetate of Potash. Subborate of Soda. Tartrate of Potash.
Barytes. Potash. Soda. Lime. Magnesia. Ammonia. Copper.	Corrosive Muriate of Mercury.	Most Sulphates. Carbonate of Barytes. ——— Lime. ——— Magnesia. ——— Potash. ——— Soda. ——— Ammonia.

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Previous Requisites.

Decomposition by Single Affinity.	Salt.	Decomposition by Double Affinity.
Barytes. Potash. Soda. Phosphoric Acid. Nitric Acid. Muriatic Acid.	Phosphate of Soda.	Sulphate of Potash. ——— Copper. Nitrate of Silver. Muriate of Barytes. ——— Lime.
Sulphuric Acid.	Carbonate of Barytes.	Supersulphate of Alumina and Potash. Sulphate of Magnesia. ——— Potash. ——— Soda. Nitrate of Silver. Muriate of Ammonia. Corrosive Muriate of Mercury. Supertartrate of Potash.
Barytes. Oxalic Acid. Sulphuric Acid. Tartaric Acid. Phosphoric Acid. Nitric Acid. Muriatic Acid. Citric Acid. Boracic Acid. Acetic Acid.	Carbonate of Lime.	Supersulphate of Alumina and Potash. Sulphate of Magnesia. Nitrate of Silver. Corrosive Muriate of Mercury. Supertartrate of Potash.
Barytes. Potash. Soda. Lime. Oxalic Acid. Sulphuric Acid. Nitric Acid. Muriatic Acid. Tartaric Acid. Citric Acid. Boracic Acid. Acetic Acid.	Carbonate of Magnesia.	Supersulphate of Alumina and Potash. Nitrate of Silver. Corrosive Muriate of Mercury, Carbonate of Iron. Supertartrate of Potash.
Barytes. Lime. Oxalic Acid. Sulphuric Acid. Nitric Acid. Muriatic Acid. Tartaric Acid. Citric Acid. Boracic Acid. Acetic Acid.	Carbonate of Potash.	All the Sulphates except those of Potash and Soda. Nitrate of Silver. Muriate of Barytes. ——— Ammonia. Corrosive Muriate of Mercury. Supertartrate of Potash.
Barytes. Potash. Lime. Oxalic Acid. Sulphuric Acid. Nitric Acid, &c. as before.	Carbonate of Soda.	Sulphates as in the last. Nitrate of Silver. Muriate of Barytes. ——— Soda. Supertartrate of Potash.
Barytes. Potash. Soda. Lime. Oxalic Acid. Sulphuric Acid, &c. as above.	Carbonate of Ammonia.	Supertartrate of Alumina and Potash. Sulphate of Magnesia. Nitrate of Silver. Muriates of Barytes and Lime. Supertartrate of Potash.

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Decomposition by Single Affinity.	Salt.	Decomposition by Double Affinity.
Acids as in the last.	Carbonate of Iron.	Supertartrate of Potash.
Acids as in the last, and, beside, Phosphoric Acid.	Carbonate of Zinc.	
Sulphuric, Nitric, Muriatic, and Phosphoric Acids. Oxalic, Tartaric, Boracic, and Citric Acids.	Acetate of Potash.	Muriate of Ammonia. Tartrate of Potash and Soda.
Barytes. Potash. Soda. Lime. Ammonia. Magnesia. Gallic Acid. Muriatic Acid. Oxalic Acid. Phosphoric Acid. Sulphuric Acid. Tartaric Acid. Citric Acid. Boracic Acid.	Acetate of Mercury.	Sulphate of Magnesia. ——— Potash. ——— Soda. ——— Copper. ——— Iron. Muriate of Soda.
Substances as above, and nearly in the same order.	Acetate of Iron.	
Five first substances as before. Tin. Gallic, Sulphuric, Oxalic, and Tartaric Acids. Benzoic, Muriatic, Nitric, and Citric Acids.	Acetate of Lead.	Sulphates of Alumina, Magnesia, Potash, Soda, Copper, and Iron. Muriate of Soda.
Lime. Barytes. Magnesia. Gallic Acid. Sulphuric, Nitric, and Muriatic Acids. Phosphoric Acid. Oxalic and Tartaric Acids. Citric and Acetic Acids.	Subborate of Soda.	Supersulphate of Alumina and Potash. Sulphate of Magnesia. ——— Copper. ——— Iron. Nitrate of Silver. Muriate of Barytes. ——— Lime.
Lime. Barytes. Magnesia. Potash. Soda. Ammonia.	Supertartrate of Potash.	Carbonates of Barytes, Lime, Magnesia, Potash, Soda, Ammonia, and Iron.
Almost all other Acids. Lime. Barytes. Magnesia.	Tartrate of Potash.	Sulphates of Magnesia, Potash, and of Soda. Muriate of Ammonia.

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Decomposition by Single Affinity.	Salt.	Decomposition by Double Affinity.
Barytes. Lime. Sulphuric, Muriatic, and Nitric Acids.	Tartrate of Potash and Soda.	
Soda. Lime. Ammonia. Gallic, Sulphuric, Nitric, and Muriatic Acids.	Tartrate of Antimony and Potash.	Carbonate of Soda. ——— Ammonia.

30 Explanation.

This second part of the table of secondary salts consists of three columns. In the middle column are set down the names of the secondary salts employed in medicine, in the same order as in the former table; and in the adjoining columns on each side are noted those substances employed in medicine which are capable of effecting a decomposition of each salt; those in the left-hand column being such as decompose the salt by what is called *single affinity*, in consequence of that substance having a superior attraction for the acid or the base of the salt; while the substances in the right-hand column are secondary salts, between which and the opposite salt in the middle column such an action may take place as to effect their mutual decomposition.

31 Uses of the tables.

With tables of this kind before him, a prescriber will avoid several mistakes into which he might be betrayed from a deficiency of chemical knowledge. Thus, knowing the solubility of any salt, he will not prescribe a greater quantity of it than is capable of being retained in solution in the watery part of any draught or mixture which he is to order. For instance, knowing that *sulphate of potash* requires sixteen parts of water at 60° for its solution, he will, if he proposed to prescribe a draught containing two drams of this salt, be aware that such a quantity would require at least four ounces of water; but this making the draught too large is a great objection to giving the medicine in that form. Or suppose that he wished to give half an ounce of *supertartrate of potash* (*crystals of tartar*), by way of laxative; he sees, that to dissolve this quantity it would require at least two pounds of water, and therefore that he cannot order it in the form of solution, though, when mixed up with syrup into an electuary, it affords a good and efficacious cooling laxative. Again, knowing that *sulphate of soda* effloresces in the air, and thereby loses nearly half its weight, he will take care always to prescribe it in the form of crystals; and if he is to order a laxative draught containing one ounce of this salt, he must prescribe at least three ounces of liquid.

The information conveyed in the second column respecting the deliquescence or efflorescence of certain salts, or the readiness with which they imbibe water from the atmosphere, or part with their water of crystallization, is extremely useful in pointing out the proper forms of exhibition. Seeing, for instance, that *acetate of potash* (*diuretic salt*) is a deliquescent salt, no one would think of prescribing it in the form of pills; while, on the other hand, *carbonate of soda* being efflorescent, is well adapted to that form, and accordingly has been so prescribed by Dr Beddoes; (see *Kirby's Tables, formula* 153.).

Knowing the proportional quantities of the component part of any salt, we can, by calculation, ascertain pretty nearly how much of the one is required to decompose the other, and thus employ no more of either than is necessary. Thus, suppose it were required to decompose 100 grains of *green sulphate of iron* by *carbonate of soda*, in order to procure the greatest possible quantity of *carbonate of iron*. We find by the first table, that 100 grains of the *sulphate* contain 28 grains of *oxide of iron*, and to saturate this, we find by computation, that there are required 9 grains of *carbonic acid*. Now, on examining the composition of *carbonate of soda*, we find that 100 grains of this salt contain about $14\frac{1}{7}$ grains of *carbonic acid*, and consequently, that about 60 grains of *carbonate of soda* are sufficient to decompose 100 grains of *green sulphate of iron*.

Further, knowing the substances that are capable of decomposing any particular salt, a prescriber will not order any of these substances in the same formula with that salt, unless some manifest advantage were to be the result of their mutual action. He knows that *sulphate of zinc* and *acetate of lead* decompose each other, and that the *acetate of zinc* formed by their mixture, is a better remedy in cases of ophthalmia than either of the former salts. Here then is an advantage. *Tartrate of antimony and potash* is a good remedy in fever, so is *decoction of Peruvian bark*; but we find by the tables, that this salt is decomposable by *gallic acid*, and we know that *decoction of cinchona* contains this acid, especially after having stood for some time. It would therefore be improper to prescribe these remedies in conjunction, as has sometimes been recommended, because the salt would be so much altered by the decomposition as to be no longer the medicine we propose to administer. A similar instance of unscientific prescription, arising from a want of chemical knowledge, occurs in a formula attributed to Mr Coleman, and published in the fifth edition of the *Pharmacopœia Chirurgica*, p. 58. under the title of *Collyrium hydrargyri muriati cum calce*. It is composed of a scruple of *muriate of mercury* dissolved in an English pint of boiling distilled water, with the addition of two drams of *quicklime*, and after the whole is completely mixed, we are directed to filter the clear liquor through paper. The author of this Pharmacopœia seems aware that "the different elective attractions operating in the mixture of the lime with the solution of muriate of mercury, are such as produce

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produce a new chemical arrangement, in which the activity of the ingredients is mutually diminished. The fact is, that the large quantity of lime here directed will completely decompose the muriate of mercury, so that the clear liquor will contain nothing but uncombined *lime*, and *muriate of lime*. Hence the *muriate of mercury* is an unnecessary ingredient, and if the medicine be efficacious as a collyrium, it would be better to form it at once by the addition of a small quantity of *muriate of lime* to *lime-water*.

32 Dover's powder.

A physician who is familiar with the principles of chemistry will not direct a chemical medicine to be prepared of more ingredients, or in a more operose manner, than is requisite to produce the desired effect. When Dr Dover first gave to the public the composition of his *sudorific powder*, he ordered it to be prepared in the following manner. Four ounces of *nitre*, and the same quantity of *vitriolated tartar (sulphate of potash)*, are to be thrown into a red-hot crucible, and kept stirring till the deflagration ceases. To the mixture, while hot, is to be added an ounce of sliced *opium*. The whole is then to be reduced to powder and well mixed with an ounce of powdered *ipecacuanha*, and the same quantity of powdered *liquorice root*. It is well known to the chemists of the present day, that *nitrate of potash*, when thrown on an ignited combustible body, deflagrates, and is decomposed; but that it does so when thrown into an ignited crucible, with an incombustible body, such as the *sulphate of potash*, we can scarcely conceive. If it does, the effect must be, that the *nitric acid* is carried off, and there remains the *potash*, which is an unnecessary ingredient in the composition. Again, the only use of heating the salt, would be to dry the *opium* and thus render it more easily pulverised; but as dried opium is always kept in the shops, and by means of *sulphate of potash*, is very easily reduced to powder, that part of the operation is superfluous. Accordingly, a powder equally efficacious, and much less operose, is prepared by rubbing together *sulphate of potash*, *opium*, and *ipecacuanha*, forming the present *pulvis ipecacuanhæ et opii*, Ed. or *pulvis ipecacuanhæ compositus*, Lond.

33 Burnt sponge.

From the same want of chemical knowledge, some medicines have been extolled as efficacious remedies, from not knowing their real nature. Thus burnt sponge has long been celebrated for the cure of scrofula. We do not altogether deny its efficacy in this complaint; but as burnt sponge is composed almost entirely of charcoal, with the addition of a little carbonate of soda, a powder composed of these ingredients must be equally efficacious.

34 Errors in respect to consistence.

Under this head we may notice an error which is frequently made by prescribers who have not been accustomed to see and prepare the remedies which they prescribe. We have often seen a mass for pills ordered to be prepared of such ingredients as are naturally too hard to form into pills, as for instance, extract of cinchona, and extract of liquorice, and yet there has been directed a quantity of liquorice powder, to form the mass of a proper consistence. Sometimes again, the matters directed are already too soft, or become too soft by mixture, as when aloes and extract of gentian are directed to be beaten together with a proper quantity of syrup, to form a mass for pills. See the *Edin. Phar.* edit. 1783.

35 Water.

We shall conclude this part of our subject with remarking, that it is of consequence in a chemical point of view, to prescribe as the constituent of a liquid medicine, such water as will not decompose any of the other ingredients. It is common to order the water by the name of *aqua pura*, or *aqua fontana*. Now, if this water be hard, i. e. impregnated with *sulphate of lime*, &c. it will decompose many of the secondary salts, and thus diminish their efficacy. *Acetate of lead*, for instance, is always decomposed by hard water, and a turbid liquor is thus formed, which by standing deposits a sediment. It would therefore be better in all cases to prescribe distilled water, or where this is not likely to be found, as in small country towns, soft water.

III. We have thus considered at some length the previous knowledge required by a practitioner before he can pretend to prescribe for his patient in a scientific manner. We shall now endeavour to apply the observations that have been made, and from the application deduce some general rules for extemporaneous prescription. 36

37 Practical hints.

When a practitioner is called to a patient, he will first examine into the symptoms and causes of the malady under which the patient labours, and attend to the age, sex, and peculiar habit of the patient. He will then consider whether or not a cure is probable, or whether it may be in his power only to relieve the distressing symptoms. If a cure appears to be practicable, he will proceed to form his indications, and in conformity with these he will prescribe the remedies that seem best adapted to the case. It is this method of procedure that distinguishes the scientific practitioner from the ignorant empiric. The latter, from a superficial view of the most obvious symptoms, hastily determines the nature of the complaint, which he probably contrives shall be some one of which he has witnessed many cases, or for the cure of which he is in possession of some favourite remedy. Having resolved what the disease shall be, he has nothing to do but apply his remedy, and this he does without considering whether existing circumstances may not render the administration of it improper.

To return from this digression, we shall endeavour to give an example as simple as will answer our purpose, to illustrate the above method of procedure. We shall suppose that a practitioner is sent for to a middle-aged man, in moderate circumstances, who has been for some days labouring under a tertian intermittent fever, with which he had never before been affected, but had commonly been strong and healthy. The practitioner sees nothing in the circumstances of the case which can lead to an unfavourable prognosis, and he therefore has little hesitation in pronouncing, that the fever will probably soon be removed. Considering the indications usually laid down in practical writers on intermittents, he proceeds to prescribe the remedies which appear best suited to the case in point. Thus the indications given by Dr Cullen are,

1. In the time of intermission to prevent the recurrence of paroxysms.

2. In the time of paroxysms to conduct these so as to obtain a final solution of the disease.

3. To take off certain circumstances which might prevent the fulfilling of the two first indications *.

In considering the first indication, the practitioner reflects on the effect of the usual exciting cause of an intermittent,

* Cullen's *First Lines*, § 228.

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termittent, *marsh miasmata*, which he sees to be a debilitated state of the system. This he learns is to be removed by tonics; and of those the bark of the *cinchona officinalis* is justly celebrated in the cure of intermittents. This then he would immediately prescribe; but that experience has shewn it to be better to begin the administration of this medicine as soon as possible after a *paroxysm*. We shall suppose, however, that the last paroxysm took place the day before he saw the patient, and consequently may be expected to return the next day. He finds also that the patient is costive, a circumstance which must be removed according to the third indication. Now, attending to the second indication, he knows that this is generally best fulfilled by the exhibition of an emetic at the commencement of the cold fit, and of an opiate at the commencement of the hot fit; but the costiveness of the patient contraindicating the use of opium, he must endeavour to find for it a substitute which has not a tendency to excite or increase constipation. He will perhaps prescribe as follows:

38 Example of prescription.

℞. Vini ipecacuanhæ, unc. 1.
—— Tartritis antimonii (*Edin.*) unc. $\frac{1}{2}$. M. fiat haustus.

Signetur. *The emetic to be taken just as the next cold fit is coming on.*

℞. Pulveris Rhei Palmati, gr. 25.
Submuriatis Hydrargyri, gr. 3.
Succi Spissati Hyoscyami, gr. 4.
Syrupi q. s. Fiat bolus.

Signetur. *To be taken just as the next hot fit is coming on.*

℞. Pulveris Cinchonæ officinalis, scr. 2.
—— Croti Elutheriæ, gr. 10. M. f. pulvis.

Signetur. *One to be taken in a little wine and water as soon as the hot fit is gone off, and repeated every two hours till the expected return of the next cold fit.*

The analysis of this prescription will afford us some useful practical observations.

39 Arrangement of formulæ.

1. It will be observed that the *formulæ are arranged in the order in which the medicines are to be exhibited*, a circumstance to which it is always proper to attend, when the prescription is to contain more than one formula or circumstance to be directed by the practitioner. Thus when any thing is required immediately, as *bleeding*, the *application of leeches*, or of a blister, this should form the first clause in the prescription, in the following manner.

Mittatur sanguis è brachio STATIM *ad unc.* 12.; or,

Applicentur quamprimum temporibus hirudines sex; or,

Applicetur statim emplastrum vesicatorium capite raso.

40 Arrangement of ingredients.

2. *The ingredients directed in each formula should be arranged in the order in which they are to be mixed by the compounder.* This may be thought a matter of slight importance, but it is more deserving of notice than is generally supposed. For the most part, indeed, in whatever order the practitioner may arrange the ingredients in his formula, a skilful apothecary will combine them in that order which experience has shewn him to be the most convenient; but it is surely much neater that the order of preparation should be preserved in the prescription, this being considered as the guide by which the compounder is to direct his operations. Suppose we were to prescribe a medicine containing *castor oil*, *distilled water*, *mucilage of gum arabic*, *syrup of rhubarb*, and *tincture of senna*. In the preparation of this medicine the apothecary will first rub together the *oil* and *mucilage*; he will then add the *syrup*, and perhaps the *tincture*, and lastly the *water*. In this order then it would be best to express the formula. See Kirby's *Tables*, *formula* 54. In this manner the neatness of the medicine is insured, and the preparation of it rendered more easy and expeditious. It is very usual for prescribers to begin with the article that is to be most abundant in the medicine, as the water, and so gradually descend to that of least quantity; and particular care is generally taken to place in succession those ingredients that are employed in equal quantities, with the sign ($\bar{a}\bar{a}$ *singulorum*, of each) after the last. This seems rather a puerile method, and is commonly inconsistent with the practice of composition.

There are other reasons for arranging the ingredients in the order of composition. In some cases a very volatile substance forms a part of the medicine, as æther, or ammonia; and it is proper that this should be the last ingredient in the composition of the medicine, that as little as possible of it may be dissipated. It is proper, therefore, that it should stand last in the formula (see Kirby's Tables, formulæ 126, 129, and 130.). There is a formula given in the Pharmacopœia Chirurgica for an embrocation, to be composed of 2 drams of *tincture of camphor* (*camphorated spirit*), 1 dr. *water of acetated litharge* (*Goulard's extract*) and a pound of *distilled water*. We are told that the mixture of these ingredients is to take place in the order in which they are set down, otherwise the camphor will be separated *.

We have already mentioned (N° 3) the names of the several parts of which a compound medicine may be formed, as the *basis*, the *adjuvant*, the *corrector*, and *constituent*; and have explained the reasons for the addition of the three latter. There are some rules respecting these, which it will be proper to consider in this place.

41 Rules for the basis;

3. *The basis should always be single, unless some manifest advantage is expected to arise from the employment of two or more remedies of the same kind.* The reason of this rule is sufficiently obvious, as the effect of a single remedy is much more easily determined and proportioned than that of two or more employed together. The advantages of simplicity in prescription will be considered presently.

4. *If more than one basis be employed, they should be of the same nature, or such as produce the same effects.* This needs no illustration.

42 for the adjuvant;

5. With respect to the *adjuvant*, we shall remark only that one use generally assigned to it, viz. that of facilitating the solution of the basis in the stomach, appears equivocal. It is not uncommon to order resinous drugs to be made up into pills with *soap*, which is considered by many as acting in the way of promoting solution. Soap is often a good constituent, but we do not think it can produce the effect above alluded to.

43 for the corrector.

6. The use of the *corrector* requires a little more discussion. One of the first intentions of the corrector is to diminish the too violent action of the principal remedy, or to prevent its exerting an action in an improper part of the body. Thus, *mucilage* may be added to *colocynth*,

* Pharm. Chirurg. 5th edit. p. 159.

colocynth, (*bitter apple*), or given after it, to blunt or lessen the acrimony which this substance is commonly found to possess. So again, *mercury* is often combined with *opium*, when it is required to introduce a considerable quantity of the former into the system, or to speak more properly, to acquire the full benefit of its accumulated stimulus. This can scarcely be effected, if it be allowed to run off by the bowels. *Camphor* is often given after the application of a blister, to obviate the strangury which frequently attends the external application of *cantharides*. In some cases the *cinchona bark* produces sickness or purging, and here the addition of a few drops of *tincture of opium* to each dose is proper.

7. Another use of the corrector is to obviate or disguise the unpleasant taste or odour of the principal remedy. Thus, the emetic in our prescription is ordered to be prepared of the *wine* of ipecacuanha instead of the *powder*, as the wine that forms the solvent of that remedy disguises its unpleasant taste. The articles usually employed as correctors of flavour, are *syrups* and *tinctures* of various kinds, *essential aromatic oils*, &c. and the use of these has been often much abused. The addition of a large quantity of sugar, in some cases, especially in *dyspepsia* or indigestion, seldom fails of increasing the symptoms of the disease, as in a debilitated state of the stomach it quickly passes into a state of fermentation, and produces flatulence, pain, and *anorexia* or loss of appetite, the very symptoms which we are to remove. It is a common practice to add syrup to several of the neutral salts, as *sulphate of soda*, *sulphate of iron*, &c. with a view to improve their flavour; but we apprehend that whoever has tasted the nauseous mixture will scarcely agree with the prescriber that he has gained his point.

44 Abuse of tinctures.

8. The abuse of *alcohol* in the form of tinctures has been sometimes carried to a great, and, we think, a culpable excess. This has arisen sometimes from the desire of the patient to have his medicines made strong and good, and not unfrequently, perhaps, from mercenary views in the practitioner, to induce the patient to swallow a greater quantity of medicine, because it is rendered agreeable to his palate. We have no doubt that many well-meaning practitioners order a considerable dose of tincture from a mistaken complaisance to their patients, without apprehending any ill consequences from it; but in fact, the intemperate use of these tinctures is injurious to the stomach, and has, we believe, not unfrequently drawn some of the most sober persons into a habit of dram-drinking. The propensity to the use of cordials, which is now become so prevalent, has probably arisen from this source. The quantity of alcohol ordered by some prescribers is truly astonishing. A book lately came into our hands, which is called a *translation of elegant medical prescriptions for various disorders by the late Dr Hugh Smith*. For the accuracy of the translation we cannot vouch, not having seen the original; but if it be accurate, the *spirituous cinnamon water* (*spirit of cinnamon*), seems to have been a very favourite article in Dr Smith's catalogue of medicines, as it is no unusual thing to see an ounce, or 1½ ounce of it ordered in a single draught, or four ounces in an eight-ounce mixture. Did not this occur so frequently in the prescriptions of Dr Smith, we should suppose it to be some blunder of the translator or transcriber, in mistaking the character denoting dram for the symbolical character signifying ounce.

9. A third use of the corrector is to render the medicine more agreeable to the stomach. Thus, *sulphate of soda* is to many persons very nauseous, and is not unfrequently rejected by vomiting; but the addition of a small quantity of *lemon juice*, or of *supertartrate of potash*, is found to correct this unpleasant quality. The bark of *cinchona* does not agree with some stomachs, without the addition of an aromatic; the *cascarilla* ordered in the above powders, affords a useful addition, with the view of rendering it more agreeable to the stomach. 45

The unpleasant odour of a medicine is more difficult to correct than its flavour. In internal medicines this is usually best effected by regulating the form in which they are exhibited; as, in prescribing the sulphurate of potash, it is better to order it in the form of a powder to be sweetened with sugar, to be swallowed dry (see Kirby's Tables, formula 68), than by way of draught or mixture. The odour of external medicines is best corrected by the essential oils and perfumes. Thus, in using *sulphur* for cutaneous diseases, it is usual to add a quantity of *essence of bergamot* or *oil of lavender*, which, though they do not entirely destroy the odour of the sulphur, have a considerable effect in disguising it. 46

10. In ordering a corrector, the practitioner should be aware that it is not the quantity of the basis, but its quality that he is to correct. If a dose of *digitalis* or of *squill* makes the patient sick, we should not think of giving *opium* or effervescing draughts to prevent this effect, but we should lessen the quantity of the medicine at its next exhibition. We have been rather minute on the subject of the corrector, as we conceive that much will depend on the adroit management of this part of a formula, in showing the neatness and address of the prescriber. By a proper use of correctors he can often regulate the action of a medicine, and considerably relieve the feelings of his patient. 47 Quantity of a remedy to be regulated.

11. The *constituent* employed in a formula will of course vary with the form of the medicine. In the more solid compositions, as boluses, pills, and electuaries, it is generally syrup, conserve, confection or extract. In liquid medicines, it is either simple water, or some watery liquid, as *decoctions*, *infusions*, or *water distilled* from some aromatic plant. It is proper to remark, that the prescriber should consider whether a constituent ordered as such, be necessary, for it often happens, that the extracts or pilular masses kept in the shops, are already of a proper consistence for making into pills. It is obvious that the constituent, if it be not simple water, should have similar qualities with the other parts of the medicine, unless when it contains in it the corrector. 48 Remarks on the constituent.

12. In the prescription which we have given as an example, the names of the articles are written at length. We do not, however, approve of this being generally done in practice. To an apothecary's apprentice it can answer no other end than to exercise his latinity, and display the erudition of the prescriber. In fact, it may even tend to mislead him; for as the names of the articles kept in his master's shop, are always painted on the labels, or drawers, in an abbreviated form, the words at full length are not better understood by the compounder, 49 Names of ingredients need not be written at length.

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compounder, and indeed they are often more intelligible in the concise form in which he is accustomed to see them. Add to this, that the writing of the words at full length may occasionally betray the practitioner into an unguarded mistake, which may call in question his grammatical accuracy. In Fox's *Formulæ Selectæ*, *calomelas* perpetually occurs as the genitive instead of *calomelanos;* and in a work on midwifery, published by Dr Pugh of Chelmsford, grammatical errors both in the names and in the directions are to be detected *passim*. The only advantage that writing at length seems to possess, is that it teaches a beginner to read a prescription, which by the way is often at first no easy matter. But practice soon renders this familiar.

50 Symbolical characters to be avoided.

13. The quantities of the ingredients in the above prescription are not expressed in the usual symbols, but we have employed the contracted forms of the words *uncia* and *drachma*, and the common Arabian figures, as recommended in the preface to Dr Kirby's Tables. The directions also are written in English. The reasons assigned in the work above referred to, are as follow. "The characters ʒ and ℥ are so similar, that they may easily be written for each other, and that they have sometimes been so written cannot be denied. The consequence is obvious; a stroke of the pen too much may kill the patient, and a stroke too little may produce a medicine of little or no efficacy. Strange! that physicians should have been so misled by an affectation of mystery or concealment, (for to what else can be attributed the use of these hieroglyphics)? as to place the safety of their patients at the mercy of a *lapsus pennæ! Unc.* and *dr.* can never be written for each other, and we see no good reason why these abbreviations should not be employed for *uncia* and *drachma*, as well as *gr.* and *gtt.* for *granum* and *gutta*. Dr Spens, in his elegant edition of the *Pharmacopœia Nosocomii Edinburgensis*, has employed these contracted words, but has retained the Roman numerals.

"The use of the Arabian figures appears calculated to insure both perspicuity and dispatch. They are more easily written, occupy less room in a prescription, and (by their familiarity) remove all possibility of mistake.

"As to the directions, they should always be written in the vernacular language. In a prescription, perspicuity is always our first object; it is not here that we are called upon to display our learning and classical elegance; and whoever considers that these are properties not always to be met with in the shop of an apothecary or a druggist, will readily wave them, in order to insure the perfect understanding of his prescriptions. It does not indeed require any great knowledge of Latin to translate the directions which usually occur in prescriptions; but as there are cases in which a long and rather complex direction is employed, we should leave nothing to the contingency of the learning or ignorance of the compounder, but by writing the directions ourselves in the received language of the country, put it out of his power to injure our reputation, or endanger the safety of the patient."

51 Rules for the doses of medicines.

The doses of medicines must, in a great measure, be determined by experience; but after having thus ascertained the medium dose proper for an adult under ordinary circumstances, and of an ordinary constitution, there are certain general considerations, according to which we may proportion the doses of the same substance to various constitutions and ages. In regulating the doses of medicine, we are to attend chiefly to the following considerations.

a. The circumstances of the disease and the vital powers of the patient.

b. The powers, mode of exhibition, and particular intention of the medicine employed.

c. The age, sex, constitution, and habits of the patient.

52 Doses regulated by the disease.

14. *The circumstances of the disease to be attended to are its nature, seat, period, and degree of violence.* There are several diseases that require Herculean remedies, and these in very large doses. It is well known that maniacs require much greater doses to produce the same effect than most other patients. If we are to administer an emetic to a person in this situation, it would be of no use to prescribe 2 or 3 grains of *tartrate of antimony and potash*, or a scruple of *ipecacuanha*, the usual doses in ordinary cases. Less than 6 grs. of the former will scarcely excite vomiting, and it is sometimes necessary to order 10 or 15 grs. If we wish to procure sleep to these wretched beings, a few grains of opium are a trifle. Dr Darwin mentions two cases of insanity, in one of which 2 scruples of solid opium were administered, and four hours after, a third scruple; while in the other, a furious maniac was rendered calm and rational in the space of a few hours by a dose of 400 drops of tincture of opium.

Again, the more violent the disease, the larger doses are generally required for its removal; but, on the other hand, the later the period or stages of several diseases, as fever, consumption, and similar affections attended with great debility, the less is the quantity required to produce the same effect; or rather the less able will the patient be to bear the usual doses. When the vital powers are much diminished, a large dose may be attended with very serious consequences. Thus, in cases of suspended animation by drowning, where the vital energy is nearly exhausted, if, when the powers of life are just returning, we were to oblige the patient to swallow a quantity of brandy, or even a glass of pure wine, we should probably smother the glimmering spark. Again, in cases of torpor from cold, if we expose the frozen limb to a sudden considerable heat, a gangrene ensues; whereas, had we in the former case given a little wine and water, and in the latter applied a moderate gradually increasing warmth, attended with gentle friction, we should probably have restored the patient, and preserved the limb.

53 By the nature and intention of the medicines.

15. *The powers, form, and intention of the medicine must be considered.* The more active remedies must be administered with greater caution than such as are of inferior efficacy. Thus, if we are to exhibit the *corrosive muriate of mercury*, the *oxide of arsenic*, the *nitrate of silver*, or other powerful and dangerous remedies, we must begin with a quantity rather below than above the medium dose, and gradually increase it according to the effect produced. On the other hand, however, we must not descend to doses that are trifling and inert. It is as ridiculous to prescribe a *scruple* of *cinchona* twice or thrice a day, to restore vigour to a debilitated system, as it would be improper to order *half an ounce* of *rhubarb* for an ordinary cathartic. A prudent practitioner will avoid both extremes of timidity and rashness, and will

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will neither risk the safety of his patient by an excessive dose, nor give him lingering suspense and pain, for want of the due application of the proper remedies.

Much will depend on the form in which the medicine is to be exhibited. Thus, if we are to employ externally, or by way of blister, such medicines as are usually given by the mouth, it is necessary to order them in much larger quantity. The usual dose of tincture of opium is 25 or 30 drops; but if this is to be applied by friction, from 2 drams to half an ounce will sometimes be required for one application; and in a glyster it is usual to prescribe a dram or two. The tincture of cantharides, whether given internally, or applied by friction to the surface, is a powerful remedy; but in the former case, 20 or 30 drops are sufficient, while in the latter a dram or two is usually employed. Similar remarks might be made with respect to the use of mercury, and many other remedies.

The intention with which the medicine is administered must also be taken into consideration, as there are many substances that produce different effects, according to the quantity employed. Thus, *tartrate of antimony and potash* may be given as an *emetic*, a *diaphoretic*, an *expectorant*, or a *cathartic*, according to the magnitude or repetition of the dose. Two or three grains given at once, or a grain every 15 minutes, usually excite vomiting; but from $\frac{1}{8}$ gr. to 1 gr. given every 5 or 6 hours, generally keeps up a constant nausea without vomiting, and thus, by sympathy, the medicine acts as a diaphoretic or antispasmodic. The medicine given in the dose of a third of a grain twice or thrice a-day is a good expectorant; and in the dose of $\frac{1}{4}$ gr. every two or three hours, usually operates by the bowels. It is well known that the effect of opium varies considerably, according to the dose and the interval at which it is administered. If we wish to promote sleep, or relieve pain, we give what is called a full dose, that is, a grain or two. It thus acts as a narcotic, and an antispasmodic or a diaphoretic. Given in small repeated doses, it acts as a general stimulus, promotes absorption, and answers the purposes of diuretic and an astringent. Ten or twelve grs. of aloes exhibited at once, are cathartic; but one or two grs. given twice or thrice a day gently stimulates the rectum and neighbouring parts, and acts in particular cases as an emmenagogue.

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We need scarcely remark, that when two or more articles of a similar nature are prescribed in the same formula, the dose of each must be proportionally lessened.

54 Age, &c. of the patient.

16. *We must regulate our doses according to the age, sex, constitution, and habits of the patient.*

It is evident that various ages must require various proportions; but experience shews that the required doses are not directly proportional to the ages, as might *à priori* be expected, and as the mathematical physicians in the beginning of the 18th century believed (B). Experience has enabled us to construct a table, in which may be shewn the doses proportioned to various ages, adjusted from a certain medium dose for an adult: such a table is the following.

55 Table.

Age.		Proportional dose 1.	Absolute dose, dr. 1.
Weeks,	7	$\frac{1}{15}$	grs. 4
Months,	7	$\frac{1}{12}$	grs. 5
	14	$\frac{1}{8}$	grs. 10
	28	$\frac{1}{5}$	grs. 12
Years,	$3\frac{1}{2}$	$\frac{1}{4}$	grs. 15
	5	$\frac{1}{3}$	scr. 1
	7	$\frac{1}{2}$	dr. $\frac{1}{2}$
	14	$\frac{2}{3}$	scr. 2
	21	1	dr. 1
	63	$\frac{11}{12}$	gr. 55
	77	$\frac{5}{6}$	gr. 50
	100	$\frac{4}{6}$	scr. 2

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(B) At the time when Newton had by his discoveries rendered the study of mathematics as fashionable as it is useful, medicine partook of the general bias, and several physicians of ingenuity and erudition attempted to reduce its theory and practice under the dominion of their favourite science. Among these Dr Strother read and published a course of lectures on the rationale of medicines, which he entitles *Prelectiones Physico-mathicæ et Medico-practicæ*. In his 21st lecture he treats of the doses of medicine, and after discussing in a very philosophical manner the general mode of regulating these according to the size and shape of the particles of medicines, and their momentum as determined by their celerity multiplied by their quantity of matter, he proceeds to point out how we are to proportion the doses to various ages. He has the following question: *If a person of 30 years of age takes 60 grains of any medicine, how much must a child of 5 years of age take?* This question he of course resolves by the rule of proportion in the following manner.

$$30 : 5 :: 60 : \left(\frac{300}{30} = \right) 10$$

In order to render this generally applicable to every case, he calls in the aid of algebra, and substituting symbols for the above numbers we have

r = the greater age given
a = the less age given
t = the dose given
e = the dose required.

Then $r : a :: t : \left(\frac{at}{r} = \right) e$.

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56 Explanation.

The above table may serve as a general guide to the young practitioner. The second column shows the aliquot parts of the medium dose for an adult, that are adapted to different ages from seven weeks to 100 years, supposing this medium dose to be 1; and the third column gives the absolute quantities in grains, &c. taking the medium dose at 1 dr. This table, however, will by no means apply in all cases. Thus, the dose of opium adjusted from this table, for a child of five years old, is $\frac{1}{3}$ gr. and that of submuriate of mercury or calomel, 1 gr.; but in cases of *phrenitis hydrocephalica* (water in the head), we may administer half a grain of the former, and three or four of the latter. Females in general require less doses than males; and persons of a robust and vigorous constitution, such as country labourers, the more active mechanics, servants, and those of the melancholic and phlegmatic temperaments, will, all other things being equal, require larger doses than persons of an opposite description.

57 Climate.

The climate also seems to have some influence in this respect. In America and the West Indies we are informed that much larger doses of submuriate of mercury are given than are usually prescribed in Britain. In cases where we would give three or four grains, they would order 10 or 15. We are told, too, that in some parts of India, in order to excite vomiting in a native, it is sometimes necessary to give 20 scruples of ipecacuanha. The Germans, and especially, according to Gaubius, the inhabitants of Saxony and Westphalia, require much larger doses than the inhabitants of any other country in Europe.

58 Idiosyncracy.

Peculiarities of constitution, commonly called *idiosyncrasies*, require attention on the part of the prescriber. It is therefore proper to inquire whether any circumstance of this kind occurs in any individual, especially when called for the first time.

The habits of the patient must also be regarded, as in general medicines lose some of their effect by being often repeated, and therefore require to have their dose increased. Thus, persons who are accustomed to the use of opium, will derive no benefit from the ordinary doses of that medicine, but when labouring under a complaint that requires the exhibition of opium, they must take a quantity somewhat larger than that to which they are habituated. It is well known what quantities of opium are consumed by some of the eastern nations; and the writer of this article has seen a travelling gypsy who never went to rest without taking more than half a dram of solid opium (c).

59 Perspicuity, a principal consideration.

17. Perspicuity is essentially necessary in writing a prescription, and every thing which can in any degree diminish it ought to be carefully avoided. Many of the observations already made have been directed to this point; and we have yet one or two remarks to complete this part of our subject. A prescriber should be very careful not to introduce into his prescription articles which are obsolete, or which are no longer contained in our pharmacopœias, unless he is certain that the apothecary who is to prepare the medicine keeps such articles beside him; and even then, as it is most likely that they have been long prepared, and have lost much of their efficacy, he cannot depend on their answering the end he proposes. Thus, few would now think of prescribing the *confectio paulina*, the *theriaca Andromachi*, or the *aqua alexiteria simplex*, or many other compounds, which have given place to more simple and convenient forms. 60

Obsolete or uncommon medicines to be ordered with caution.

18. The same cautions will apply, though perhaps with some limitations, to those medicines which are rarely met with, or have been newly introduced into our Pharmacopœias. Before we venture to prescribe an article of this description, we should ascertain whether or not it is to be procured in or near the place where the patient resides, or, where possible, we should give timely notice to the apothecary to provide himself with some of it. Many unpleasant circumstances may arise from not attending to this caution, especially where the patient is apprised that he is about to take a new remedy which has been found very beneficial in cases similar to his own. For instance, the *Rus Toxicodendron* has lately been much extolled in the cure of palsy. Suppose a physician in a provincial town, at a great distance from the capital, were to prescribe this medicine. The apothecary has none of it, nay, perhaps, has never heard of the medicine, and it must be procured from the capital. This occasions a delay for several days, and in the mean time the paralytic person is impatient to try the effect of the new remedy, and probably refuses to take any other. When the medicine arrives, the

(c) Before dismissing the subject of the *Doses* of Medicine, we must notice an improvement lately proposed, and which appears likely to be adopted by the London College in the intended new edition of their *Pharmacopœia*, we mean that of abolishing the usual method of measuring small doses or quantities of liquids by drops. There can be no doubt that in many cases this method of *dropping* liquids is liable to great uncertainty; the size of the drops, and of course the quantity of liquid which they contain, varying greatly according to the nature of the liquid, the size and form of the neck of the phial from which they are let fall, and even the state of the atmosphere. The dram, by measure, of *distilled water*, will afford only 60 drops from an ordinary two ounce phial with a neck of the usual diameter; whereas the same bulk of *proof spirit* may be divided into 120 drops, and some tinctures will afford many more. Considering this uncertainty, it is proposed to abolish the very name of drops (*gutt.*) in prescriptions, and to employ the small graduated measures of Lane, in which the dram is divided into 60 equal parts, which may be called *grains*. Thus, instead of ordering *gutt.* 30 of *tinct. opii*, we shall order *gr.* 15. (*fifteen grains*) or $\frac{1}{4}$ of a dram, allowing for the difference between *water* and *spirit*. This will certainly be an improvement where moderate doses are to be prescribed, but when the dose does not exceed two or three drops, as in some of the *essential oils*, *arseniate of potash*, &c. so much would be lost in the measure that the dose would be rendered very uncertain.

On the whole, we would recommend that in all cases the medicine shall be so diluted that the dose shall not be less than *half a dram*, and spoons might be made for family use that should contain that quantity, as an ordinary tea-spoon now contains a dram.

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the patient has perhaps, as not unfrequently happens, lost his enthusiasm, and begins to take it with reluctance or disgust, feelings which not a little influence the success of a remedy, and thus disappoint the hopes both of the patient and physician.

Under this head of *avoiding uncommon medicines*, it may be proper to remark, that though a physician in this empire is allowed to prescribe articles from any of the national dispensatories, he should in general confine himself to that which is most used in the part of the empire where he resides, and if he mentions an article from either of the others, he should subjoin to the name of that article the initials *Ph. Ed. Ph. Lond.* or *Ph. Dub.* to prevent mistakes, thus,

R. Tincturæ Scillæ (*Ph. Lond.*) dr. 2.
R. Tincturæ Angusturæ (*Ph. Dub.*) unc. 1.
R. Solutionis muriatis Calcis (*Ph. Ed.*) dr. 1.

61 Compounds, not officinal, to be specifically described.

19. With the same view of ensuring perspicuity, we should never prescribe a compound medicine which is not officinal, merely by its usual title, without specifying the component parts, or at least the proportions of these. Thus, if we propose to order an *infusion of quassia*, or a *decoction of oak bark*, it would not be sufficient to write in the formula *infusi quassiæ*, or *decocti quercus*, but it would be proper either to prescribe the mode of preparing them at length, thus,

R. Rasuræ ligni quassiæ excelsæ, dr. 1.
Aquæ distillatæ ferventis, ℔j
Infunde per horam, et cola; or,
R. Quercus contusi, unc. 1.
Aquæ distillatæ ℔ij.
Coque ad dimidium, et cola;

And then to prescribe the proper quantity, as,

R. Infusi hujuce, unc. 7, &c. or,
R. Decocti supra præscripti, unc. 8, &c.

Or, it would at least be proper to mention within a parenthesis, the proportions to be employed in the composition, in the following manner:

R. Infusi quassiæ excelsæ (cum dr. 1. ad aquæ ℔j. &c.); or,
R. Decocti quercus (cum corticis uncia 1 ad aquæ ℔j.) &c.

Again, it would be absurd in private practice to prescribe the *citrate of potash* or of *ammonia* by the names of *mistura salina*, or *julepum neutrale;* but it would be necessary to introduce into the formula the proper quantities of lemon juice and of carbonate of potash, or carbonate of ammonia, to prepare these secondary salts. See Kirby's Tables, *formula* 13.

62 Simplicity to be studied.

20. *That we may the better avoid mistakes in composition, it is advisable to study simplicity as much as possible:* the physician is considered as the assistant of nature, and ought to follow her example in producing effects by the most simple means. Nothing looks so unscientific as a crowded formula; it bears the marks of empiricism in its very face, and always reminds us of those monuments of pharmaceutical folly, the theriaca and the mithridate to be hereafter noticed. It seems as if the prescriber said to himself, "I will put plenty of ingredients into this medicine, and the deuce is in it if some of them do'nt answer." There are many favourite recipes of old practitioners handed down from father to son, or from master to apprentice, which seem to owe their celebrity chiefly to the multitude of their ingredients. The Lisbon diet drinks have long been famous in the cure of diseases of the skin. The following is one of these, as taken from the Pharmacopœia Chirurgica.

63 Errors in point of simplicity.

R. Decoctum Lusitanicum, No. 2.
Sarsaparillæ concisæ,
Ligni santali rubri,
Ligni santali citrini, *sing.* unc. iss.;
Radicis glycyrrhizæ,
Radicis mezerei, *sing.* drach. ij.
Ligni rhodii,
Ligni guaiaci officinalis,
Ligni sassafras, *sing.* unc. ss.;
Antimonii unc. j.
Aquæ distillatæ ℔ v.

These ingredients are to be macerated for 24 hours, and afterwards boiled till the fluid is reduced to half its original quantity. From one to two pints are given daily *.

Some practitioners adhere to this form; but others, less bigotted to old customs, have recourse to a contracted form of it, retaining only the guaiacum, sassafras, and liquorice, and adding raisins, similar to the decoctum guaiaci compositum of the Pharmacopœias.

* Pharm. Chirurg. p. 66.

The following is given in Fox's Formulæ as a remedy for dropsy.

R. Succ. limon. rec. unciam,
Sal absynth. scrupulos duos,
—— corn. cerv. scrupulum,
Tinct. cinnam. et
Aceti scillit. *sing.* drachmas duas,
Tinct. cort. Peruv. semunciam,
Aq. menth. vulg. simp. et
—— puræ *sing.* unciam,
Vini antim. Huxhami guttas quadraginta,
Tinct. Theb. guttas viginti.
Fiat mistura, pro dosibus duabus.

On examining this prescription, we shall find the resulting medicine to be composed of *citrate of potash*, *acetate of ammonia*, a solution of *tartrate of antimony and potash*, and *tincture of opium*, all which are *diaphoretics;* of *squill*, which is *diuretic;* and of *cinnamon*, *Peruvian bark*, *alcohol*, and *mint water*, which are *tonic* and *stimulant*. Now, a diaphoretic, a diuretic, and a stimulant, may not form a bad compound in dropsy, but as they may be given in a much more simple form, the present medicine is absurdly complex and unscientific. It might be reduced as follows:

R. Aquæ acetitis ammoniæ, unc. 1.
Tincturæ scillæ, dr. 1.
——— lauri cinnamomi, unc. ½.
Vini tartritis antimonii, dr. 1.
Tincturæ opii, gt. 40.
Aquæ distillatæ, unc. vi. M.

We shall quote one other example of a medical farrago, taken from De Gorter's Formulæ. It is for a powder formed of vegetables; and we may remark it is in the vegetable kingdom that prescribers have most exuberantly displayed their talent at composition.

R. Rad.

℞. Rad. Imperator
Aristolochii utriusque
——— zeodar.
Siler. montan. āā dr. 1.
Zinzib. scr. 2.
Flor. Centaur. min. dr. 1.
——— Rorismar. scr. 1.
——— Gratiol. German. dr. ½.
Bacca Lauri
——— junip. āā dr. 1ss.
Thymi,
Serpylli,
Absinthiæ,
Tanaceti,
Summitat. Santon. āā. dr. 1. M. f. pulv.

Such a powder as this may vie in composition with the theriaca and mithridate of redoubted fame. As this medicine is composed of so many ingredients, possessed of various powers, it must of course be endowed with many virtues, or must be a *pulvis polychrestus*. Accordingly, its author acquaints us, in the margin, that it is resolvent, sudorific, stimulant, roborant, calefacient, aromatic, stomachic, discutient, diaphoretic, diuretic, and aperient; that it is of service in dropsy, *chlorosis*, *paralysis*, apoplexy, fever, delirium, and fifty other diseases and morbid affections, for a full detail of which we must refer our readers to the work itself.

One would think that the absurdity of these complex formulæ would be abundantly evident to every man of common sense; but the empirical prescriber will probably say, such is the medicine which I have frequently seen given with success, and how am I sure that, by omitting one of the materials, I may not destroy the efficacy of the medicine!

64
Disadvantages of complex formulæ.

The more compounded a medicine is, the more difficult it will be to ascertain and proportion the effects produced by its several parts on the human system. When several articles are employed at the same time, we cannot be certain to which of them we are to attribute the benefit which appears to result, or the noxious qualities which the compound may possess. This rage for composition has been one great obstacle to the improvement of medicine. The effects of various substances on the body have been but little attended to; and indeed the investigation is difficult, and requires a long series of careful and nice experiments, and these made, not on the inferior animals, but on man himself. The administration of medicines to the lower classes of animals, can throw but little light on their action upon the human body. Several substances which are highly injurious to man, are taken by some other animals with impunity. The old story of the origin of the name of antimony is probably well known to many of our readers. See ANTIMONY. On the contrary, some substances are poisons to many of the lower animals, but are much less injurious to man. A small quantity of *nux vomica* will destroy a garden mouse, but a man may take five or ten grains with safety, and even advantage. The doses of medicines, too, bear no proportion in the various animals. A few grains of aloes are sufficient to purge a man, but a horse requires from half an ounce to a whole ounce. It is therefore necessary that man himself should be the subject of experiment; and where great nicety is required, the enquirer should make the experiment on his own person. Innumerable are the dogs, birds, and frogs, that have been sacrificed on the altar of science. Few experimentalists have, like Pelletier and Davy, ventured to operate on themselves; and even where this has been done, the effects of prejudice and previous hypothesis have considerably diminished the value of their researches.

It is advisable that every practitioner should, from the number of his patients, select a few cases to which he may particularly attend, carefully observing and comparing the effects of the medicines prescribed. In this way he will in time collect a body of information, from which he may be able to draw some valuable conclusions. It is more peculiarly requisite to make observations on the effects of compound medicines, and compare them with those produced by the component simples, when, given separately.

65
All complex medicines not to be condemned.

It would be unfair to dismiss this part of our subject, without admitting that there are some compound medicines, the good effects of which must be acknowledged, though we cannot in the present state of medical science, explain their action. There are two medicines of this kind, which the writer of this article has often seen prescribed by physicians of whose abilities and experience he has a high opinion, with evident good effect, and which yet have much of the complex empirical air that we have been condemning. One of these is a remedy for the advanced stage of dysentery, and is prescribed nearly in the following manner.

℞. Infusi quassiæ (cum dr. 1. ad. aquæ ℔j) unc. 6.
Magnesiæ ustæ dr. 2.
Tincturæ sennæ unc. 2.
——— opii dr. 2.
Electuarii aromatici dr. 1.
Syrupi Rhei dr. 3. M.
Signetur. *Three or four table spoonsful to be taken every six hours, shaking the phial, and one spoonful after every loose stool.*

Here are a bitter, an absorbent, a stimulant, a laxative, and a narcotic, combined in the same medicine. To which of these are we to attribute the good effects which have appeared to us to result from the exhibition of the whole? Probably the slight laxative and the absorbent are here of little use, and the chief benefit is to be ascribed to the bitter and the stimuli, considering the opium in this light.

The other medicine to which we allude is considered as an antiseptic, and is frequently ordered in putrid diseases, especially in *cynanche maligna* or *scarlatina anginosa*. It is as follows.

℞. Muriatis sodæ dr. 1½.
Succini limonis. dr. 1½.
Sacchari purificati, unc. ½.
Spiritus myristic. moschati, dr. 3.
Ætheris sulphurici cum alcohole, dr. 2.
Aquæ menthæ piperitæ, unc. 6. M.
Signetur. *Three table spoonsful to be taken every four hours (and in cynanche some of it to be frequently used by way of gargle).*

What an apparent confusion of salt and sour, of sweet and strong! It is true that there is here no decomposition, and yet the medicine is certainly unscientific and empirical.

Rules for Prescriptions.

66 21. *A prescriber should adapt his prescription as far as may be to the worldly circumstances of his patient*, directing for the poorer class those forms which are least expensive, such as powders, pills, electuaries, and ingredients for teas and decoctions, with proper directions how to prepare them. To his more wealthy patients he may prescribe those forms which, by uniting neatness with convenience, will both please his patient, and allow an adequate remuneration to the apothecary, who in most places derives from his practice little profit, except what arises from the sale of his medicines. The forms best adapted to such patients are those of draughts, boluses, powders, and julep, &c.

67 Neatness to be observed.

22. *Neatness in prescription should always be regarded;* for as the effects of medicines often depend much on the feelings of the patient, we should take care that his taste, sight, and smell, be offended as little as possible, that disgust may not either prevent his taking the medicine at all, or at least prevent him from taking it with confidence. In liquid medicines, we ought as much as possible to avoid powders, and every thing which can render the liquid unpleasant to the eye; and if we prescribe a formula containing oil, we ought to take care that this be intimately mixed with the other ingredients. Thus, suppose, when about to employ opium by friction, we were to order equal parts of tincture of opium and oil of olives. Though when well shaken together, these ingredients would incorporate sufficiently to answer the purpose of opiate friction, yet when allowed to stand, they would speedily separate, and give the embrocation an unpleasant appearance. It would be better, therefore, to insure their combination by adding a little solution of ammonia.

23. In this respect much will depend on the form of the medicine; and a physician should be perfectly aware what form is best adapted to the articles he is to employ, as well as what is most agreeable to the patient. This subject of forms was sufficiently explained in the article MATERIA MEDICA, Part III. chap. 2.

68 Recapitulation.

We have now finished all that appeared most important on the general rules for extemporaneous prescriptions; but it may be proper to bring under one general view the principles which have been laid down. The great object of a practitioner is to cure his patient safely, agreeably, and expeditiously. That he may cure him safely, he is to study perspicuity and simplicity. To insure perspicuity, he should arrange his formulæ in the order of exhibition; write the words so that they may be most intelligible; arrange the articles of each formula in the mode of composition; use abbreviated words for quantities instead of symbols; employ the common numerals; write the directions in English; avoid obsolete or uncommon remedies, and order no article, not officinal, merely by its name. To insure simplicity, he must employ no more ingredients than are necessary. That he may cure his patient agreeably, he must observe neatness in his prescriptions; adapt his forms to the nature of the remedies employed, and not prescribe offensive remedies where those that are agreeable or palatable will answer the same purpose.

That he may cure his patients expeditiously, he should employ the most efficacious remedies in the proper doses, and take care they are administered in such a manner as to be most likely to produce the desired effect.

We shall now conclude these general observations on prescription with a few practical cautions, for which we are chiefly indebted to Dr Percival.

1. A practitioner should attend to the feelings and prejudices of his patient. Dr Percival ordered bleeding to a patient labouring under peripneumony, who had a great dread of the operation, and appears to have died in consequence of its having been attempted.

2. A physician, after having ascertained the nature of a disease, in considering the treatment which he means to adopt, should first reflect whether any evacuation be necessary, as bleeding, the application of leeches or of blisters, cupping, vomiting, purging, &c.

3. He should next enquire whether any particular symptom, such as hemorrhage, great pain, excessive vomiting or purging, be so violent or so distressing as to require immediate attention.

4. He is to consider whether the disease under notice is one for the cure of which any specific remedy has been discovered, such as *mercury* in *syphilis*, *cinchona* in *intermittents*, &c.

5. In chronic diseases, where the usual remedies fail of success, it is often of consequence to endeavour to rouse the system into a new action by mercury, electricity, opium, &c. This practice appears rather empirical, but the experience of many able physicians has evinced its propriety.

6. In commencing the treatment of any case, it is proper to begin with the simplest and safest method; and if this does not succeed, to try others of a more complex and bolder description.

7. A physician should not change his plan or his remedies too soon or too often.

8. The cases of new born infants require peculiar caution, as a moderate dose of a powerful medicine may prove fatal. Four drops of tincture of opium have been given to a child a few weeks old for gripes. The infant was seized with stupor and convulsions, and died. A practitioner of midwifery gave an infant two tea-spoonfuls of castor oil by way of purgative; severe vomiting and convulsions came on, and the child sunk under them.

69 Origin of modern pharmacy.

IV. Modern pharmacy may be said to commence about the middle of the 15th century, at which time it appears to have been in a most deplorable state of empirical barbarity. Though it is probable that, among the earlier practitioners of medicine, remedies were employed in their most simple forms, the art of compounding a number of simples together into one medicine had, by the time of which we are now speaking, arrived at a pitch of extravagance which has never been exceeded.

What carried this ostentation of composition to the highest excess, was the object of framing antidotes, which being previously administered, might defend against any poison whatever, that should afterwards be taken into the body. To this scheme is owing the enormous length of the celebrated mithridate and *theriaca;* for such medicines must of course recommend themselves by the number and variety of their ingredients, as they were to contain a proper antidote for every possible species of poison, and more especially as these compositions were to be farther wrought up into little less than universal remedies for all diseases to which the human body is subject.

The first of these antidotes was said to be composed

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Historical Sketches.

from the result of experiments made separately with all kinds of simple antidotes by the famous king whose name it bears; but as no records are left us of any of those particular experiments, we may reasonably consider this tale as fabulous. As it is not likely that this medicine and the theriaca will ever again appear in our Pharmacopœias, we shall, for the amusement of our readers, describe the composition of each, as given in the London Pharmacopœia published in 1746. The mithridate is thus composed.

70 Account of the mithridate.

"Take of cinnamon 14 drams, of myrrh 11 drams; agaric, spikenard, ginger, saffron, seeds of treacle mustard, or of mithridate mustard, frankincense, chio turpentine, of each 10 drams; camel's hay, costus, or in its stead zedoary, Indian leaf, or in its stead mace, French lavender, long pepper, seeds of hartwort, juice of the rape of cistus, strained storax, opopanax, strained galbanum, balsam of Gilead, or in its stead expressed oil of nutmegs, Russian castor, of each an ounce; poley-mountain, water-germander, the fruit of the balsam tree, or in its stead cubebs, white pepper, seeds of the carrot of Crete, bdellium strained, of each seven drams; Celtic nard, gentian root, leaves of dittany of Crete, red roses, seeds of Macedonian parsley, the lesser cardamom seeds freed from their husks, sweet fennel seeds, gum Arabic, opium strained, of each five drams; root of the sweet flag, root of wild valerian, anise-seed, sagapenum strained, of each three drams; spignel, St John's wort, juice of acacia, or in its stead Japan earth, the bellies of scinks, of each two drams and a half; clarified honey, thrice the weight of all the rest. Dissolve the opium first in a little wine, and then mix it with the honey made hot; in the mean time melt together in another vessel the galbanum, storax, turpentine, and the balsam of Gilead, or the expressed oil of nutmeg, continually stirring them round, that they may not burn; and as soon as these are melted, add to them the hot honey, first by spoonfuls, and afterwards more freely: lastly, when this mixture is nearly cold, add by degrees the rest of the species reduced to powder.

71 Account of the theriaca.

The preparation of the *Theriaca andromachi*, or Venice treacle, is thus directed.

"Take of the troches of squills, half a pound; long pepper, opium strained, dried vipers, of each three ounces; cinnamon, balm of Gilead, or in its stead expressed oil of nutmeg, of each two ounces; agaric, the root of Florentine orris, water-germander, red roses, seeds of navew, extract of liquorice, of each an ounce and a half; spikenard, saffron, ammomum, myrrh, costus, or in its stead zedoary, camel's hay, of each an ounce; the root of cinquefoil, rhubarb, ginger, Indian leaf, or in its stead mace, leaves of dittany of Crete, of horehound, and of calamint, French lavender, black pepper, seeds of Macedonian parsley, olibanum, Chio turpentine, root of wild valerian, of each six drams; gentian root, Celtic nard, spignel, leaves of poleymountain, of St John's wort, of ground pine, tops of creeping germander, with the seed, the fruit of the balsam tree, or in its stead cubebs, aniseseed, sweet fennel seed, the lesser cardamom seeds freed from their husks, seed of bishop's-weed, of hartwort, of treacle mustard or mithridate mustard, juice of the rape of cistus, acacia, or in its stead Japan earth, gum Arabic, storax strained, sagapenum strained, Lemnian earth, or in its stead bole Armenic or French bole, green vitriol calcined, of each half an ounce; root of creeping birthwort, or in its stead of the long birthwort, tops of the lesser centaury, seeds of the carrot of Crete, opopanax, galbanum strained, Russia castor, Jews pitch, or in its stead white amber prepared, root of the sweet flag, of each two drams; of clarified honey thrice the weight of all the rest. The ingredients are to be mixed in the same manner as in the mithridate.

The theriaca may be considered as a modification of the mithridate by Andromachus, though we are not informed what were his reasons for the variations, except that by the addition of the viper's flesh the medicine was rendered more useful against the bite of that animal *. The theriaca was in so great repute before the decline of the Roman empire, that even the wise Marcus Aurelius was induced to make a daily use of it, to the great prejudice of his health; for we are told by Galen, that his head was so much affected, that he dosed in the midst of business; and when on this account he omitted the opium in the composition, he could not sleep at all.

* Galen de Antidotis, lib. i. cap. i.

It is not a little amusing to observe the reasons that induced the ancient compounders of medicines to crowd their receipts with such a multitude of ingredients. Medicines were then distributed into four qualities, of *heating*, *cooling*, *drying*, and *moistening*, by the combination of which, and the structure of the substance in which they adhered, whether consisting of gross or subtle parts, was deduced another head of qualities from consequential effects they were supposed by this means to have on the body, of *inciding*, *attenuating*, *incrassating*, *relaxing*, *astringing*, and the like; by a farther prosecution of this speculation was derived from the same source a third arrangement of *cephalics*, *hepatics*, *stomachics*, *diuretics*, and others; these orders being closed by a fourth head, to comprehend such, whose effects surmounted even the acuteness of this system to explicate; these were said to operate *tota substantia*. The first of these qualities, as well as those which depended on them, were farther divided into four degrees, and each of these into three subdivisions, whereby medicines might be adapted to each case with the nicest subtilty by the rules of arithmetic. Again, when the composition was thus happily adjusted, it was farther to be enquired, whether the medicine after all might not be suspected of some noxious quality, requiring correction; and this, whether real or imaginary, was by the farther addition of some proper accompaniment to be provided for. It was also to be considered, that a medicine might be serviceable to a remote part, but exposed to be destroyed by the powers of digestion before it arrived there; then it was to be assisted by some material, by which it should be defended and conducted safely, so as neither to be acted upon, nor act, till it reached the designed part, and then be left to operate without impediment, its guide and protector being itself there opportunely consumed: some medicines were pretended to run too swiftly through the body, others to move on too sluggishly; the first of these required a curb, the others a spur: often a director was necessary, that the medicine might not stray from its destined course; every medicine was supposed to have its peculiar station, in which, left to itself, its operation would be exerted; if it were required to perform its office sooner, it was to be committed to

72 Origin of the several parts of a formula.

to the custody of some other, which might fix it to the region desired; if it were designed to proceed farther, it must have an assistant to open it a passage.

How much ingenious men have been perplexed to account for these irregularities and superfluities of the earliest pharmaceutical writers, may in some measure be conceived from Bauderon's comment on the *Aurea Alexandrina*, the first composition in the collection of Nicholaus, whom we shall presently notice. Opium, it seems, is the base whose powers are heightened by other ingredients, which require also others to correct their ill qualities. Besides these, one list of ingredients is to direct the operation to the head, another set to the breast, others to the heart, stomach, spleen, liver, kidneys, and other parts; insomuch, says the author, that this one medicine, in regard to the diseases he enumerates, may very justly be considered as a whole apothecary's shop, contained in a gallypot. Rondelet, in his remarks on the *Syrupus Hyssopi Mesuæ*, seems less disposed to admire what he did not understand, when he tells us, he long doubted with himself, under what head, whether of attenuants or incrassants, it ought to be ranged, it containing so many species of each kind; and at last has recourse to this frank reason for retaining it at all, *erit nobis usui, cum nondum erimus certi, incrassarene, an attenuare oporteat.*

73 Improvements introduced by the alchemists.

When the alchemists had extended the bounds of their art from the mere drudgery of manufacturing gold and silver, to the more noble and philosophic employment of composing an universal elixir that should secure its possessor from disease, and prolong his life to an indefinite period, pharmacy derived from their labours considerable and solid advantages. The experiments instituted by these visionaries with the metals, led to the accidental discovery of some of the most efficacious remedies which we at present employ, especially the preparations of antimony and mercury, and most of what are called the neutral or secondary salts. By calling in the aid of fire, they enabled us to produce in bodies, changes which, without the assistance of this powerful agent, we should have been unable to effect. Now, every thing was submitted to *digestion*, *calcination*, *fermentation*, *distillation*, and *sublimation*; but, as generally happens in cases of innovation or reform, these new methods of obtaining active remedies were carried to an absurd and ridiculous extent. Finding that the healing powers of many substances were eliminated or increased by the application of heat, they seemed to imagine that the simple medicine could in no case possess any medical virtue till it had been placed upon the fire, or kept for some hours in a furnace. Hence the immense number of distilled waters and spirits, essential and empyreumatic oils, with which the old pharmacopœias are crowded, and which seem in many cases to possess no other powers than what they derive from the water or the spirit that forms the bulk of the preparation. Not only plants and minerals, but animals and animal matters of all kinds, were distilled, digested, or calcined. Thus, we find a *water of snails*, a *spirit of millipedes*, an *oil of earth worms*, &c. &c. The absurd and pompous names by which the preparations were distinguished, are truly ridiculous. *Magisterial balsam*, *hierapicra*, *Ethiops mineral*, *ens veneris*, *flores martis*, *calomelas*, *aquila alba*, are a few which long retained their seat, both in public and private dispensatories. As these preparations were, from their contrivers, denominated *chemical;* the more ancient medicines, which were drawn almost entirely from the animal and vegetable kingdoms, were denominated *Galenical*, because chiefly employed by the followers of Galen. Hence the division of medicines into *Galenical* and *chemical*, a division which obtained for some hundred years, and which only a few years ago was preserved in the sale catalogues of the London druggists.

However amusing to a scientific modern chemist it may be to wander through the labyrinths of the earlier pharmaceutical writers, it is necessary for us to be brief upon the subject. These absurdities are now fast disappearing; and pharmacy, guided by the increasing brightness of her younger but more enlightened sister, has begun to assume a more scientific and a more decided character. The principles and improvements of modern chemistry have been introduced into our pharmacopœias, and the civilized nations of Europe are now vying with each other in the amelioration of these guides to the medical practitioner. In our own country, the Edinburgh college led the way to this reform. They have been followed by the Dublin physicians; and we may soon expect the completion of the revolution in our national pharmacy, by the publishing of a new edition of the London Pharmacopœia, which is, we understand, now under review. 74

75 Progress of modern pharmacy.

The progress of our present officinal pharmacy, from the time of its first introduction by the Arabians, so far as we can trace it through the obscurities attending its origin, has been as follows. Saladinus of Ascoli, an author who wrote about the middle of the 15th century, while as yet there were no pharmacopœias established by any public authority, informs us, that the books with which the apothecaries were generally furnished, were these: a book of Avicenna and another of Serapion, which treat on simples; Simon Januensis *de synonymis;* a treatise of an Arabian author under the name of *Liber Servitoris*, containing the preparations of simples, and the chemical medicines then in use; likewise two *Antidotaria*, one of Johannes Damascenus or Mesue, and another of Nicholaus de Salerno.

Some time after, Nicholaus Præpositus of Tours wrote a general dispensatory, that might supply the place of all these; in which the compositions are almost entirely taken from Mesue, and the forementioned more ancient Nicholaus. The *Thesaurus Aromatariorum* written near the same time, and the *Lumen Apothecariorum*, consist also of similar extracts; and in the *Luminare Majus* published soon after, which contains a more extensive collection, these two authors generally lead each head. The same *Antidotaria* have also been made the general basis of the modern pharmacopœias, though we know little more of their authors than that they were the favourites of those barbarous times in which they lived.

76 Mesue.

It is probable that Mesue lived about the 12th century, which is all that we can ascertain respecting a writer to whose authority such implicit submission has been paid; and even this circumstance has been disputed: for some have confounded him with a much earlier writer of the same name, who resided at the court of Bagdat.

77 Nicholaus.

Of the other father of pharmacy, Nicholaus, little more is known. From his being styled of Salerno, we might imply

imply that he resided in that school. Of his work, Saladin gives the following account: that there were two *Antidotaria* under the name of this Nicholaus, the one distinguished by the title of *Nicholaus Magnus*, and the other by that of *Nicholaus Parvus*; that the latter was in most frequent use, and was only an epitome of the former, containing but a part of the compositions, and those reduced to less quantities. Among the collections of pieces often published together as a supplement to Mesue, one is entitled *Antidotarium Nicholai*, and in this are contained the compositions which were delivered by dispensatory writers, under the name of Nicholaus. This is the lesser *antidotarium*, and there is also a copy of the greater, published under the name of Nicholaus Alexandrinus, as translated from the Greek by Nicholaus of Reggio, the first translator of Galen. In this translation, as in the former *antidotarium*, the compositions are arranged in the order of the Latin alphabet: whereas, in the original, the Greek alphabetical order seems to have been followed. Here, beside a much greater number of articles than in the other Nicholaus, those which they have in common are in greater quantities.

78 Foreign public Pharmacopœias.

The first Pharmacopœia which was set forth by public authority, was that of Valerius Cordus, published in 1542, under the sanction of the senate of Nuremberg. This consists almost entirely of collections from the two authors above mentioned, with short notes in relation to such names of plants or drugs in the compositions as were of doubtful signification. Subsequent pharmacopœias, however they might be rendered more copious by additions from other authors, also paid the like regard to Nicholaus and Mesue. This Pharmacopœia of Cordus has been made more celebrated from the comments made on it by Hoffman. In 1561, Clusius published at Antwerp a Latin translation of the *Florentine Antidotarium*. In 1581 was published at Bergamo, in Italy, the *Pharmacopœia Bergamensis*, which was followed by the *Pharmacopœia Augustana*, at Augsburg in 1601; republished at Rotterdam, with notes by Zwelfer in 1654, and again in 1666. The pharmacopœia of the faculty at Paris first appeared in 1637; and about the same time there was published at Paris a collection of Arabian formulæ, called the *Persian Pharmacopœia*. In the latter end of the 17th century, the incorporated physicians of Sweden published their Dispensatory under the title of *Phamacopœia Holmiensis*, which was republished in 1775 and 1784 by the title of *Pharmacopœia Suecica*. The Prussian Dispensatory, *Pharmacopœia Borussica*, was first published in 1799. The Pharmacopœia of Vienna was first published in 1729, and republished in 1765.

Besides these, we have seen or heard of the following:

The Dispensatory of Wirtemburg, of which the first edition is that of 1771.

Pharmacopœia Genevensis, published in 1780, republished in Italian in 1800.

Dispensatorium Lippiacum in 1792.

Pharmacopœia Bremensis in 1792.

Pharmacopœia Austriaco-provincialis, 1794.

Pharmacopœia Austriaco-castrensis, 1795.

Pharmacopœia Rossica, published at St Petersburgh first in 1798, and again in 1803.

Of the British *Pharmacopœias*, the earliest is that of the London college, which was first published in 1618. It was again published either at the close of the 17th, or beginning of the 18th century, in 18mo; again in 1746 in 4to, and last in 1791. The college is now preparing a new edition, and has circulated among its members a *specimen* of the proposed alterations. We have been favoured with a perusal of this specimen, and we have no doubt, that with respect to accuracy of preparation, and judicious selection of remedies, the new work will not be inferior to the late editions of the Edinburgh and Dublin *Pharmacopœias*. In point of nomenclature, however, we cannot help thinking, that the committee have in a great measure failed in their desire to avoid error and confusion. Should the nomenclature of the *specimen* be adopted in the *published* edition, we fear that the *novelty* of the terms will be the smallest objection to their use; but that being so perfectly different, both from the language of modern chemistry and of the late pharmacy of the London druggists and apothecaries, will occasion serious inconvenience both to prescribers and compounders. It would be indecorous for us to particularize instances, but we chiefly allude to the names of the *secondary salts*, which we consider as very objectionable. The new edition will be evidently much improved, many new articles are admitted, and not a few of such as were less efficacious, or which may be prepared extemporaneously, are omitted.

79 British public Pharmacopœias.

The college of Edinburgh first published their Pharmacopœia in 1722; and improved editions have successively appeared in 1736, 1747, 1756, 1775, 1783, 1792, 1803, and 1805, this last being little more than a new impression of the preceding. The Dublin college first published, or rather *printed*, a Pharmacopœia in 1794; and they have lately, viz. in 1807, republished it with considerable improvements. In this edition they have chiefly followed the plan of the Edinburgh Pharmacopœia, but they retain the usual pharmaceutical names of the simples, though they have in general adopted the reformed chemical nomenclature. The most material improvements will be noticed in the *appendix* to this article.

80 Foreign private Dispensatories.

Besides the Pharmacopœias printed under the authority of public colleges, a great many have been published by individuals both on the continent and in Britain. We shall notice the principal of these in chronological order.

The earliest of these that we find on record, after those of Nicholaus, is the *Antidotarium Speciale* of Wecker, which was printed in 1561. Four years after appeared the *Antidotarium* of Montagna, published at Venice; and at the same place in 1600, appeared a work by Fioraventi, entitled *Secreti Rationale Intorno Alla Medicina*. In 1608, Renodæus published at Paris his *Officina Pharmaceutica seu Antidotarium*. Mynsicht's *Armamentarium Medico-chymicum* appeared in 1631; and in 1656, Schroeder published at Leyden his *Pharmacopœia Medico-Chemica*. In 1676 Charas published his *Pharmacopée Galenique et Chemique* at Paris, and in 1684 the same work was republished in Latin at Genoa. In 1698 appeared the celebrated *Pharmacopée Universelle* of Lemery; and in the same year the *Pharmacopœia Spagyrica* of Poterius. Of those that have appeared in the 18th century, beside those mentioned in the introduction to MATERIA MEDICA, we may

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may notice as being of superior merit; Triller's *Dispensatorium Pharmaceuticum Universale*, published at Frankfort in 1764; Spielman's *Pharmacopœia Generalis* at Strasburg in 1783, and Reuss's *Dispensatorium Universale* at the same place.

81 British private Dispensatories.

In our own country, several useful works of this kind have been produced. One of the earliest (D), and among the most remarkable of these, is the *Pharmacopœia Officinalis et Extemporanea*, or *Complete English Dispensatory* of Dr Quincy, which was first published in 1718, again in 1722, and in 1739 had reached the eleventh edition, now before us. Considering the time at which it was written, this is an excellent performance, and is the more interesting, as it formed the foundation on which were composed those more accurate and scientific works the *New Dispensatory* of Lewis, and the *Edinburgh New Dispensatory*. Quincy's Dispensatory was followed by similar works, as by James's Dispensatory in 1747, Lewis's in 1753, and the *Edinburgh New Dispensatory* by Webster in 1786. At length, in 1803, Dr Andrew Duncan, Junior, published his *Edinburgh New Dispensatory*, which, from the important additions and improvements progressively introduced in four editions, must be considered as a new work, and has entirely superseded every similar publication.

82 Collections of formulæ.

Of collections of formulæ, both by continental and English writers, there is no want; but it will be difficult for an unexperienced prescriber to make a judicious selection from among them. The best we have seen in this country are, the Thesaurus Medicaminum, now admitted to be the production of Dr R. Pearson; the Pharmacopœia Chirurgica; and perhaps we may add those published in Dr Kirby's Tables of the Materia Medica. The first of these was published in 1794, and a third edition of it materially improved appeared in 1804. The Pharmacopœia Chirurgica is a valuable selection of formulæ, chiefly intended for surgeons, and drawn up principally from the practical Pharmacopœiæ of the different London hospitals. The first edition appeared, we believe, in 1794; and in 1802 there was published a fifth edition, with the addition of a synoptical table of the formulæ contained in the volume, arranged according to the order of their principal incredients. The formulæ annexed to each of the classes in Dr Kirby's Tables are intended principally to serve as examples of the method of prescribing the principal articles enumerated in the class to which they are attached. They are selected partly from the best writers on extemporaneous prescription and the practice of medicine, and are partly derived from the private experience of the author or his medical friends.

Of the older collections of formulæ, we may notice the Pharmacopœia Extemporanea of Fuller, which contains 1000 select formulæ, arranged in alphabetical order, and accompanied by practical and pharmaceutical remarks. This work went through many editions, both in England and on the Continent. The best which we have seen is that published at Paris in 1768, under the care of Theodore Baron.

83 Works on extemporaneous prescription.

We know of very few works that have been written, containing practical rules for the writing of prescriptions. In our own country, almost the only work on the subject with which we are acquainted, is *Quincy's Lectures on Pharmacy*; a work now very little known, though the principal parts of it were introduced under their proper heads, in the later editions of the complete English Dispensatory. Quincy's rules, though now a little antiquated, are for the most part very good; and allowing for the imperfect state of chemical science in the beginning of the 18th century, may still be perused with advantage. Similar rules, which were indeed little more than modifications of those given by Quincy, were laid down by Dr Lewis in his New Dispensatory.

84 Gaubius.

One of the most celebrated foreign elementary works on this subject, and that which we believe is best known in this country, is *Libellus de Methodo Concinnandi Formulas Medicamentorum*, by Gaubius, a second edition of which was published at Leyden in 1752. After laying down some general rules to be observed before prescribing, Gaubius gives an account of the nature and construction of formulæ in general, and then treats particularly of the several forms of medicines usually employed. These he divides into internal and external, reckoning among the former powders, boluses, electuaries, *eclegmata* or lynctuses, pills, lozenges, &c. which he distinguishes into *tabellæ* and *rotuli*, infusions, decoctions, expressed juices, emulsions, juleps, mixtures, and draughts or contracted mixtures. External forms he divides into injections, *adspergines* (powder sprinkled on the surface), fomentations, dry epithems, cataplasms or poultices, baths, fumigations, plasters, cerates, ointments, odoriferous balsams, liniments, epispastics or blistering plasters, frictions, *collyria* or eye-waters, errhines or snuffs, dentifrices or tooth-powders, apophlegmatisms, gargles, clysters, suppositories, and pessaries. He gives ample rules for the preparation of each of these forms, with examples. This work, however, from the antiquated style and prolixity with which it is written, and the obsolete names that every where occur throughout the examples, is of little use except as a book of reference.

85 Eberhard.

In 1754, Joannes Petrus Eberhard, professor of medicine in the university of Halle, in the duchy of Magdeburg, published his *Methodus Conscribendi Formulas Medicas*, a small pamphlet in 18mo, containing rules arranged in a tabular form. In this little work the author first treats of the nature of a medical formula, and explains the characters usually employed in prescription. He then lays down his plan of division, and lastly treats of the preparation of each particular form, with practical hints respecting the ingredients proper for each form, with their proportional doses, and the cases to which they are more particularly adapted. This work was first intended for the professor's pupils, but he published it under the conviction that it would be found of advantage by practitioners in general. On the whole, it is a useful

(D) The only Pharmacopœias worth notice in this country that preceded the Dispensatory of Quincy, were, we believe, the *Pharmacopœia Bateana*, edited by Dr Thomas Fuller, and the *Pharmacopœia Extemporanea*, drawn up by the same author, (to be presently noticed), both published early in the 18th century.

Historical Sketches. useful publication, but is as much too brief as that of Gaubius is too prolix. The rules are not illustrated by examples.

86 Grüner. The best work that we have seen on the elements of extemporaneous prescription, is entitled, *Via et Ratio Formulas Medicas conscribendi*, by Grüner, professor of medicine in the university of Jena. As we have seen only one copy of this work, belonging to the college library Edinburgh, and when this article went to press, could not procure a second perusal of it, we cannot present our readers with any analysis of its contents; but from the favourable impression we received on examining it several years ago, we consider it as a valuable work.

87 Alibert. The last writer on this subject whom we shall notice is M. Alibert, who, at the end of the second volume of his *Nouveaux Elémens de Thérapeutique et de Matiere Medicale*, has given what he calls a New Essay on the Art of Prescribing; in the first part of which he treats of the general rules of the art, and in the second explains the particular formulæ which act on the vital properties of the different organic systems of the human body. M. Alibert's arrangement is peculiar, and we shall therefore give a sketch of it. He arranges his formulæ under six sections, and divides each section into several articles. In the first section he treats of the formulæ or compound medicines which the medical art principally directs towards the vital properties of the system of the digestive organs. In the first article of this section he describes the compound medicines which are particularly directed to the muscular contractility of the stomach, in common language, emetics; in the second article, those which are particularly directed to the muscular contractility of the intestinal canal, viz. cathartics; in the third article he treats of those which are particularly adapted to the changes of the vital properties that result from the presence of worms in the stomach and intestines, namely, anthelmintics; in the fourth article, of those which are particularly directed against the effects of poisons introduced into the stomach or intestines; and in the fifth, of those compound medicines which are particularly directed to the vital properties of the larger intestines.

In the second section he treats of these medicines, which the art particularly adapts to the vital properties of the urinary passages; diuretics.

In third section he describes those that particularly refer to the vital properties of the respiratory organs, viz. expectorants and refrigerants.

In the fourth section he treats of those compound medicines which are particularly directed to the vital properties of the *dermoid system*, or the skin; namely, diaphoretics, emollients, and epispastics.

In the fifth section he notices those medicines which are particularly directed to the vital properties of the nervous system; viz. antispasmodics, narcotics, sternutatories and sialagogues.

In the sixth and last section he treats of the compound medicines that the art particularly directs toward the vital properties of the system of generation.

Some other late French writers on Pharmacy have given a number of examples of medical formulæ, especially M. Bouillon La Grange, in his *Manuel du Pharmacien*. In all these formulæ is employed the new French standard of weights and measures, commonly accompanied by the synonymous troy weights and measures, as used by the French apothecaries under the old government; but as neither of these are familiar to English readers, we shall here add two tables of the French weights and measures of capacity, reduced to English wine measures and troy and apothecary weights.

TABLE I. *A Comparison of French Grammes with Troy, French, and Nuremberg, Apothecary Grains.*

Grammes.	Troy grains.	Old French Grains	Nuremberg Grains.
1=	15.444=	18.883=	16.128
2=	30.888=	37.766=	32.256
3=	46.332=	56.649=	48.384
4=	61.776=	75.532=	64.512
5=	77.220=	94.415=	80.640
6=	92.664=	113.298=	96.768
7=	108.108=	132.181=	112.896
8=	123.552=	151.064=	129.024
9=	138.996=	169.947=	145.152
10=	154.440=	188.830=	161.280

TABLE II. *French Measures of Capacity, reduced to cubic inches, and English Wine Measure.*

French Measures.	English cubic inches.	Tuns.	Hhds.	Gallons	Pints.
Millilitre =	.06102	0	0	0	.002
Centilitre =	.61028=	0	0	0	.0211
Decilitre =	6.10280=	0	0	0	.2113
Litre =	61.02800=	0	0	0	2.1133
Decalitre =	610.28000=	0	0	2.	5.1352
Hecatolitre=	6102.80000=	0	0	26.419	
Chiliolitre =	61028.00000=	1	0	12.19	
Myriolitre =	610280.00000=	10	1	58.9	

APPENDIX.

APPENDIX.

88 THE new edition of the *Dublin Pharmacopœia* having appeared since the printing of our article MATERIA MEDICA, it becomes us to notice the principal improvements introduced by the Dublin college; and as particular circumstances prevented our doing so under PHARMACY, we have reserved them for an appendix to the present article. We shall also take this opportunity of supplying some omissions in the article MATERIA MEDICA, rendered unavoidable by the circumstance of that article coming on at the conclusion of a volume, beyond which we could not with propriety extend it, especially by the addition of a complete table of the synonymous Latin names of all the officinal compounds.

We shall notice the additions and improvements of the Dublin college in the same order which we have observed in MATERIA MEDICA, Part IV.

CHAP. I. *Animal Substances.*

2. MURIAS AMMONIÆ (E).

89 Carbonate of ammonia. Preparation *c*. CARBONAS AMMONIÆ. See MATERIA MEDICA, N° 238.

In the preparation of this salt, the Dublin college now employ carbonate of soda for decomposing the muriate of ammonia, instead of chalk. The only advantage of this seems to be that the decomposition is effected at a lower temperature.

90 Solution of carbonate of ammonia. Preparation *d*. AQUA CARBONATIS AMMONIÆ. MATERIA MEDICA, N° 239.

Here too carbonate of soda is employed in the proportion of 28 oz. to the pound of muriate of ammonia.

91 Hydrosulphuret of ammonia. Preparation *f*. HYDROSULPHURETUM AMMONIÆ. MATERIA MEDICA, N° 241.

This is now introduced into the Dublin Pharmacopœia, and is directed to be prepared much in the same manner as in the pharmacopœia of Edinburgh.

92 Aromatic ammoniated alcohol. Preparation *h*. ALCOHOL AMMONIATUM AROMATICUM. MATERIA MEDICA, N° 243.

The only change made in the preparation is, in substituting ½ oz. of nutmegs for 2 drs. of the essential oil, and distilling off the ammoniated alcohol, thus rendering the solution of the aromatic principles more complete.

5. CERVUS ELAPHUS.

93 Phosphate of lime. Preparation *a*. PHOSPHAS CALCIS. MATERIA MEDICA, N° 254.

The Dublin college order this under the name of *Pulvis cornu cervini usti*, to be prepared in the usual manner as directed by the Edinburgh Pharmacopœia.

Preparation *b*. DECOCTUM CORNU CERVINI, Dub. Decoction of hartshorn.

This is made by boiling two ounces of burnt hartshorn reduced to powder, and 3 drs. of gum arabic, in 3 pints of water to 2 pints, continually stirring, and then straining the liquor. 94 Decoction of hartshorn.

In this way a considerable quantity of the phosphate of lime is, by means of the gum arabic, suspended in the water; but we do not think this so good a method of administering the remedy as giving the powder itself, mixed with syrup or mucilage.

CHAP. II. *Vegetable Substances.*

24. ALCOHOL. MATERIA MEDICA, N° 294.

Preparation *a*. ALCOHOL. 95 Alcohol.

The new process of the Dublin college for preparing alcohol is as follows: A gallon of rectified spirit of wine is first mixed with an ounce of caustic potash in powder; then a pound of pearl ashes dried at the heat of 300° of Fahrenheit, and reduced to powder, is added while still warm, and the mixture digested for three days in a close vessel with frequent agitation. The spirit is then poured off, mixed with half a pound of dried muriate of lime (which is usually obtained from the residuum after the preparation of pure ammonia), and distilled with a moderate heat till what remains in the retort begins to grow thick.

26. ACIDUM ACETOSUM IMPURUM.

Preparation *b*. ACIDUM ACETOSUM FORTE, E. MATERIA MEDICA, N° 307.

ACIDUM ACETICUM, Dub.

This is prepared by putting into a tubulated retort, 3 ounces by weight of sulphuric acid, and adding to it gradually in small portions, 6 ounces of acetate of potash, waiting after each addition till the mixture be cold; and after the whole is mixed, distilling to dryness. What comes over is the acetic acid. 96 Acetic acid.

Preparation *d*. ACIDUM ACETOSUM CAMPHORATUM, E. MATERIA MEDICA, N° 309.

ACIDUM ACETICUM CAMPHORATUM, Dub.

Prepared much in the same manner with the Edinburgh acid, only with half the quantity of acid. 97 Camphorated acetic acid.

29. CERA. MATERIA MEDICA, N° 319.

Preparation *a*. CERA FLAVA PURIFICATA, Dub. Purified yellow wax.

Wax is purified by melting it with a moderate heat (*as in a water bath*), scumming it, and pouring off the clear fluid from the dregs. 98 Purified wax.

32. ANGUSTURA, MATERIA MEDICA, N° 331.

Preparation

(E) In the following enumerations the numbers prefixed to the simple articles correspond to those in the same situation in the arrangement of Part IV. in MATERIA MEDICA; while those which follow some of the articles refer to the paragraphs of that article as numbered in the marginal notes.

Preparation *a*. TINCTURA ANGUSTURÆ, Dub. Tincture of Angustura.

99 Tincture of angustura. This is prepared by digesting two ounces of coarsely powdered angustura bark in two pints of proof spirit for seven days, and straining.

This preparation, now first made officinal by the Dublin college, is a good form for exhibiting the angustura in small doses. Ordinary dose about 2 drs. generally in composition.

CLASS II. Order 3. DIANDRIA TRIGYNIA.

100 45. PIPER NIGRUM.

Ointment of black pepper. Preparation *a*. UNGUENTUM PIPERIS NIGRI, Dub. Ointment of black pepper. A stimulating ointment, made by mixing 4 oz. of finely powdered black pepper, with a pound of prepared hogs lard.

CLASS III. Order 1. TRIANDRIA MONOGYNIA.

48. VALERIANA OFFICINALIS, MATERIA MEDICA,
101 N° 354.

Infusion of valerian. Preparation *d*. INFUSUM VALERIANÆ, Dub. Infusion of valerian.

This is made by digesting 2 drs. of valerian root, coarsely powdered, in 7 oz. by measure of boiling water, for an hour, and draining off the liquor when cold.

This is a good antispasmodic, especially in hysteric cases, and the stomach is said to bear it better than the powder. Dose, a glassful twice or thrice a-day.

In our MATERIA MEDICA, in the names of the preparations of valerian, the genitive case of valeriana is inadvertently printed *valeriani*.

CLASS V. Order 1. PENTANDRIA MONOGYNIA.

69. HYOSCYAMUS NIGER.

102 Tincture of henbane. Preparation *b*. TINCTURA HYOSCYAMI NIGRI, MATERIA MEDICA, N° 392.

Now added by the Dublin college, and made rather stronger than the Edinburgh tincture, the proportions being $2\frac{1}{2}$ ounces of the dried leaves in coarse powder, to an English pint of proof spirit.

72. CINCHONA OFFICINALIS.

103 Infusion of cinchona. Preparation *a*. INFUSUM CINCHONÆ OFFICINALIS, E. MATERIA MEDICA, N° 402.

INFUSUM CINCHONÆ SINE CALORE, Dub.

Prepared by macerating an ounce of cinchona bark in coarse powder in 12 ounces of cold water for 24 hours; then pouring off the liquor.

Order 2. DIGYNIA.

84. ULMUS CAMPESTRIS.

104 Decoction of elm bark. Preparation *a*. DECOCTUM ULMI.

The Dublin college order this decoction to be prepared much in the same manner as that of the London pharmacopœia.

90. FERULA ASAFOETIDA.

105 Fetid clyster. Preparation *f*. ENEMA FOETIDUM, Dub. Fetid clyster.

This is made by adding to the purging clyster to be described presently, 2 drs. of tincture of asafœtida.

CLASS VI. Order 2. HEXANDRIA TRIGYNIA.

112 *. RUMEX AQUATICUS, Dub. Great water dock. The root. 106 Great water dock.

One of the new additions to the Dublin Materia Medica.

It ranks among astringents, and has been celebrated as a remedy in scurvy, diseases of the skin, and venereal complaints. It is generally given by way of infusion.

CLASS VII. Order 1. HEPTANDRIA MONOGYNIA.

113. ÆSCULUS HIPPOCASTANUM. 107

Now adopted by the Dublin college.

127. CASSIA SENNA.

Preparation *h*. SYRUPUS SENNÆ, Dub. Syrup of Senna. See SYRUPUS MANNÆ, MATERIA MEDICA, N° 795. 108 Syrup of senna.

CLASS X. Order 1. DECANDRIA MONOGYNIA.

130. SWIETENIA FEBRIFUGA. 109

Now also first adopted in the Dublin pharmacopœia.

134. QUASSIA EXCELSA.

Preparation *a*. TINCTURA QUASSIÆ, Dub. Tincture of quassia. 110 Tincture of quassia.

This is prepared by digesting an ounce of quassia shavings in 2 pints of proof spirit for 7 days, and filtering.

This forms a strong solution of the bitter principle of quassia.

137. STYRAX OFFICINALE.

Preparation *b*. PILULÆ E STYRACE, Dub. Storax pills. 111 Storax pills.

Prepared by beating well together 3 drs. of purified storax, 1 dr. of soft purified opium, and the same quantity of saffron.

This may properly be considered as a preparation of opium, of which it contains a fifth part.

CLASS XI. Order 2. DODECANDRIA DIGYNIA.

142 *. AGRIMONIA EUPATORIA, Dub. The herb. 112 Agrimony.

A slight astringent now added by the Dublin college.

CLASS XII. Order 5. ICOSANDRIA POLYGINIA.

158. GEUM URBANUM, Dub. Avens. *The root.* 113 Avens.

This has now obtained a place in the pharmacopœia of Dublin, and as a useful indigenous *tonic*, merits particular notice. Dose of the powder from *half a dram* to *a dram*.

CLASS

Appendix. CLASS XIII. Order I. POLYANDRIA MONOGYNIA.

160. PAPAVER SOMNIFERUM. Opium.

114 Opium. As the account of this important remedy given in the article Botany may not be deemed sufficiently satisfactory by our medical readers, and as in the Materia Medica we were so much confined that we could only refer to the best writers that have treated on opium, we shall here supply that deficiency, by giving a comprehensive view of the effects of opium; of the discoveries that have been made by late chemical analyses respecting the nature of its narcotic principle; shall point out the general means by which the ill effects which sometimes attend the exhibition of this medicine may be obviated, and enumerate those articles of the Materia Medica which may be most conveniently employed as substitutes for a drug now become so scarce and expensive.

Perhaps no article of the Materia Medica ranks higher in point either of antiquity or efficacy than opium. Its peculiar properties and mode of operation have, however, been long a subject of debate, both among theoretical and practical writers. The place assigned to it in systematic arrangement has been continually fluctuating; Cullen and his followers considering it as one of the most powerful sedatives which we possess, while Brown, Darwin, and the advocates for their doctrines, as strenuously contend that it ought to be ranked amongst the most active and diffusible stimuli. In fact, the parties engaged in this controversy appear chiefly to differ about words, and probably they are both partly right and partly wrong.

They agree that the effects of opium are similar to those of wine and alcohol, liquors which are generally, though indeed not universally, accounted stimulants. If opium produces similar effects with these, we see no good reason why it should not be arranged in the same class. All these substances may indeed be considered as both stimulant and sedative, according as we advert to their primary or secondary effects. If by a stimulant be meant something which increases the force and frequency of action in the muscular fibres, and possesses the power of sustaining or increasing the vital powers, which is, we believe, the generally received definition, we can surely not refuse this character to alcohol, and its modifications. Who that has ever felt the cheering influence of wine, that has experienced the exhilaration, the flow of spirits, and the energy of action, which are the usual effects of the bottle, can refuse to acknowledge the effects of the stimulating powers of this too fascinating beverage. Again, if by a sedative we are to understand something which diminishes the force and vigour of muscular action, and depresses all the vital energies, every one who has felt the effects consequent to a too free libation at the shrine of Bacchus, will readily admit that wine and alcohol are, in an eminent degree, possessed of sedative powers. Now, that opium resembles alcohol in both these circumstances, is generally admitted.

115 [Gen]eral ef[fect]s of opi[um]. When a moderate quantity of opium (we mean not more than two grains), is received into the stomach, it excites there a gentle warmth, which is gradually diffused over the whole body, attended with an itching of the skin, and usually followed by an increase of perspiration. The pulsation of the heart and arteries is at first rendered fuller and more frequent, and there is commonly a heat and flushing of the face; the eyes appear enlivened, and the spirits are exhilarated. Pain is alleviated, and all care for the time forgotten. The effects of this substance on those who swallow it as a substitute for wine, as is usual in the east, are familiar to most of our readers, and sufficiently prove its stimulating effect. Similar proofs appear to have been exhibited during the present war, among Europeans. We are told that the French soldiers are plied indifferently with opium or brandy, in order to increase their courage and ferocity; and we have been credibly informed, that some of the most celebrated performers on the London stage, particularly in tragic parts, which require peculiar self-command, or energy of expression, are accustomed to take doses of opium proportioned to the circumstances of the character which they are to perform.

The excretion of urine is sometimes increased; but as an increase of absorption is a usual consequence of opium, other excretions, except, as we have said, the perspiration, appear to be diminished. Opium also acts as a powerful stimulus to the genital organs, and excites the venereal appetite. It is said that on examining the bodies of Turks slain in battle, the penis has been often found in a state of erection, even in old men *.

After these effects have continued for a time, appearances of a different nature present themselves. At first a languor and lassitude not unpleasing come on, and are soon followed by yawning and a strong propensity to sleep. If the quantity taken has been considerable (above two gr.), the previous symptoms of excitement are more remarkable, but they generally continue for a shorter time, and are followed by a proportional depression. Considerable nausea supervenes, and sometimes a severe vomiting is excited, by which great part of the opium is expelled from the stomach. But if this should fail to take place, and often when it has to a partial degree appeared, a heavy stupor comes on, attended with giddiness and headach; the breathing becomes difficult and laborious; the person falls into a profound sleep, from which he is roused with great difficulty, and into which, if left to himself, he speedily relapses; the face becomes pale, the lips livid, the extremities cold, universal torpor seizes the limbs, and is followed by convulsions and fatal apoplexy.

116 Appearances on dissection. On examining the bodies of those animals which have fallen victims to opium, the stomach is found distended, and containing frothy mucus, its internal coat in a state of inflammation, and sometimes the pyloris contracted. The vessels of the brain are exceedingly turgid, and commonly an effusion of blood is found to have taken place.

When a person awakes after having taken opium, he usually finds himself heavy and giddy, and not unfrequently complains of headach and dimness of sight; his bowels are costive, and his appetite defective. Some people, so far from being soothed and lulled to sleep by opium, are rendered exceedingly irritable and restless; others, if they are made to sleep by the influence of this medicine, are harassed with frightful dreams, and awake unrefreshed.

Effects similar to what we have described arise from opium when injected into the rectum; but they require a larger dose. When this substance is applied to the eye, the urethra, or other sensible parts, it excites pain and redness *, which, however, do not long continue. When merely applied to the surface of the body, while the

* Murray Apparat. Medicam. tom. ii p. 282.

* Crumpe's Enquiry, p. 23.

Appendix. the cuticle is entire, it produces no change; but when the tincture of opium, or opium in fine powder, mixed with an oily substance, is rubbed on the skin, pain is alleviated, sleep induced, delirium assuaged, and other sedative effects brought on; but the stimulating effects of the medicine are, in this way, said to be less apparent.

117 Ill effects of opium. The ill effects which sometimes attend the exhibition of opium, may arise, either directly from its stimulating power, or from consequent exhaustion.

I. The ill effects which appear to be the immediate consequence of the stimulus are, excitement, increased absorption, and determination of the blood to the head. These effects render it an improper remedy in the early stages of inflammatory diseases, particularly in phrenitis, pneumonia, catarrh, and dysentery. By increasing excitement and determining to the head, opium is improper in phrenitis; and it is hurtful in the other diseases by increasing absorption, and hence lessening expectoration, and producing costiveness. In some cases of inflammation, however, where increased perspiration is desirable, as in rheumatism, if the medicine be so managed as to produce full sweating in a short time after exhibition, it may be employed with advantage.

II. The ill effects which arise from the secondary circumstances following the administration of opium, are chiefly headach, general debility, tremors, spasms, paralysis, and hypochondriasis. Of course, in cases where these symptoms and diseases are to be apprehended, it must be employed with considerable caution.

118 Analysis of opium. Opium has been analysed by several chemists, especially by Gren, Bucholtz, Josse, Proust, Dr Duncan junior, and very lately by Derosne. "By evaporating a watery solution of opium to the consistence of a syrup, Derosne obtained a precipitate, which was increased by diluting it with water. He dissolved this in hot alcohol, from which it again separated on cooling. When purified by repeated solutions, it crystallized in rectangular prisms with rhomboidal bases, had no taste or smell, was insoluble in cold water, and soluble in 400 parts of boiling water, did not affect vegetable blues, was soluble in 24 parts boiling alcohol and 110 cold; soluble in hot ether and volatile oils, and separated from them as they cooled; very soluble in all acids, and highly narcotic *.

* *Duncan's Dispensat.* 4th edit. p. 329.

A considerable proportion of the substance of opium is insoluble both in water and alcohol; and it is remarkable that the insoluble part is very different in Turkey opium from what it is in that which comes from the East Indies; being in the former a ductile, plastic, coherent mass, in the latter an incoherent, powdery matter, diffusible in water. According to Dr Duncan, the active constituent of opium appears to be of a volatile nature; and as this must be carried off by boiling or distillation, the usual processes for purifying opium tend to diminish its medical effects.

119 Means of obviating the ill effects of opium. The ill effects of opium are to be obviated or counteracted by regulating the dose according to the effect intended to be produced; by the mode of administration, whether internally, or by friction, or by combining with it some correcting substance which has the effect of counteracting its unpleasant properties, such as *lemon-juice, ammonia, tartrate of antimony and potash, submuriate of mercury*, or *aromatics*. The languor and general debility felt after having taken opium, are best relieved by wine and exercise. Appendix.

When a person has swallowed such a quantity of opium as there is reason to fear will prove fatal, if its effects are not prevented or counteracted, it is proper to exhibit an emetic as soon as convenient, in order to evacuate from the stomach as much of the opium as possible. With this view, a scruple or half a dram of sulphate of zinc dissolved in a little water, is to be given, and the action of vomiting promoted several times by proper diluting liquors. We should then administer lemon juice in considerable quantities; and if the stupor be very great, all methods are to be employed for rousing the patient, and obliging him to exert himself in moving about. If the more alarming symptoms are made to yield, we should give wine, ether, or other stimulants, in moderate doses, still taking care to keep alive the attention of the patient. Strong coffee has been highly recommended in these cases.

As opium is now become a very expensive article, it is of consequence to consider what other remedies that are likely to produce the same good effects may be substituted for it. Several of the narcotic vegetables have been employed for this purpose, especially *lactuca virosa, conium maculatum* or hemlock, *datura stramonium* or thorn apple, *atropa belladonna* or deadly nightshade, *humulus lupulus* or hop, and *hyoscyamus niger* or henbane. Of these the two last seem to be best adapted to this purpose. 120 Substitutes for opium.

Preparation *d*. EXTRACTUM OPII AQUOSUM, Dub.

The Dublin College have made some alteration in their mode of preparing this extract, though they preserve the same proportions. They direct the opium to be triturated with hot water for ten minutes, when the water is to be poured off, a fresh quantity added, and the trituration continued for the same period. This trituration to be repeated a third time. Then all the liquors are to be mixed together, suffered to stand in an open vessel for two days, strained through linen, and then inspissated to the consistence of an extract. 121 Watery extract of opium.

CLASS XIV. Order I. DIDYNAMIA GYMNOSPERMIA.

168. MENTHA VIRIDIS.

Preparation *p*. INFUSUM COMPOSITUM, Dub. Compound infusion of mint.

This is prepared by first digesting, for half an hour, in a close vessel, two drams of dried mint in as much boiling water as, when strained, may produce six ounces, and then mixing with the strained liquor, two drams of fine white sugar, and three drops of essential oil of mint, previously dissolved in half an ounce of compound tincture of cardamom. 122 Compound infusion of mint.

This forms a very grateful stomachic.

174. TEUCRIUM CHAMÆDRYS, Dub. Wall germander. *The herb*. 123 Wall germander.

An indigenous tonic, employed in domestic medicine in cases of *chlorosis, gout*, and *intermittent fever*.

Order

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Order. 2 ANGIOSPERMIA.

180. DIGITALIS PURPUREA.

124 Tincture of digitalis.

Preparation *b*. TINCTURA DIGITALIS PURPUREÆ.

This medicine is now introduced into the Dublin Pharmacopœia, and is prepared in the same manner as directed by the Edinburgh college.

CLASS XIX. Order 2. SYNGENESIA POLYGAMIA SUPERFLUA.

216. ANTHEMIS NOBILIS.

125 Compound decoction of chamomile.

Preparation *a* *. DECOCTUM CHAMEMÆLI COMPOSITUM, Dub. Compound decoction of chamomile.

Made by boiling for a little half an ounce of chamomile flowers and two drams of sweet fennel seeds in a pint of water, and straining.
Used chiefly for clysters.

CLASS XXI. Order 8. MONOECIA POLYANDRIA.

226. QUERCUS CERRIS. *Galls.*

126 Tincture of galls.

Preparation *a*. TINCTURA GALLARUM, Dub. Tincture of galls.

Prepared by digesting four ounces of powdered galls in two pints of proof spirit for seven days, and straining.
A strong solution of the astringent principle of galls.

Order 10. MONADELPHIA.

228. PINUS ABIES. *Burgundy pitch.*

127 Calefacient plaster.

Preparation *b*. EMPLASTRUM CALEFACIENS, Dub. Calefacient plaster.

A warm stimulating plaster, made by melting together, with a moderate heat, seven parts of *Burgundy pitch* and one part of *ointment of cantharides*.

Order 12. SYNGENESIA.

236. CUCUMIS COLOCYNTHIS.

128 Compound pills of colocynth.

Preparation *b*. PILULÆ COLOCYNTHIDIS COMPOSITÆ, Dub. Compound pills of colocynth.

These are prepared by beating together half an ounce of the pith of colocynth, half an ounce of hepatic aloes, and the same quantity of scammony, all in powder, with two drams of Spanish soap, a dram of cloves, and a sufficient quantity of simple syrup, to form a mass for pills. This is a strong cathartic, and may be given in a dose of 10 or 15 grains.

244. JUNIPERUS SABINA.

129 Savine ointment.

Preparation *d*. UNGUENTUM SABINÆ, Dub. Savine ointment.

Prepared by boiling half a pound of fresh savine leaves, bruised, in two pounds of prepared hog's lard till they become crisp, then pressing out the lard and melting in it half a pound of bees wax.
A stimulating ointment, used in dressing issues, for which it is said to be preferable to cantharides ointment.

CLASS XXIV. Order 2. CRYPTOGAMIA. FUCI.

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255 *. FUCUS VESICULOSUS, QUERCUS MARINA, Dub. Yellow bladder wrack. 130 Bladder wrack.

A common indigenous sea-weed, the charcoal from which is employed in the following preparation.

a. PULVIS QUERCUS MARINÆ, Dub. Powder of sea-wrack. 131 Powder of sea-wrack.

This is prepared by drying and cleaning any quantity of yellow bladder wrack, gathered while in fruit; then exposing it to the fire in an iron pot or crucible, covered with a perforated lid, till the volatile matters have evaporated, and the mass becomes of a dull red colour. This is to be reduced to a very fine powder, and kept in close vessels.
The medical virtues of this preparation, if it have any, are similar to those of burnt sponge, and it may be given in the same dose.

Order 3. ALGÆ.

256. LICHEN ISLANDICUS, N° 799.

Preparation *a*. DECOCTUM LICHENIS ISLANDICI, Dub. Decoction of Iceland liverwort. 132 Decoction of Iceland liverwort.

This is prepared by digesting half an ounce of Iceland liverwort in a pint of hot water for two hours, in a close vessel, then boiling for 15 minutes, and straining off the liquor while hot.

CHAP. III. *Mineral Substances.*

SECT. 2. *Inflammable Substances.*

260. SULPHUR SUBLIMATUM.

Preparation *g*. AQUA SULPHURETI KALI, Dub. Water of sulphuret of potash. 133 Water of sulphuret of potash.

This is prepared by boiling together half an ounce of sublimed sulphur with nine ounces by measure of caustic ley for 10 minutes, and straining through paper. The liquor is to be kept in vessels well closed.
The specific gravity of this liquid is assigned by the Dublin college to be to that of distilled water, as 1120 to 1000.

Preparation *h*. AQUA SULPHURETI AMMONIÆ, Dub. Water of sulphuret of ammonia. 134 Water of sulphuret of ammonia.

This is prepared by shaking four ounces of fresh-burnt lime in an earthen vessel, which is to be kept covered till the lime has fallen into powder, and become cool; when there are to be added four ounces of powdered muriate of ammonia, and two ounces of sublimed sulphur mixed together, avoiding the vapours. The whole is now to be put into a retort, and distilled with a sudden and pretty strong heat, and the liquor that comes over is to be kept in a phial well closed with a glass stopper.

SECT. 4. *Alkalies and Alkaline Salts.*

265. NITRAS POTASSÆ.

Preparation *g*. ÆTHER NITROSUS, Dub. Nitrous ether. 135 Nitrous ether.

Prepared by pouring gradually, and in different portions, upon a pound and a half of nitre, dried and coarsely powdered, in a tubulated retort, placed in a bath of cold

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water, a pound of sulphuric acid previously mixed with 19 ounces by measure of rectified spirit of wine, the mixture having been allowed to cool. With a very slight degree of heat, such as that of tepid water, an etherial liquor will pass over from the retort, and the heat which soon spontaneously arises in the retort must be moderated by cooling with cold water. The receiver should also be cooled with ice or snow, and furnished with a proper apparatus, to carry off and condense the superabundant vapours. The etherial liquor that spontaneously comes over, is to be put into a phial with a ground glass stopper, and as much dry subcarbonate of potash added as may be sufficient to saturate the superabundant acid, which is commonly done after the addition of about a dram of the salt. The ether which now floats on the upper part of the phial, is to be separated by means of a funnel, and kept for use.

Nitrous ether is a powerful stimulus, but is seldom employed in medicine.

136 266. MURIAS SODÆ.

Oxymuriatic alkaline water.

Preparation *d*. AQUA ALKALINA OXYMURIATICA, Dub. Oxymuriatic alkaline water.

This is prepared by putting into a matrass two pounds of dried muriate of soda, and a pound of powdered manganese mixed, then pouring on two pounds of water, and gradually adding at different times two pounds of sulphuric acid, adapting a proper apparatus of tubes and recipients, that the gas which comes over may pass through a solution of four ounces of carbonate of potash, in 29 ounces by measure of water.

This preparation is a solution of *oxymuriate of potash*, a salt which was lately in great esteem as a remedy in several diseases, especially *typhus*, scurvy, and *siphilis*, from an idea that it imparted to the system the oxygen defective in these diseases. The remedy is already out of fashion in this country.

137 Oxymuriatic water.

Preparation *e*. AQUA OXYMURIATICA, Dub. Oxymuriatic water.

Made by passing the gas extricated from the mixture of muriate of soda, manganese, and sulphuric acid, in the preceding preparation, through a pound of distilled water, by which this is impregnated with *oxymuriatic acid gas*.

Forms a good bleaching liquor, but is scarcely employed in medicine.

SECT. 6. *Earths and Earthy Salts.*

272. CARBONAS CALCIS.

138 Water of muriate of lime.

Preparation *f*. SOLUTIO MURIATICA CALCIS, E. MATERIA MEDICA, N° 876. AQUA MURIATIS CALCIS, Dub. Water of muriate of lime.

The Dublin college direct this to be prepared by dissolving an ounce of chalk in coarse powder in two ounces of diluted muriatic acid, and straining.

139 Precipitated chalk.

Preparation *g*. CRETA PRÆCIPITATA, Dub. Precipitated chalk.

Prepared by precipitating the chalk from the above solution, by adding carbonate of soda, filtering and washing the precipitate.

The carbonate of lime is thus procured very pure and in a very fine powder.

273. SULPHAS MAGNESIÆ.

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Preparation *d*. ENEMA CATHARTICUM, Dub. Purging clyster. 140

Purging clyster.

Made by dissolving an ounce of manna in 10 ounces by measure of compound decoction of chamomile, (see N° 125.), and adding an ounce of olive oil, and half an ounce of sulphate of magnesia.

SECT. 7. *Metals, and Metallic Preparations.*

275. ACIDUM ARSENIOSUM. 141

Arseniate of potash.

Preparation *a*. ARSENIAS KALI, Dub. Arseniate of potash.

The Dublin college direct this salt to be prepared by mixing together an ounce of white oxide of arsenic, and the same quantity of nitrate of potash, separately reduced to powder, putting them into a glass retort placed in a sand bath, and applying a gradual heat, till the bottom of the retort assumes an obscure red; then dissolving the residuum in four pounds of boiled distilled water, evaporating, and setting it aside to crystallize.

The use of arsenic, in the cure of many diseases of debility, has of late been much extended. It is now employed, not only in intermittents, but in protracted rheumatism, and many other cases where the vital powers are much diminished.

276. SULPHURETUM ANTIMONII.

Preparation *h*. OXIDUM ANTIMONII NITRO-MURIATICUM, olim CALX STIBII PRÆCIPITATA, Dub. (See N° 879.). Nitro-muriatic oxide of antimony. 142

Nitro-muriatic oxide of antimony.

This precipitate is now directed to be prepared by mixing together 11 ounces by measure of muriatic acid, and 1 ounce by measure of nitrous acid, taking care to avoid the fumes, and gradually adding to the mixture 2 ounces of prepared sulphuret of antimony; then digesting with a gradually increased heat, till the effervescence ceases, and boiling for an hour; filtering the liquor when cold, so that it may drop into a gallon of water. The powder which falls to the bottom is to be repeatedly washed till the water poured from it is perfectly free from acid, and is then to be dried on blotting paper.

Preparation *k*. TARTRAS ANTIMONII ET POTASSÆ. TARTARUM ANTIMONIATUM, SIVE EMETICUM. Dub. Antimoniated or emetic tartar. 143

Antimoniated tartar.

In the Dublin pharmacopœia we are directed to prepare this medicine by boiling 18 ounces by measure of distilled water in a glass vessel, and gradually throwing into it 2 ounces of nitro-muriatic oxide of antimony, and $2\frac{1}{2}$ ounces of powdered crystals of tartar, previously mixed, continuing the boiling for half an hour, then filtering the liquor, and cooling it gradually, that crystals may be formed.

277. HYDRARGYRUM.

Preparation *a*. HYDRARGYRUM CUM MAGNESIA, Dub. Mercury with magnesia. 144

Quicksilver with magnesia.

This is a new preparation, formed by first rubbing together an ounce of quicksilver with the same quantity of manna, adding now and then a few drops of water,

so

Appendix. so as to reduce the mixture to the consistence of syrup, till the whole of the mercury disappears; then still continuing the trituration, adding first a dram of magnesia, and when all are well mixed, a pint of hot water, and shaking the mixture. When the sediment has completely subsided, the liquor is to be poured off, and the washing twice repeated, so as to dissolve the whole of the manna. To the sediment, still moist, are to be added three drams more of magnesia, and the compound is to be dried on blotting paper.

This preparation is similar in its medical effects to the *hydrargyrus cum creta*, described in MATERIA MEDICA, N° 914.

145 Ammoniated submuriate of mercury. Preparation *b*. SUBMURIAS HYDRARGYRI AMMONIATUM. Dub. Ammoniated submuriate of mercury.

Prepared by adding to the liquor from which precipitated submuriate of mercury has been obtained, a quantity of caustic water of ammonia, washing the precipitate with cold distilled water, and drying on blotting paper. The same with the *calx hydrargyri alba*, London.

278. ZINCUM.

146 Tincture of acetate of zinc. Preparation *g*. TINCTURA ACETATIS ZINCI. Dub. Tincture of acetate of zinc.

Made by rubbing together an ounce of sulphate of zinc, and the same quantity of acetate of potash, then adding a pint of rectified spirit of wine, macerating for a week with frequent agitation, and filtering the tincture.

Chiefly used as an external astringent.

280*. OXIDUM MANGANESII NIGRUM. Manganesium, Dub. Black oxide of manganese.

Employed chiefly in preparing the oxymuriatic alkaline water. Appendix.

287. SULPHAS FERRI NATIVUS.

Preparation *e**. ACETAS FERRI. Dub. Acetate of iron. 147 Acetate of iron.

Made by digesting half an ounce of carbonate of iron in 3 ounces by measure of acetic acid, and filtering.

Preparation *f*. TINCTURA MURIATIS FERRI CUM OXIDO RUBRO, Dub. Tincture of muriate of iron with red oxide. 148 Tincture of muriate of iron with red oxide.

Prepared by digesting an ounce of red oxide of iron with four ounces by measure of muriatic acid for 24 hours, then boiling for half an hour, evaporating the filtered liquor to the consistence of syrup, and when cold, adding rectified spirit of wine, with frequent agitation, till the tincture acquires the specific gravity of 1050.

A modification of the tincture of muriated iron described under MATERIA MEDICA, N° 965, and is employed in similar cases.

The above appear to be the most material changes made in the new edition of the Dublin Pharmacopœia. A few articles of less consequence are omitted, and the new names of others will be seen in the following Table. In this Table we have followed the alphabetical order of the last Edinburgh Pharmacopœia, and in the third column we have caused the London names to be printed in Italics, leaving a space above each for the insertion of such new names as may occur in the new edition of their Pharmacopœia which the London College is expected soon to publish.

TABLE of Synonymous Names of the Officinal Compounds.

EDINBURGH NAMES.	DUBLIN NAMES.	LONDON NAMES IN 1791.
Acetis hydrargyri.	Acetas hydrargyri.	
Hydrargyrus acetatus.	*Hydrargyrum acetatum.*	*Hydrargyrus acetatus.*
Acetis plumbi.	Acetas plumbi.	
Saccharum saturni.	*Cerussa acetata.*	*Cerussa acetata.*
Acetis potassæ.	Acetas kali.	
Lixiva acetata.	*Alkali vegetabile acetatum.*	*Kali acetatum.*
Acidum acetosum destillatum.	Acetum distillatum.	
Acetum vini distillatum.		*Acetum distillatum.*
Acidum acetosum forte.	Acidum aceticum.	*Acidum acetosum.*
Acidum acetosum camphoratum.	Acidum aceticum camphoratum.	
Acidum benzoicum.	Acidum benzoicum.	
Flores benzoini.	*Sal benzoini.*	*Flores benzoës.*
Acidum sulphuricum.	Acidum sulphuricum.	
Acidum vitriolicum.	*Acidum vitriolicum.*	*Acidum vitriolicum.*
Æther sulphuricus.	Æther sulphuricus.	
Æther vitriolicus.	*Æther vitriolicus.*	*Æther vitriolicus.*
Alcohol.	Alcohol.	
Spiritus vinosus rectificatus.		*Alcohol.*
Alcohol ammoniatum.	Spiritus ammoniæ.	
Spiritus ammoniæ.	*Spiritus alkali volatilis.*	*Spiritus ammoniæ.*
Alcohol ammoniatum aromaticum.	Spiritus ammoniæ aromaticus.	
Spiritus ammoniæ aromaticus.	*Spiritus alkali volatilis aromaticus.*	*Spiritus ammoniæ compositus.*
Alcohol ammoniatum fœtidum.	Spiritus ammoniæ fœtidus.	*Spiritus ammoniæ fœtidus.*

EDINBURGH NAMES.	DUBLIN NAMES.	LONDON NAMES IN 1791.
Ammoniaretum cupri.	Cuprum ammoniatum.	
Cuprum ammoniacum.		
Aqua acetitis ammoniæ.	Aqua acetatis ammoniæ.	
Aqua ammoniæ acetatæ.	*Liquor alkali acetatis volatilis.*	*Aqua ammoniæ acetatæ.*
Aqua ammoniæ.	Aqua ammoniæ causticæ.	
Aqua ammoniæ causticæ.	*Aqua alkali volatilis caustici.*	*Aqua ammoniæ puræ.*
Aqua carbonatis ammoniæ.	Aqua carbonatis ammoniæ.	
Aqua ammoniæ.	*Liquor alkali volatilis mitis.*	*Aqua ammoniæ.*
	Aqua cupri ammoniati.	
	Liquor cupri ammoniati.	*Aqua cupri ammoniati.*
Aqua potassæ.	Aqua kali caustici.	
Aqua lixivæ causticæ.	*Lixivium causticum.*	*Aqua kali puri.*
	Aqua subcarbonatis kali.	
	Lixivium mite.	*Aqua kali præparati.*
Carbonas ammoniæ.	Carbonas ammoniæ.	
Sal ammoniacus volatilis.	*Alkali volatile mite.*	*Ammonia præparata.*
Carbonas calcis præparatus.	Creta preparata.	
Creta alba.		*Creta præparata.*
Carbonas ferri præparatus.		
Rubigo ferri.		*Rubigo ferri.*
Carbonas ferri præcipitatus.	Carbonas ferri.	
Carbonas magnesiæ,	Magnesia.	
Magnesia alba.		*Magnesia alba.*
Carbonas potassæ.	Carbonas potassæ.	
Lixiva purificata.	*Alkali vegetabile mite.*	*Kali præparatum.*
Carbonas sodæ.	Carbonas sodæ.	
Soda.	*Alkali fossile mite.*	*Natron præparatum.*
Decoctum anthemidis nobilis.	Decoctum chamæmeli.	
Decoctum commune.		*Decoctum pro enemate.*
Decoctum guaiaci compositum.	Decoctum sarsaparillæ compositum.	
Decoctum lignorum.		*Decoctum sarsaparillæ compositum.*
Decoctum cinchonæ officinali.	Decoctum corticis cinchonæ.	
	Decoctum corticis peruviani.	*Decoctum corticis peruviani.*
Electuarium aromaticum.	Electuarium aromaticum.	
Confectio cardiaca.		*Confectio aromatica.*
Electuarium cassiæ sennæ.	Electuarium sennæ.	
Electuarium lenitivum.		*Electuarium è senna.*
Electuarium mimosæ catechu.	Electuarium catechu compositum.	
Confectio Japonica.		
Electuarium opiatum.		
Electuarium thebaicum.		*Confectio opiata.*
Emplastrum gummosum.		
	Emplastrum galbani.	*Emplastrum lithargyri compositum.*
	Emplastrum aromaticum.	*Emplastrum ladani compositum.*
Emplastrum meloes vesicatorii.	Emplastrum cantharidis.	
Emplastrum vesicatorium.		*Emplastrum cantharidis.*
Emplastrum oxidi plumbi semivitrei.	Emplastrum lithargyri.	
Emplastrum commune.		*Emplastrum lithargyri.*
Emplastrum oxidi ferri rubri.	Emplastrum thuris.	
Emplastrum roborans.		*Emplastrum thuris.*
Emplastrum resinosum.	Emplastrum lithargyri cum resina.	
Emplastrum adhæsivum.		*Emplastrum lithargyri cum resina.*
Emplastrum saponaceum.	Emplastrum saponis.	
	Emplastrum saponaceum.	*Emplastrum saponis.*
Emulsio amygdali communis.		
Emulsio communis.		*Lac amygdalæ.*
Emulsio mimosæ niloticæ.	Emulsio Arabica.	
Emulsio Arabica.		
Emulsio camphorata.	Mistura camphorata.	*Mistura camphorata.*
Extractum anthemidis nobilis.	Extractum florum chamæmeli.	*Extractum chamæmeli.*
Extractum cinchonæ officinalis.	Extractum cinchonæ rubræ resin.	
Extractum corticis peruviani.	*Extractum corticis peruviani.*	*Extractum corticis peruviani cum resino.*

Appendix.

Edinburgh Names.	Dublin Names.	London Names in 1791.
Extractum convolvuli jalapæ.	Extractum jalapæ.	*Extractum jalapii.*
Extractum jalapæ.		
Extractum glycyrrhizæ glabræ.	Extractum glycyrrhizæ.	*Extractum glycyrrhizæ.*
Extract. hæmatoxyli campechiani.	Extractum scobis hæmatoxyli.	
Extractum ligni campechensis.		*Extractum ligni campechensis.*
Extractum rutæ graveolentis.	Extractum foliorum rutæ.	
Extractum foliorum rutæ.		*Extractum rutæ.*
	Hydrargyrum cum creta.	*Hydrargyrus cum creta.*
Infusum cinchonæ officinalis.	Infusum cinchonæ sine calore.	
Infusum rosæ gallicæ.		
Infusum rosarum.	Infusum rosæ.	*Infusum rosæ.*
Infusum tamarindi cum senna.	Infusum sennæ cum tamarindis.	
Magnesia.		
Magnesia usta.	Magnesia usta.	*Magnesia usta.*
Mucilago astragali tragacantha.		
Mucilago gummi tragacanthæ.	Mucilago gummi tragacanthæ.	*Mucilago tragacanthæ.*
Mucilago mimosæ niloticæ.		
Mucilago gummi Arabici.	Mucilago gummi Arabici.	*Mucilago Arabici gummi.*
Murias ammoniæ et ferri.		
Flores martiales.	Murias ammoniæ et ferri.	*Ferrum ammoniacale.*
Murias hydrargyri.	Murias hydrargyri corrosivum.	
Mercurius sublimatus corrosivus.	*Hydrargyrum muriat. corrosivum.*	*Hydrargyrus muriatus.*
Murias antimonii.		
Butyrum antimonii.		*Antimonium muriatum.*
Nitras argenti.	Nitras argenti.	
Causticum lunare.	*Argentum nitratum.*	*Argentum nitratum.*
Oleum ammoniatum.		
Linimentum volatile.	Linimentum ammoniæ.	*Linimentum ammoniæ.*
	Oleum cornu cervi rectificatum.	*Oleum animale.*
Oleum volatile juniperi communis.	Oleum baccarum juniperi.	*Oleum essentiale baccæ juniperi.*
Oleum volatile lauri sassafras.	Oleum corticis et ligni sassafras.	*Radicis sassafras.*
Oleum lavandulæ spicæ.	Oleum florum lavandulæ.	*Oleum lavandulæ.*
Oleum juniperi sabinæ.	Oleum foliorum sabinæ.	
Oleum volatile menthæ piperitæ.	Oleum herbæ florescentis menthæ piperitidis.	*Oleum menthæ piperitidis.*
Oleum volatile myrti pimentæ.	Oleum baccarum pimento.	
Oleum volatile pimpinellæ anisi.	Oleum seminum anisi.	*Oleum essentiale anisi.*
Oleum volatile pini.	Oleum terebinthinæ rectificatum.	*Oleum terebinthinæ rectificatum.*
Oleum volatile roris marini officinalis.	Oleum roris marini.	*Oleum roris marini.*
Oleum sulphuratum.		
Balsamum sulphuris.		*Oleum sulphuratum.*
Oxidum antimonii cum phosphate calcis.	Pulvis antimonialis.	
Antimonium calcareo-phosphorat.		*Pulvis antimonialis.*
Oxidum antimonii cum sulph. per nitrat. potassæ.		
Crocus antimonii.		*Crocus antimonii.*
Oxidum antimonii cum sulphure vitrificatum.		
Vitrum antimonii.		*Antimonium vitrificatum.*
Oxidum ferri nigrum.	Oxydum ferri nigrum.	
Ferri squamæ.		
Oxidum rubrum.	Oxydum ferri rubrum.	
Ferrum vitriolatum ustum.		
	Oxydum hydrargyri.	*Hydrargyrus calcinatus.*
Oxid. hydrargyri per acidum nitricum	Oxydum hydrargyri nitricum.	
Mercurius præcipitatus ruber.	*Hydrargyrum subnitratum.*	*Hydrargyrus nitratus ruber.*

Oxidum

Appendix.

Edinburgh Names.	Dublin Names.	London Names in 1791.
Oxidum hydrargyri cinereum.	Oxydum hydrargyri cinereum.	
Pulvis mercurii cinereus.		
Oxidum zinci.	Oxydum zinci.	
Calx zinci.	*Zincum ustum.*	*Zincum calcinatum.*
Phosphas sodæ.	Phosphas sodæ.	
Soda phosphorata.		
Pilulæ aloeticæ.	Pilulæ aloes cum zingibere.	
	Pilulæ aloeticæ.	*Pilulæ aloes compositæ.*
Pilulæ aloes cum colocynthide.	Pilulæ colocynthidis compositæ.	
Pilulæ ex colocynthide cum aloe.		
Pilulæ assæfœtidæ compositæ.	Pilulæ myrrhæ compositæ.	
Pilulæ gummosæ.		*Pilulæ è gummi.*
Pilulæ scilliticæ.	Pilulæ scillæ cum zingibere.	
	Pilulæ scilliticæ.	*Pilulæ scillæ.*
Potassa.	Kali causticum.	
Causticum commune acerrimum.	*Alkali vegetabile causticum.*	*Kali purum.*
Potassa cum calce.	Kali cum calce.	
Causticum commune mitius.	*Causticum mitius.*	*Calx cum kali puro.*
Potio carbonatis calcis.	Mistura cretæ.	
Potio cretacea.	*Mistura cretacea.*	*Mistura cretacea.*
Pulvis carbonatis calcis compositus.		
Pulvis cretaceus.		*Pulvis cretæ compositus.*
Pulvis ipecacuanhæ et opii.	Pulvis ipecacuanhæ compositus.	
Pulvis doveri.		*Pulvis ipecacuanha compositus.*
Solutio sulphatis cupri composita.		
Aqua styptica.		
Spiritus ætheris nitrosi.	Spiritus æthereus nitrosus.	
Spiritus nitri dulcis.	*Liquor æthereus nitrosus.*	*Spiritus ætheris nitrosi.*
Spiritus ammoniæ aromaticus.	Spiritus ammoniæ aromaticus.	
Spiritus volatilis aromaticus.	*Spiritus alkali volatilis aromaticus.*	*Spiritus ammoniæ compositus.*
Spiritus lauri cinnamomi.	Spiritus cinnamomi.	
Aqua cinnamomi spirituosa.		*Spiritus cinnamomi.*
Spiritus myristicæ moschatæ.	Spiritus nucis moschatæ.	*Spiritus myristicæ.*
Subacetis cupri præparatus.	Ærugo præparata.	
Ærugo æris.		*Ærugo præparata.*
Submurias hydrargyri.	Submurias hydrargyri sublimatum.	
Hydrargyrus muriatus mitis.	*Hydrargyrum muriatum mite sublimatum.*	*Calomelas.*
Submurias hydrargyri præcipitatus.	Submurias hydrargyri præcipitatum.	
	Hydrargyrum muriatum mite præcipitatum.	*Hydrargyrus muriatus mitis.*
	Submurias hydrargyri ammoniatum.	*Calx hydrargyri alba.*
Subsulphas hydrargyri flavus.	Oxydum hydrargyri sulphuricum.	
Mercurius flavus, vel turpeth. min.		*Hydrargyrus vitriolatus.*
Succus spissatus conii maculati.	Succus spissatus cicutæ.	
Extractum seminum cicutæ.		*Succus cicutæ spissatus.*
Succus spissatus momordicæ elaterii.	Elaterium.	
Elaterium.		*Elaterium.*
Sulphas aluminæ exsiccatus.	Alumen ustum.	
Alumen ustum.		*Alumen ustum.*
Sulphas ferri.	Sulphas ferri.	
Sal martis.	*Ferrum vitriolatum.*	*Ferrum vitriolatum.*
Sulphas potassæ.	Sulphas kali.	
Lixiva vitriolata.	*Alkali vegetabile vitriolatum.*	*Kali vitriolatum.*
Sulphas potassæ cum sulphure.		
Sal polychrestus.		
Sulphas sodæ.	Sulphas sodæ.	
Soda vitriolata.	*Alkali fossile vitriolatum.*	*Natron vitriolatum.*
Sulphas zinci.	Sulphas zinci.	
Vitriolum album.	*Zincum vitriolatum.*	*Zincum vitriolatum.*
Sulphuretum antimonii præcipitatum	Sulphur antimonii fuscum.	
Sulphur antimonii præcipitatum.		

Edinburgh Names.	Dublin Names.	London Names in 1791.
Sulphuretum hydrargyri nigrum.	Sulphuretum hydrargyri nigrum.	
Æthiops mineralis.	*Hydrargyrum sulphurat. nigrum.*	*Hydrargyrus cum sulphure.*
Sulphuretum hydrargyri rubrum.	Sulphuretum hydrargyri rubrum.	
Cinnabaris factitia.	*Hydrargyrum sulphurat. rubrum.*	*Hydrargyrus sulphuratus ruber.*
Sulphuretum potassæ.	Sulphuretum kali.	
Hepar sulphuris.	*Alkali vegetabile sulphuratum.*	*Kali sulphuratum.*
Syrupus citri aurantii.	Syrupus aurantii.	
Syrupus è cortice aurantiorum.		*Syrupus corticis aurantii.*
Syrupus citri medici.	Syrupus limonis.	
Syrupus è succo malorum limon.		*Syrupus limonis.*
Syrupus dianthi caryophylli.	Syrupus caryophylli rubri.	
Syrupus caryophyllorum.		*Syrupus caryophylli rubri.*
Syrupus toluiferi balsami.		
Syrupus balsamicus.		*Syrupus tolutanus.*
Tartris antimonii.	Tartarum antimoniatum.	
Tartarus antimonialis sive emet.	*Tartarum stibiatum.*	*Antimonium tartarisatum.*
Tartris potassæ.	Tartaras kali.	
Tartarum solubile.	*Alkali vegetabile tartarisatum.*	*Kali tartarisatum.*
Tartris potassæ et sodæ.	Tartaras sodæ et kali.	
Sal rupellensis.	*Sal rupellensis.*	*Natron tartarisatum.*
Tinctura aloes et myrrhæ.	Tinctura aloes composita.	*Tinctura aloes composita.*
Tinctura aristolochiæ serpentariæ.	Tinctura serpentariæ.	*Tinctura serpentariæ.*
Tinctura benzoin composita.		
Balsamum traumaticum.		*Tinctura benzoes composita.*
Tinctura camphoræ.	Spiritus camphoratus.	
Spiritus vinosus camphoratus.		*Spiritus camphoratus.*
Tinctura convolvuli jalapæ.	Tinctura jalapæ.	*Tinctura jalapæ.*
Tinctura ferulæ assæfœtidæ.	Tinctura assæfœtidæ.	*Tinctura assæfœtidæ.*
Tinctura lauri cinnamomi.	Tinctura cinnamomi.	*Tinctura cinnamomi.*
Tinctura meloes vesicatorii.	Tinctura cantharidis.	*Tinctura cantharidis.*
Tinctura cantharidum.		
Tinctura mimosæ catechu.	Tinctura catechu.	*Tinctura catechu.*
Tinctura japonica.		
		Tinctura ferri muriati.
Tinctura muriatis ferri.	Tinctura muriatis ferri.	
Tinctura opii ammoniata.	Tinctura opii camphorata.	*Tinctura opii camphorata.*
Elixir paregoricum.		
		Tinctura rhabarbari.
Tinctura rhei palmati.	Tinctura rhei.	
Tinctura saponis.	Linimentum saponis.	*Linimentum saponis compositum.*
Linimentum saponaceum.		
Tinctura saponis et opii.		
Linimentum anodynum.		
Tinctura toluiferi balsami.	Tinctura balsami tolutani.	
Tinctura tolutana.		*Unguentum cerussæ acetatæ.*
Unguentum acetitis plumbi.	Unguentum acetatis plumbi.	
Unguentum saturninum.		*Unguentum ceræ.*
Unguentum album.	Unguentum ceræ.	
Unguentum nitratis hydrargyri.	Unguentum supernitratis hydrargyri	*Unguentum hydrargyri nitrati.*
Unguentum citrinum.	*Unguentum hydrargyri nitrati.*	
Unguentum oxidi plumbi albi.		
Unguentum è cerussa.	Unguentum cerussæ.	
Unguentum meloes vesicatorii.	Unguentum cantharidis.	*Unguentum cantharidis.*
Unguentum epispast. è pulv. canth.		
Unguentum resinosum.	Unguentum resini albi.	*Unguentum resini flavi.*
Unguentum basilicum.		
Unguentum subacetitis cupri.	Unguentum æruginis.	*Vinum antimonii tartarisati.*
Vinum tartritis antimonii.		
Vinum è tartaro antimoniali.		

INDEX.

N.

Presence, Present Tense.

PRESENCE, a term of relation, used in opposition to absence, and signifying the existence of a person in a certain place.

Present Tense, in *Grammar*, the first tense of a verb, expressing the present time, or that something is now performing; as *scribo*, I write, or am writing. See Grammar.

Present Tense, Presentation.

PRESENTATION, in ecclesiastical law. See Patronage.

Presentation of the Virgin, is a feast of the Rom-ish

ish church, celebrated on the 21st of November, in memory of the Holy Virgin's being presented by her parents in the temple, to be there educated. Emanuel Comnenus, who began to reign in 1143, makes mention of this feast in his Constitutions. Some imagine it to have been established among the Greeks in the 11th century; and think they see evident proofs of it in some homilies of George of Nicomedia, who lived in the time of Photius. Its institution in the West is ascribed to Gregory XI. in 1372. Some think it was instituted in memory of the ceremony practised among the Jews for their new-born females; corresponding to the circumcision on the eighth day for males.

Presentation of our Lady also gives the title to three orders of nuns. The first, projected in 1618, by a maid named Joan of Cambray. The habit of the nuns, according to the vision she pretended to have, was to be a gray gown of natural wool, &c.; but this project was never accomplished. The second was established in France, about the year 1627, by Nicholas Sanguin, bishop of Senlis; it was approved by Urban VIII. This order never made any great progress. The third was established in 1664, when Frederic Borromeo, being apostolical visitor in the Valteline, was intreated by some devout maids at Morbegno to allow them to live in community in a retired place; which he granted, and erected them into a congregation, under the title of *congregation of our Lady*. They live under the rule of St Augustine.

PRESENTMENT, in *Law*. See Prosecution.

A presentment, generally taken, is a very comprehensive term; including not only *presentments* properly so called, but also inquisitions of office, and indictments by a grand jury. A presentment, properly speaking, is the notice taken by a grand jury of any offence from their own knowledge or observation, without any bill of indictment laid before them at the suit of the king: As the presentment of a nuisance, a libel, and the like; upon which the officer of the court must afterwards frame an indictment, before the party presented can be put to answer it. An inquisition of office is the act of a jury, summoned by the proper officer to inquire of matters relating to the crown, upon evidence laid before them. Some of these are in themselves convictions, and cannot afterwards be traversed or denied; and therefore the inquest, or jury, ought to hear all that can be alleged on both sides. Of this nature are all inquisitions of *felo de se;* of flight in persons accused of felony; of deodands, and the like; and presentments of petty offences in the sheriff's tourn or court-leet, whereupon the presiding officer may set a fine. Other inquisitions may be afterwards traversed and examined; as particularly the coroner's inquisition of the death of a man, when it finds any one guilty of homicide; for in such cases the offender so presented must be arraigned upon this inquisition, and may dispute the truth of it; which brings it to a kind of indictment, the most usual and effectual means of prosecution. See Indictment.

PRESERVATION island, a small island on the southern coast of New Holland, and one of the groupe called *Furneaux islands*, derives its name from the circumstance of the crew of a ship which was wrecked on the coast, having saved their lives, and resided for some time upon it. This island is in most places extremely barren, and is remarkable for large blocks of granite scattered on its surface in many places. But one of the most singular phenomena in the history of this island was, the discovery of a petrified wood in the midst of a patch of naked sand; and at least 100 feet above the level of the sea. Some of the stumps of the trees rose a foot and a half above the surface; some were furnished with branches, and even it is said a green leaf was seen on one of them when they were first discovered. The petrifactions were found to be of a calcareous nature. We think it probable that the trees here said to be petrified may be of the nature of corals, may have been formed as usual at the bottom of the sea, and elevated to their present situation by some convulsion.

In some parts of the island a little vegetation was observed, with some brush wood and stunted trees. Small kangaroos were found in abundance, with different kinds of birds and some noxious snakes. *Collins's Account of New South Wales*, II.

PRESERVING *Lives of Shipwrecked Persons.* In our account of life-boats, we laid before our readers every thing that seemed useful on so important a subject which was then known to us. Since that time we have met with the following description of a similar invention by a Mr Lukin of London, suggested during his casual residence at Lowestoff in Suffolk.

A boat constructed on this principle cannot be overset or sunk by any power of wind and water; in proof of which the following particulars and description of the construction are made public, with the hope of rendering more generally known the easy means of saving many valuable lives; which might certainly be done, if one or two of these boats were built at each of our ports, and every ship furnished with one (at least) in proportion to her size.

Description and Dimensions of the Lowestoff Life-Boat.

	Feet.	Inches.
Length aloft - -	40	0
——— keel - -	37	0
Breadth amidships -	10	0
Depth - - -	3	6 exclusive of
a moveable wash strake of	0	8

The form the same as the yawns of that coast; the stern post nearly upright.

External gunwales hollow, forming an oblique section of a parabola with the side of the boat, and projecting nine inches from it on each side: these gunwales are reduced a little in their projection towards their ends, and are first formed by brackets and thin boards, covered at top and bottom with one thickness of good sound cork, and the extremity or apex of the projection having two thicknesses of cork, the better to defend it from any violent blows it may meet with in hard service. The depth of these gunwales from top to bottom was 15 inches, and the whole covered with very strong canvas, laid on with strong cement to resist the water, and that will not stick to any thing laid upon it.

A false keel of wrought iron three inches deep, made of three bars rivetted together, and bolted under the common keel, which it greatly strengthens, and makes a very essential part of her ballast; being fixed so much below the floor, it has nearly double the power the same weight would have if laid on the floor, and therefore

much

Preserving || Presidial.

much preferable to any other ballast that can be used for sailing boats.

Thwarts and gang-board as usual; three masts and lug sails, and 12 short oars.

In this state, this boat is much safer than any common boat of the same dimensions, will carry more sail, and bear more weather; but to make it completely unimmergible, empty casks of about 22 inches diameter were ranged along withinside the gunwales, lashed firmly to the boat, lying even with the tops of the gunwales, and resting upon brackets fastened to the timbers for that purpose: also two such casks in the head, and two in the stern, and all removable in a short time, if desired; there were also some empty casks placed under the gang-board; these would be an addition to the buoyancy if empty, and an increase to her ballast if full.

Thus equipped, this boat was launched on the 19th of November, in a very squally day. About 20 men were launched in her, most of them pilots or seamen. They ran her immediately from the beach across the Corton sand, in the midst of the breakers, which would have been almost certain destruction to any common sailing boat, as that would have been filled and sunk immediately. They then turned to the southward along the top of the sand to its end: when they tacked and stood to the northward, pulled up the plugs in her bottom, and let in as much water as would come that way; the water rose very little above the thwarts. With all this water in it, the boat sailed better than without it. The plugs were now put in again, and water poured in by buckets, until it ran over both gunwales; and in this state it was the opinion of those on board that she would have carried 60 men without sinking, and to upset it is not possible. But it is Mr Lukin's opinion that more than 50 men should not be taken in when the boat is full of water, and all her casks empty.

It is particularly advisable that all life-boats should be built of the form most approved by the pilots or seamen on the coast where they are to be used; as no one form will suit all shores; and these principles of safety are applicable to every form.

To this description we have only to add, that Mr Lukin is said to be the inventor of the first life-boat ever built in England, and to have obtained a patent for it in the year 1785. It would appear, too, that he published a pamphlet on the subject, but this pamphlet we have had no opportunity of seeing.

PRESIDENT, PRÆSES, is an officer, created or elected to preside over a company or assembly; so called in contradistinction to the other members, who are termed *residents*.

Lord PRESIDENT *of the Council*, is a great officer of the crown, who has precedence next after the lord chancellor and lord treasurer; as ancient as the time of King John, when he was styled *consiliarius capitalis*.—His office is to attend on the king, to propose business at the council-table, and to report to the king the several transactions there. See *Privy-Council*.

PRESIDIAL, was a tribunal, or bench of judges, established (before the Revolution) in the several considerable cities of France, to judge ultimately, or in the last resort, of the several causes brought before them by way of appeal from the subaltern judges. The presidials made one company with the officers of the bailliages and seneschaussees, where they were established.

Press.

PRESS (PRELUM), in the mechanic arts, a machine made of iron or wood, serving to squeeze or compress any body very close.

The ordinary presses consist of six members, or pieces; viz. two flat smooth planks; between which the things to be pressed are laid; two screws, or worms, fastened to the lower plank, and passing through two holes in the upper; and two nuts, in form of an S, serving to drive the upper plank, which is moveable against the lower, which is stable, and without motion.

Presses used for expressing Liquors, are of various kinds; some, in most respects, the same with the common presses, excepting that the under plank is perforated with a great number of holes to let the juice expressed run through into a tub, or receiver, underneath.

A very useful machine for a press, in the process of cyder-making, has been constructed by Mr Anstice, who, with his well-known zeal for the improvement of mechanics, permits us to lay before our readers the following description of it.

AA fig. 1. two pieces of timber, 21 feet long, 12 by 6 inches, laid side by side at the distance of 12 inches, and secured in that situation by blocks placed between and bolts passing through them; this frame forms the bed of the machine. BB, two uprights, 12 feet long, 6 by 8 inches, morticed upon them, and secured in their position by pins and iron squares. CC, two uprights, five feet long, six by ten inches, morticed near the end of the under frame, and secured as before. D, a lever, 17 feet long, 12 by 13 inches, turning on a large bolt which passes through the short uprights, also through iron straps, which secure them to the bed inside, and a stirrup of iron which passes over the end of the lever, and which makes the turning point in the line of its lower side, and not through its middle. E, a lever 20 feet long, six by eight inches at its largest part and tapering towards the other end: this lever turns on a bolt in the uprights BB. F, 1, 2, 3, 4. four pieces of oak (which he calls *needles*, 10 feet long), four by two and a half inches, morticed loosely into the upper lever, and hung thereto by bolts, so as to swing perpendicularly and play in a long mortice or channel cut through the large lever to receive them. These needles have inch-holes pretty closely bored through them (in a direction crossing the machine), from the lower ends as far upwards as the great lever will reach, when it is as high as it can go. G, a bed to receive what is to be pressed. H, a frame to support a winch worked by a handle at I. At the end of the small lever two blocks or pulleys are fixed, one above, and the other below it; a rope of about half an inch diameter is then fastened to the cieling (or continuation of the uprights of the winch frame if necessary) at K; then passed through the upper block on the lever, from thence passed through a block at L, and then goes with four turns round the winch, from whence it is carried through the block under the lever, and fastens to the machine at M; by this means, if the winch be turned one way, it raises the end of the small lever if the other depresses it.

Plate CCCCXXXIX. fig. 1.

To work the machine. If we suppose the great lever bearing on the matter to be pressed, an iron pin must be put into one of the holes in the needles above the great lever; and when the small lever is worked as

 far

Press.

far as it will go, either up or down, another bolt is to be put into the hole, which comes nearest above the great lever on the other side of the uprights BB, and the winch then turned the contrary way, by which means the pressing goes on whether the small lever rises or falls. Before the resistance is very great, the needles farthest from the fulcrum of the small lever are used; after that the nearest are employed, which doubles the power of the machine. In raising the great lever, or lowering it to its bearing, the needles most distant from the fulcrum of the small lever, are used *under* instead of *over* it. As the rope is liable to stretch and get slack, he passes it, after taking two turns on the winch, through a pulley, to which is suspended a weight of half a hundred, and then takes two turns more before it is carried through the other block, by which means the slack is constantly gathered in, and the weight holds on without increasing the friction, as by hanging under the winch it counteracts the pressure upwards on its axis.

The power of this machine is very great, being as one to 1136 nearly, and capable by a trifling addition of any other proportion. It is applicable to many purposes beside cyder pressing, and is more simple, and less liable to injury, than any other which has fallen under our observation. Perhaps, however, it would be an improvement to use, instead of the ropes and pulleys, by which the lever E is moved, a small wheel or pinion of 10 or 12 teeth, on the axis of the winch W (fig. 2.), and a stiff beam *e n* down from the lever, having on its lower end an iron rack, of which the teeth take into those of the pinion. The action of these teeth would, in our opinion, be less diminished by friction and obliquity, than the pulleys are by friction and the stiffness of the rope; and the machine would retain all its other advantages.

Fig. 2.

Press used by Joiners, to keep close the pieces they have glued, especially panels, &c. of wainscot, is very simple, consisting of four members; viz. two screws, and two pieces of wood, four or five inches square, and two or three feet long; whereof the holes at the two ends serve for nuts to the screws.

Press used by Inlayers, resembles the joiner's press, except that the pieces of wood are thicker, and that only one of them is moveable; the other, which is in form of a tressel, being sustained by two legs or pillars, joined into it at each end. This press serves them for sawing and cleaving the pieces of wood required in marquetry or inlaid work.

Founder's Press, is a strong square frame, consisting of four pieces of wood, firmly joined together with tenons, &c. This press is of various sizes, according to the sizes of the moulds; two of them are required to each mould, at the two extremities of which they are placed; so as that, by driving wooden wedges between the mould and the sides of the presses, the two parts of the mould wherein the metal is to be run may be pressed close together.

Printing-Press. See *Printing-Press*.

Rolling-Press, is a machine used for taking off prints from copper-plates. It is much less complex than that of the letter-printers. See its description and use under the article *Rolling-Press Printing*.

Press, in *Coining*, is one of the machines used in striking of money; differing from the balance, in that it has only one iron bar to give it motion, and press the moulds or coins; is not charged with lead at its extreme, nor drawn by cordage. See Coining.

Press, Pressing.

Binder's Cutting-Press, is a machine used equally by book-binders, stationers, and pasteboard-makers; consisting of two large pieces of wood, in form of cheeks, connected by two strong wooden screws; which, being turned by an iron bar, draw together, or set asunder, the cheeks, as much as is necessary for the putting in the books or paper to be cut. The cheeks are placed lengthwise on a wooden stand, in the form of a chest, into which the cuttings fall. Aside of the cheeks are two pieces of wood, of the same length with the screws, serving to direct the cheeks, and prevent their opening unequally. Upon the cheeks the plough moves, to which the cutting-knife is fastened by a screw; which has its key to dismount it, on occasion, to be sharpened.

The plough consists of several parts; among the rest a wooden screw or worm, which, catching within the nuts of the two feet that sustain it on the cheeks, brings the knife to the book or paper which is fastened in the press between two boards. This screw, which is pretty long, has two directories, which resemble those of the screws of the press. To make the plough slide square and even on the cheeks, so that the knife may make an equal paring, the foot of the plough where the knife is not fixed, slides in a kind of groove, fastened along one of the cheeks. Lastly, the knife is a piece of steel, six or seven inches long, flat, thin, and sharp, terminating at one end in a point, like that of a sword, and at the other in a square form, which serves to fasten it to the plough. See *Book-Binding*.

As the long knives used by us in the cutting of books or papers, are apt to jump in the cutting of thick books, the Dutch are said to use circular knives, with an edge all round; which not only cut more steadily, but last longer without grinding.

Press, in the woollen manufactory, is a large wooden machine, serving to press cloths, serges, rateens, &c. thereby to render them smooth and even, and to give them a gloss.

This machine consists of several members; the principal whereof are the cheeks, the nut, and the worm or screw, accompanied with its bar, which serves to turn it round, and make it descend perpendicularly on the middle of a thick wooden plank, under which the stuffs to be pressed are placed. The calender is also a kind of press, serving to press or calender linens, silks, &c.

Liberty of the Press. See *Liberty of the Press*.

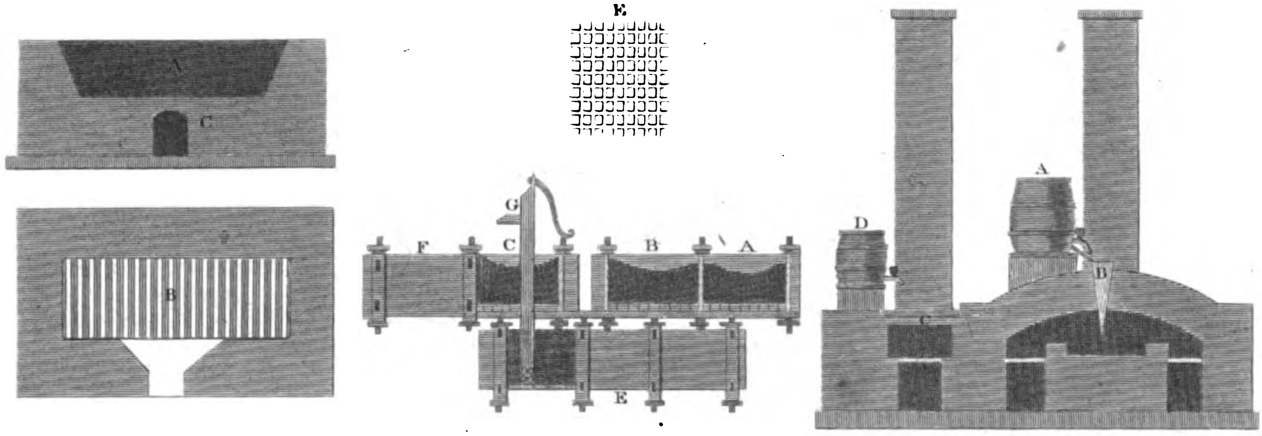
PRESSING, in the manufactures, is the violently squeezing a cloth, stuff, &c. to render it smooth and glossy.

There are two methods of pressing, viz. cold and hot.

As to the former, or cold pressing: After the stuff has been scoured, fulled, and shorn, it is folded square in equal plaits, and a skin of vellum or pasteboard put between each plait. Over the whole is laid a square wooden plank, and so put into the press, which is screwed down tight by means of a lever. After it has lain a sufficient time in the press, they take it out, removing the pasteboards, and lay it up to keep. Some only lay the stuff on a firm table after plaiting and pasteboarding, cover

POTASH. *PLATE CCCCXXXIX.*

Kiln for preparing.



PRESS Cyder.

Fig. 1.

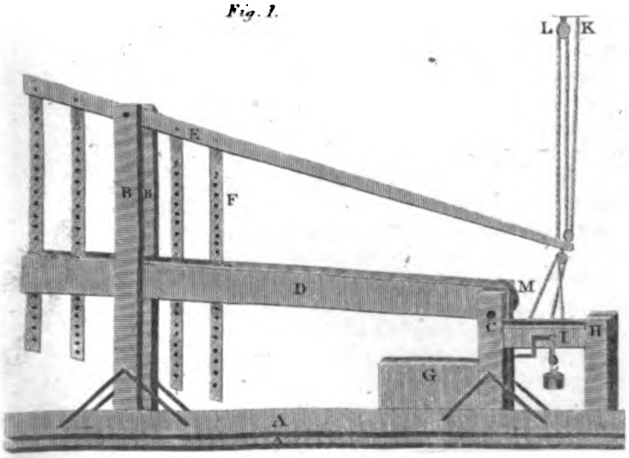
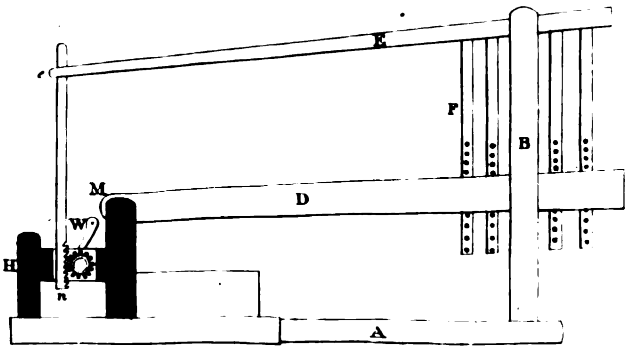


Fig. 2.



cover the whole with a wooden plank, and load it with a proper weight.

The method of pressing hot is this: When the stuff has received the above preparations, it is sprinkled a little with water, sometimes gum-water; then plaited equally, and between each two plaits are put leaves of pasteboard; and between every sixth and seventh plait, as well as over the whole, an iron or brass plate well heated in a kind of furnace. This done, it is laid upon the press, and forcibly screwed down. Under this press are laid five, six, &c. pieces at the same time, all furnished with their pasteboards and iron plates. When the plates are well cooled, the stuffs are taken out and stitched a little together to keep them in the plaits. This manner of pressing was only invented to cover the defects of the stuffs; and, accordingly, it has been frequently prohibited.

PRESSING, or *Impressing*. See IMPRESSING.

PRESSION, or PRESSURE, in the Cartesian philosophy, is a supposed impulsive kind of motion, or rather an endeavour to move, impressed on a fluid medium, and propagated through it.

PRESSURE OF AIR. See PNEUMATICS.

PRESSURE of Fluids. See HYDRODYNAMICS and PNEUMATICS.

PREST, is used for a duty in money, to be paid by the sheriff on his account, in the exchequer, or for money left or remaining in his hands: 2 & 3 Edw. VI. c. 4.

PREST-Money, is so called from the French word *prest*, that is, *promptus*, *expeditus*; for that it binds those who receive it, to be ready at all times appointed, being commonly meant of soldiers.

PRESTATION-MONEY, is a sum of money paid yearly by archdeacons and other dignitaries to their bishop, *pro exteriori jurisdictione*.

PRESTATION (*præstatio*), was anciently used for other payments: *Et quieti sint de præstatione muragii*. Chart. Hen. VII. Sometimes also for pourveyance.

PRESTEIGN is a town in Radnorshire, distant 149 miles west-north-west from London, in the direct road to Aberystwith, and throughout South Wales, in N. Lat. 52° 12′, bounded to the north and north-east by Herefordshire. It is a neat well built town, with clean and regular streets, and is the residence of many genteel families. The neighbourhood abounds with all the comforts and conveniencies of life. It is seated on a gravelly soil on the banks of the river Lug, and at the head of a very fertile vale: the mountains to the west and north-west of the town forming, as it were, an amphitheatre round it. The name of it in Welsh, is *Slan-Andras*, which is supposed to be derived from the church, which is dedicated to Saint Andrew. The town is divided into four wards, which have each a separate jurisdiction, separate officers, levies, &c. The curfew-bell of William the Conqueror still remains in this place, and is rung every night. It is a borough by prescription, and is governed by a bailiff annually elected, and sworn in by a steward appointed by the crown. The living is a rectory and vicarage united, and reported to be worth from 500l. to 600l. per annum; the parish lying in two counties. Here is an excellent free school well endowed. The county hall, the county gaol, the county bridewell, and house of correction, are kept in this place. The markets are held on Saturdays; and there are two fairs in the year. About a century and a half ago Presteign was considerably larger; had a good woollen manufactory, of which the very large buildings now standing (formerly belonging to clothiers) bear ample testimony; but a fire, succeeded by the plague, in the town, about the year 1636, reduced the same, and with it its consequence as a manufacturing town. The parish embraces a circle of at least 19 miles; and is reckoned very healthy.

PRESTER JOHN, or JEAN, an appellation formerly given to an emperor of the Tartars, who was overcome and killed by Jenghiz Khan. Since that time it has been given to the emperor of Abyssinia or Ethiopia; however, in Ethiopia itself this name is utterly unknown, the emperor being there called the *grand negus*.

PRESTER, a meteor, consisting of an exhalation thrown from the clouds downwards with such violence, as that by the collision it is set on fire. The word is Greek, πρηστηρ, the name of a kind of serpent, called also *dipsas*, to which this meteor is supposed to bear a resemblance. The prester differs from the thunderbolt in the manner of its inflammation; and in its burning and breaking every thing it touches with greater violence.

PRESTER, a word used by some to express the external part of the neck, which is usually inflated in anger.

PRESTIMONY, in *Canon Law*, is derived *à præstatione quotidiana;* and is, by some, defined to be a kind of benefice, served by a single priest. Others say, it is the incumbency of a chapel, without any title or collation; such as are most of those in castles, where prayers or mass are said; and which are mere unendowed oratories. Whence the term is also applied, in the Romish church, to certain perpetual offices bestowed on canons, religious, or others, for the saying of masses, by way of augmentation of their livings. Others think it is a lease, or concession of any ecclesiastical fund or revenue, belonging to a monastery, to be enjoyed during life. Du Moulin calls it a *profane benefice*, which, however, has a perpetual title, and an ecclesiastical office, with certain revenues attached to it; which the incumbent is allowed to sell, and which may be possessed without tonsure; such as the lay churchwardens of Notre-dame. He adds, that, in propriety, the canonries of chapels are benefices of this nature. The most probable opinion seems to be, that prestimony is a fund, or revenue, appropriated by the founder for the subsistence of a priest, without being erected into any title of benefice, chapel, prebend, or priory; and which is not subject either to the pope or to the ordinary, but whereof the patron, and those who have a right from him, are the collators, and nominate and confer *pleno jure*.

PRESTO, in the Italian music, intimates to perform quick; as *prestissimo* does extremely quick.

PRESTON, a town of Lancashire in England, seated on the river Ribble, over which there is a handsome stone bridge. Here is held a court of chancery, and other offices of justice for the county palatine of Lancaster. It is noted for the defeat of the rebels here in 1715, when they were all made prisoners, and sent up to London. It contained 17,085 inhabitants in 1811. W. Long. 2. 26. N. Lat. 53. 45.

PRESTRE. See VAUBAN.

PRETENSED or PRETENDED right, in *Law*, is where one is in possession of lands and tenements, which another, who is out, claims and sues for. Here the pretensed right is in him who so claims or sues.

PRETERITE, in *Grammar*, a tense which expresses the time past, or an action completely finished; as, *scripsi*, "I have written." See PERFECT and GRAMMAR.

PRETERITION, or PRETERMISSION, in *Rhetoric*, a figure whereby, in pretending to pass over a thing untouched, we make a summary mention thereof. *I will not say he is valiant, he is learned, he is just*, &c. The most artful praises are those given by way of preterition. See ORATORY.

PRETEXT, a colour or motive, whether real or feigned, for doing something.

TOGA PRETEXTA, among the ancient Romans, a long white gown, with a border of purple round the edges, and worn by children of quality till the age of puberty, viz. by the boys till 17, when they changed it for the *toga virilis*; and by the girls till marriage.

PRETIUM SEPULCHRI, in old law books, &c. those goods accruing to the church wherein a corpse is buried. In the Irish canons, lib. xix. cap. 6. it is ordered, that along with every body that is buried, there go his cow, horse, apparel, and the furniture of his bed; none of which may be disposed of otherwise than for the payment of debts, &c. as being familiars and domestics of the deceased.

PRETOR, a magistrate among the ancient Romans, not unlike our lord chief justices, or lord chancellor, or both in one; as being vested wtth the power of distributing justice among the citizens. At first there was only one pretor; but afterwards, another being created, the first or chief one had the title of *prætor urbanus*, or the "city pretor:" the other was called *peregrinus*, as being judge in all matters relating to foreigners. But, besides these, there were afterwards created many provincial pretors; who were not only judges, but also assisted the consuls in the government of the provinces, and even were invested with the government of provinces themselves.

PRETORIAN GUARDS, in Roman antiquity, were the emperor's guards, who at length were increased to 10,000: they had this denomination, according to some, from their being stationed at a place called *Prætorium*: their commander was styled *præfectus prætorii*.

PRETORIUM, or PRÆTORIUM, among the Romans, denoted the hall or court wherein the pretor lived, and wherein he administered justice.

It likewise denoted the tent of the Roman general, wherein councils of war, &c. were held: also a place in Rome where the Pretorian guards were lodged.

PREVARICATION, in the civil law, is where the informer colludes with the defendants, and so makes only a sham prosecution.

PREVARICATION, in our laws, is when a man falsely seems to undertake a thing, with intention that he may destroy it; where a lawyer pleads booty, or acts by collusion, &c. It signifies also the false and contradictory testimony of a witness; and denotes sometimes the secret abuse committed in the exercise of a public office, or of a commission given by a private person.

PRIAM, king of Troy, was the son of Laomedon. He was carried into Greece after the taking of that city by Hercules; but was afterwards ransomed, on which he obtained the name of *Priam*, a Greek word signifying "ransomed." At his return he rebuilt Ilium, and extended the bounds of the kingdom of Troy, which became very flourishing under his reign. He married Hecuba, the daughter of Cisseus king of Thrace, by whom he had 19 children; and among the rest Paris, who carried off Helen, and occasioned the ruin of Troy, which is supposed to have been sacked by the Greeks about 1184 B. C. when Priam was killed by Pyrrhus the son of Achilles at the foot of an altar where he had taken refuge, after a reign of 52 years. See TROY.

PRIAPISMUS, or PRIAPISM, is an erection of the penis without any concomitant pain, or the consent of other parts. It is thus called, because the person in this state resembles the lewd god Priapus. Cœlius Aurelianus says it is a palsy of the seminal vessels, and other nerves distributed to the parts about the penis, by the distension of which this disorder is produced. It is of the same nature as the satyriasis. See MEDICINE, N° 372,

PRIAPUS, in Pagan worship, the son of Bacchus and Venus, who presided over gardens and the most indecent actions. He was particularly adored at Lampsacus, a city at the mouth of the Hellespont, said to be the place of his birth; and his image was placed in gardens to defend them from thieves and birds destructive to fruit. He was usually represented naked, with a stern countenance, matted hair, and holding either a wooden sword or sickle in his hand, and with a monstrous privity; from whence downward his body ended in a shapeless trunk. The sacrifice offered to this obscene deity was the ass; either on account of the natural uncomeliness of this animal, and its propensity to venery, or from the disappointment which Priapus met with on his attempting the chastity of Vesta, while that goddess was asleep, when she escaped the injury designed her by her being awaked by the braying of old Silenus's ass.

PRICE, REV. RICHARD, D. D. L. L. D. fellow of the Royal Society of London, and of the Academy of Sciences, New England, was born at Tynton in Glamorganshire, February 22. 1723. His father was a dissenting minister at Bridgend in that county, and died in 1739. At eight years old he was placed under a Mr Simmons of Neath; and in four years removed to Pentwyn in Caermarthenshire under the Rev. Samuel Jones, whom he represented as a man of a very enlarged mind, and who first inspired him with liberal sentiments of religion. Having lived as long with him as with Mr Simmons, he was sent to Mr Griffith's academy at Talgarth in Breconshire. In 1740 he lost his mother; and on this he quitted the academy and came to London. Here he was settled at that academy, of which Mr Eames was the principal tutor, under the patronage of his uncle the Rev. S. Price, who was copastor with Dr Watts upwards of 40 years. At the end of four years he left this academy, and resided with Mr Streatfield of Stoke Newington in the quality of domestic chaplain, while at the same time he regularly assisted Dr Chandler at the Old Jewry, and occasionally assisted others. Having lived with Mr Streatfield near

Price. 13 years, on his death and his uncles's he was induced to change his situation, and in 1757 married Miss S. Blundell of Leicestershire. He then settled at Hackney, but being shortly after chosen minister at Newington Green, he lived there until the death of his wife, which was in 1786, when he returned to Hackney. He was next chosen afternoon preacher at the meeting-house in Poor Jewry-street, but this he resigned on being elected pastor of the Gravel-pit meeting Hackney, and afternoon-preacher at Newington Green. These he resigned with a farewel-sermon in February 1791. Shortly after he was attacked with a nervous fever, which disappearing, was succeeded by a disorder in his bladder, which reduced him to such a degree that, worn out with agony and disease, he died without a groan on the 19th April 1791. He left his property to a sister and two nephews.

Dr Kippis, speaking of his learning and pursuits, observes *, that "his chief aim was to lay a foundation for solid knowledge, by an application to sciences of the noblest kind. It was on the great and fundamental principles and obligations of morality, on the higher species of mathematics, on the sublimer parts of natural philosophy, on the true basis of government, and on the questions which relate to the essential welfare and dignity of man, that his studies were employed; and in the prosecution of these studies he not only enriched his own mind, but was enabled to become of eminent service to his country and to the world. In his moral writings he has laboured with distinguished ability to build the science of ethics on an immutable basis; and what he has advanced will always stand high in estimation as one of the strongest efforts of human reason in favour of the system he has adopted. For myself (adds Dr Kippis), I scruple not to say, that I regard the treatise referred to as a rich treasure of valuable information, and as deserving to be ranked among the first productions of its kind. With respect to his other ethical works, every one must admire the zeal, earnestness, and strength, with which he endeavours to lead men into pious views of God, of providence and prayer; and to promote the exercise of devout and amiable dispositions. In consequence of his profound knowledge in mathematical calculations, he was qualified at a particular crisis for being of singular utility to his fellow-citizens. A number of schemes for insurance for lives and the benefit of survivorship, promising mighty advantages, were rising up in the metropolis. These ruinous schemes would have been carried to great excess, had not Dr Price stepped forward and dispelled the delusion. Gratitude will not allow us to forget the ability and spirit with which he awakened the attention of his countrymen to the reduction of the national debt. With him it was that the scheme of the present minister for that purpose is understood to have originated. What crowned the whole of his character was, its being an assemblage of the most amiable and excellent private virtues. His piety was sincere, humble, and fervent; his soul pure and elevated; in his views disinterested and noble; and in his manners mild and gentle: the applause of his talents and virtues will be transmitted to future ages, and he will be united in the catalogue with the most eminent benefactors of mankind."

Address his neral, o.

This is the panegyric of a friend; but with few abatements it will be admitted by every candid reader. In morals Dr Price's principles were those of Cudworth and Clarke; and by many who have themselves adopted a very different theory, he is allowed to have defended those principles with greater ability than any other writer in the English language) see *Moral Philosophy*, N° 14.). In metaphysics he was perhaps too great an admirer of Plato, from whom he has borrowed a doctrine concerning ideas which we confess ourselves unable to comprehend. He was a firm believer in the immateriality of the soul; but, with Dr Law, the late learned bishop of Carlisle, he thought, that from death to the resurrection of the body it remains in a dormant or quiescent state. He contended for its indivisibility, but maintained at the same time its extension: which furnished Dr Priestley with some advantages in their celebrated controversy, which his own acuteness would never have obtained. In propagating his political principles, which were republican, he sometimes expressed himself with undue vehemence; and he was a zealous enemy to all religious establishments, which, in his opinion, encroach upon that liberty wherewith Christ has made us free. His faith respecting the Son of God was what has been called sometimes *low Arianism* and sometimes *Semi-arianism*. From a very early age he claimed the privilege of thinking for himself on every subject. His father was a rigid Calvinist, and spared no pains to instil his own theological dogmas into the tender mind of his son; but young Richard would often start his doubts and difficulties, and sometimes incur the old man's displeasure by arguing against his favourite system with an ingenuity that perplexed, and a solidity that could not be easily overturned. He had once the misfortune to be caught reading a volume of Clarke's sermons, which his father in great wrath snatched from him and threw into the fire. Perhaps he could not have taken a more effectual method to make the book a favourite, or to excite the young man's curiosity after the other works of the same author; and it is by no means improbable that this orthodox bigotry contributed more than any other circumstance to lay the foundation of his son's Arianism.

But whatever may be thought of Dr Price's speculative opinions, whether political or religious, his virtues in private life have never been called in question. Of his practical religion it is impossible to speak in terms too high. There was a fervour even in his public prayers which indicated the strongest sensibility as well as sincerity in himself, and communicated its warmth to those who joined with him. But in his family devotions he gave still fuller scope to the pious emotions of his soul, and proved to those friends who were occasionally present at them how deeply he felt religious impressions, and how happily he blended in this as well as in other things the cool decisions of the understanding with the amiable and exalted sensibilities of the heart.

But it is not in devotion only that these sensibilities were displayed. He was as exemplary in affection to his relatives as in love to his Maker. Of this he gave a striking though private instance before he first quitted his native place to try his fortune in London. His father had left to an elder brother by a former marriage a very considerable fortune; to Richard he left a mere trifle; and to each of two sisters still less. Our author divided his share between his sisters, reserving

Price.

ving to himself only a few pounds to defray the expences of his journey, and trusting for his future support to the blessing of God upon his talents and his industry. As in early life he was an affectionate and generous brother, in old age he was a loving and attentive husband. His wife, who for a considerable time before her death was almost wholly helpless, found during the last years of her life hardly any enjoyment except in a game at whist; and though our Doctor disliked cards as a waste of time, and never touched them on any other occasion, to amuse her he would sit down every evening to the card-table, and play till it was late, with a cheerfulness and good humour which charmed every person who had the happiness of viewing him in that endearing situation.

Yet, though thus attentive to the obligations of domestic life, he did not suffer his private affections to encroach upon his social duties. His talents and his labours were ever ready at the call of friendship; nay so much did his nature abound with the milk of human kindness, that he could not resist without extreme reluctance even troublesome and unreasonable solicitations. His hours of study and retirement were frequently broken in upon by applications for assistance and advice, especially in matters relating to annuities and life-insurances; and in this way he sacrificed much of his personal convenience to individuals of whom he knew but little, and from whom he would accept of no pecuniary recompense. His good nature in this respect amounted almost to a foible; and subjected him to importunities and loss of time, of which he would sometimes complain as interfering materially with more important and more generally useful studies.

Whilst he thus obliged the rich by his mental talents, he succoured the poor with his earthly substance. A fifth part of his annual income was regularly devoted to charitable purposes; and he was laudably anxious to distribute it in such a way as might produce the greatest good. In the practice of this, and indeed of all his virtues, he was utterly devoid of ostentation. Simplicity and humility were among the strong features of his character. No man was ever less sensible of his own excellence, or less elated by his own celebrity; and in no man was the dignity of artless manners and unaffected modesty more happily displayed.

His face was the true index of his mind. It beamed with philanthropy; and when lighted up in conversation with his friends, assumed an aspect peculiarly pleasing. His person was slender, and rather below the common size, but possessed of great muscular strength and remarkable activity. A habit of deep thought had given a stoop to his figure, and he generally walked a brisk pace with his eyes on the ground, his coat buttoned, one hand in his pocket, and the other swinging by his side.

It is natural to suppose that such a man as Dr Price, some of whose writings were translated into foreign languages, would be very generally respected in the republic of letters, and have many correspondents. The supposition is well founded. In 1763 or 1764 he was chosen a fellow of the Royal Society, and contributed largely to the transactions of that learned body; in 1769 he received from Aberdeen a diploma creating him DD.; and in 1783 the degree of LL.D. was conferred upon him by the college of Yale in Connecticut. As in 1770 he had refused an American degree which had been conveyed to him by Dr Franklin, his acceptance of one 13 years afterwards can be attributed only to his extravagant attachment to a republican form of government; which was the greatest defect in his character, and shows what prejudices the most vigorous mind will imbibe by thinking always on the same subjects, and in the same track. Among his correspondents, the most eminent in his own country were the late Lord Chatham, Lord Stanhope, Lord Lansdowne, the late bishops of Carlisle and St Asaph, and the present bishop of Landaff; Mr Hume, Mr Harris of Salisbury, Dr Gregory of Edinburgh, and the celebrated Mr Howard, who lived with him on terms of the greatest intimacy; in America he corresponded with Dr Franklin, Dr Chauncey, Mr Adams, and others; and in France with the celebrated Turgot, the Duke de Rochefoucault, and several of the first national assembly. One of his female correspondents sketched his character with great justness many years ago under the fictitious but well applied name of *Simplicius*; and with this character we shall close these short memoirs.

"While the vain man is painfully striving to outshine the company, and to attract their admiration by false wit, forced compliments, and studied graces, he must surely be mortified to observe how constantly Simplicius engages their attention, respect, and complacency, without having once thought of himself as a person of any consequence among them. Simplicius imparts his superior knowledge, when called upon, as easily and naturally as he would tell you what it is o'clock; and with the same readiness and good will informs the most ignorant or confers with the most learned. He is as willing to receive information as to give it, and to join the company, as far as he is able, in the most trifling conversation into which they may happen to fall, as in the most serious and sublime. If he disputes, it is with as much candour on the most important and interesting as on the most insignificant subjects; and he is not less patient in hearing than in answering his antagonist. If you talk to him of himself or his works, he accepts praise or acknowledges defects with equal meekness, and it is impossible to suspect him of affectation in either. We are more obliged by the plain unexaggerated expressions of his regard, than by the compliments and attentions of the most accomplished pattern of high breeding; because his benevolence and sincerity are so strongly marked in every look, word, and action, that we are convinced his civilities are offered for our sakes, not for his own, and are the natural effects of real kindness, not the studied ornaments of behaviour. Every one is desirous to show him kindness in return, which we know will be accepted just as it is meant. All are ready to pay him that deference which he does not desire, and to give him credit for more than he assumes, or even more than he possesses. With a person ungraceful, and with manners unpolished by the world, his behaviour is always proper, easy, and respectable; as free from constraint and servility in the highest company, as from haughtiness and insolence in the lowest. His dignity arises from his humility; and the sweetness, gentleness, and frankness of his manners, from the real goodness and rectitude of his heart, which lies open to inspection in all the fearlessness of truth, without any need of disguise or ornament."

Such

Such was Dr Price.—Of his public principles men will think differently; of his private worth there can be but one opinion. He will live in the memory of his friends till memory has lost her power. To posterity his works will be his monument. They are: A Review of the principal Questions and Difficulties in Morals, 8vo, 1758; Dissertations on Providence, &c. 8vo. 1767; Observations on Reversionary Payments, &c. 8vo. 1771; Appeal on the National Debt, &c. 8vo. 1773; Observations on the Nature of Civil Liberty, 1776: on Materialism and Necessity, in a correspondence between Dr Price and Dr Priestley, 1779; on Annuities, Assurances, Population, &c. 8vo. 1779; on the Population of England, 1780; on the Public Debts, Finances, Loans, &c. 8vo. 1783; on Reversionary Payments, 2 vols. 1783; on the importance of the American Revolution, 1784: besides Sermons, and a variety of papers in the Philosophical Transactions on astronomical and other philosophical subjects.

PRIDE, inordinate and unreasonable self-esteem, attended with insolence and rude treatment of others.—It is frequently confounded with vanity, and sometimes with dignity; but to the former passion it has no resemblance, and in many circumstance it differs from the latter. Vanity is the parent of loquacious boasting; and the person subject to it, if his pretences be admitted, has no inclination to insult the company. The proud man, on the other hand, is naturally silent, and, wrapt up in his own importance, he seldom speaks but to make his audience feel their inferiority. It is this circumstance which distinguishes pride from dignity, and constitutes its sinfulness. Every man possessed of great powers of mind is conscious of them, and feels that he holds a higher rank in the scale of existence than he whose powers are less. If he recollect, at the same time, that he has nothing which he did not receive, and that his superiority is owing to the good pleasure of Him who forms his creatures differently, as the potter forms his clay; he will be so far from insulting his inferiors, that when necessarily in company with them he will bear with their foibles, and, as far as is proper, make them lose sight of the distance which the laws of God and man have for ever placed between them and him. This condescension, however, if he be a man of dignity, will never lead him to join with them in any mean or dirty action. He will even excuse in them many things which he would condemn in himself, and give them his good wishes, after they have forfeited his esteem. Such a character is amiable and respectable, and what every man should labour to obtain. From the weakness of human nature, however, it is too apt to degenerate into pride.

To a man of great intellectual powers and various erudition, the conversation of ordinary persons affords neither instruction nor amusement; and such conversation, when often repeated, must, from the nature of things, become tedious and irksome. But it requires great command of temper and of manners to prevent uneasiness long felt from sometimes betraying itself by external symptoms, such as peevish expressions, a forbidding look, or absence of mind; and these are the infallible indications of contempt for the company, the very worst ingredient in the passion of pride. If this contempt be often excited, it will be formed into a habit; and the proud man will be so much under its influence, as to insult his inferiors, and sometimes his equals, without forming the resolution to insult either the one or the other. Such a character is hateful to every company, and is so far from indicating true dignity of mind in him to whom it belongs, that it is obviously associated with meanness, and indicates a consciousness of some radical defect. He who possesses real and conspicuous merit has no occasion to depress others for the purpose of raising himself; his superiority will be cheerfully acknowledged; but when a man of undoubted eminence in one respect, is so swollen with pride as to make him wish to appear great in all respects, he has no other means of enforcing his ill-founded claim, than displaying his acknowledged superiority, with such insolence as may drive at a distance from him every person by whom he is conscious that in many instances he might be more than rivalled. Whoever is proud of knowledge, would do well to consider how much knowledge he wants.

The same observations which we have made on pride of parts will apply to every other species of pride, such as pride of birth, office, or riches, &c. The peace and order of society require difference of rank, accompanied with different degrees of authority; and he who inherits a title or office from his ancestors, may without pride be conscious of his superiority, provided he forget not that such superiority is conferred on families and individuals, not for their own sakes, but for the good of the community. The peer who keeps this circumstance in mind, may maintain his station, and repress the forward petulance of the plebeian, without giving offence to any thinking man; but if he dwell upon his rank with too much complacency, he will in process of time be apt to consider himself and his family as superior by nature to those upon whom no title has been conferred, and then his pride will become intolerable. If we could trace our descents, says Seneca, we should find all slaves to come from princes, and all princes from slaves. To be proud of knowledge, is to be blind in the light; to be proud of virtue, is to poison ourselves with the antidote; to be proud of authority, is to make our rise our downfal. The best way to humble a proud man is to neglect him.

PRIDEAUX, Humphry, a learned clergyman of the church of England, was born at Padstow in Cornwall in 1648. He studied three years at Westminster under Dr Busby; and then was removed to Christ-church, Oxford. Here he published, in 1676, his *Marmora Oxoniensia ex Arundelianis, Seldenianis, aliique conflata, cum perpetuo Commentario.* This introduced him to the lord chancellor Finch, afterward earl of Nottingham, who in 1679 presented him to the rectory of St Clements near Oxford, and in 1681 bestowed on him a prebend of Norwich. Some years after he was engaged in a controversy with the Papists at Norwich, concerning the validity of the orders of the church of England, which produced his book upon that subject. In 1688 he was installed in the archdeaconry of Suffolk; to which he was collated by Dr Lloyd, then bishop of Norwich. In 1691, upon the death of Dr Edward Pococke, the Hebrew professorship at Oxford being vacant, was offered to Dr Prideaux, but he refused it. In 1697, he published his Life of Mahomet, and in 1702 was installed dean of Norwich. In 1710 he was cut for the stone, which interrupted his studies for

for more than a year. Some time after his return to London, he proceeded with his Connection of the History of the Old and New Testament; which he had begun when he laid aside the design of writing the History of Appropriations. He died in 1724.

Chandler's Travels in Asia Minor.

PRIENE, an ancient town of Asia Minor. It is now called *Samsun*, and *Samsun-katesi*, which do not however appear to be very recent. It was taken in 1391 by Bajazet, who subdued Ionia. It had formerly, without including the citadel, three gateways; one of which was towards Kelibesh, an adjoining village; and without it are vaults of sepulchres. The entrance was not wide. A part of the arch, consisting of a single row of massive stones, still remains: but those on which it rests are so corroded by age, broken, or distorted, as to seem every moment ready to yield and let down their load. A rugged way leads to a second opening in the wall opposite to this, and about a mile from it; beyond which are likewise vaults of sepulchres. Between these was a gate facing to the plain; and on the left hand going out of it is a hole, resembling the mouth of an oven, in the side of a square tower; and over it an inscription in small characters, exceedingly difficult to be read. It signifies, that a certain Cyprian in his sleep had beheld Ceres and Proserpine arrayed in white; and that in three visions they had enjoined the worship of a hero, the guardian of the city, and pointed out the place where, in obedience to them, he had erected the god. This was probably some local hero, whose little image was set in the wall, and whose name and memory have perished.

PRIEST, a person set apart for the performance of sacrifice, and other offices and ceremonies of religion. Before the promulgation of the law of Moses, the first-born of every family, the fathers, the princes, and the kings, were priests. Thus Cain and Abel, Noah, Abraham, Melchizedec, Job, Isaac, and Jacob, offered themselves their own sacrifices. Among the Israelites, after their exod from Egypt, the priesthood was confined to one tribe, and it consisted of three orders, the *high*-priest, *priests*, and *Levites*. The priesthood was made hereditary in the family of Aaron, and the first-born of the oldest branch of that family, if he had no legal blemish, was always the high-priest. This divine appointment was observed with considerable accuracy till the Jews fell under the dominion of the Romans, and had their faith corrupted by a false philosophy.—Then, indeed, the high-priesthood was sometimes set up to sale, and instead of continuing for life, as it ought to have done, it seems from some passages in the New Testament, to have been nothing more than an annual office. There is sufficient reason, however, to believe, that it was never disposed of but to some descendant of Aaron, capable of filling it, had the older branches been extinct. (For the consecration and offices of the Jewish priesthood, we refer our readers to the books of Moses). In the time of David, the inferior priests were divided into 24 companies, who were to serve in rotation, each company by itself, for a week. The order in which the several courses were to serve was determined by lot; and each course was in all succeeding ages called by the name of its original chief.—All nations have had their *priests*. The pagans had *priests* of Jupiter, Mars, Bacchus, Hercules, Osiris, and Isis, &c.; and some deities had *priestesses*. The Mahometans have priests of different orders, called *schiek*, and *mufti*; and the Indians and Chinese have their *bramins* and *bonzes*.

It has been much disputed, whether, in the Christian church, there be any such officer as a *priest*, in the proper sense of the word. The church of Rome, which holds the *propitiatory* sacrifice of the *mass*, has of course her proper *priesthood*. In the church of England, the word *priest* is retained to denote the second order in her hierarchy, but we believe with very different significations, according to the different opinions entertained of the Lord's supper. Some few of her divines, of great learning, and of undoubted Protestantism, maintain that the Lord's supper is a *commemorative* and *eucharistical sacrifice*. Those consider all who are authorised to administer that sacrament as in the strictest sense *priests*. Others hold the Lord's supper to be a *feast* upon the *one* sacrifice, once offered on the cross; and these too must consider themselves as clothed with some kind of priesthood. Great numbers, however, of the English clergy, perhaps the majority, agree with the church of Scotland, in maintaining that the Lord's supper is a rite of no other moral import, than the mere commemoration of the death of Christ. These cannot consider themselves as *priests* in the rigid sense of the word, but only as *presbyters*, of which the word *priest* is a contraction of the same import with *elder*. See *SUPPER of the Lord*.

PRIESTLEY, JOSEPH, LL.D. F. R. S. and member of many foreign literary societies, was born on the 24th of March 1733, at Field-head, in the parish of Bristall, in the west riding of Yorkshire. His father was a cloth-manufacturer, and both his parents were respectable among Calvinistic dissenters. A strong desire for reading was one of the first passions which this philosopher exhibited, and which probably induced his parents and friends to change their mind respecting his destination, and instead of a tradesman, to fit him for some learned profession. He acquired a knowledge of Hebrew, Greek, and Latin, in the school of an eminent teacher at Bartley, and at the age of 19 became a theological student in the academy of Daventry. When about the age of 22 he was made choice of to be assistant minister to the Independent congregation of Needham-market, in Suffolk. Having staid at Needham for about three years, he received an invitation to be pastor of a small flock at Namptwitch, in Cheshire, of which he accepted. Here he opened a day-school, in the management of which he displayed that turn for research, and that spirit of improvement, which were afterwards destined to be such prominent features of his character. His reputation as a man of extraordinary talents and diligent enquiry soon spread among his professional brethren, and when Dr Aikin was chosen to succeed the reverend Dr Taylor as tutor in divinity at Warrington, the vacant department of belles lettres was assigned to Mr Priestley.

His literary career may probably be said to have commenced at Warrington; and the extent, as well as the originality of his pursuits, were soon announced to the world by a variety of valuable publications. Much of his attention about this period was taken up with general politics, on which he delivered a number of lectures. Although it was reasonable to think that his time would be sufficiently occupied by his academical and literary employments, yet his unwearied activity and industry

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found means to accomplish the first great work in philosophy which laid a solid foundation for his future fame.

Having long amused himself with an electrical machine, and felt himself interested in the progress of discovery in that branch of physics, he undertook a history of electricity, with an account of its present state. This work made its first appearance at Warrington in the year 1767, which was so well received by the learned world, that it went through a fifth edition in 4to in the year 1794. It is justly deemed a valuable performance, and its original experiments are allowed to be very ingenious.

About the year 1768, he was chosen pastor of a large and respectable congregation of Protestant dissenters at Leeds, which made him turn a very large share of his attention to theological subjects. His mind is said to have been strongly impressed with sentiments of piety and devotion from a child; and though he changed most of those religious sentiments in which he had been instructed, for such as he regarded to be more rational and consistent with truth, his piety and devotion never deserted him.

He was at the head of the modern Unitarians, whose leading tenet is the proper humanity of Christ, confining every species of religious worship and adoration to the one supreme. Some, we believe, have charged him with a design to subvert the Christian religion; but such an insinuation argues a total want of candour, as zeal for Christianity, as a divine dispensation, and the most valuable of all gifts bestowed upon the human race, was his ruling passion.

His History and present state of Discoveries relating to Vision, Light, and Colours, appeared in 1772, in two vols. 4to. This is allowed to be a performance of great merit, having a lucid arrangement; but it did not bring him such a large share of popularity as his History of Electricity, as it is probable that he was scarcely qualified to explain the abstruser parts of the science. In the year 1770, he quitted Leeds for a situation entirely different. His philosophical writings, and the recommendation of Dr Price had made him so favourably known to the earl of Shelburne, that this nobleman made him such advantageous proposals for residing with him, that a regard for his family would not permit them to be rejected. The domestic tuition of Lord Shelburne's sons having been previously committed to a man of merit, they received no instructions from Dr Priestley farther than some courses of experimental philosophy. He also attended his lordship in a visit to Paris, where he had an opportunity of seeing some of the most celebrated men of science in that country, whom he astonished by asserting a firm belief in revealed religion, which had been presented to their minds in such colours, that they thought no man of sense could hesitate in rejecting it as an idle fable.

In 1775, he published his examination of Dr Reid on the Human Mind; Dr Beattie on the Nature and Immutability of Truth; and Dr Oswald's Appeal to Common Sense. The design of this volume was to refute the new doctrine of *common sense*, employed as the test of truth by the metaphysicians of Scotland. He never intentionally misrepresented either the arguments or purposes of an opponent; but he measured the respect with which he treated him by that which he felt for him in his own mind. In the year 1777, he published his disquisitions relating to Matter and Spirit, in which he gave a history of the philosophical doctrine respecting the soul, and openly supported the *material* system, which makes it homogeneous with the body. This subjected him to more odium than any of his other opinions. As he materialized spirit, so he in some measure spiritualized matter, by assigning to it penetrability and some other subtle qualities. About the same period he became the champion of philosophical necessity; a doctrine not less obnoxious to many, on account of its supposed effects on morality, than the former. So astonishing was the versatility of his mind, that he at the same time carried on that course of discovery concerning aeriform bodies which has rendered his name so illustrious among philosophical chemists. A second volume was published in 1775, and a third in 1777. Some of his most memorable discoveries were those of nitrous and dephlogisticated or pure air; of the restoration of vitiated air by vegetation; of the influence of light on vegetables, and of the effects of respiration on the blood.

The name of Priestley was by these means spread through the countries of Europe, and honours were heaped upon him from scientific bodies in various parts. The term of his engagement with Lord Shelburne having expired, Dr Priestley was at liberty to choose a new situation for himself, retiring with a pension for life of 150l. a-year. He chose the vicinity of the populous town of Birmingham, as it was the residence of several men of science, such as Watt, Withering, Bolton, and Keir, whose names are well known to the public. Here he was invited to become pastor of a dissenting congregation, of which he accepted about the latter end of the year 1780. Soon after this appeared his Letters to Bishop Newcome, on the Duration of Christ's Ministry, and his History of the Corruptions of Christianity, which were afterwards followed by his History of Early Opinions.

He displayed his attachment to freedom by his Essay on the First Principles of Government; and by an anonymous pamphlet on the State of Public Liberty in this country; and had shown a warm interest in the cause of America at the time of its unfortunate quarrel with the mother country.

The celebration of the anniversary of the destruction of the Bastile, by a public dinner, on July 14th 1791, at which Dr Priestley was not present, gave the signal of those riots which have thrown lasting infamy on the town of Birmingham, and in some degree on the national character. Amidst burning houses of worship and private dwellings, Dr Priestley was the great object of popular rage; his house, library, manuscripts, and apparatus, were made a prey to the flames; he was hunted like a criminal, and experienced not only the furious outrages of a mob, but the most unhandsome treatment from some who ought to have sustained the parts of gentlemen, and the friends of good order. He now lay under a load of public odium and suspicion, and he was constantly harassed by the petty malignity of bigotry.

It was of consequence not to be wondered at, that he looked for an asylum in a country to which he had always shewn a friendly attachment, and which he supposed was in possession of all the blessings of civil and religious liberty. In the year 1794, he took leave of his

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his native country, and embarked for North America. He took up his residence in Northumberland, a town in the interior of the state of Pennsylvania, which he selected on account of the purchase of landed property in its neighbourhood; otherwise its remoteness from the sea-ports, its want of many of the comforts of life, and of all the helps to scientific pursuit, rendered it a peculiarly undesirable abode for one of Dr Priestley's habits and employments. The loss of his amiable wife, and of a most promising son, as well as repeated attacks of disease, severely tried the fortitude and resignation of this great and good man.

In America he was received with general respect, and the angry contests of party were not able wholly to deprive him of the esteem due to his character. He was heard as a preacher by some of the most distinguished members of congress; and he was offered, but declined, the place of chemical professor of Philadelphia. It became his great object to enable himself in his retirement at Northumberland to renew that course of philosophical experiment, and especially that train of theological writing, which had occupied so many of the best years of his life. By numerous experiments on the constitution of airs, he became more and more fixed in his belief of the phlogistic theory, and in his opposition to the new French chemical system, of which he lived to be the only opponent of any celebrity. By the liberal contributions of his friends in England, he was enabled to commence the printing of two extensive works, on which he was zealously bent, a Church History, and an Exposition of the Scriptures; and through the progress of his final decline he unremittingly urged their completion.

An article in the Philadelphia Gazette speaks of him in the following honourable terms:

"Since his illness at Philadelphia, in the year 1801, he never regained his former good state of health. His complaint was constant indigestion, and a difficulty of swallowing food of any kind. But during this period of general debility, he was busily employed in printing his Church History, and in the first volume of his notes on the Scriptures, and in making new and original experiments. During this period, likewise, he wrote his pamphlet of Jesus and Socrates compared, and reprinted his Essay on Phlogiston.

"From about the beginning of November, 1803, to the middle of January, 1804, his complaint grew more serious; yet, by judicious medical treatment, and strict attention to diet, he, after some time, seemed, if not gaining strength, at least not getting worse; and his friends fondly hoped that his health would continue to improve as the season advanced. He, however considered his life as very precarious. Even at this time, besides his miscellaneous reading, which was at all times very extensive, he read through all the works quoted in his Comparison of the different Systems of Grecian Philosophers with Christianity; composed that work, and transcribed the whole of it in less than three months; so that he has left it ready for the press.

"In the last fortnight of January, his fits of indigestion became more alarming, his legs swelled, and his weakness increased. Within two days of his death he became so weak, that he could walk but a little way, and that with great difficulty. He was fully sensible that he had not long to live, yet he talked with cheerness to all who called on him. He dwelt upon the peculiarly happy situation in which it had pleased the divine Being to place him in life, and the great advantage he had enjoyed in the acquaintance and friendship of some of the best and wisest men of the age in which he lived, and the satisfaction he derived from having led an useful as well as happy life. On the 9th of February 1804, he breathed his last, so easily, that those who were sitting close to him did not immediately perceive it. He had put his hand to his face, which prevented them from observing it."

Priestley Primer Seasin.

In the constitution of Dr Priestley's mind ardour and vivacity of intellect were united with a mild and placid temper. With a zeal for the propagation of truth which nothing could subdue, he joined a calm patience, an unruffled serenity, which rendered him proof against disappointments. The rights of private judgment were rendered sacred to him by every principle of his understanding, and his heart would not have suffered him to injure his bitterest enemy. He was naturally disposed to be cheerful, and when his mind was not occupied with serious thoughts, could unbend with playful ease and negligence, in the private circle of friends. He commonly spoke little in large and mixed companies, and in the domestic relations of life was uniformly kind and affectionate. His parental feelings were those of the tenderest and best of fathers. Not even malice itself could ever fix a stain on his private conduct, or impeach his integrity.

PRIMÆ VIÆ, among physicians, denote the whole alimentary duct; including the œsophagus, stomach, and intestines, with their appendages.

PRIMAGE, in *Commerce*, a small duty at the waters-side, usually about 12d. per ton, or 6d. per bale, due to the master and mariners of a ship.

PRIMARY, first in dignity, chief, or principal.

PRIMARY Qualities of Bodies. See METAPHYSICS, Nº 152.

PRIMATE, in church-polity, an archbishop, who is invested with a jurisdiction over other bishops.

PRIME, PRIMUS, an appellation given to whatever is first in order, degree, or dignity, among several things of the same or like kind; thus we say, the prime minister, prime cost, &c.

Prime is sometimes used to denote the same with decimal, or the tenth part of an unit.

PRIME-Figure, in *Geometry*, one which cannot be divided into any other figures more simple than itself, as a triangle among planes, and the pyramid among solids.

For prime numbers, in arithmetic, see the article NUMBER.

PRIME of the Moon, is the new moon when she first appears, which is about three days after the change.

PRIME Vertical, is that vertical circle which passes through the poles of the meridian, or the east and west points of the horizon; whence dials projected on the plane of this circle are called *prime vertical*, or *north-and-south dials*.

PRIME, in the Romish church, is the first of the canonical hours succeeding to lauds.

PRIME, in *Fencing*, is the first of the chief guards. See GUARD.

PRIMER SEASIN, in *Feodal Law*, was a feodal burden, only incident to the king's tenants *in capite*, and not

not to those who held of inferior or mesne lords. It was a right which the king had, when any of his tenants *in capite* died seized of a knight's fee, to receive of the heir (provided he were of full age) one whole year's profits of the lands if they were in immediate possession, and half a year's profits if the lands were in reversion expectant on an estate for life. This seems to be little more than an additional relief (see RELIEF); but grounded upon this feodal reason, That by the ancient law of feods, immediately upon the death of a vassal the superior was entitled to enter and take seisin or possession of the land, by way of protection against intruders, till the heir appeared to claim it, and receive investiture; and for the time the lord so held it, he was entitled to take the profits; and unless the heir claimed within a year and day, it was by the strict law a forfeiture. This practice, however, seems not to have long obtained in England, if ever, with regard to tenures under inferior lords; but, as to the king's tenures *in capite*, this *prima seisina* was expressly declared, under Henry III. and Edward II. to belong to the king by prerogative, in contradistinction to other lords. And the king was entitled to enter and receive the whole profits of the land, till livery was sued; which suit being commonly within a year and day next after the death of the tenant, therefore the king used to take at an average the *first-fruits*, that is to say, one year's profits of the land. And this afterwards gave a handle to the popes, who claimed to be feodal lords of the church, to claim in like manner from every clergyman in England the first year's profits of his benefice, by way of *primitiæ*, or first-fruits.—All the charges arising by primer seisin were taken away by 12 Car. II. c. 24.

PRIMING, in *Gunnery*, the train of powder that is laid, from the opening of the vent, along the gutter or channel on the upper part of the breech of the gun: which, when fired, conveys the flame to the vent, by which it is further communicated to the charge, in order to fire the piece. This operation is only used on shipboard at the proof, and sometimes in garrison; for, on all other occasions, tubes are used for that purpose.

Priming-Wire, in *Gunnery*, a sort of iron needle employed to penetrate the vent or touch-hole of a piece of ordnance, when it is loaded: in order to discover whether the powder contained therein is thoroughly dry and fit for immediate service; as likewise to search the vent and penetrate the cartridge, when the guns are not loaded with the loose powder.

PRIMING, among painters, signifies the laying on of the first colour.

PRIMIPILUS, in antiquity, the centurion of the first cohort of a legion, who had the charge of the Roman eagle.

PRIMITIÆ, the first-fruits gathered off the earth, whereof the ancients made presents to the gods.

PRIMITIVE, in *Grammar*, is a root or original word in a language, in contradistinction to *derivative*; thus, *God* is a primitive; *godly*, a derivative; and *godlike*, a compound.

PRIMOGENITURE, the right of the first-born, has among most nations been very considerable. The first-born son in the patriarchal ages had a superiority over his brethren, and, in the absence of his father, was priest to the family. Among the Jews, he was consecrated to the Lord, had a double portion of the inheritance, and succeeded in the government of the family or kingdom. It is, however, remarkable, and unquestionably shows the connection between this institution and the birth and office of our Saviour, that if a woman's first child were a girl, neither she, nor the children that came after her, were consecrated.

In every nation of Europe, the right of primogeniture prevails in some degree at present, but it did not prevail always. The law which calls the elder-born to the crown, preferably to the others, was not introduced into France till very late; it was unknown to the first race of kings, and even to the second. The four sons of Clovis shared the kingdom equally among themselves; and Louis le Debonnaire did the same: it was not till the race of Hugh Capet, that the prerogative of succession to the crown was appropriated to the first-born.

By the ancient custom of *Gavel-kind*, still preserved in some parts of our island, primogeniture is of no account; the paternal estate being equally shared by all the sons. And it has been a matter of violent and learned dispute, whether at the death of Alexander III. Baliol or Bruce was, by the law as it then stood, heir to the crown of Scotland. The former had undoubtedly the right of primogeniture, but the latter stood in one degree of nearer relation to the deceased sovereign; and the Scottish barons, not being able to determine whose claim was best founded, referred the question to Edward I. of England, and thereby involved their country in a long and ruinous war. See SCOTLAND.

PRIMORIE, is a name given by the Slavi to that tract of sea-coast which lies between the two rivers Cettina and Narenta, the first of which is the Nestus and Tiluras, and the second the Narus, of the ancients; comprising what was properly called Dalmatia two ages before our era, and which was known to the Greeks of the low times under the name of *Paratalassia*. Appian informs us that the Ardei or Vardei possessed many cities there, part of which they seized before the invasion of the Romans, and part they built themselves. We learn also from the *Tabula Peutingeriana*, that after the conquest many of those cities remained, and were inhabited by the conquerors, who also founded new settlements. And indeed were these proofs wanting, the numerous inscriptions found near the sea, and sometimes among the hills, would render it at least probable. The coast is extremely pleasant, the soil fertile, and the situation most convenient for commerce with the inland provinces. By bad management, however, much ground has been lost near the sea, by its being covered with gravel; and by imprudent cultivation of the hills, the impetuous fury of the mountain torrents has rendered a part of it uninhabitable. Macarska is now the only town in the territory, and it appears to have risen out of the ruins of the ancient RATANEUM of Pliny. It formed a part of the Narentan state for several ages, and afterwards, together with the rest of Primorie, passed under the obedience of various Christian princes. It afterwards became subject to the Ottoman Porte, and at last voluntarily subjected itself to the Venetian republic. See DALMATIA and MACARSKA. See also Fortis's *Travels into Dalmatia*, p. 265—318.

PRIMULA, the PRIMROSE; a genus of plants belonging to the pentandria class: and in the natural method

Primula ‖ Prince

thod ranking under the 21st order, *Preciæ*. See BOTANY *Index*. This genus includes the primrose, the cowslip, the polyanthus, and the auricula; some of the earliest and most beautiful ornaments of the flower-garden. For the mode of culture, see GARDENING.

PRIMUM MOBILE, in the Ptolemaic astronomy, the ninth or highest sphere of the heavens, whose centre is that of the world, and in comparison of which the earth is but a point. This is supposed to contain within it all other spheres, and to give them motion, turning them quite round, as well as revolving itself, in 24 hours.

PRINCE, PRINCEPS, in polity, a person invested with the supreme command of a state, independent of any superior.

PRINCE also denotes a person who is a sovereign in his own territories, yet holds of some other as his superior; such are the princes of Germany, who, though absolute in their respective principalities, are bound to the emperor in certain services.

PRINCE also denotes the issue of princes, or those of the royal family. In France, before the revolution, they were called *princes of the blood*, and during the short continuance of the constitution of 1791, *French princes*. In England the king's children are called *sons and daughters of England*; the eldest son is created prince of Wales; the cadets are created dukes or earls as the king pleases; and the title of all the children is *royal highness*: all subjects are to kneel when admitted to kiss their hand, and at table out of the king's presence they are served on the knee. See *ROYAL Family*.

PRINCE of the Senate, in old Rome, the person who was called over first in the roll of senators, whenever it was renewed by the censors: he was always of consular and censorian dignity. See the article SENATE.

PRINCE's Metal, or *Pinchbeck*, an alloy of copper and zinc, which has a resemblance to gold. See CHEMISTRY, N° 2014.

PRINCETOWN. See *New JERSEY*.

PRINCE of Wales's Island, or *Pulo Penang*, is situated in the entrance of the straits of Malacca, in 100° of east longitude, and in 5° of north latitude. It is about seven leagues in length and three in breadth, and is supposed to contain about 160 square miles. Its northern extremity runs nearly parallel with the main land at a distance of about two miles, by which a fine channel is formed, where the greatest fleets might ride in perfect safety, the height of the surrounding mountains acting as a barrier against the force of the prevailing winds.

Edin. Phil. Trans. v. iii. p. 13, &c.

The purchase of this island from the king of Queddah, on the opposite Malay coast, was made on behalf of the East India Company by Mr Light, who took possession of it on the 12th of August 1786. The settlement continued to enjoy peace and security till the year 1791, when a jealousy on the part of the king of Queddah, probably arising from a collision of interests, threatened it with the calamities of war. Mr Light, however, anticipated the attack of the enemy, and carried the scene of action to his own shores. A fort constructed by the Malays at the town of Prya on the opposite shore, and only two miles distant from George Town in Prince of Wales's island, was taken by assault; and almost the whole of the prows collected in the river for the conveyance of troops to attack the British settlement, were destroyed. A new treaty was entered into, by which it was stipulated, that the Malay king should receive an annual payment of 6000 dollars. In 1800, a tract of land on the opposite shore, of 18 miles in length and three in breadth, was ceded to the company by the king of Queddah, on condition of receiving annually an additional sum of 4000 dollars. The number of inhabitants in 1797 was computed at about 12,000 persons of all descriptions.

Prince.

The climate, considering its vicinity to the equator, is remarkably mild. The thermometer on the high grounds never rises above 78°, seldom more than 74°; and falls as low as 66°; while on the plain it ranges from 76° to 90°. Its healthfulness is certainly not surpassed by that of any European settlement on the coast. Out of a garrison of 300 troops (natives of Hindostan), not one died for the space of 14 months; a singular fact to be experienced by a new settlement in an uncleared country. This great salubrity is perhaps the effect of a constant ventilation, supported by almost continued but gentle breezes, added to the dryness of the soil, the uniform but gradual elevation from the sea to the foot of the hills preventing those stagnations of water, which, in tropical latitudes, are so highly prejudicial to the health of man.

A ridge of beautiful mountains, deeply indented with valleys, and covered with evergreens, divides the island longitudinally. Flagstaff hill, nearly the highest on the island, is estimated at 2500 feet above the level of the sea. Innumerable rivulets receive their origin from these mountains, and are remarkable for the transparency and coolness of their waters. The soil, which is light and sandy near the sea, gradually changes to a rich clay as it approaches to the high lands. There the sugar-cane grows with the utmost luxuriance, and the most plentiful crops of rice are everywhere produced. The gardens have already furnished the inhabitants with cabbages and potatoes; and when industry shall have reached the tops of the mountains, it will be no surprise to see in the plantations most of the productions of Europe in their utmost perfection. Here are also produced pepper, cocoa-nuts, coffee, cotton, ginger, yams, sweet potatoes, a great variety of vegetables, and many different sorts of fruits. Among the exotics are the clove, nutmeg, cinnamon, pimento, hyapootee, colalava, and a number of other plants from the Moluccas and Eastern isles, introduced only a few years ago. In decorating the landscapes of this little island, nature has been peculiarly lavish. An assemblage of flowering trees and shrubs in perpetual blossom, and endless in the variety of their species, form the first shade. These are overtopped by forest trees of an immense height, which spread their vast branches on every side, and are covered with the richest foliage. Here strangers feel with rapture the effect of the breezes, which, from whatsoever quarter they blow, are strongly impregnated with the fragrance of the groves.

The original animal productions of this island are very limited. Of quadrupeds, the wild hog, deer, and squirrel, nearly comprehend the whole; but the absence of the tiger and leopard, whose numbers and ferocity almost render the opposite shores uninhabitable, amply compensates for this deficiency. The flying fox and squirrel are natives of this island; the former a nondescript,

descript, and a great natural curiosity. Of birds there are also but few, and only one which is remarkable for the melody of its notes. The crow and sparrow, the never-failing attendants on population, have but lately made their appearance. They are now, however, rapidly increasing and multiplying. All the domestic animals arrive here at great perfection.

The sea which surrounds the island, affords a vast variety of fish of the most delicious flavour, and its shores abundance of the finest turtle and oysters. In no situation indeed are the conveniencies and luxuries of life enjoyed in greater profusion. The advantages of the island in a political and commercial view are very considerable. There were nothing but wooden bridges on this island in the year 1800, which were perpetually liable to be injured, and which the rapid swell of the rivers frequently carried away; but four substantial bridges of brick and mortar were soon after that period completed, their foundations being of stone.

The markets are well supplied with different kinds of fish, poultry of all sorts, pork, grain, and great variety of the finest fruits and vegetables. The quality of the beef and veal is none of the best, and they import sheep from Bengal. Milk, butter, and bread, bear a high price, the two former of which are not very abundant.

Prince of Wales Island produces a great variety of timber, fit for every purpose of ship-building, and can furnish masts of any dimensions. Ships of 74 guns were provided with lower masts of one piece in the course of the late war.

There are few, if any places, more abundantly supplied with water, than this island, numerous streams of water flowing from the hills in every direction. Three or four of these streams unite, and form the Penang river, after traversing a considerable space; and it discharges itself into the sea, about a mile to the southward of the town.

This island contains mines of tin; but it is said they have never been worked.

Persons convicted of felonies, &c. in any of the British settlements in the East Indies are frequently banished to Prince of Wales Island, so that it may be considered as the Botany Bay of the East.

The following table exhibits the revenue and disbursements of the island, at several different periods, from 1789 to 1804.

	Revenue.	*Disbursements.*
	Dollars.	Dollars.
1789	2500	78,884
1790	4100	96,274
1791	11,235	108,290
1795	19,612	115,379
1796	28,000	192,598
1800	53,155	184,469
1802	74,280	176,000
1803	75,000 estimated.	180,000 estimated.

The imports of this island consist of the various natural productions of the east, as well as of a great variety of the manufactures of the industrious inhabitants of those regions.

In 1799, 95 English ships, 37 American, Portuguese, and Danish, and 36 Asiatic, arrived in this island. The total number of arrivals, in 1800, amounted to 193; and in 1802, to 241, equal nearly to 57,000 tons.

Prince William's Sound, situated on the north-west coast of America, and so named by Captain Cook in 1778. The men, women, and children of this sound are all clothed in the same manner. Their ordinary dress is a sort of close frock, or rather robe, which sometimes reaches only to the knees, but generally down to the ancles. These frocks are composed of the skins of various animals, and are commonly worn with the hairy side outwards. The men often paint their faces of a black colour, and of a bright red, and sometimes of a bluish or leaden hue; but not in any regular figure. The women puncture or stain the chin with black, that comes to a point in each of their cheeks. Their canoes are of two sorts; the one large and open, the other small and covered. The framing consists of slender pieces of wood, and the outside is composed of the skins of seals, or other sea animals, stretched over the wood. Their weapons, and implements for hunting and fishing, are the same as those used by the Greenlanders and Esquimaux. Many of their spears are headed with iron, and their arrows are generally pointed with bone. The food they were seen to eat was the flesh of some animal, either roasted or broiled, and dried fish. Some of the former that was purchased had the appearance of bear's flesh. They also eat a larger sort of fern-root, either baked or dressed in some other method. Their drink, in all probability, is water; for, in their canoes, they brought snow in wooden vessels, which they swallowed by mouthfuls. Our knowledge of the animals of this part of the American continent is entirely derived from the skins that were brought by the natives for sale. These were principally of bears, common and pine martens, sea otters, seals, racoons, small ermines, foxes, and the whitish cat or lynx. The birds found here were the halycon, or great king's-fisher, which had fine bright colours; the white-headed eagle, and the humming-bird. The fish that were principally brought to market for sale were torsk and holibut. The rocks were almost destitute of shell-fish; and the only other animal of this tribe that was observed was a reddish crab, covered with very large spines. Few vegetables of any kind were observed; and the trees that chiefly grew about this sound were the Canadian spruce pine, some of which were of a considerable size. E. Long. 115. 21. N. Lat. 59. 33.

PRINCIPAL, the chief and most necessary part of a thing. The principal of a college or hall is the master thereof.

In commerce, principal is the capital of a sum due or lent; so called in opposition to interest. See INTEREST.

It also denotes the first fund put by partners into a common stock, by which it is distinguished from the calls or accessions afterwards required.

PRINCIPAL, in *Music*. See FUNDAMENTAL, in MUSIC, and GENERATOR, in MUSIC.

PRINCIPAL, in *Law*, is either the actor or absolute perpetrator of the crime, who is called a *principal*, in the first degree; or he who is present, aiding and abetting the fact to be done, who is denominated a *principal* in the second degree. The presence of a principal need not

not always be an actual immediate standing by, within sight or hearing of the fact; but there may be also a constructive presence, as when one commits a robbery or murder, and another keeps watch or guard at some convenient distance. And this rule has also other exceptions; for, in case of murder by poisoning, a man may be a principal felon by preparing and laying the poison, or giving it to another (who is ignorant of its poisonous quality) for that purpose; and yet not administer it himself, nor be present when the very deed of poisoning is committed. And the same reasoning will hold, with regard to other murders committed in the absence of the murderer, by means which he had prepared before-hand, and which probably could not fail of their mischievous effect. As by laying a trap or pit-fall for another, whereby he is killed; letting out a wild beast, with an intent to do mischief; or exciting a madman to commit murder, so that death thereupon ensues: in every one of these cases the party offending is guilty of murder as a principal, in the first degree. For he cannot be called an accessory, that necessarily presupposing a principal; and the poison, the pit-fall, the beast, or the madman, cannot be held principals, being only the instruments of death. As therefore he must be certainly guilty, either as principal or accessory, and cannot be so as accessory, it follows that he must be guilty as principal; and if principal, then in the first degree; for there is no other criminal, much less a superior in the guilt, whom he could aid, abet, or assist.

Blackst. Comment. b. iv. c. 3.

Principal *Point*, in *Perspective*, is a point in the perspective plane, upon which a line drawn from the eye perpendicular to the plane falls.

This point is in the intersection of the horizontal and vertical plane; and is also called the *point of sight*, and *point of the eye*. See Perspective.

Principal *Ray*, in *Perspective*, is that which passes perpendicularly from the spectator's eye to the perspective plane, or picture.

Whence the point where this ray falls on the plane, is by some also called the *principal point*, which other writers call *the centre of the picture*, and *the point of concurrence*.

PRINCIPATO, the name of a province of Italy, in the kingdom of Naples, which is divided into two parts, called by the Italians the *Principato Ultra*, and the *Principato Citra*, the Hither and Farther Principato. The Hither Principato is bounded on the north by the Farther Principato and part of the Terra-di-Lavoro, on the west and south by the Tuscan sea, and on the east by the Basilicata. It is about 60 miles in length, and 30 in breadth; the soil is fertile in wine, corn, oil, and saffron; and they have a great deal of silk, besides several mineral springs. The capital town is Salerno. The Farther Principato is bounded on the north by the county of Molese and the Terra-di-Lavoro, on the west by the Tuscan sea, on the south by the Hither Principato, and on the east by the Capitanata. It is about 37 miles in length, and 30 in breadth. The Apennine mountains render the air cold; and the soil is not very fertile either in corn or wine, but it produces chesnuts, and pastures in great plenty. Benevento is the capital town. The population of both in 1817 was 764,000.

PRINCIPLE, Principium, in general, is used for the cause, source, or origin of any thing.

Principle, in human nature. See Disposition.

Principle, in science, is a truth, admitted without proof, from which other truths are inferred by a chain of reasoning. Principles are of two kinds, *primary* and *general*; and to the last the name of *axioms* is usually given on account of their importance and *dignity*. An axiom or *general* principle, when the terms in which it is expressed are understood, must be a self-evident truth; but from its very nature it cannot be a *first* truth. Our first truths are all *particular*. A child knows that two *particular* lines, each an inch long, are equal to one another, before he has formed any *general* notions of length and equality. "Things equal to one and the same thing are equal to one another," is the first of Euclid's axioms; and an axiom it undoubtedly is, but to no man has it been a *first* truth. It is, if we may use the expression, a *genus* or *class* of truths, comprehending under it numberless individuals. Were a full-grown man introduced into the world, without a single idea in his mind, as we may suppose Adam to have been, he would instantly perceive, upon laying together three pieces of wood each a foot long, that they were all equal in length; and if he were to cut another to the same length with *any one* of them, he would find upon trial that it was of the same length with them all. After a few simple experiments of this kind, he would, by a law of human thought, infer, that all things equal in length or in any other dimension, to any *one* thing, are in that dimension equal to one another.

It was not therefore with such weakness as some have imagined, that Hobbes affirmed those propositions commonly called axioms, not to be primary but secondary principles. A primary principle deserves not the name of an axiom, as it is only a particular truth including in it no other truth. There is not one of Euclid's axioms which has not been the result of induction, though we remember not the time at which the induction was made. That the whole is greater than any of its parts is a general truth which no man of common sense can controvert; but every one discovered that truth by observing that his body was larger than his head, his foot, or his hand; that a mountain is larger than a mole-hill in the middle of it; and that a piece of timber measuring what is called a yard is longer than any one of the divisions marked upon it, and termed inches. The particular observations are made through the senses and treasured up in the memory; and the intellect, by its constitution, compares them together, marks in what they agree and disagree, and thence draws its *axioms* or *general* principles. He, therefore, who should admit the truth of an axiom, and deny the evidence of sense and perception, would act as absurdly as he who accepts payment in a bank bill, and refuses it in the individual pieces of gold or silver which that bill represents. General axioms are of infinite use in the pursuits of science; but it is not because they create new truths; they only shorten the process in the discovery of such as might be found, with labour, through the medium of particular propositions. See *Campbell's Philosophy of Rhetoric* and *Tatham's Chart and Scale of Truth*.

Principles, in *Physics*, are often confounded with elements, or the first and simplest parts whereof natural bodies are compounded, and into which they are again resolvable by the force of fire.

PRINGLE, Sir John, an eminent physician and philosopher, Pringle. philosopher, was a younger son of Sir John Pringle of Stitchel, in the shire of Roxburgh, Baronet; took the degree of M. D. at Leyden, 1730; and published there *Dissertatio Inauguralis de Marcore Senili*, 4to. After having been some years professor of moral philosophy at Edinburgh, he was in June 1745 appointed physician to the duke of Cumberland, and physician-general to the hospital of the forces in Flanders, where the earl of Stair appears to have been his patron. In February 1746, Dr Pringle, Dr Armstrong, and Dr Barker, were nominated physicians to the hospital of lame, maimed, and sick soldiers, behind Buckingham-house; and in April 1749, Dr Pringle was appointed physician in ordinary to the king. In 1750 he published "Observations on the Nature and Cure of Hospital and Gaol Fevers, in a letter to Dr Mead," 8vo (reprinted in 1755); and in 1752 he favoured the public with the result of his long experience, in an admirable treatise under the title of "Observations on the Disorders of the Army in Camp and Garrison," 8vo. On the 14th of April 1752, he married Charlotte, second daughter of Dr Oliver, an eminent physician at Bath. In 1756 he was appointed jointly with Dr Wintringham (now Sir Clifton Wintringham, Bart.) physician to the hospital for the service of the forces of Great Britain. After the accession of his present majesty, Dr Pringle was appointed physician to the queen's household, 1761; physician in ordinary to the queen in 1763, in which year he was admitted of the college of physicians in London; and on the 5th of June 1766, he was advanced to the dignity of a baronet of Great Britain. In 1772 he was elected president of the Royal Society, where his speeches for five successive years, on delivering the prize-medal of Sir Godfrey Copley, gave the greatest satisfaction. Sir John Pringle in 1777 was appointed physician extraordinary to the king. He was also a fellow of the College of Physicians at Edinburgh, and of the Royal Medical Society at Paris; member of the Royal Academies at Paris, Stockholm, Gottingen, and of the Philosophical Societies at Edinburgh and Haerlem; and continued president of the Royal Society till November 1778; after which period he gradually withdrew from the world, and in 1781 quitted his elegant house in Pall Mall (where he had long distinguished himself as the warm friend and patron of literary men of every nation and profession), and made an excursion to his native country. He returned to London in the latter end of the year; died greatly beloved and respected, January 18. 1782; and having no children, was succeeded in estate, and also (agreeably to the limitation of the patent) in title, by his nephew, Sir James Pringle, Bart. Among the worthy physician's communications to the Royal Society, the following are the principal: 1. "Some Experiments on Substances resisting Putrefaction," Phil. Trans. N° 495. p. 580; and N° 496, p. 525, 550; reprinted, with additions, in Martin's Abridgement, vol. xi. p. 1365. 2. "Account of some Persons seized with the Gaol Fever by working in Newgate, and of the manner by which the Infection was communicated to one entire Family," vol. xlviii. p. 42. At the request of Dr Hales, a copy of this useful paper was inserted in the Gentleman's Magazine, 1753, p. 71, before its appearance in the Transactions. 3. "A remarkable Case of Fragility, Flexibility, and Dissolution of the Bones, ib. p. 297. 4. "Account of the Earthquake felt at Brussels," vol. xlix. p. 546. 5. "Account of the sinking of a river near Pontypool, in Monmouthshire," ib. p. 547. 6. "Account of an Earthquake felt Feb. 18. 1756, along the coast of England, between Margate and Dover," ib. p. 579. 7. "Account of the Earthquake felt at Glasgow and Dumbarton; also of a shower of Dust falling on a Ship between Shetland and Iceland," ib. p. 509. 8. "Several Accounts of the Fiery Meteor which appeared on Sunday, November 26. 1758, between eight and nine at night, vol. l. p. 218. 9. "Account of the Virtues of Soap in dissolving the Stone, in the Case of the Reverend Mr Matthew Simson," ib. p. 221. 10. "Account of the effects of Electricity in Paralytic Cases," ib. 481. And see a letter to him on that subject from Professor Winthorp. "Some Account of the Success of the *Vitrum Ceratum Antimonii*," was printed in the Edinburgh Medical Essays, vol. v.

Pringle ‖ Printing.

PRINOS, in *Botany*, a genus of the monogynia order, belonging to the hexandria class of plants; and in the natural method ranking under the 43d order, *Dumosæ*. The calyx is sexfid; the corolla monopetalous, and rotaceous; the belly hexaspermous.

PRINTER, a person who composes and takes impressions from moveable characters ranged in order, by means of ink and a press.

PRINTING, the art of taking impressions from characters or figures, moveable and immoveable, on paper, linen, silk, &c. There are three kinds of printing: the one from moveable letters, for books; another from copper-plates, for pictures; and the last from blocks, in which the representation of birds, flowers, &c. are cut, for printing calicoes, linen, &c. The first is called *common* or *letter-press* printing; the second, *rolling-press* printing; and the last, *calico*, &c. printing. The principal difference between the three consists in this, that the first is cast in relievo, in distinct pieces; the second engraven in creux; and the third cut in relievo, and generally stamped, by placing the block upon the materials to be printed, and striking upon the back of it.

1 Letter-press printing.

Of the above branches, Letter-Press Printing is the most curious, and deserves the most particular notice: for to it are owing chiefly our deliverance from ignorance and error, the progress of learning, the revival of the sciences, and numberless improvements in arts, which, without this noble invention, would have been either lost to mankind, or confined to the knowledge of a few. "To the art of printing, (says an elegant essayist *), it is acknowledged we owe the reformation. It has been justly remarked, that if the books of Luther had been multiplied only by the slow process of the hand-writing, they must have been few, and would have been easily suppressed by the combination of wealth and power; but, poured forth in abundance from the press, they spread over the land with the rapidity of an inundation, which acquires additional force from the efforts used to obstruct its progress. He who undertook to prevent the dispersion of the books once issued from the press, attempted a task no less arduous than the destruction of the hydra. Resistance was vain, and religion was reformed: and we who are chiefly interested in this happy revolution must remember, amidst the praises bestowed on Luther, that

2 Utility of this art.

* Dr Knox.

Printing.

that his endeavours had been ineffectual, unassisted by the invention of Faustus.

3 Good and evil resulting from it.

"How greatly the cause of religion has been promoted by the art, must appear, when it is considered, that it has placed those sacred books in the hand of every individual, which, besides that they were once locked up in a dead language, could not be procured without great difficulty. The numerous comments on them of every kind, which tend to promote piety, and to form the Christian philosopher, would probably never have been composed, and certainly would not have extended their beneficial influence, if typography had still been unknown. By that art, the light, which is to illuminate a dark world, has been placed in a situation more advantageous to the emission of its rays: but if it has been the means of illustrating the doctrines, and enforcing the practice of religion, it has also, particularly in the present age, struck at the root of piety and moral virtue, by propagating opinions favourable to the sceptic and the voluptuary. It has enabled modern authors wantonly to gratify their avarice, their vanity, and their misanthropy, in disseminating novel systems subversive of the dignity and happiness of human nature: but though the perversion of the art is lamentably remarkable in those volumes which issue, with offensive profusion, from the vain, the wicked, and the hungry; yet this good results from the evil, that as truth is great and will prevail, she must derive fresh lustre, by displaying the superiority of her strength in the conflict with sophistry.

"Thus the art of printing, in whatever light it is viewed, has deserved respect and attention. From the ingenuity of the contrivance, it has ever excited mechanical curiosity; from its intimate connection with learning, it has justly claimed historical notice; and from its extensive influence on morality, politics, and religion, it is now become a subject of very important speculation.

4 Its good effects overbalance the bad.

"But however we may felicitate mankind on the invention, there are perhaps those who wish, that, together with its compatriot art of manufacturing gunpowder, it had not yet been brought to light. Of its effects on literature, they assert, that it has increased the number of books, till they distract rather than improve the mind; and of its malignant influence on morals, they complain, that it has often introduced a false refinement, incompatible with the simplicity of primitive piety and genuine virtue. With respect to its literary ill consequences, it may be said, that though it produces to the world an infinite number of worthless publications, yet true wit and fine composition will still retain their value, and it will be an easy task for critical discernment to select these from the surrounding mass of absurdity: and though, with respect to its moral effects, a regard to truth extorts the confession, that it has diffused immorality and irreligion, divulged with cruel impertinence the secrets of private life, and spread the tale of scandal through an empire; yet these are evils which will either shrink away unobserved in the triumphs of time and truth over falsehood, or which may, at any time, be suppressed by the legislative interposition."

5 History of the invention of printing.

Some writers have ascribed the origin of this art to the East, and affixed a very early period to its invention; particularly P. Jovius, (*Hist.* lib. xiv. p. 226. ed. Florent. 1550), from whom Osorius and many others have embraced the same opinion. But these have evidently confounded the European mode of printing with the *engraved tablets* which to this day are used in China. The invention of these tablets has been ascribed by many writers even to an earlier period than the commencement of the Christian era; but is with more probability assigned, by the very accurate Phil. Couplet, to the year 930. The *Historia Sinensis* of Abdalla, written in Persic in 1317, speaks of it as an art in very common use. MEERMAN, vol. i. p. 16. 218, 219, vol. ii. p. 186. N. Trigault asserts that the Chinese practised the art of printing five centuries before. Count Ferre Rezzonico found at Lyons plates with words and names engraven by a Nuremberger 1380.

The honour of having given rise to the European method has been claimed by the cities of *Haerlem*, *Mentz* and *Strasburg*. And to each of these it may be ascribed in a qualified sense, as they made improvements upon one another.

6 Claim of Haerlem.

I. The first testimony of the inventor is that recorded by Hadrian Junius, in his *Batavia*, p. 253, ed. Lugd. Bat. 1588; which, though it hath been rejected by many, is of undoubted authority. Junius had the relation from two reputable men; Nicholaus Galius (A), who was the schoolmaster; and Quirinius Talesius, his intimate and correspondent. He ascribes it to LAURENTIUS, the son of John (Ædituus, or Custos, of the cathedral of HAERLEM, at that time a respectable office), upon the testimony of Cornelius, some time a servant to Laurentius, and afterwards bookbinder to the cathedral, an office which had before been performed by Franciscan friars. His narrative was thus: "That, walking in a wood near the city (as the citizens of opulence use to do), he began at first to cut some letters upon the rind of a beech tree; which, for fancy's sake being impressed on paper, he printed one or two lines, as a specimen for his grand-children (the sons of his daughter) to follow. This having happily succeeded, he meditated greater things (as he was a man of ingenuity and judgment); and first of all, with his son-in-law Thomas Peter (who, by the way, left three sons, who all attained the consular dignity), invented a more glutinous writing-ink, because he found the common ink sunk and spread; and then formed whole pages of wood, with letters cut upon them; of which sort I have seen some essays, in an anonymous work, printed only on one side, entitled *Speculum nostræ salutis*: in which it is remarkable, that in the infancy

(A) Galius seems to be the same who is called *Claes Lottynsz. Gael*, Scabinus Harlemi, as it is in the Fasti of that city, in the years 1531, 1533, and 1535. Quirinus in the same Fasti is called *Mr Quiryn Dirkszoon.* He was many years amanuensis to the great Erasmus, as appears from his epistle, 23d July 1529. tom. iii. Oper. p. 1222. He was afterwards Scabinus in 1537 et seq. and consul in 1552 et seq. But in the troubles of Holland he was cruelly killed by the Spanish soldiers, May 23. 1563. There are some letters of Hadrian Junius to this Talesius, in the *Epistolæ Junianæ*, p. 198.

fancy of printing (as nothing is complete at its first invention) the back sides of the pages were pasted together, that they might not by their nakedness betray their deformity. These beechen letters he afterwards changed for leaden ones, and these again for a mixture of tin and lead [*stanneæ*] as a less flexible and more solid and durable substance. Of the remains of which types, when they were turned to waste metal, those old wine-pots were cast, that are still preserved in the family-house, which looks into the market-place, inhabited afterwards by his great-grandson Gerard Thomas, a gentleman of reputation; whom I mention for the honour of the family, and who died old a few years since. A new invention never fails to engage curiosity. And when a commodity never before seen excited purchasers, to the advantage of the inventor, the admiration of the art increased, dependents were enlarged, and workmen multiplied; the first calamitous incident! Among these was one John, whether, as we suspect, he had ominously the name of *Faustus* (B), unfaithful and unlucky to his master, or whether it was really a person of that name, I shall not much inquire; being unwilling to molest the silent shades, who suffer from a consciousness of their past actions in this life. This man, bound by oath to keep the secret of printing, when he thought he had learned the art of joining the letters, the method of casting the types, and other things of that nature, taking the most convenient time that was possible, on Christmas eve, when every one was customarily employed in lustral sacrifices, seizes the collection of types, and all the implements his master had got together, and, with one accomplice, marches off to Amsterdam, thence to Cologne, and at last settled at Mentz, as at an asylum of security, where he might go to work with the tools he had stolen. It is certain, that in a year's time, viz. in 1442, the *Doctrinale* of Alexander Galius, which was a grammar much used at that time, together with the *Tracts* of Peter of Spain, came forth there, from the same types as Laurentius had made use of at Haerlem."

Thus far the narrative of Junius, which he had frequently heard from Nicolaus Galius; to whom it was related by Cornelius himself, who lived to a great age, and used to burst into tears upon reflecting on the loss his master had sustained, not only in his substance, but in his honour, by the roguery of his servant, his former associate and bedfellow. Cornelius, as appears by the registers of Haerlem cathedral, died either in 1515, or the beginning of the following year; so that he might very well give this information to Nicolaus Galius, who was schoolmaster to Hadrian Junius.

Though this circumstance is probable as to the main fact, yet we must set aside the evidence of it in some particulars. 1. The first obvious difficulty is noticed by Scriverius; "that the types are said to be made of the *rind* of beach, which could not be strong enough to bear the impression of the press:" though this is removed, if, instead of the *bark*, we substitute a *bough* of the beech. The idea of the *bark*, when Junius wrote this, was perhaps strong in his mind, from what Virgil

Bower and Nichols's Origin of Printing.

tells us (Ecl. v. 13.) of its being usual to cut words on the *bark* of a beech; and thence he was easily led to make a wrong application of it here.

2. The letters were at first *wooden*, and are said to be afterwards exchanged for *metal* types; from which the wine-pots were formed, remaining in the time of Junius. According to tradition, printing was carried on in the same house long after the time of Laurentius: these pots might therefore be formed from the waste metal of the printing-house, after the use of *fusile types* became universal.—But Laurentius seems to have carried the art no farther than *separate wooden types*. What is a remarkable confirmation of this, Henry Spiechel, who wrote, in the 16th century, a Dutch poem entitled *Hertspiegel*, expresses himself thus: "Thou first, Laurentius, to supply the defect of wooden tablets, adaptedst *wooden types*, and afterwards didst connect them with a thread, to imitate writing. A treacherous servant surreptitiously obtained the honour of the discovery. But truth itself, though destitute of common and wide-spread fame; truth, I say, still remains." No mention in the poem of *metal types*; a circumstance which, had he been robbed of such, as well as of *wooden* ones, would scarcely have been passed over in silence.

When Laurentius first devised his rough specimen of the art, can only be guessed at. He died in 1440, after having published the *Speculum Belgicum*, and two editions of *Donatus*, all with different *wooden types*; which it is probable (considering the difficulties he had to encounter, and the many artists whom he must necessarily have had occasion to consult) cost him some years to execute; so that the first essay might be about 1430, which nearly agrees with Petrus Scriverius, who says, the invention was about 10 or 12 years before 1440. See LAURENTIUS.

3. What was the specimen he first diverted himself with in cutting, at the distance of three centuries, one would think impossible to be discovered. And yet Joh. Enschedius, a printer, thinks he was so happy as to find it, being an old parchment *Horarium*, printed on both sides, in eight pages, containing the Letters of the Alphabet, the Lord's Prayer, the Apostles Creed and three short prayers. And Mr Meerman having shown this to proper artists who were judges of these matters, they gave it as their opinion that it agreed exactly with the description of Junius. It is conformable to the first editions of the Dutch *Speculum Salvationis*, and the fragments of both *Donatus's* of Holland, both which are the works of the same Laurentius, and were preceded by this. In these types, which are certainly moveable, cut, and uneven, there is a rudeness which Mr Meerman has not observed in any other instances. There are no numbers to the pages, no signatures, no *direction-words*, no divisions at the end of the lines; on the contrary, a syllable divided in the middle is seen, thus, *Spi ritū*, in p. 8. l. 2, 3. There are neither distinctions nor points, which are seen in the other works of Laurentius; and the letter *i* is not marked with an accent, but with a dot at the top. The lines throughout

(B) *John Faust*, or *Fust*, is by many supposed to have derived his name from *faustus*, "happy;" and Dr Faustus seems to carry an air of grandeur in the appellation: but very erroneously. *John Faust*, or *Fust*, is no more than *John Hand*, whence our name *Fist*.

Printing. out are uneven. The shape of the pages not always the same; not (as they should be) rectangular, but sometimes rhomb-like, sometimes an *isoscele trapezium:* and the performance seems to be left as a specimen both of his piety, and of his ingenuity in this essay of a new invented art. Mr Meerman has given an exact engraving of this singular curiosity.

But, whatever else may appear doubtful in the narrative of Junius, it is very clear, that the first essays of the art are to be attributed to Laurentius, who used only *separate wooden types*. See the article LAURENTIUS.

Printing. II. Some of Laurentius's types were stolen from him by one of his servants (c) *John* GEINSFLEICH *senior;* who fled therewith to MENTZ. Having introduced the art from Haerlem into this his native city, he set with all diligence to carry it on; and published, in 1442, *ALEXANDRI GALLI Doctrinale*, and *PETRI HISPANI Tractatus;* two works, which, being small, best suited his circumstances; and for which, being much used in the schools, he might reasonably expect a profitable sale. They were executed with *wooden types*, cut after the model of those he had stolen.

7 Claim of Mentz.

In 1443 he hired the house Zum Jungen; and was assisted

(c) Authors differ as to the person who committed this robbery. It is clear from all accounts that his name was *John;* but what his surname was is the disputed point. Junius, after some hesitation, ascribes it to John Fust; but with injustice: for he was a wealthy man, who assisted the first printers at Mentz with money; and though he afterwards was proprietor of a printing-office, yet he never, as far as appears, performed any part of the business with his own hands, and consequently he could never have been a servant to Laurentius. Nor is the conjecture of Scriverius better founded, which fixes it upon John Gutenberg, who (as appears by authentic testimonies) resided at Strasburg from 1436 to 1444, and during all that period employed much fruitless labour and expence in endeavouring to attain this art. Mr Meerman once thought, "it might be either John Meidenbachius, (who, we are told by Seb. Munster and the author of *Chronographia Moguntinensis*, was an assistant to the first Mentz printers); or John Petersheimius (who was some time a servant to Fust and Schoeffer, and set up a printing-house at Francfort in 1459): or, lastly, some other person, who, being unable through poverty to carry on the business, discovered it to *Geinsfleich* at Mentz." But more authentic intelligence afterwards convinced him there were two persons of this name; and that John Geinsfleich senior * was the dishonest servant, who was born at Mentz, and who in the papers published by Kohlerus, we find there in the year 1441, and not before: for though he was of a good family, yet he was poor, and seems to have been obliged, as well as his brother, to seek his livelihood in a foreign country; and perhaps was content to be under Laurentius, that, when he had learned the art, he might follow it in his own. But, to leave conjecture, we may produce some certain testimonies.

1. It is what Junius himself says, that the person who stole the types did it with a view to set up elsewhere; nor is it likely that he would either make no use of an art he had seen so profitable to Laurentius, or that he would teach it to another and submit to be again a servant.

The Lambeth Record (which is printed below, from Mr Atkyns) tells us, that "Mentz gained the art by the brother of one of the workmen of Haerlem, who learned it at home of his brother, who after set up for himself at Mentz."—By the strictest examination of the best authorities, it is plain, that by these *two brothers* the two Geinsfleiches must be meant. But as the younger (*Gutenberg*) was never a servant to Laurentius, it must be the senior who carried off the types, and instructed his brother in the art; who first applied himself to the business at Strasburg, and afterwards joined his elder brother, who had in the mean time settled at Mentz.

What is still stronger, two chronologers of Strasburg, the one named *Dan Speklinus*, the other anonymous (in Meerman's *Documenta*, N° LXXXV. LXXXVI.), tell us expressly, that John Geinsfleich (viz. the senior, whom they distinguished from Gutenberg), having learned the art by being servant to its *first inventor*, carried it by theft into Mentz his native country. They are right in the fact, though mistaken in the application of it; for they make Strasburg the place of the invention, and Mentelius the inventor, from whom the types were stolen. But this is plainly an error: for Geinsfleich lived at Mentz in 1441, as appears from undoubted testimonies; and could not be a servant to Mentelius, to whom the before-mentioned writers ascribe the invention in 1440, though more ancient ones do not attempt to prove that he began to print before 1444 or 1448. Nor will the narrative agree better with Gutenberg, who was an earlier printer than Mentelius; since, among the evidences produced by him in his law-suit, 1439, no Geinsfleich senior appears, nor any other servant but Laurentius Beildek. The narration therefore of the theft of Geinsfleich, being spread by various reports through the world, and subsisting in the time of these chronologers, was applied by them (to serve the cause they wrote for) to Strasburg; but serves to confirm the truth, since no writer derives the printing spoils from any other country than Holland or Alsatia. The chronologers have likewise, instead of Fust, called Gutenberg the wealthy man; who, from all circumstances, appears to have been poor, They also call Schoeffer the son-in-law of Mentelius; when it is clear that he married the daughter of Fust.

* He was called *Geinsfleich* κατ' ἐξοχήν; the other was distinguished by the name of *Gutenberg*. They were both poor; though of a family distinguished by knighthood. They were both married men; and were most probably brothers, as it was not uncommon in that age for two brothers to have the same Christian name. These both appear in a disreputable light. The eldest robbed his master, with many aggravating circumstances. The youngest was remarkably contentious; and, after entering into a contract of marriage with Anna, a noble girl of *The Iron Gate*, refused to marry her till compelled by a judicial decree; and afterwards cared not what became of the lady, but left her behind at Strasburg when he removed to Mentz. He had not only frequent quarrels with his wife; but with *Andrew Drizehen*, *Andrew Heilmann*, and *John Riff*, all of whom were associated with him at Strasburg in his different employments of making of looking glasses, polishing of precious stones, and endeavouring to attain the art of printing; and with these he involved himself in three law-suits. See *Meerman*, vol. i. p. 163, &c. N.

Printing. assisted with money by FUST, a wealthy person, who in return had a share of the business: and about the same time *John Meidenbachius* was admitted a partner, as were some others whose names are not transmitted to our times; and in 1444 they were joined by GUTENBERG, who for that purpose quitted Strasburg. Wooden types being found not sufficiently durable, and not answering expectation in other respects, the two brothers first invented *cut metal types*. But while these were preparing, which must have been a work of time, several works were printed, both on *wooden separate types* and on *wooden blocks;* which were well adapted to small books of frequent use, such as the *Tabula Alphabetica*, the *Catholicon*, *Donati Grammatica*, and the *Confessionalia*.

From the above-mentioned printers in conjunction, after many smaller essays, the Bible was published in 1450, with *large cut metal types* (D). And it is no wonder, considering the immense labour this work cost, that it should be seven or eight years in completing. In this same year the partnership was dissolved, and a new one entered into, in August, between *Fust* and *Gutenberg;* the former supplying the money, the latter skill, for their common benefit. Various difficulties arising, occasioned a law-suit for the money which Fust had advanced; which was determined against Gutenberg. A dissolution of this partnership ensued in 1455; and in 1457 a magnificent edition of the Psalter was published by *Fust* and *Schoeffer*, with a remarkable commendation, in which they assumed to themselves the merit of a new invention (viz. of *metal types*), *ad inventionem artificiosam imprimendi ac characterizandi*. This book was uncommonly elegant, and in some measure the work of Gutenberg; as it was four years in the press, and came out but 18 months after the partnership was dissolved between him and Fust.

The latter continued in possession of the printing-office: and *Gutenberg*, by the pecuniary assistance of Conrad Humery syndic of Mentz (E), and others, opened another office in the same city; whence appeared, in 1460, without the printer's name, the *Catholicon Jo. de Janua*, with a pompous colophon in praise of its beauty, and ascribing the honour of the invention to the city of Mentz. It was a very handsome book, though inferior to the Psalter which had been published in 1457 by Fust and Schoeffer. Both the Psalter and *Catholicon* were printed on *cut metal types* (F). It may not be improper to observe here, that as the Psalter is the earliest book which is known to have a genuine date, it became a common practice, after that publication, for printers to claim their own performances, by adding their names to them.

III. The progress of the art has been thus traced through its *second* period, the invention of *cut metal types*. But the honour of completing the discovery is due to PETER SCHOFFER (G) de Gernsheim.

8 Invention of casting types. A very clear account of this final completion of the types is preserved by Trithemius (H). *Post hæc inventis successerunt subtiliora, inveneruntque modum* fundendi formas *omnium Latini alphabeti literarum, quas ipsi* matrices *nominabant: ex quibus rursum æneos sive stanneos characteres fundebant, ad omnem pressuram sufficientes, quos prius manibus sculpebant. Et revera sicuti* ante *xxx* ferme annos *ex ore Petri Opilionis de Gernsheim, civis Moguntini, qui gener erat primi artis inventoris, audivi, magnam à primo inventionis suæ hæc ars impressoria habuit difficultatem.—Petrus autem memoratus Opilio, tunc famulus postea gener, sicut diximus, inventoris primi Johannis Fust, homo ingeniosus et prudens, faciliorem modum* fundendi characteres *excogitavit, et artem, ut nunc est, complevit.*

Another ample testimony in favour of Schoeffer is given by Jo. Frid. Faustus of Aschaffenburg, from papers preserved in his family: "Peter Schoeffer of Gernsheim, perceiving his master Fust's design, and being himself ardently desirous to improve the art, found out (by the good providence of God) the method of cutting (*incidendi*) the characters in a *matrix*, that the letters might easily be singly *cast* instead of being *cut*. He privately *cut matrices* for the whole alphabet; and when he showed his master the letters cast from these matrices, Fust was so pleased with the contrivance, that he promised Peter to give him his only daughter, Christina, in marriage;

(D) Many writers have supposed that this was the edition of which some copies were sold in France, by Fust, as manuscripts, for the great price of 500 or 600 crowns, which he afterwards lowered to 60, and at last to less than 40. But it was the second and more expensive edition of 1462, that was thus disposed of, when Fust went to Paris in 1466, and which had cost 4000 florins before the third *quaternion* (or quire of four sheets) was printed. MEERMAN, vol. i. p. 6. 151, 152.

(E) At the death of Gutenberg, Conrad Humery took possession of all his printing materials; and engaged to the archbishop Adolphus, that he never would sell them to any one but a citizen of Mentz. They were, however, soon disposed of to Nicholas Bechtermuntze of Altavilla, who, in 1469, published *Vocabularium Latino-Teutonicum*, which was printed with the same types which had been used in the *Catholicon*. This very curious and scarce *Vocabulary* was shown to Mr Meerman, by Mr Bryant, in the duke of Marlborough's valuable library at Blenheim. It is in quarto, 35 lines long, contains many extracts from the *Catholicon*, and is called *Ex quo*, from the preface beginning with those words. MEERMAN, vol. ii. p. 96.

(F) Gutenberg never used any other than either *wooden* or *cut metal types* till the year 1462. In 1465 he was admitted *inter Aulicos* by the elector Adolphus, with an annual pension; and died in February 1468. His elder brother Geinsfleich died in 1462. Their epitaphs are printed by Mr Meerman, vol. ii. p. 154, 295.

(G) In German, Schoeffer; in Latin, *Opilio;* in English, *Shepherd.*——He is supposed by Mr Meerman to have been the first engraver on copperplates.

(H) *Annales Hirsaugienses*, tom. ii. ad ann. 1450.—As this book was finished in 1514, and Trithemius tells us he had the narrative from Schoeffer himself about 30 years before; this will bring us back to 1484, when Schoeffer must have been advanced in years, and Trithemius about 22 years old, who died in 1516. See *Voss.* Hist. Lat. l. 1. c. 10. *Fabr.* Med. & Infim. Æt. l. 9.

riage; a promise which he soon after performed. But there were as many difficulties at first with these letters, as there had been before with *wooden* ones; the metal being too soft to support the force of the impression: but this defect was soon remedied, by mixing the metal with a substance which sufficiently hardened it (I)."

Fust and Schoeffer concealed this new improvement, by administering an oath of secrecy to all whom they intrusted, till the year 1462; when, by the dispersion of their servants into different countries, at the sacking of Mentz by the archbishop Adolphus, the invention was publicly divulged.

The first book printed with these *improved types* was *Durandi Rationale*, in 1459; at which time, however, they seem to have had only *one size* of *cast* letters, all the larger characters which occur being *cut types*, as appears plainly by an inspection of the book. From this time to 1466, Fust and Schoeffer continued to print a considerable number of books; particularly two famous editions of *Tully's Offices*. In their earliest books, they printed more copies on *vellum* than on *paper*, which was the case both of their *Bibles* and *Tully's Offices*. This, however, was soon inverted; and *paper* introduced for the greatest part of their impressions; a few only being printed on *vellum* for curiosities, and for the purpose of being *illuminated*. How long Fust lived, is uncertain; but in 1471 we find Schoeffer was in partnership with *Conrad Henlif* and a kinsman of his master Fust. He published many books after the death of his father-in-law; the last of which that can be discovered is a third edition of the *Psalter* in 1490, in which the old *cut* types of the first edition were used.

9
Claim of Strasburg.

IV. With regard to the claim of STRASBURG: It has been already mentioned, that Gutenberg was engaged in that city in different employments; and, among others, in endeavouring to attain the art of printing. That these endeavours were unsuccessful, is plain from an authentic judicial decree of the senate of Strasburg in 1439, after the death of Andrew Drizehen (K).

But there are many other proofs that Gutenberg and his partners were never able to bring the art to perfection.

1. Wimphelingius *, the oldest writer in favour of Strasburg, tells us, that Gutenberg was the inventor of "a new art of writing," *ars impressoria*, and which might also be called a *divine benefit*, and which he happily completed at Mentz; but does not mention one book of his printing: though he adds, that Mentelius printed many volumes correctly and beautifully, and acquired great wealth; whence we may conclude that he perfected what Gutenberg had in vain essayed.

* *Epitome Rerum Germanicarum* ed. Argent. 1505, Meerman, vol. i. p. 202. vol. ii. p. 139.

2. Wimphelingius, in another book †, tells us, the art of printing was found out by Gutenberg *incomplete*; which implies, not that he practised the art in an imperfect manner (as Laurentius had done at Haerlem), but rather that he had not been able to accomplish what he aimed at.

† *Catal. Episc.* Argent. 1508. *Meerman*, ut supra.

3. Gutenberg, when he left Strasburg in 1444 or the following year, and entered into partnership with Geinsfleich senior and others, had occasion for his brother's assistance to enable him to complete the art; which shows that his former attempts at Strasburg had been unsuccessful ‡.

‡ *Meerman* ut supra.

4. These particulars are remarkably confirmed by Trithemius, who tells us, in two different places §, that Gutenberg spent all his substance in quest of this art; and met with such insuperable difficulties, that, in despair, he had nearly given up all hopes of attaining it, till he was assisted by the liberality of Fust, and by his brother's skill, in the city of Mentz.

§ *Annal. Hirsag.* ut supra, et *Chron. Sponheim.* See *Meerman*, vol. ii p. 103. 127.

5. Ulric Zell says ‖ the art was completed at Mentz; but that some books had been published in Holland earlier than in that city. Is it likely that Zell, who was a German, would have omitted to mention Strasburg, if it had preceded Mentz in printing?

‖ *Chronica Coloniæ*, 1499.

There is little doubt, therefore, that all Gutenberg's labours at Strasburg amounted to no more than a fruitless attempt, which he was at last under the necessity of relinquishing: and there is no certain proof of a single book having been printed in that city till after the dispersion of the printers in 1462, when Mentelius and Eggestenius successfully pursued the business.

In fine, the pretensions of *Strasburg* fall evidently to be set aside. And as to the other two cities, *Haerlem* and *Mentz*, the disputes between them seem easily cleared up, from the twofold invention of printing above mentioned: the first with *separate* WOODEN *types* at Haerlem, by Laurentius, about 1430, and after continued by his family; the other with *METAL types*, first *cut*, and afterwards *cast*, which were invented at Mentz, but not used in Holland till brought thither by Theodoric Martens at Alost about 1472.

From this period printing made a rapid progress in most of the principal towns of Europe. In 1490, it reached Constantinople; and, according to Mr Palmer, p. 281, &c. it was extended, by the middle of the next century, to Africa and America. It was introduced into Russia about 1560: but, from motives either of policy

(I) See *Meerman*, vol. i. p. 183. who copied this testimony from Wolfius, *Monument. Typograph*, vol. i. p. 468. et seq.

(K) Their first attempts were made about 1436 with *wooden types*. Mr Meerman is of opinion that Geinsfleich junior (who was of an enterprising genius, and had already engaged in a variety of projects) gained some little insight into the business by visiting his brother who was employed by Laurentius at Haerlem, but not sufficient to enable him to practise it. It is certain that, at the time of the law-suit in 1439, much money had been expended, without any profit having arisen; and the unfortunate Drizehen, in 1438, on his death-bed, lamented to his confessor, that he had been at great expence, without having been reimbursed a single *obolus*. Nor did Gutenberg (who persisted in his fruitless endeavours) reap any advantage from them; for, when he quitted Strasburg, he was overwhelmed in debt, and under a necessity of selling every thing he was in possession of. [MEERMAN, vol. i. p. 198—202.]. All the depositions in the law-suit abovementioned (with the judicial decree) are printed by Mr Meerman, vol. ii. p. 58.—88. N.

Printing.

policy or superstition, it was speedily suppressed by the ruling powers; and, even under the present enlightened empress, has scarcely emerged from its obscurity.—That it was early practised in the inhospitable regions of Iceland, we have the respectable authority of Mr Bryant: "Arngrim Jonas was born amidst the snows of Iceland; yet as much prejudiced in favour of his country as those who are natives of a happier climate. This is visible in his *Crymogæa*, but more particularly in his *Anatome Blefkiniana*. I have in my possession this curious little treatise, written in Latin by him in his own country, and printed *Typis Holensibus in Islandia Boreali anno* 1612. *Hola* is placed in some maps within the Arctic circle, and is certainly not far removed from it. I believe it is the farthest north of any place where arts and sciences have ever resided." *Observations and Inquiries relating to various parts of Ancient History*, 1767, p. 277.

10 Introduction of the art into Britain.

It was a constant opinion, delivered down by our historians, as hath been observed by Dr Middleton, that the Art of Printing was introduced and first practised in England by *William Caxton*, a mercer and citizen of London; who, by his travels abroad, and a residence of many years in Holland, Flanders, and Germany, in the affairs of trade, had an opportunity of informing himself of the whole method and process of the art; and by the encouragement of the great, and particularly of the abbot of Westminster, first set up a press in that abbey, and began to print books soon after the year 1471.

This was the tradition of our writers; till a book, which had scarce been observed before the Restoration, was then taken notice of by the curious, with a date of its impression from Oxford, anno 1468, and was considered immediately as a clear proof and monument of the exercise of printing in that university several years before Caxton began to deal in it.

This book, which is in the public library at Cambridge, is a small volume of 41 leaves in 4to, with this title: *Expositio Sancti Jeronimi in Simbolum Apostolorum ad Papam Laurentium*: and at the end, *Explicit expositio, &c. Impressa Oxonie et finita Anno Domini* M.CCCC.LXVIII. XVII. *die Decembris*.

11 The first printing-press set up in England, was at Oxford.

The appearance of this book has robbed Caxton of a glory that he had long possessed, of being the author of printing in this kingdom; and Oxford has ever since carried the honour of the first press. The only difficulty was, to account for the silence of history in an event so memorable, and the want of any memorial in the university itself concerning the establishment of a new art amongst them of such use and benefit to learning. But this likewise has been cleared up by the discovery of a record, which had lain obscure and unknown at Lambeth-palace, in the Register of the See of Canterbury, and gives a narrative of the whole transaction, drawn up at the very time.

An account of this record was first published in a thin quarto volume, in English; with this title: "The Original and Growth of Printing, collected out of History, and the Records of this Kingdome: wherein is also demonstrated, that Printing appertaineth to the Prerogative Royal, and is a Flower of the Crown of England. By Richard Atkyns, esq.—Whitehall, April the 25. 1664. By order and appointment of the right honourable Mr Secretary Morrice, let this be printed. Tho. Rycaut, London: Printed by John Streater, for the Author, 1664." 4to.

It sets forth in short, "That as soon as the art of printing made some noise in Europe, Thomas Bourchier, archbishop of Canterbury, moved the then king (Henry VI.) to use all possible means for procuring a printing mould (for so it was then called) to be brought into this kingdom. The king (a good man, and much given to works of this nature) readily hearkened to the motion; and taking private advice how to effect his design, concluded it could not be brought about without great secrecy, and a considerable sum of money given to such person or persons as would draw off some of the workmen of Haerlem in Holland, where John Gutenberg had newly invented it, and was himself personally at work. It was resolved, that less than 1000 merks would not produce the desired effect; towards which sum the said archbishop presented the king 300 merks. The money being now prepared, the management of the design was committed to Mr Robert Turnour, who then was master of the robes to the king, and a person most in favour with him of any of his condition. Mr Turnour took to his assistance Mr Caxton, a citizen of good abilities, who traded much into Holland; which was a creditable pretence, as well for his going, as stay in the Low Countries. Mr Turnour was in disguise (his beard and hair shaven quite off); but Mr Caxton appeared known and public. They, having received the said sum of 1000 merks, went first to Amsterdam, then to Leyden, not daring to enter Haerlem itself; for the town was very jealous, having imprisoned and apprehended divers persons who came from other parts for the same purpose. They staid till they had spent the whole thousand merks in gifts and expences: so as the king was fain to send 500 merks more, Mr Turnour having written to the king that he had almost done his work; a bargain, as he said, being struck betwixt him and two Hollanders, for bringing off one of the underworkmen, whose name was Frederick Corsells (or rather Corsellis), who late one night stole from his fellows in disguise into a vessel prepared before for that purpose; and so, the wind favouring the design, brought him safe to London. It was not thought so prudent to set him on work at London: but, by the archbishop's means (who had been vice-chancellor and afterwards chancellor of the university of Oxon), Corsellis was carried with a guard to Oxon; which guard constantly watched, to prevent Corsellis from any possible escape, till he had made good his promise in teaching them how to print. So that at Oxford, printing was first set up in England which was before there was any printing-press or printer in France, Spain, Italy, or Germany (except the city of Mentz), which claims seniority, as to printing, even of Haerlem itself, calling her city, *Urbem Moguntinam artis typographicæ inventricem primam*; though it is known to be otherwise, that city gaining the art by the brother of one of the workmen of Haerlem, who had learnt it at home of his brother, and after set up for himself at Mentz. This press at Oxon was at least ten years before there was any printing in Europe, except at Haerlem and Mentz, where it was but new-born. This press at Oxford was afterwards found inconvenient to be the sole printing-place of England; as being too far from London and the sea. Wherefore the king set up a press

Printing. press at St Alban's, and another in the city of Westminster, where they printed several books of *divinity* and *physic: for the king* (for reasons best known to himself and council) *permitted then no law-books to be printed;* nor did any printer exercise that art, but only such as were the king's sworn servants; *the king himself having the price and emoluments for printing books.*—By this means the art grew so famous, that anno primo Richard III. c. 9. when an act of parliament was made for restraint of aliens for using any handicrafts here (except as servants to natives), a special proviso was inserted, that strangers might bring in printed or written books to sell at their pleasure, and exercise the art of printing here, notwithstanding that act: so that in the space of 40 or 50 years, by the indulgence of Edward IV. Edward V. Richard III. Henry VII. and Henry VIII. the English proved so good proficients in printing, and grew so numerous, as to furnish the kingdom with books; and so skilful, as to print them as well as any beyond the seas; as appears by the act 25 Hen. VIII. c. 15. which abrogates the said proviso for that reason. And it was further enacted in the said statute, that if any person bought foreign books bound, he should pay 6s. 8d. per book. And it was further provided and enacted, that in case the said printers or sellers of books were unreasonable in their prices, they should be moderated by the lord chancellor, lord treasurer, the two lords chief justices, or any two of them, who also had power to fine them 3s. 4d. for every book whose price should be enhanced.—But when they were by charter corporated with *bookbinders, booksellers,* and *founders of letters,* 3 and 4 Philip and Mary, and called *The Company of Stationers,* they kick'd against the power that gave them life, &c.—Queen Elizabeth, the first year of her reign, grants by patent *the privilege of sole printing all books that touch or concern the common laws of England,* to Tottel a servant to her majesty, who kept it entire to his death; after him, to one Yest Weirt, another servant to her majesty; after him, to Weight and Norton; and after them, King James grants the same privilege to More, one of the signet; which grant continues to this day, &c."

12 Whether Caxton or Corsellis was the first printer.

From the authority of this record, all our later writers declare Corsellis to be the first printer in England; Mr Anthony Wood, the learned Mr Maittaire, Palmer, and one John Bagford, an industrious man, who had published proposals for An History of Printing, (Phil. Trans. for April 1707). But Dr Middleton has called in question the authenticity of this account, and has urged several objections to it, with the view of supporting Caxton's title to the precedency with respect to the introduction of the art into this country; of which we shall quote one or two, with the answers that have been made to them.

Objection 1.—" The silence of Caxton concerning a fact in which he is said to be a principal actor, is a sufficient confutation of it: for it was a constant custom with him, in the prefaces or conclusions of his works, to give an historical account of all his labours and transactions, as far as they concerned the publishing and printing of books. And, what is still stronger, in the continuation of the Polychronicon, compiled by himself, and carried down to the end of Henry the Sixth's reign, he makes no mention of the expedition in quest of a printer: which he could not have omitted had it been true; whilst in the same book he takes notice of the invention and beginning of printing in the city of Mentz."

Answer.—As Caxton makes no mention in his Polychronicon of his *expedition in quest of a printer*; so neither does he of his *bringing the art into England,* which it is as much a wonder he should omit as the other. And as to his saying that *the invention of printing was at Mentz,* he means, of printing on *fusile* separate types. In this he copies, as many others have, from the *Fasciculus Temporum;* a work written in 1470, by Wernerus Rolevinch de Laer, a Carthusian monk, a MS. copy of which was in the library of Gerard Jo. Vossius (see lib. iii. *de Histor. Latin.* c. 6.); and afterwards continued to the year 1474, when it was first printed at Cologne *typis Arnoldi ter Huernen.* It was republished in 1481 by Heinricus Wirczburgh de Vach, a Cluniac monk, without mentioning the name either of the printer or of the place of publication. It is plain that Caxton had one at least, or more probably both, of these editions before him, when he wrote his continuation of Polychronicon, as he mentions this work in his preface, and adopts the sentiments of its editor. (See MEERMAN, vol. ii. p. 37. and his *Documenta,* N° vii. xxiv. and xxv.).

Obj. 2.—" There is a farther circumstance in Caxton's history, that seems inconsistent with the record; for we find him still beyond sea, about 12 years after the supposed transactions, " learning with great charge and trouble the art of printing" (*Recule of the Histories of Troye,* in the end of the 2d and 3d books); which he might have done with ease at home, if he had got Corsellis into his hands, as the record imports, so many years before: but he probably learnt it at Cologne, where he resided in 1471, (*Recule,* &c. ibid.), and whence books had been first printed with date the year before."

Ans.—Caxton tells us, in the preface to *The History of Troye,* that he began that translation March 1. 1468, at Bruges; that he proceeded on with it at Ghent; that he finished it at Cologne in 1471; and printed it, probably, in that city with his own types. He was 30 years abroad, chiefly in Holland; and lived in the court of Margaret duchess of Burgundy, sister of Edward IV. It was therefore much easier to print his book at Cologne, than to cross the sea to learn the art at Oxford. But further, there was a special occasion for his printing it abroad. Corsellis had brought over so far the art of printing as he had learned it at Haerlem, which was the method of printing on *wooden separate* types, having the face of the letter cut upon them. But the art of *casting* metal types being divulged in 1462 by the workmen of Mentz, Caxton thought proper to learn that advantageous branch before he returned to England. This method of casting the types was such an improvement, that they looked on it as the *original* of printing; and Caxton, as most others do, ascribes that to Mentz.—Caxton was an assistant with Turnour in getting off Corsellis; but it is nowhere supposed that he came with him into England. (See MEERMAN, vol. ii. p. 34. B.).

Obj. 3.—" As the Lambeth record was *never heard of before the publication of Atkyn's book,* so it has never since been seen or produced by any man; though the registers of Canterbury have on many occasions been diligently

ligently and particularly searched for it. They were examined, without doubt, very carefully by Archbishop Parker, for the compiling his *Antiquities of the British Church*; where, in the life of Thomas Bourchier, though he congratulates that age on the noble and useful invention of printing, yet he is silent as to the introduction of it into England by the endeavours of that archbishop: nay, his giving the honour of the invention to Strasburg clearly shews that he knew nothing of the story of Corsellis conveyed from Haerlem, and that the record was not in being in his time. Palmer himself owns, "That it is not to be found there now; for that the late earl of Pembroke assured him, that he had employed a person for some time to search for it, but in vain:" (*Hist. of Printing*, p. 314.). On these grounds we may pronounce the record to be a forgery; though all the writers above mentioned take pains to support its credit, and call it an *authentic piece*.

Atkyns, who by his manner of writing seems to have been *a bold and vain man*, might possibly be *the inventor;* for he had an interest in imposing it upon the world, in order to confirm the argument of his book, that *printing was of the prerogative royal;* in opposition to to the *company of stationers*, with whom he was engaged in an expensive suit of law, in defence of the *king's patents*, under which he claimed *some exclusive powers of printing*. For he tells us, p. 3. 'That, upon considering the thing, he could not but think that a public person, more eminent than a mercer, and a public purse, must needs be concerned in so public a good: and the more he considered, the more inquisitive he was to find out the truth. So that he had formed his hypothesis before he had found his record; which he published, he says, as a friend to truth; not to suffer one man to be intitled to the worthy achievements of another; and as a friend to himself, not to lose one of his best arguments of intitling the king to this art.' But, if Atkyns was not himself the contriver, he was imposed upon at least by some more crafty man; who imagined that his interest in the cause, and the warmth that he shewed in prosecuting it, would induce him to swallow for genuine whatever was offered of the kind.

Ans.—On the other hand, is it likely that Mr Atkyns would dare to *forge* a record, to be laid before the king and council, and which his adversaries, with whom he was at law, could disprove?—(2.) He says he received this history from a person of honour, who was some time keeper of the Lambeth library. It was easy to have confuted this evidence, if it was false, when he published it, April 25. 1664.—(3.) John Bagford (who was born in England in 1651, and might know Mr Atkyns, who died in 1677), in his History of Printing at Oxford, blames those who doubted of the authenticity of the Lambeth MS.; and tells us that he knew Sir John Birkenhead had an authentic copy of it, when in 1665 [which Bagford by some mistake calls 1664, and is followed in it by Meerman] he was appointed by the house of commons to draw up a bill relating to the exercise of that art. This is confirmed by the Journals of that house, Friday Oct. 27. 1665, vol. viii. p. 622, where it is ordered, that this Sir John Birkenhead should carry the bill on that head to the house of lords for their consent.—The act was agreed to in the upper house on Tuesday Oct. 31. and received the royal assent on the same day; immediately after which the parliament was prorogued. See *Journals of the House of Lords*, vol. xi. p. 700.—It is probable, then, that after Mr Atkyns had published his book in April 1664, the parliament thought proper, the next year, to inquire into *the right of the king's prerogative;* and that Sir John Birkenhead took care to inspect the original, then in the custody of Archbishop Sheldon: and, finding it not sufficient to prove what Mr Atkyns had cited it for, made no report of the MS. to the house; but only moved that the former law should be renewed. The MS. was probably never returned to the proper keeper of it; but was afterwards burnt in the fire of London, Sept. 13. 1666.—(4.) That printing was practised at Oxford, was a prevailing opinion long before Atkyns. Bryan Twyne, in his *Apologia pro Antiquitate Academiæ Oxoniensis*, published 1608, tells us, it is so delivered down in *ancient writings:* having heard, probably, of this Lambeth MS. And King Charles I. in his letters patent to the University of Oxford, March 5. in the eleventh of his reign, 1635, mentions printing as brought to Oxford from abroad. As to what is objected, "that it is not likely that the press should undergo a ten or eleven years sleep, viz. from 1468 to 1479," it is probably urged without foundation. Corsellis might print several books without date or name of the place, as Ulric Zell did at Cologne, from 1467 to 1473, and from that time to 1494. Corsellis's name, it may be said, appears not in any of his publications; but neither does that of Joannes Petersheimius. [See MEERMAN, vol. i. p. 34.; vol. ii. p. 21—27, &c.]

Further, the famous Shakespeare, who was born in 1564, and died 1616, in the Second Part of Henry VI. act iv. sc. 7. introduces the rebel John Cade, thus upbraiding Lord Treasurer Say: "Thou has most traiterously corrupted the youth of the realm, in creating a grammar-school: and whereas, before, our forefathers had no other book but the score and the tally, thou hast caused *Printing* to be used; and, contrary to the king, his crown, and dignity, thou hast built a paper-mill."—Whence now had Shakespeare this accusation against Lord Say? We are told in the Poetical Register, vol. ii. p. 231. ed. Lond. 1724, that it was from Fabian, Pol. Vergel, Hall, Hollingshed, Grafton, Stow, Speed, &c. But not one of these ascribes printing to the reign of Henry VI. On the contrary, Stow, in his Annals, printed at London, 1560, p. 686, gives it expressly to William Caxton, 1471. "The noble science of printing was about this time found out in Germany at Magunce, by one John Guthumburgus a knight. One Conradus an Almaine brought it into Rome: William Caxton of London, mercer, brought it into England about the year 1471, and first practised the same in the abbie of St Peter at Westminster; after which time it was likewise practised in the abbies of St Augustine at Canterburie, Saint Albons, and other monasteries of England." What then shall we say, that the above is an anachronism arbitrarily put into the mouth of an ignorant fellow out of Shakespeare's head? We might believe so, but that we have the record of Mr Atkyns confirming the same in King Charles II.'s time. Shall we say, that Mr Atkyns borrowed the story from Shakespeare, and published it with some improvements of money laid out by Henry VI. from whence it might be received by Charles II. as a prerogative of the crown? But this is improbable, since Shakespeare makes Lord Treasurer

Treasurer Say the intrument of importing it, of whom Mr Atkyns mentions not a word. Another difference there will still be between Shakespeare and the Lambeth MS.; the poet placing it before 1449, in which year Lord Say was beheaded; the MS. between 1454 and 1459, when Bourchier was archbishop. We must say, then, that Lord Say first laid the scheme, and sent some one to Haerlem, though without success; but after some years it was attempted happily by Bourchier. And we must conclude, that as the generality of writers have overlooked the invention of printing at Haerlem with *wooden* types, and have ascribed it to Mentz where *metal* types were first made use of; so in England they have passed by Corsellis (or the first *Oxford Printer*, whoever he was, who printed with *wooden* types at Oxford), and only mention Caxton as the original artist who printed with *metal* types at Westminster. [See MEERMAN, vol. ii. 7, 8.]. It is strange, that the learned commentators on our great dramatic poet, who are so minutely particular upon less important occasions, should every one of them, Dr Johnson excepted, pass by this curious passage, leaving it entirely unnoticed. And how has Dr Johnson trifled, by slightly remarking, "that Shakespeare is a little *too early* with this accusation!"—The great critic had undertaken to decipher obsolete words, and investigate unintelligible phrases; but never, perhaps, bestowed a thought on Caxton or Corsellis, on Mr Atkyns or the authenticity of the Lambeth Record.

But, independent of the record altogether, the book stands firm as a monument of the exercise of printing in Oxford six years older than any book of Caxton's with a date. In order to get clear of this strong fact, Dr Middleton,

1. Supposes the date in question to have been falsified originally by the printer, either by design or mistake; and an X to have been adopted or omitted in the age of its impression. Examples of this kind, he says, are common in the history of printing. And, "whilst I am now writing, an unexpected instance is fallen into my hands, to the support of my opinion; an *Inauguration Speech of the Woodwardian Professor*, *Mr Mason*, just fresh from the press, with its date given 10 years earlier than it should have been, by the omission of an X, viz. MDCCXXIV; and the very blunder exemplified in in the last piece printed at Cambridge, which I suppose to have happened in the first from Oxford."——To this it has been very properly answered, That we should not pretend to set aside the authority of *a plain date*, without very strong and cogent reasons; and what the Doctor has in this case advanced will not appear, on examination to carry that weight with it that he seems to imagine. There may be, and have been, mistakes and forgeries in the date both of books and of records too; but this is never allowed as a reason for suspecting such as bear no mark of either. We cannot from a blunder in the last book printed at Cambridge, infer a like blunder in the first book printed at Oxford. Besides, the *type* used in this our Oxford edition seems to be no small proof of its antiquity. It is the German letter, and very nearly the same with that used by Fust [who has been supposed to be] the first printer; whereas Caxton and Rood use a quite different letter, something between his German and our old English letter, which was soon after introduced by De Worde and Pynson.

2. "For the probability of his opinion (he says), the book itself affords sufficient proof: for, not to insist on what is less material, *the neatness of the letter, and regularity of the page*, &c. above those of Caxton, it has one mark, that seems to have carried the matter beyond probable, and to make it even certain, viz. *the use of signatures*, or letters of the alphabet placed at the bottom of the page, to show the sequel of the pages and leaves of each book; an improvement contrived for the direction of the bookbinders; which yet was not practised or invented at the time when this book is supposed to be printed; for we find no signatures in the books of Faust or Schoeffer at Mentz, nor in the improved or beautiful impressions of John de Spira and Jenson at Venice till several years later. We have a book in our library, that seems to fix the very time of their invention, at least in Venice; the place where the art itself received the greatest improvements: *Baldi lectura super Codic. &c.* printed by *John de Colonia* and *Jo. Manthem de Gherretzem, anno* MCCCCLXXIIII. It is a large and fair volume in folio, *without signatures*, till about the middle of the book, in which they are first introduced, and so continued forward: which makes it probable, that the first thought of them was suggested during the impression; for we have likewise *Lectura Bartholi super Codic.* &c. in two noble and beautiful volumes in folio, printed the year before at the same place, by Vindelin de Spira, without them: yet from this time forward they are generally found in all the works of the Venetian printers, and from them propagated to the other printers of Europe. They were used at (L) Cologne, in 1475; at Paris, 1476; by Caxton, not before 1480: but if the discovery had been brought into England, and practised at Oxford 12 years before, it is not probable that he would have printed so long at Westminster without them Mr Palmer indeed tells us, p. 54, 180, that Anthony Zarot was esteemed the inventor of signatures; and that they are found in a Terence printed by him at Milan in the year 1470, in which he first printed. I have not seen that Terence; and can only say that I have observed the want of them in some later works of this

(L) Dr Middleton is mistaken in the time and place of the invention of signatures. They are to be found even in very ancient MSS. which the earliest printers very studiously imitated; and they were even used in some editions from the office of Lawrence Coster (whence Corsellis came), which consisted of wooden cuts, as in *Figuræ typicæ et antitypicæ Novi Testamenti;* and in some editions with metal types, as in *Gasp. Pergamensis epistolæ*, published at Paris, without a date, but printed A. D. 1470, (Maittaire *, Annal. vol. i. p. 25.); and in *Mammetrectus*, printed by Helias de Llouffen, at Bern in Switzerland, 1470; and in *De Tondeli visione*, at Antwerp, 1472. Venice, therefore, was not the place where they were first introduced.—They began to be used in *Baldus*, it seems, when the book was half finished. The printer of that book might not know, or did not think, of the use of them before. See *Meerman*, vol. ii. p. 18; and Phil. Trans. vol. xxiii. N° 208. p. 1509.

* See *Maittaire.*

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this as well as of other excellent printers of the same place. But, allowing them to be in the Terence, and Zarot the inventor, it confutes the date of our Oxford book as effectually as if they were of later origin at Venice; as I had reason to imagine, from the testimony of all the books that I have hitherto met with."——As to these proofs, first, the neatness of the letter, and the regularity of the page, prove, if any thing, the very reverse of what the Doctor asserts. The art of printing was almost in its infancy brought to perfection; but afterwards debased by later printers, who consulted rather the cheapness than the neatness of their work. Our learned dissertator cannot be unacquainted with the labours of Fust and Jenson. He must know, that though other printers may have printed more correctly, yet scarce any excel them, either in the neatness of the letter, or the regularity of the page. The same may be observed in our English printers. Caxton and Rood were indifferently good printers; De Worde and Pynson were worse; and those that follow them most abominable. This our *anonymous Oxford printer* excels them all; and for this very reason we should judge him to be the most ancient of all. Our dissertator lays great stress on the use of signatures. But no certain conclusion can be drawn either from the use or non-use of these lesser improvements of printing. They have in different places come in use at different times, and have not been continued regularly even at the same places. If Anthony Zarot used them at Milan in 1470, it is certain later printers there did not follow his example; and the like might happen also in England. But, what is more full to our purpose, we have in the Bodleian library an Æsop's Fables printed by Caxton. This is, it is believed, the first book which has *the leaves numbered.* But yet this improvement, though more useful than that of the signatures, was disused both by Caxton himself and other later printers in England. It is therefore not at all surprising (if true) that the signatures, though invented by our Oxford printer, might not immediately come into general use. And consequently, this particular carries with it no such certain or effectual confutation as our dissertator boasts of.

3. What the Doctor thinks farther confirms his opinion is, "That, from the time of the pretended date of this book, anno 1468, we have no other fruit or production from the press at Oxford for 11 years next following; and it cannot be imagined that a press, established with so much pains and expence, could be suffered to be so long idle and useless."—To this it may be answered, in the words of Oxonides, 1st, That his books may have been lost. Our first printers, in those days of ignorance, met with but small encouragement; they printed but few books, and but few copies of those books. In after-times, when the same books were reprinted more correctly, those first editions, which were not as yet become curiosities, were put to common uses. This is the reason that we have so few remains of our first printers. We have only four books of Theodoric Rood, who seems by his own verses to have been a very celebrated printer. Of John Lettou-William de Machlinia, and the schoolmaster of St Albans, we have scarce any remains. If this be considered, it will not appear *impossible*, that our printer should have followed his business from 1468 to 1479, and yet time have destroyed his intermediate works. But, 2dly, We may account still another way for this distance of time, without altering the date. The Civil Wars broke out in 1469: this might probably oblige our Oxford printer to shut up his press; and both himself and his readers be otherwise engaged. If this were the case, he might not return to his work again till 1479; and the next year, not meeting with that encouragement he deserved, he might remove to some other country with his types.

Dr Middleton concludes with apologizing for his "spending so much pains on an argument so inconsiderable, to which he was led by his zeal to do a piece of justice to the memory of our worthy countryman William Caxton; nor suffer him to be robbed of the glory, so clearly due to him, of having *first imported into this kingdom* an art of great use and benefit to mankind: a kind of merit, that, in the sense of all nations, gives the best title to true praise, and the best claim to be commemorated with honour to posterity."

13
The real claims of Caxton and Corsellis respectively.

The fact, however, against which he contends, but which it seems impossible to overturn, does by no means derogate from the honour of Caxton, who, as has been shown, was the first person in England that practised the art of printing with *fusile types*, and consequently the first who brought it to perfection; whereas Corsellis printed with *separate cut types in wood*, being the only method which he had learned at Haerlem. Into this detail, therefore, we have been led, not so much by the importance of the question, as on account of several anecdotes connected with it, which seemed equally calculated to satisfy curiosity and afford entertainment.

Caxton had been bred very reputably in the way of trade, and served an apprenticeship to one Robert Large a mercer; who, after having been sheriff and lord mayor of London, died in the year 1441, and left by will, as may be seen in the prerogative office, XXIIII merks to his apprentice William Caxton: a considerable legacy in those days, and an early testimonial of his good character and integrity.

From the time of his master's death, he spent the following thirty years beyond sea in the business of merchandise: where, in the year 1464, we find him employed by Edward IV. in a public and honourable negociation, jointly with one Richard Whitehill, Esq. to transact and conclude a treaty of commerce between the king and his brother-in-law the duke of Burgundy, to whom Flanders belonged. The commission styles them, *ambassiatores, procuratores, nuncios, et deputatos speciales;* and gives to both or either of them full powers to treat, &c.

Whoever turns over his printed works, must contract a respect for him, and be convinced that he preserved the same character through life, of an honest, modest, man; greatly industrious to do good to his country, to the best of his abilities, by spreading among the people such books as he thought useful to religion and good manners, which were chiefly translated from the French. The novelty and usefulness of his art recommended him to the special notice and favour of the great; under whose protection, and at whose expence, the greatest part of his works were published. Some of them are addressed to King Edward IV. his brother the duke of Clarence, and their sister the duchess of Burgundy; in whose service and pay he lived many years before he began to print, as he often acknowledges with great gratitude. He printed likewise for the use, and by the

Printing. the express order, of Henry VII. his son Prince Arthur, and many of the principal nobility and gentry of that age.

It has been generally asserted and believed, that all his books were printed in the abbey of Westminster; yet we have no assurance of it from himself, nor any mention of the place before the year 1477: so that he had been printing several years without telling us where.

There is no clear account left of Caxton's age: but he was certainly very old, and probably above fourscore, at the time of his death. In the year 1471 he complained of the infirmities of age creeping upon him, and feebling his body: yet he lived 23 years after, and pursued his business, with extraordinary diligence, in the abbey of Westminster, till the year 1494, in which he died; not in the year following, as all who write of him affirm. This appears from some verses at the end of a book, called "Hilton's Scale of Perfection," printed in the same year:

Infynite laude with thankynges many folde
  I yield to God me socouryng with his grace
This boke to finyshe which that ye beholde
  Scale of Perfection calde in every place
Whereof th' auctor Walter Hilton was
  And Wynkn de Worde this hath sett in print
In William Caxtons hows so fyll the case,
  God rest his soule. In joy ther mot it stynt.
    Impressus anno salutis MCCCCLXXXXiiii.

Though he had printed for the use of Edward IV. and Henry VII. yet there appears no ground for the notion which Palmer takes up, that the first printers, and particularly Caxton, were sworn servants and printers to the crown; for Caxton, as far as can be observed, gives not the least hint of any such character or title; though it seems to have been instituted not long after his death; for of his two principal workmen, Richard Pynson and Wynkyn de Worde, the one was made printer to the king, the other to the king's mother the lady Margaret. Pynson gives himself the first title, in The Imitation of the Life of Christ; printed by him at the commandment of the lady Margaret, who had translated the fourth book of it from the French, in the year 1504: and Wynkyn de Worde assumes the second, in The Seven Penitential Psalms, expounded by Bishop Fisher, and printed in the year 1509. But there is the title of a book given by Palmer, that seems to contradict what is here said of Pynson; viz. *Psalterium ex mandato victoriosissimi Angliæ Regis Henrici Septimi, per Gulielmum Fanque, impressorem regium*, anno MDIIII; which being the only work that has ever been found of this printer, makes it probable that he died in the very year of its impression, and was succeeded immediately by Richard Pynson. No book hath yet been discovered printed in Scotland in this period, though the English printers were able to export some of their works to other countries. See Henry's History of Great Britain, vol. v. p. 471.

14 Different characters when first used in printing.

Before 1465, the uniform character was the old *Gothic* or *German*; whence our *Black* was afterwards formed. But in that year an edition of Lactantius was printed in a kind of Semi-Gothic, of great elegance, and approaching nearly to the present *Roman* type; which last was first used at Rome in 1467, and soon after brought to great perfection in Italy, particularly by Jenson.

Towards the end of the 15th century, Aldus invented the *Italic* character which is now in use, called, from his name, *Aldine* or *cursivus*. This sort of letter he contrived, to prevent the great number of abbreviations that were then in use.

15 Of the first Greek printing.

The first essays in Greek that can be discovered are a few sentences which occur in the edition of Tully's *Offices*, 1465, at Mentz; but these were miserably incorrect and barbarous, if we may judge from the specimens Mr Maittaire has given us, of which the following is one:

Οτιcαταακαςτμακατα και τατατικα.

In the same year, 1465, was published an edition of Lactantius's *Institutes*, printed *in monasterio Sublacensi*, in the kingdom of Naples, in which the quotations from the Greek authors are printed in a very neat Greek letter. They seem to have had but *a very small quantity* of Greek types in the monastery; for, in the first part of the work, whenever a long sentence occurred, a blank was left, that it might be written in with a pen: after the middle of the work, however, all the Greek that occurs is printed.

The first printers who settled at Rome were Conrad Sweynheim and Arnold Pannartz, who introduced the present *Roman* type, in 1466, in Cicero's *Epistolæ Familiares*: in 1469 they printed a beautiful edition of *Aulus Gellius*, with the Greek quotations in a fair character, without accents or spirits, and with very few abbreviations.

The first whole book that is yet known is the Greek Grammar of Constantine Lascaris, in quarto, revised by Demetrius Cretensis, and printed by Dionysius Palavisinus, at Milan, 1476. In 1481, the Greek *Psalter* was printed here, with a Latin translation, in folio; as was Æsop's Fables in quarto.

Venice soon followed the example of Milan; and in 1486 were published in that city the *Greek Psalter* and the *Batrachomyomachia*, the former by Alexander, and the latter by Laonicus, both natives of Crete. They were printed in a very uncommon character; the latter of them with *accents* and *spirits*, and also with *scholia*.

In 1488, however, all former publications in this language were eclipsed by a fine edition of *Homer's Works* at Florence, in folio, printed by Demetrius, a native of Crete. Thus printing, says Mr Maittaire, (p. 185.) seems to have attained its ακμη of perfection, after having exhibited most beautiful specimens of Latin, Greek, and Hebrew.

In 1493, a fine edition of *Isocrates* was printed at Milan, in folio, by Henry German and Sebastian ex Pantremulo.

All the above works are prior in time to those of Aldus, who has been erroneously supposed to be the *first* Greek printer: the beauty, however, correctness, and number of his editions, place him in a much higher rank than his predecessors; and his characters in general were more elegant than any before used. He was born in 1445, and died in 1515.

Though the noble Greek books of Aldus had raised an universal desire of reviving that tongue, the French were backward in introducing it. The only pieces printed ed by them were some quotations, so wretchedly performed, that they were rather to be guessed at than read; in a character very rude and uncouth, and without accents. But Francis Tissard introduced the study of this language at Paris, by his Βίβλος ἡ γνωμαγυρικη, in 1507; and that branch of printing was afterwards successfully practised by Henry, Robert, and Henry Stephens. See the article STEPHENS.

The earliest edition of the *whole Bible* was, strictly speaking, the Complutensian Polyglott of Cardinal Ximenes; but as that edition, though finished in 1517, was not published till 1522, the *Venetian* Septuagint of 1518 may properly be called the first edition of the *whole* Greek Bible; Erasmus having published the New Testament *only* at Basil in 1516.

16 Of the first Hebrew printing.

A very satisfactory account of Hebrew printing is thus given by Dr Kennicott in his *Annual Accounts of the Collation of Hebrew MSS.* p. 112. "The method which seems to have been originally observed in printing the Hebrew Bible was just what might have been expected: 1. The Pentateuch in 1482. 2. The Prior Prophets, in 1484. 3. The Posterior Prophets, in 1486. 4. The Hagiographa, in 1487. And, after the four great parts had been thus printed separately (each with a comment), the whole text (without a comment) was printed in one volume in 1488; and the text continued to be printed, as in these first editions, so in several others for 20 or 30 years, without marginal *Keri* or *Masora*, and with greater arguments to the more ancient MSS. till about the year 1520 some of the Jews adopted later MSS. and the *Masora;* which absurd preference has obtained ever since."

Thus much for the ancient editions given by Jews.

In 1642 a Hebrew Bible was printed at Mantua under the care of the most learned Jews in Italy. This Bible had not been heard of among the Christians in this country, nor perhaps in any other; though the nature of it is very extraordinary. The text indeed is nearly the same with that in other modern editions; but at the bottom of each page are various readings, amounting in the whole to above 2000, and many of them of great consequence, collected from manuscripts, printed editions, copies of the Talmud, and the works of the most renowned Rabbies. And in one of the notes is this remark:—"That in several passages of the Hebrew Bible the differences are so many and so great, that they know not which to fix upon as the true readings."

We cannot quit this subject without observing, on Dr Kennicott's authority, that as the first printed Bibles are more correct than the latter ones; so the variations between the first edition, printed in 1488, and the edition of Vander Hooght, in 1705, at Amsterdam, in 2 vols. 8vo, amount upon the whole, to above 1200. See further *Bowyer and Nichols*, p. 112—117.

17 Anecdotes of early printing.

When the art of printing was first discovered, they only made use of one side of a page: they had not yet found out the expedient of impressing the other. When their editions were intended to be curious, they omitted to print the first letter of a chapter, for which they left a blank space, that it might be painted or illuminated at the option of the purchaser. Several ancient volumes of these early times have been found, where these letters are wanting, as they neglected to have them painted.

When the art of printing was first established, it was the glory of the learned to be correctors of the press to the eminent printers. Physicians, lawyers, and bishops themselves, occupied this department. The printers then added frequently to their names those of the correctors of the press; and editions were then valued according to the abilities of the corrector.

In the productions of early printing may be distinguished the various splendid editions they made of *Primers* or *Prayer-books.* They were embellished with cuts finished in a most elegant taste: many of them were ludicrous, and several were obscene. In one of them an angel is represented crowning the Virgin Mary, and God the Father himself assisting at the ceremony. We have seen in a book of natural history the Supreme Being represented as *reading* on the seventh day, when he rested from all his works. Sometimes St Michael is seen overcoming Satan; and sometimes St Anthony appears attacked by various devils of most hideous forms. The *Prymer of Salisbury*, 1533, is full of cuts: at the bottom of the title page there is the following remarkable prayer:

God be in my Bede,
  And in my Understandynge.
God be in my Eyen,
  And in my Lookynge.
God be in my Mouthe,
  And in my Spekynge.
God be in my Herte,
  And in my thinkinge.
God be at myn ende,
  And at my departynge.

Stereotype Printing. Different persons in different countries have claimed the merit of this invention; but from Mr Nicholls's Biographical memoirs of William Ged, it appears undeniable that he was the first by whom it was invented. Mr Tilloch, the editor of the Philosophical Magazine informs us, that he had turned his attention to the subject for a number of years, and having hit at last upon the discovery, he flattered himself that it was purely original, even feeling vexed when given to understand that he had been anticipated by Mr Ged of Edinburgh, who had printed books from plates about 50 years before. 18 History. Vol. x.

So far back as the year 1725, we find that Mr Ged had begun to prosecute plate-making. In 1727, he entered into a contract with a person who had a small capital, but who was so intimidated by the insinuations of some printer, that he expended no more than 22l. in the course of two years. In this manner he had printed both bibles and common prayer-books, but the compositors when they corrected one fault, purposely made half a dozen more; and the pressmen when the masters were absent, battered the letter to second the compositors. In consequence of these abominable proceedings, the books were suppressed by authority, and the plates sent to the King's printing-house, and from thence to the foundery.

In consequence of Mr Tilloch's invention and improvement, Stereotype printing was afterwards practised by him in conjunction with Mr Foulis, printer to the university of Glasgow, who obtained patents both for England and Scotland, as Mr Ged's invention had died with

with his son. This art, therefore, may be said to have been twice invented in Britain; after which Didot, a French printer, published several Latin classics in the same manner, and to whom some of his countrymen wished to ascribe the merit of the invention, which must be a mistake. We admit it possible that he might have discovered the secret of the art for himself; but it is not supposeable that he could be ignorant of Ged's progress and that of Mr Foulis, especially since, when patents are obtained, a specification of the process must be put upon record, of which any one may obtain an office copy at a small expence.

Neither is it at all probable that stereotype printing was the invention of a Dutchman, who is said to have practised the art even before Ged; since we are assured that Ged himself had offers from Holland repeatedly, either to go over there, or sell his invention, which could not possibly have been the case, had it been in possession of their own countrymen.

Founding of pages, on the first view of it, promises many advantages of an economical nature, and to science it holds out what can never be obtained in any other way; we mean editions of books without a single error. From books cast into solid pages, no more copies would be printed than might be wanted for immediate sale; the money thus saved from being sunk in paper, to be piled up in warehouses for years, as is the case at present, would serve as surplus capital to print other works; thus the printer, his workmen, and the booksellers, would all be benefited.

Some are of opinion, that the expence of stereotype precludes the use of it, except in the case of standard authors, whose works are sure of an extensive sale; but the very reverse of this is the truth. If there would be an advantage in applying the stereotype art to books of rapid sale, there would be a still greater one in the case of such whose sale would not be so certain, as at the worst there could only be the loss of the plates, instead of that of the paper and press-work of a whole edition, which in almost every instance would amount to a much larger sum. To the advantages already mentioned we may add a few others, as stated by Mr Wilson, Stereotype office Duke street, Lincoln's Inn Fields. The expence of Stereotype plates is not 20 per cent. of that of moveable type pages. A room that is fire-proof will hold Stereotype plates of works, of which the dead stock in printed paper would require a warehouse twenty times the size; and thus warehouse rent and insurance are saved; with the additional advantage, in case of accident by fire, that the stereotype plates may be instantly put to press, instead of going through the tedious operations of moveable type printing; and thus no loss will be sustained from the works being out of print. In stereotype, every page of the most extensive work has a separate plate; of consequence all the pages of the said work must be equally new and beautiful. The types of each sheet are distributed by the old method, by which the subsequent sheets are composed; so that, although the first few sheets of a volume may be well composed, the last part of the volume will appear to be executed in a very inferior manner. Stereotype plates admit of alteration; and it will be found that they will yield at least twice the number of impressions that moveable types are capable of producing. It seems evident upon the whole, says Mr Wilson, that a saving of from 25 to 40l. per cent. will accrue to the public in the prices of all books of standard reputation and sale, which, he believes, are pretty accurately ascertained to comprehend three-fourths of all the book printing of England, Scotland, and Ireland. It is fair to conclude, therefore, that both foreign and domestic sales will be much increased, and that the duties on paper will be proportionally productive; so that the public will reap advantage in a twofold way by the general adoption and encouragement of the stereotype art.

The advantages of this mode of printing now mentioned, are such as have been suggested by men who were competent judges; but we leave it to our readers to determine for themselves, whether the adoption of the stereotype art of printing would be more beneficial to society at large, than the publishing of books by means of moveable types.

19 Method of printing.

The workmen employed in the art of printing are of two kinds: compositors, who range and dispose the letters into words, lines, pages, &c. according to the copy delivered them by the author; and pressmen, who apply ink upon the same, and take off the impression. The types being cast, the compositor distributes each kind by itself among the divisions of two wooden frames, an upper and an under one, called *cases;* each of which is divided into little cells or boxes. Those of the upper case are in number 98: these are all of the same size; and in them are disposed the capitals, small capitals, accented letters, figures, &c. the capitals being placed in alphabetical order. In the cells of the lower case, which are 54, are placed the small letters, with the points, spaces, &c. The boxes are here of different sizes, the largest being for the letters most used; and these boxes are not in alphabetical order, but the cells which contain the letter oftenest wanted are nearest the compositor's hand. Each case is placed a little aslope, that the compositor may the more easily reach the upper boxes. The instrument in which the letters are set is called a *composing-stick* (fig. 1.), which consists of a long and narrow plate of brass or iron, &c. on the right side of which arises a ledge, which runs the whole length of the plate, and serves to sustain the letters, the sides of which are to rest against it; along this ledge is a row of holes, which serve for introducing the screw *a*, in order to lengthen or shorten the extent of the line, by moving the sliders *b c* farther from or nearer to the shorter ledge at the end *d*. Where marginal notes are required in a work, the two sliding-pieces *b c* are opened to a proper distance from each other in such a manner, as that while the distance between *d c* forms the length of the line in the text, the distance between the two sliding-pieces forms the length of the lines for the notes on the side of the page. Before the compositor proceeds to compose, he puts a rule or thin slip of brass-plate, cut to the length of the line, and of the same height as the letter, in the composing-stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor having the copy lying before him, and his stick in his left-hand, his thumb being over the slider *c;* with the right he takes up the letters, spaces, &c. one by one, and places them against the rule, while he supports them with his left thumb by pressing them to the end of the slider *c*, the other hand being constantly

Plate CCCXL. fig. 1.

stantly employed in setting in other letters: the whole being performed with a degree of expedition and address not easy to be imagined.

A line being thus composed, if it end with a word or syllable, and exactly fill the measure, there needs no further care; otherwise more spaces are to be put in, or else the distances lessened, between the several words, in order to make the measure quite full; so that every line may end even. The spaces here used are pieces of metal exactly shaped like the shanks of the letters: they are of various thicknesses, and serve to support the letters, and to preserve a proper distance between the words; but not reaching so high as the letters, they make no impression when the work is printed. The first line being thus finished, the compositor proceeds to the next; in order to which he removes the brass rule from behind the former, and places it before it, and thus composes another line against it after the same manner as before; going on thus till his stick is full, when he empties all the lines contained in it into the gally.

The compositor then fills and empties his composing-stick as before, till a complete page be formed; when he ties it up with a cord or pack-thread; and setting it by, proceeds to the next, till the number of pages to be contained in a sheet is completed; which done, he carries them to the imposing-stone, there to be ranged in order, and fastened together in a frame called a *chess*; and this is termed *imposing*. The chess is a rectangular iron frame, of different dimensions according to the size of the paper to be printed, having two cross-pieces of the same metal, called a *long* and *short cross*, mortised at each end so as to be taken out occasionally. By the different situations of these crosses the chess is fitted for different volumes: for quartos and octavos, one traverses the middle lengthwise, the other broadwise, so as to intersect each other in the centre: for twelves and twenty-fours, the short cross is shifted nearer to one end of the chess; for folios, the long cross is left entirely out, and the short one left in the middle; and for broadsides, both crosses are set aside. To dress the chess, or range and fix the pages therein, the compositor makes use of a set of furniture, consisting of slips of wood of different dimensions, and about half an inch high, that they may be lower than the letters: some of these are placed at the top of the pages, and called *head-sticks*; others between them, to form the inner margin; others on the sides of the crosses, to form the outer margin, where the paper is to be doubled; and others in the form of wedges to the sides and bottoms of the pages. Thus all the pages being placed at their proper distances, and secured from being injured by the chess and furniture placed about them, they are all united, and fastened together by driving small pieces of wood called *quoins*, cut in the wedge-form, up between the slanting side of the foot and the side-sticks and the chess, by means of a piece of hard wood and a mallet; and all being thus bound fast together, so that none of the letters will fall out, it is ready to be committed to the pressmen. In this condition the work is called a *form*; and as there are two of these forms required for every sheet, when both sides are to be printed, it is necessary the distances between the pages in each form should be placed with such exactness, that the impression of the pages in one form shall fall exactly on the back of the pages of the other, which is called *register*.

As it is impossible but that there must be some mistakes in the work, either through the oversight of the compositor, or by the casual transposition of letters in the cases; a sheet is printed off, which is called a *proof*, and given to the corrector; who reading it over and, rectifying it by the copy, making the alterations in the margin, it is delivered back to the compositor to be corrected.

The compositor then unlocking the form upon the correcting-stone, by loosening the quoins or wedges which bound the letters together, rectifies the mistakes by picking out the faulty or wrong letters with a slender sharp pointed steel-bodkin, and putting others into their places. After this another proof is made, sent to the author and corrected as before; and lastly, there is another proof called a *revise*, which is made in order to see whether all the mistakes marked in the last proof are corrected.

The pressman's business is to work off the forms thus prepared and corrected by the compositor; in doing which there are four things required, paper, ink, balls, and a press. To prepare the paper for use, it is to be first wetted by dipping several sheets together in water: these are afterwards laid in a heap over each other; and to make them take the water equally, they are all pressed close down with a weight at the top. The ink is made of oil and lamp-black; for the manner of preparing which, see *Printing-Ink*. The balls, by which the ink is applied on the forms, are a kind of wooden funnels with handles, the cavities of which are filled with wool or hair, as is also a piece of alum leather or pelt nailed over the cavity, and made extremely soft by soaking in urine, and by being well rubbed. One of these the pressman takes in each hand; and applying one of them to the ink-block, daubs and works them together to distribute the ink equally; and then blackens the form which is placed on the press, by beating with the balls upon the face of the letter.

Fig. 2.

The printing-press, represented fig. 2. is a very curious though complex machine. The body consists of two strong cheeks *a*, *a*, placed perpendicularly, and joined together by four cross-pieces, the cap *b*; the head *c*, which is moveable, being partly sustained by two iron pins or long bolts, that pass the cap; the till or shelf *d d*, by which the spindle and its apparatus are kept in their proper position; and the winter *e*, which bears the carriage, and sustains the effort of the press beneath. The spindle *f* is an upright piece of iron pointed with steel, having a male screw which goes into the female one in the head about four inches. Through the eye *g* of this spindle is fastened the bar *k*, by which the pressman makes the impression. The spindle passes through a hole in the middle of the till; and its point works into a brass pan or nut, supplied with oil, which is fixed to an iron plate let into the top of the platten. The body of the spindle is sustained in the centre of an open frame of polished iron, 1, 1, 2, 2, 3, 3, fixed to it in such a manner as, without obstructing its free play, to keep it in a steady direction; and at the same time to serve for suspending the platten. This frame consists of two parts; the upper called the *garter*, 1, 1; the under, called the *crane*, 2, 2. These are connected together

gether by two short legs or bolts, 3, 3.; which being fixed below in the two ends of the crane, pass upward, through two holes in the till, and are received at top into two eyes at the ends of the garter, where they are secured by screws. The carriage *l l* is placed a foot below the platten, having its fore-part supported by a prop called the *fore-stay*, while the other rests on the winter. On this carriage, which sustains the plank, are nailed two long iron bars or ribs; and on the plank are nailed short pieces of iron or steel called *cramp irons*, equally tempered with the ribs, and which slide upon them when the plank is turned in or out. Under the carriage is fixed a long piece of iron called the *spit*, with a double wheel in the middle, round which leather-girts are fastened, nailed to each end of the plank: and to the outside of the spit is fixed a rounce *m*, or handle to turn round the wheel. Upon the plank is a square frame or coffin, in which is inclosed a polished stone on which the form *n* is laid; at the end of the coffin are three frames, *viz.* the two tympans and frisket: the tympans *o* are square, and made of three slips of very thin wood, and at the top a piece of iron still thinner; that called the *outer tympan* is fastened with hinges to the coffin: they are both covered with parchment; and between the two are placed blankets, which are necessary to take off the impression of the letters upon the paper. The frisket *p* is a square frame of thin iron, fastened with hinges to the tympan: it is covered with paper cut in the necessary places, that the sheet, which is put between the frisket and the great or outward tympan, may receive the ink, and that nothing may hurt the margins. To regulate the margins, a sheet of paper is fastened upon this tympan, which is called the *tympan sheet*; and on each side is fixed an iron point, which makes two holes in the sheet, which is to be placed on the same points when the impression is to be made on the other side. In preparing the press for working, the parchment which covers the outer tympan is wetted till it is very soft, in order to render the impression more equable; the blankets are then put in, and secured from slipping by the inner tympan: then while one pressman is beating the letter with the balls *q*, covered with ink taken from the ink-block, the other person places a sheet of white paper on the tympan-sheet; turns down the frisket upon it, to keep the paper clean and prevent its slipping; then bringing the tympans upon the form, and turning the rounce, he brings the form with the stone, &c. weighing about 300 lbs. weight, under the platten; pulls with the bar, by which means the platten presses the blankets and paper close upon the letter, whereby half the form is printed; then easing the bar, he draws the form still forward; gives a second pull; and letting go the bar, turns back the form, takes up the tympans and frisket, takes out the printed sheet, and lays on a fresh one; and this is repeated till he has taken off the impression upon the full number of sheets the edition is to consist of. One side of the sheet being thus printed, the form for the other is laid upon the press, and worked off in the same manner.

To the above description of the printing press, we shall add that of one invented by Mr Nicholson, and for which a patent was granted in 1790. This machine is recommended by the inventor as being superior to other printing presses in cheapness, accuracy, and neatness, and is adapted with some slight variations in its construction for printing on paper, linen, cotton, and woollen. Three particulars are to be attended to in the invention.

1st, The manner of preparing and placing the types, engravings, or carvings, from which the impression is to be made; *2dly*, In applying the ink or colouring matter to types or engravings; and, *3dly*, In taking off the impression.

1st, The moulds, punches, and matrices, for casting letters, are made in the same manner, and with the same materials, as other letter-founders do, excepting that, instead of leaving a space in the mould for the stem of one letter only, he leaves spaces for two, three, or more letters, to be cast at one pouring of the metal; and at the lower extremity of each of those spaces (which communicate by a common groove at top) he places a matrix, or piece of copper, with the letter punched upon its face in the usual way. And moreover, he brings the stem of his letters to a due form and finish, not only by rubbing it upon a stone, and scraping it when arranged in the finishing-stick, but likewise by scraping it, on one or more sides, in a finishing-stick whose hollowed part is less deep at the inner than the outer side. He calls that side of the groove which is nearest the face of the disposed letter, the outer side; and the purpose accomplished by this method of scraping is, that of rendering the tail of the letter gradually smaller the more remote it is, or farther from the face. Such letters may be firmly imposed upon a cylindrical surface, in the same manner as common letters are imposed upon a flat stone.

2dly, The ink or colouring matter is applied to the types, forms, or plates, by causing the surface of a cylinder, smeared or wetted with the colouring matter, to roll over the surfaces of the said forms or plates, or by causing the forms or plates apply themselves successively to the surface of the cylinder. The surface of this colouring cylinder is covered with leather, or with woollen, linen, or cotton cloth. When the colour to be used is thin, as in calico-printing, and in almost every case, the covering is supported by a firm elastic stuffing, consisting of hair, or wool, or woollen cloth wrapped one or more folds round the cylinder. When the covering consists of woollen cloth, the stuffing must be defended by leather or oilskin, to prevent its imbibing too much colour, and by that means losing its elasticity. It is absolutely necessary that the colouring matter be evenly distributed over the surface of the cylinder; and for this purpose, when the colour is thick and stiff, as in letter-press printing, he applies two, three, or more small cylinders, called distributing-rollers, longitudinally against the colouring cylinders, so that they may be turned by the motion of the latter; and the effect of this application is, that every lump or mass of colour which may be redundant, or irregularly placed upon the face of the colouring cylinder, will be pressed, spread, and partly taken up, and carried by the small rollers to the other parts of the colouring cylinder; so that this last will very speedily acquire and preserve an even face of colour. But if the colouring matter be thinner, he does not apply more than one or two of these distributing-rollers; and, if it be very thin, he applies an even blunt edge of metal, or wood, or a straight brush, or both of these last, against the colouring cylinder, for the purpose of rendering its colour uniform. When he applies colour to an engraved plate, or cylinder, or through

Fig. 1.

Fig. 2.

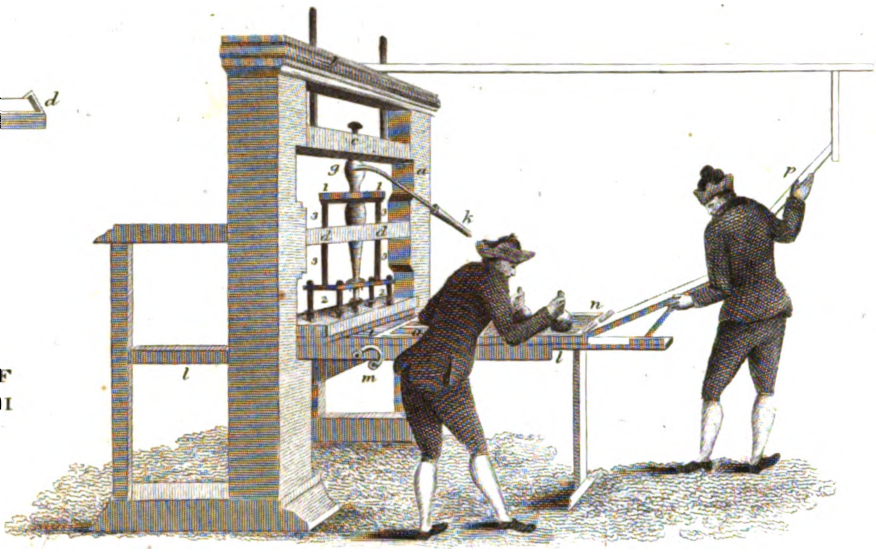


Fig. 3.

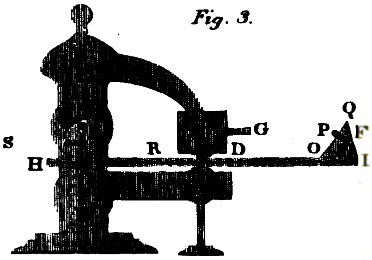


Fig. 4.

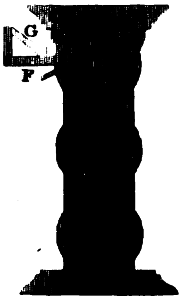


Fig. 5.

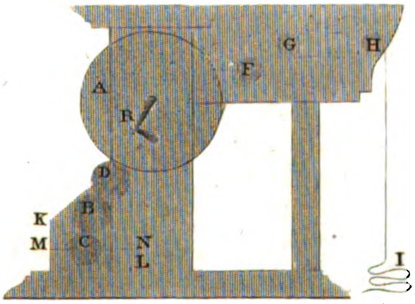


Fig. 6.

Fig. 7.

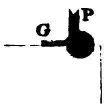


Fig. 8.

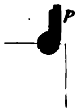


Fig. 9.

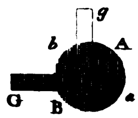


Fig. 10.

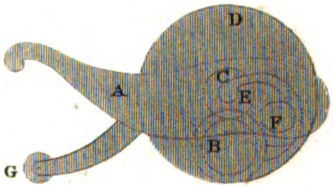


Fig. 11.

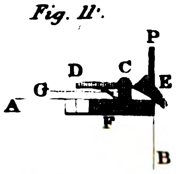


Fig. 12.

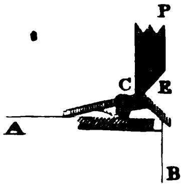


Fig. 13.

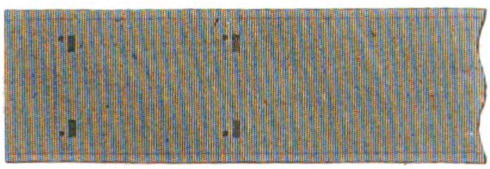


Fig. 14.

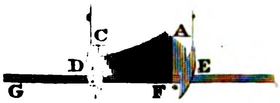
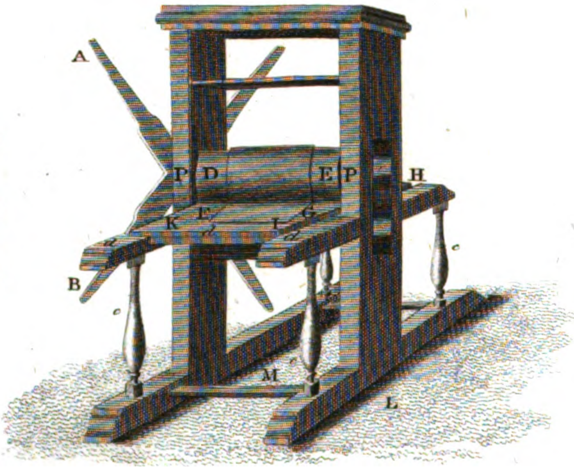


Fig. 15.



E. Mitchell Sculp.t

Printing. through the interstices of a perforated pattern, as in the manufacturing of some kinds of paper-hangings, he uses a cylinder entirely covered with hair or bristles in the manner of a brush.

3dly, The impressions, even in letter-press printing, are performed by the action of a cylinder or cylindrical surface. The following is the construction of this machine. Fig. 3. represents a printing-press, more especially applicable to the printing of books. A and E are two cylinders, running or turning in a strong frame of wood, or metal, or both. The cylinder A is faced with woollen cloth, and is capable of being pressed with more or less force upon HI, by means of the lever M. HI is a long table, which is capable of moving endwise, backwards and forwards, upon the rollers E and K. The roller A acts upon this table by means of a cog-wheel, or by straps, so as to draw it backwards and forwards by the motion of its handle L. The table is kept in the same line by grooves on its sides, which contain the cylinder A. D is a chess, containing letter set up and imposed. B is a box, containing a colouring-roller, with its distributing-rollers CC; it is supported by the arm N. O is a cylinder faced with leather, and lying across an ink-block; this cylinder is fixed by the middle to a bended lever moveable on the joint Q.

Fig. 3.

The action. When D, or the letter, is drawn beneath the cylinder B, it receives ink; and when it has passed into the position R, a workman places or turns down a tympan with paper upon it (this tympan differs in no respect from the usual one, except that its hinge opens sidewise); it then proceeds to pass under the cylinder A, which presses it successively through its whole surface. On the other side, at S, the workman takes off the paper and leaves the tympan up. This motion causes the cylinder B to revolve continually, and consequently renders its inked surface very uniform, by the action of its distributing-rollers CC; and, when the table has passed to its extreme distance in the direction now spoken of, the arm G touches the lever P, and raises the cylinder O off the ink-block, by which means it dabs against one of the distributing-rollers, and gives it a small quantity of ink. The returning motion of the table carries the letter again under the roller B, which again inks it, and the process of printing another sheet goes on as before.

Fig. 4.

Fig. 4. is another printing-press. In this, B is the inking-roller; A is a cylinder, having the letter imposed upon its surface; and E is a cylinder, having its uniform surface covered with woollen cloth: these three cylinders are connected, either by cogs or straps at the edges of each. The machine is uniformly turned in one direction by the handle L. The workman applies a sheet of paper to the surface of E, where it is retained, either by points in the usual manner, or by the apparatus to be described in treating of fig. 4. The paper passes between E and A, and receives an impression; after which the workman takes it off, and applies another sheet; and in the mean time the letter on the surface of A passes round against the surface of B, and receives ink during the rotation of B. The distributing-rollers CC do their office as in the machine fig. 1.; and once in every revolution the tail F, affixed to B, raises the inking-piece G, so as to cause it to touch one of the distributing-rollers, and supply it with ink. In this way therefore the repeated printing of sheet after sheet goes on.

Fig. 5. is a printing-press, more particularly adapted to print cottons, silks, paper-hangings, or other articles which run of a considerable length. A is a cylinder covered with woollen cloth, or other soft substance. The web or piece of cotton, or other goods, is passed round this cylinder, from the carrying-roller F to the receiving-rollers GH; which are connected by a piece of linen, woollen, or hair-cloth, in the manner of a jack-towel, sewed round them; the rotation of this towel carries away the printed stuff or goods, and deposits them at I. KL is a moveable box, containing three rollers, which move against each other in rotation. The lowest roller C revolves in a mass of colour, contained in a trough or vessel in the bottom part of the box KL; the surface of this colour is represented by the line MN. The next roller B is stuffed and covered as described in section 2. The pressure of B against C prevents the cylinder B from receiving too much colour. D is a cut or carved cylinder, which receives colour, during the rotation, from the roller B, and impresses it upon the web as it passes round the cylinder A; in this way the constant and effectual action of the machine is sufficiently obvious. It must be observed, that the cylinders ADB and G are connected together by cog-wheels, straps, or other well-known equivalent contrivances; so that the handle P drives the whole, without their necessarily depending on any adhesion or friction at their surfaces. The pressure of B against D is governed by an adjustment of the axis of D, whose sockets are capable of a small motion; and the pressure of D against A is governed by the position of the whole box KL. When it is required to print more than one colour upon the same piece, it must pass two or more times through the machine; or, in those cases where the materials are liable to change their dimensions, it is necessary to apply, at one and the same time, two or more such boxes as KL, with their respective cylinders, so that the pattern cylinder of each may make its impression upon the web or material to be printed on. Printing. Fig. 5.

Fig. 6. is a printing-press, chiefly of use for books and papers. 1, 2, 3, 4, represent a long table, with ledges on each side; so that the two cylinders A and B can run backwards and forwards without any side shake. In one of these ledges is placed a strip or plate of metal cut into teeth, which lock into correspondent teeth in each cylinder; by which means the two cylinders roll along, without the possibility of changing the relative positions of their surfaces at any determinate part of the table. This may also be effected by straps, and may indeed be accomplished with tolerable accuracy, by the mere rolling of the cylinders on the smooth or flat ledges without any provision. A is the printing-cylinder, covered with woollen cloth, and B is the inking-cylinder, with its distributing-rollers. The table may be divided into four compartments marked with a thicker bounding line than the rest and numbered 1, 2, 3, 4. At 1 is placed a sheet of paper; at 2 is the form or chess, containing letter set and imposed; at 3 is an apparatus for receiving the printed sheet; and 4 is employed in no other use than as a place of standing for the carriage E, after it has passed through one operation, and when it takes ink at F. Its action is as follows: the carriage is thrust forward by the workman, and as the roller A passes over the space numbered 1, it takes up the sheet of paper previously laid there, while the roller B runs over the form and inks the letter. The sheet of paper being wrapped Fig. 6.

round the cylinder A, is pressed against the form as that cylinder proceeds, and consequently it receives an impression. When A arrives at the space numbered 3, it lets go the sheet of paper, while the prominent part of the carriage G strikes the lever P, and raises the inking-piece, which applies itself against one of the distributing-rollers. In this manner therefore the cylinder A returns empty, and the cylinder B inked, and in the mean time the workman places another sheet of paper ready in the space numbered 1. Thus it is that the operation proceeds in the printing of one sheet after another.

The preceding description is not encumbered with an account of the apparatus by which the paper is taken up and laid down. This may be done in several ways: Fig. 11. and 12. represent one of the methods. DE is a lever, moving on the centre pin C, and having its end D pressed upwards by the action of the spring G. The shoulder which contains the pin C is fixed in another piece F, which is inserted in a groove in the surface of the cylinder A (fig. 6.), so that it is capable of moving in and out, in a direction parallel to the axis of that cylinder. As that cylinder proceeds, it meets a pin in the table; which (letter P, fig. 11.) acting on the inclined plane at the other end of the lever, throws the whole inwards, in the position represented in fig. 12.; in which case the extremity D shoots inwards, and applies itself against the side of the cylinder.

Fig. 11, 12.

Fig. 13.

In fig. 13. is a representation of part of the table; the dotted square represents a sheet of paper, and the four small shaded squares denote holes in the board, with pins standing beside them. When the lever DE (fig. 12.) shoots forward, it is situated in one of these holes, and advances under the edge of the paper, which consequently it presses and retains against the cylinder with its extremity D. Nothing more remains to be said respecting the taking up, but that the cylinder is provided with two pair of these clasps or levers, which are so fixed as to correspond with four holes represented in fig. 13. It will be easy to understand how the paper is deposited in the compartment N° 3. (fig. 6.). A pin P (fig. 12.) rising out of the platform or table, acts against a pin E, projecting sidewise out of the lever, and must of course draw the slider and its lever to the original position; the paper consequently will be let go, and its disengagement is rendered certain by an apparatus fixed in the compartment numbered 3 (fig. 6.) of exactly the same kind as that upon the cylinder, and which, by the action of a pin duly placed in the surface of the cylinder A, takes the paper from the cylinder in precisely the same manner as that cylinder originally took it up in the compartment numbered 1 (fig. 6.).

Fig. 7, 8, 9.

Fig. 7, 8, and 9, represent a simpler apparatus for accomplishing the same purpose. If A *a* B *b* (fig. 9.) be supposed to represent a thick plate of metal of a circular form, with two pins, A and B, proceeding sidewise or perpendicularly out of its plane, and diametrically opposite to each other, and G another pin proceeding in the direction of that plane, then it is obvious that any force applied to the pin A, so as to press it into the position *a* (by turning the plate on its axis or centre X), will at the same time cause the pin G to acquire the position *g*; and, on the other hand, when B is at *b*, or the dotted representation of the side-pin, if any pressure be applied to restore its original position at B, the pin *g* will return back to G. Now the figures 7 and 8 exhibit an apparatus of this kind, applied to the cylinder A; and that cylinder, by rolling over the pins P and *p*, properly fixed in the table to re-act upon the apparatus, will cause its prominent part G either to apply to the cylinder and clasp the paper, or to rise up and let it go. The compartment numbered 3 (fig. 6.) must of course have an apparatus of the same kind to be acted upon by pins from A, in order that it may take the paper from that cylinder.

There is one other circumstance belonging to this machine which remains to be explained. When the carriage E (fig. 6) goes out in the direction of the numbers 1, 2, 3, 4, both rollers, A and B, press the form of letter in their passage; but in their return back again the roller A, having no paper upon it, would itself become soiled, by taking a faint impression from the letter, if it were not prevented from touching it: the manner of effecting this may be understood from fig. 14. The apparatus there represented is fixed upon the outside of the carriage E, near the lower corner, in the vicinity of the roller A; the whole of this projects sidewise beyond the ledge of the table, except the small truck or wheel B. The irregularly-triangular piece, which is shaded by the stroke of the pen, carries this wheel, and also a catch moveable on the axis or pin E. The whole piece is moveable on the pin A, which connects it to the carriage. CD, or the part which is shaded by dotting, is a detent, which serves to hold the piece down in a certain position. It may be observed, that both the detent and the triangular piece are furnished each with a claw, which holds in one direction, but trips or yields in the other, like the jacks of a harpsichord, or resembling certain pieces used in clock and watch making, as is clearly represented in the figure. These claws overhang the side of the table, and their effect is as follows: There is a pin C (fig. 6.) between the compartments of the table numbered 2 and 3, but which is marked F in fig. 14. where GH represents the table. In the outward run of the carriage these claws strike that pin, but with no other effect than that they yield for an instant, and as instantly resume their original position by the action of their respective slender back springs. When the carriage returns, the claw of the detent indeed strikes the pin, but with as little effect as before, because its derangement is instantly removed by the action of the back spring of the detent itself; but, when the claw of the triangular piece takes the pin, the whole piece is made to revolve on its axis or pin A, the wheel B is forced down, so as to lift that end of the carriage, and the detent, catching on the piece at C, prevents the former position from being recovered. The consequence of this is, that the carriage runs upon the truck B (and its corresponding truck on the opposite side) instead of the cylinder A, which is too much raised to take the letter, and soil itself; but as soon as the end of the carriage has passed clear of the letter, another pin R (fig. 6.) takes the claw of the detent, and draws it off the triangular piece; at which instant the cylinder A subsides to its usual place, and performs its functions as before. This last pin R does not affect the claw of the triangular piece, because it is placed too low; and the claw of the detent is made the longest, on purpose that it may strike this pin.

Fig. 14.

Fig.

Fig. 10.

Fig. 10. represents an instrument for printing floor-cloths, paper-hangings, and the like, with a stiff paint and a brush. D is a copper or metallic cylinder fixed in a frame A, like a garden-roller; its carved part is thin, and is cut through in various places, according to the desired pattern. A strong axis passes through the cylinder, and its extremities are firmly attached to the frame A. To this axis is fixed a vessel or box of the same kind, and answering the same purpose as the box KL in fig. 5. It carries a cylinder P, which revolves in the colour; another cylinder E, which revolves in contact with P; and a third cylinder B, whose exterior surface is covered with hair, after the manner of a brush, and revolves in contact with E. This cylinder B is adjusted by its axis, in such a manner that its brush-part sweeps in the perforated parts of the metallic cylinder D. The circle C represents a cog-wheel fixed concentric to the cylinder D, and revolving with it; this wheel takes another wheel concentric to, and fixed to, B; hence the action is as follows: When the metallic cylinder is wheeled or rolled along any surface, its cog-wheel C drives the brush B in the contrary direction; and this brush cylinder, being connected by cogs or otherwise with E and P, causes these also to revolve and supply it with colour. As the successive openings of the cylinder D, therefore, come in contact with the ground, the several parts of the brush will traverse the uncovered part of that ground, and paint the pattern upon it. The wheel G, being kept lightly on the ground, serves to determine the line of contact, that it shall be the part opposite to B, and no other.

Chinese PRINTING, is performed from wooden planks or blocks, cut like those used in printing of callico, paper, cards, &c.

Rolling-press PRINTING, is employed in taking off prints or impressions from copperplates engraven, etched, or scraped, as in mezzotintos. See ENGRAVING.

This art is said to have been as ancient as the year 1540, and to owe its origin to Finiguerra, a Florentine goldsmith, who, pouring some melted brimstone on an engraven plate, found the exact impression of the engraving left in the cold brimstone, marked with black taken out of the strokes by the liquid sulphur: upon this he attempted to do the same on silver plates with wet paper, by rolling it smoothly with a roller; and this succeeded: but this art was not used in England till the reign of King James I. when it was brought from Antwerp by Speed. The form of the rolling-press, the composition of the ink used therein, and the manner of applying both in taking off prints, are as follows:

ig. 15.

The rolling-press AL, fig. 15. may be divided into two parts, the body and carriage: the body consists of two wooden cheeks PP, placed perpendicularly on a stand or foot LM, which sustains the whole press. From the foot likewise are four other perpendicular pieces, *c*, *c*, *c*, *c*, joined by other cross or horizontal ones, *d*, *d*, *d*, which serve to sustain a smooth even plank or table HIK, about four feet and a half long, two feet and a half broad, and an inch and a half thick. Into the cheeks go two wooden cylinders or rollers, DE, FG, about six inches in diameter, borne up at each end by the cheeks, whose ends, which are lessened to about two inches diameter, and called *trunnions*, turn in the cheeks about two pieces of wood in form of half-moons, lined with polished iron to facilitate the motion. Lastly, To one of the trunnions of the upper roller is fastened a cross, consisting of two levers AB, or pieces of wood, traversing each other, the arms of which cross serve instead of the bar or handle of the letter-press, by turning the upper roller, and when the plank is between the two rollers, giving the same motion to the under one, by drawing the plank forward and backward.

The ink used for copperplates, is a composition made of the stones of peaches and apricots, the bones of sheep and ivory, all well burnt, and called *Frankfort black*, mixed with nut-oil that has been well boiled, and ground together on a marble, after the same manner as painters do their colours.

The method of printing from copperplates is as follows: They take a small quantity of this ink on a rubber made of linen-rags, strongly bound about each other, and therewith smear the whole face of the plate as it lies on a grate over a charcoal fire. The plate being sufficiently inked, they first wipe it over with a foul rag, then with the palm of their left hand, and then with that of the right; and to dry the hand and forward the wiping, they rub it from time to time in whiting. In wiping the plate perfectly clean, yet without taking the ink out of the engraving, the address of the workman consists. The plate thus prepared, is laid on the plank of the press; over the plate is laid the paper, first well moistened, to receive the impression; and over the paper two or three folds of flannel. Things thus disposed, the arms of the cross are pulled, and by that means the plate with its furniture passed through between the rollers, which pinching very strongly, yet equally, press the moistened paper into the strokes of the engraving, whence it licks out the ink.

PRINTS, the impression taken from a copperplate. See the last article, and ENGRAVING.

From the facility of being multiplied, prints have derived an advantage over paintings by no means inconsiderable. They are found to be more durable; which may, however, in some degree be attributed to the different methods in which they are preserved. Many of the best paintings of the early masters have generally had the misfortune to be either painted on walls, or deposited in large and unfrequented, and consequently damp and destructive buildings; whilst a print, passing, at distant intervals, from the *porte feuille* of one collector to that of another, is preserved without any great exertion of its owner: And hence it happens, that whilst the pictures of Raphael have mouldered from their walls or deserted the canvas, the prints of his friend and cotemporary Mark Antonio Raimondi continue in full perfection to this day, and give us a lively idea of the beauties of these paintings, which, without their assistance, had been lost to us for ever; or at least, could have been only known to us, like those of Zeuxis and Apelles, by the descriptions which former writers on these subjects have left us.

Strutt's Dict of Engravers.

Independent of the advantages which prints affords us, when considered as accurate representations of paintings, and imitations of superior productions, they are no less valuable for their positive merit, as immediate representations of nature. For it must be recollected, that the art of engraving has not always been confined to the copying of other productions, but has frequently ly itself aspired to originality, and has, in this light, produced more instances of its excellence than in the other. Albert Durer, Goltzius, and Rembrandt, amongst the Dutch and Germans; Parmigiano and Della Bella amongst the Italians, and Callot amongst the French, have published many prints, the subjects of which, there is great reason to suppose, were never painted. These prints may therefore be considered as original pictures of those masters, deficient only in those particulars in which a print must necessarily be inferior to a painting.

The preceding distinction may perhaps threw some light on the proper method of arranging and classing a collection of prints, which has been a matter of no small difficulty. As an art imitating another, the principal should take the lead, and the design, composition, and drawing, in a print, being previous requisites, to the manner of execution and finishing; prints engraved after paintings should be arranged under the name of the painter; and every person who looks upon engraving only as auxilary to painting, will consequently adopt this mode of arrangement. But when engraving is considered as an original art, as imitating nature without the intervention of other methods, then it will certainly be proper to regulate the arrangement according to the names of the engravers.

Prints, method of cleaning. The following method of cleaning prints, is recommended as safe and efficacious.

"Provide a certain quantity of the common muriatic acid, for example three ounces, in a glass bottle, with a ground stopper, of such a capacity that it may be only half full. Half an ounce of minium must then be added; immediately after which the stopper is to be put in, and the bottle set in a cold and dark place. The heat, which soon becomes perceptible, shews the beginning of the new combination. The minium abandons the greatest part of its oxygen with which the fluid remains impregnated, at the same time that it acquires a fine golden yellow, and emits the detestable smell of oxygenated muriatic acid. It contains a small portion of muriate of lead; but this is not at all noxious in the subsequent process. It is also necessary to be observed, that the bottle must be strong, and the stopper not too firmly fixed, otherwise the active elastic vapour might burst it. The method of using this prepared acid is as follows:

"Provide a sufficiently large plate of glass, upon which one or more prints may be separately spread out. Near the edges let there be raised a border of soft white wax half an inch high, adhering well to the glass and flat at top. In this kind of trough the print is to be placed in a bath of fresh urine, or water containing a small quantity of ox-gall, and kept in this situation for three or four hours. The fluid is then to be decanted off, and pure warm water poured on, which must be changed every three or four hours until it passes limpid and clear. The impurities are sometimes of a resinous nature, and resist the action of pure water. When this is the case, the washed print must be left to dry, and alcohol is then to be poured on and left for a time. After the print is thus cleaned, and all the moisture drained off, the muriatic acid prepared with minium is to be poured on in sufficient quantity to cover the print; immediately after which another plate of glass is to be laid in contact with the rim of wax, in order to prevent the inconvenient exhalation of the oxygenated acid. In this situation the yellowest print will be seen to recover its original whiteness in a very short time. One or two hours are sufficient to produce the desired effect; but the print will receive no injury if it be left in the acid for a whole night. Nothing more is necessary to complete the work, than to decant off the remaining acid, and wash away every trace of acidity, by repeated effusions of pure water. The print being then left to dry (in the sun if possible) will be found white, clear, firm, and in no respect damaged, either in the texture of the paper, or the tone and appearance of the impression."

It is farther recommended to those who shall adopt the whole process for clearing prints, to make the first trial with a print of little value, and in this way he will discover what portion of water should be employed in diluting the acid to prevent the corrosive action of the latter on the paper. *Nichol. Journ.* ii. 265. 4to.

PRIOR, in general, something before or nearer the beginning than another, to which it is compared.

Prior, more particularly denotes the superior of a convent of monks, or the next under the abbot. See Abbot.

Priors are either *claustral* or *conventual*. *Conventual* are the same as abbots. *Claustral* prior, is he who governs the religious of an abbey or priory *in commendam*, having his jurisdiction wholly from the abbot.

Grand Prior, is the superior of a large abbey, where several superiors are required.

Prior, *Matthew*, an eminent English poet, was born at London in 1664. His father dying while he was very young, an uncle, a vintner, having given him some education at Westminster school, took him home in order to breed him up to his trade. However, at his leisure hours he prosecuted his study of the classics and particularly of his favourite Horace. This introduced him to some polite company who frequented his uncle's house; among whom the earl of Dorset took particular notice of him, and procured him to be sent to St John's college in Cambridge, where, in 1686, he took the degree of A. B. and afterwards became fellow of that college. Upon the revolution, Mr Prior was brought to court by the earl of Dorset; and in 1690 he was made secretary to the earl of Berkeley, plenipotentiary at the Hague; as he was afterward to the ambassador and plenipotentiaries at the treaty of Ryswick in 1697; and the year following to the earl of Portland, ambassador to the court of France. He was in 1697 made secretary of state for Ireland: and in 1700 was appointed one of the lords commissioners of trade and plantations. In 1710, he was supposed to have had a share in writing The Examiner. In 1711, he was made one of the commissioners of the customs; and was sent minister plenipotentiary to France, for the negotiating a peace with that kingdom. Soon after the accession of George I. to the throne in 1714, he presented a memorial to the court of France, requiring the demolishing of the canal and new works at Mardyke. The year following he was recalled; and upon his arrival was taken up by a warrant from the house of commons, and strictly examined by a committee of the privy-council. Robert Walpole, Esq. moved the house of commons for an impeachment against him; and Mr Prior was ordered into

into close custody. In 1717, he was excepted out of the act of grace; however, at the close of that year, he was set at liberty. The remainder of his days he spent in tranquillity and retirement, and died in 1721. His poems are well known, and justly admired. He is said to have written the following epitaph for himself:

> "Nobles and heralds, by your leave,
> Here lie the bones of Matthew Prior,
> The son of Adam and of Eve:
> Let Bourbon or Nassau go higher."

PRIORIES, Alien, were cells of the religious houses in England which belonged to foreign monasteries: for when manors or tithes were given to foreign convents, the monks, either to increase their own rule, or rather to have faithful stewards of their revenues, built a small convent here for the reception of such a number as they thought proper, and constituted priors over them.—Within these cells there was the same distinction as in those priories which were cells subordinate to some great abbey; some of these were conventual, and, having priors of their own choosing, thereby became entire societies within themselves, and received the revenues belonging to their several houses for their own use and benefit, paying only the ancient apport (A), acknowledgement, or obvention, at first the surplusage, to the foreign house; but others depended entirely on the foreign houses, who appointed and removed their priors at pleasure. These transmitted all their revenues to the foreign head houses; for which reason their estates were generally seized to carry on the wars between England and France, and restored to them again on return of peace. These alien priories were most of them founded by such as had foreign abbeys founded by themselves or by some of their family.

The whole number is not exactly ascertained; the Monasticon hath given a list of 100: Weever, p. 338. says 110.

Some of these cells were made indigenous or denizon, or endenized. The alien priories were first seized by Edward I. 1285, on the breaking out of the war between France and England; and it appears from a roll, that Edward II. also seized them, though this is not mentioned by our historians; and to these the act of restitution, 1 Edw. III. seems to refer.

In 1237, Edward III. confiscated their estates, and let out the priories themselves with all their lands and tenements, at his pleasure, for 23 years; at the end of which term, peace being concluded between the two nations, he restored their estates 1361, as appears by his latters patent to that of Montacute, county of Somerset, printed at large in Rymer, vol. vi. p. 311. and translated in Weever's *Funeral Monuments*, p. 339. At other times he granted their lands, or lay pensions out of them, to divers noblemen. They were also sequestered during Richard II.'s reign, and the head monasteries abroad had the king's licence to sell their lands to other religious houses here, or to any particular persons who wanted to endow others.

Henry IV. began his reign with showing some favour to the alien priories, restoring all the conventual ones, only reserving to himself in time of war what they paid in time of peace to the foreign abbeys.

They were all dissolved by act of parliament 2 Henry V. and all their estates vested in the crown, except some lands granted to the college of Fotheringhay. The act of dissolution is not printed in the statute book, but it is to be found entire in Rymer's *Fœdera*, ix. 283. and in the Parliament Rolls, vol. iv. p. 22. In general, these lands were appropriated to religious uses. Henry VI. endowed his foundations at Eton and Cambridge with the lands of the alien priories in pursuance of his father's design to appropriate them all to a noble college at Oxford. Others were granted in fee to the prelates, nobility, or private persons. Such as remained in the crown were granted by Henry VI. 1440, to Archbishop Chichley, &c. and they became part of his and the royal foundations. See *Some Account of Alien-Priories*, &c. in two volumes octavo.

PRIORITY, the relation of something considered as prior to another.

Priority, in *Law*, denotes an antiquity of tenure, in comparison of another less ancient.

PRISCIANUS, an eminent grammarian, born at Cæsarea, taught at Constantinople with great reputation about the year 525. Laurentius Valla calls Priscian, Donatus, and Servius, *triumviri in re grammatica*; and thinks none of the ancients who wrote after them fit to be mentioned with them. He composed a work *De arte grammatica*, which was first printed by Aldus at Venice in 1476; and another, *De naturalibus questionibus*, which he dedicated to Chosroes king of Persia: beside which, he translated Dionysius's description of the world into Latin verse. A person who writes false Latin, is proverbially said "to break Priscian's head."

PRISCILLIANISTS, in church history, Christian heretics, so called from their leader Priscillian, a Spaniard by birth, and bishop of Avila. He is said to have practised magic, and to have maintained the principal errors of the Manichees; but his peculiar tenet was, That it is lawful to make false oaths in order to support one's cause and interests.

PRISM, in *Geometry*, is a solid body, whose two ends are any plane figures which are parallel, equal, and similar; and its sides, connecting those ends, are parallelograms.

PRISMOID, is a solid body, somewhat resembling a prism, but its ends are any dissimilar parallel plane figures of the same number of sides, the upright sides being trapezoids. If the ends of the prismoid be bounded by dissimilar curves, it is sometimes called a *cylindroid*.

PRISON, a gaol, or place of confinement.

Lord Coke observes, that a prison is only a place of safe custody, *salva custodia*, not a place of punishment. If this be the case, prisons ought not to be, what they have been in most, and still are in some places of Europe,

(A) *Apportas* or *apportagium* (from *portare*), an acknowledgement, oblation, or obvention, to the mother house or church. *Du Cange*.

Prison.

rope, loathsome dungeons. Any place where a person is confined may be said to be a prison; and when a process is issued against one, he must, when arrested thereon, either be committed to prison, or be bound in a recognizance with sureties, or else give bail, according to the nature of the case, to appear at a certain day in court, there to make answer to what is alleged against him. Where a person is taken and sent to prison, in a civil case, he may be released by the plaintiff in the suit; but if it be for treason or felony, he may not regularly be discharged, until he is indicted of the fact and acquitted. See INDICTMENT.

But a prison is not only to be considered as a place of safe custody, according to its original design, but also as a place of temporary punishment for certain crimes, and perhaps this punishment might be substituted more frequently than it is, for transportation and death. Probably this is done in no country to better purpose than in Pennsylvania; and no where has imprisonment been more abused than in Venice under the old government.

By the laws of Pennsylvania, imprisonment is imposed, not merely as an expiation for past offences, but also for the reformation of the criminal's morals. The regulations of the gaol are calculated to produce this effect in the speediest manner possible, so that such a building may rather be denominated a *penitentiary house* than a *gaol*. When a criminal is committed to prison, he is made to wash; his hair is shorn, and he is furnished with clean apparel, if he has no decent clothes of his own. He is then put into a solitary cell, where he is excluded from the sight of every living being except the gaoler, whose duty is to attend to his mere necessities, but not to converse with him upon any account. If committed for an atrocious crime, he is even debarred from the light of heaven. The treatment of each prisoner varies in proportion to the nature of his crime, and his symptoms of repentance. The longest period of confinement is for a rape, which is not to be less than ten years, nor to exceed 21; and for high treason it is not to be under 6, nor above 12.

The prisoners must bathe twice in the week, having proper conveniences within the prison, and they are regularly supplied with a change of linen. Prisoners in solitary confinement subsist upon bread and water; and such as labour are allowed broth, puddings, &c. They are allowed meat in small quantities twice a week, and no beverage except water is brought into the prison. One room is set apart for shoe-makers, another for taylors, and so of every other trade. There are stone-cutters, smiths, nailers, &c. in the yards. Such a prison has all the advantages of the rasping house of Amsterdam, without any of its enormous defects.

The following account of the common prison at Venice, is given by Dr Mosely who visited this horrible place in September 1787.

"I was conducted (says he) through the prison by one of its inferior dependants. We had a torch with us. We crept along narrow passages as dark as pitch. In some of them two people could scarcely pass each other. The cells are made of massy marble; the architecture of the celebrated Sansovini.

"The cells are not only dark, and black as ink, but being surrounded and confined with huge walls, the smallest breath of air can scarcely find circulation in them. They are about nine feet square on the floor, arched at the top, and between six and seven feet high in the highest part. There is to each cell a round hole of eight inches diameter, through which the prisoner's daily allowance of twelve ounces of bread and a pot of water is delivered. There is a small iron door to the cell. The furniture of the cell is a little straw and a small tub; nothing else. The straw is renewed and the tub emptied through the iron door occasionally.

"The diet is ingeniously contrived for the perduration of punishment. Animal food, or a cordial nutritious regimen, in such a situation, would bring on disease, and defeat the end of this Venetian justice. Neither can the soul, if so inclined, steal away, wrapt up in slumbering delusion, or sink to rest; from the admonition of her sad existence, by the gaoler's daily return.

"I saw one man who had been in a cell thirty years; two who had been twelve years; and several who had been eight and nine years in their respective cells.

"By my taper's light I could discover the prisoners horrid countenances. They were all naked. The man who had been there thirty years, in face and body was covered with long hair. He had lost the arrangement of words and order of language. When I spoke to him, he made an unintelligible noise, and expressed fear and surprise; and, like some wild animals in deserts, which have suffered by the treachery of the human race, or have an instinctive abhorrence of it, he would have fled like lightning from me if he could.

"One whose faculties were not so obliterated; who still recollected the difference between day and night; whose eyes and ears, though long closed with a silent blank, still languished to perform their natural functiions—implored, in the most piercing manner, that I would prevail on the gaoler to murder him, or to give him some instrument to destroy himself. I told him I had no power to serve him in this request. He then entreated I would use my endeavours with the inquisitors to get him hanged, or drowned in the Canal' Orfano. But even in this I could not serve him: death was a favour I had not interest enough to procure for him.

"This kindness of death, however, was, during my stay in Venice, granted to one man, who had been 'from the cheerful ways of man cut off' thirteen years.

"Before he left his dungeon I had some conversation with him; this was six days previous to his execution. His transport at the prospect of death was surprising. He longed for the happy moment. No saint ever exhibited more fervour in anticipating the joys of a future state, than this man did at the thoughts of being released from life, during the four days mockery of his trial.

"It is the Canal' Orfano where vessels from Turkey and the Levant perform quarantine. This place is the watery grave of many who have committed political or personal offences against the state or senate, and of many who have committed no offences at all. They are carried out of the city in the middle of the night, tied up in a sack with a large stone fastened to it, and thrown into the water. Fishermen are prohibited, on forfeiture of of their lives, against fishing in this district. The pretence is the plague. This is the secret history of people being lost in Venice.

"The government, with age, grew feeble; was afraid of the discussion of legal process and of public executions; and navigated this rotten Bucentaur of the Adriatic by spies, prisons, assassination, and the Canal' Orfano."

PRISONER, a person restrained or kept in prison upon an action civil or criminal, or upon commendment: and one may be a prisoner on matter of record or matter of fact. A prisoner upon matter of record, is he who, being present in court, is by the court committed to prison; and the other is one carried to prison upon an arrest, whether it be by the sheriff, constable, or other officer.

PRISTIS, the SAWFISH, is generally considered as a species of the *squalus* or *shark* genus, comprehending under it several varieties. See SQUALUS, ICHTHYOLOGY *Index*. But Mr Latham is of opinion that it ought to be considered as a distinct genus, and that the characteristics of the several varieties are sufficient to constitute distinct species.

PRIVATEERS, are a kind of private men of war, the persons concerned wherein administer at their own costs a part of a war, by fitting out these ships of force, and providing them with all military stores; and they have, instead of pay, leave to keep what they take from the enemy, allowing the admiral his share, &c.

Privateers may not attempt any thing against the laws of nations; as to assault an enemy in a port or haven, under the protection of any prince or republic, whether he be friend, ally, or neuter; for the peace of such places must be inviolably kept; therefore, by a treaty made by King William and the States of Holland, before a commission shall be granted to any privateer, the commander is to give security, if the ship be not above 150 tons, in 1500l. and if the ship exceeds that burden, in 3000l. that they will make satisfaction for all damages which they shall commit in their courses at sea, contrary to the treaties with that state, on pain of forfeiting their commissions; and the ship is made liable.

Jacob's Law Dict.

Besides these private commissions, there are special commissions for privateers, granted to commanders of ships, &c. who take pay; who are under a marine discipline; and if they do not obey their orders, may be punished with death: and the wars in later ages have given occasion to princes to issue these commissions, to annoy the enemies in their commerce, and hinder such supplies as might strengthen them or lengthen out the war; and likewise to prevent the separation of ships of greater force from their fleets or squadrons.

Ships taken by privateers were to be divided into five parts; four parts whereof to go to the persons interested in the privateer, and the fifth to his majesty: and as a farther encouragement, privateers, &c. destroying any French man of war or privateer, shall receive, for every piece of ordnance in the ship so taken, 10l. reward, &c.

By a particular statute lately made, the lord admiral, or commissioners of the admiralty, may grant commissions to commanders of privateers, for taking ships, &c. which being adjudged prize, and the tenth part paid to the admiral, &c. wholly belong to the owners of the privateers and the captors, in proportions agreed on between themselves.

PRIVATION, in a general sense, denotes the absence or want of something; in which sense darkness is only the privation of light.

PRIVATIVE, in *Grammar*, a particle, which, prefixed to a word, changes it into a contrary sense. Thus, among the Greeks, the α is used as a privative; as in α-θεος, *atheist*, *acephalus*, &c.——The Latins have their privative *in*; as, *incorrigibilis*, *indeclinabilis*, &c.——The English, French, &c. on occasion borrow both the Latin and Greek privatives.

PRIVERNUM, (Livy, Virgil); a town of the Volsci, in Latium, to the east of Setia. *Privernates*, the people. Whose ambassadors being asked, What punishment they deserved for their revolt? answered, What those deserve who deem themselves worthy of liberty. And again, being asked by the Roman consul, should the punishment be remitted, What peace was to be expected with them? If you granted a good peace, you may hope to have it sincere and lasting; but if a bad one, you may well expect it of short continuance. At which answer, the Romans were so far from being displeased, that by a vote of the people they had the freedom of the city granted them. *Privernas*, *-atis*, the epithet. The town is now called *Piperno Vecchio*, situated in the Campania of Rome. E. Long. 10. 0. N. Lat. 41. 30.

PRIVET. See LIGUSTRUM, BOTANY *Index*.

PRIVILEGE, in *Law*, some peculiar benefit granted to certain persons or places, contrary to the usual course of the law.

Privileges are said to be *personal* or *real*.

Personal privileges are such as are extended to peers, ambassadors, members of parliament, and of the convocation, &c. See LORDS, AMBASSADOR, PARLIAMENT, ARREST, &c.

A *real* privilege is that granted to some particular place; as the king's palace, the courts at Westminster, the universities, &c.

PRIVILEGES of the Clergy. See CLERGY.

PRIVY, in *Law*, is a partaker, or person having an interest, in any action or thing. In this sense they say, privies in blood: every heir in tail is privy to recover the land entailed. In old law-books, merchants privy are opposed to merchants strangers. Coke mentions four kinds of privies. Privies in blood, as the heir to his father; privies in representation, as executors and administrators to the deceased; privies in estate, as he in reversion and he in remainder, donor and donee, lessor and lessee: lastly, privy in tenure, as the lord by escheat; *i. e.* when land escheats to the lord for want of heirs.

PRIVY-Council. See COUNCIL. The king's will is the sole constituent of a privy-counsellor; and it also regulates their number, which in ancient times was about twelve. Afterwards it increased to so large a number, that it was found inconvenient for secrecy and dispatch; and therefore Charles II. in 1679, limited it to 30; whereof 15 were principal officers of state, and to be counsellors *ex officio*; and the other 15 were composed of 10 lords and five commoners of the king's choosing. Since that time, however, the number

has

has been much augmented, and now continues indefinite. At the same time also the ancient office of lord president of the council was revived, in the person of Anthony earl of Shaftesbury. Privy-counsellors are made by the king's nomination, without either patent or grant; and, on taking the necessary oaths, they become immediately privy-counsellors during the life of the king that chooses them, but subject to removal at his discretion.

Any natural born subject of England is capable of being a member of the privy-council; taking the proper oaths for security of the government, and the test for security of the church. By the act of settlement, 12 and 13 W. III. cap. 2. it is enacted, that no person born out of the dominions of the crown of England, unless born of English parents, even though naturalized by parliament, shall be capable of being of the privy-council. The duty of a privy-counsellor appears from the oath of office, which consists of seven articles. 1. To advise the king according to the best of his cunning and discretion. 2. To advise for the king's honour and good of the public, without partiality, through affection, love, meed, doubt, or dread. 3. To keep the king's counsel secret. 4. To avoid corruption. 5. To help and strengthen the execution of what shall be there resolved. 6. To withstand all persons who would attempt the contrary. And, lastly, in general, 7. To observe, keep, and do all that a good and true counsellor ought to do to his sovereign lord.

The privy-council is the *primum mobile* of the state, and that which gives the motion and direction to all the inferior parts. It is likewise a court of justice of great antiquity; the primitive and ordinary way of government in England being by the king and privy-council. It has been frequently used by all our kings for determining controversies of great importance: the ordinary judges have sometimes declined giving judgment till they had consulted the king and privy-council; and the parliament have frequently referred matters of high moment to the same, as being by long experience better able to judge of, and, by their secrecy and expedition, to transact some state affairs, than the lords and commons. At present, the privy-council takes cognizance of few or no matters except such as cannot well be determined by the known laws and ordinary courts; such as matters of complaint and sudden emergencies: their constant business being to consult for the public good in affairs of state. This power of the privy-council is to inquire into all offences against the government, and to commit the offenders to safe custody, in order to take their trial in some of the courts of law. But their jurisdiction herein is only to inquire, and not to punish; and the persons committed by them are intitled to their *habeas corpus* by statute 16 Car. I. cap. 10. as much as if committed by an ordinary justice of the peace.

In plantation or admiralty causes, which arise out of the jurisdiction of this kingdom, and in matters of lunacy and idiocy, the privy-council has cognizance, even in questions of extensive property, being the court of appeal in such causes; or, rather, the appeal lies to the king's majesty himself in council. From all the dominions of the crown, excepting Great Britain and Ireland, an appellate jurisdiction (in the last resort) is vested in this tribunal; which usually exercises its judicial authority in a committee of the whole privy-council, who hear the allegations and proofs, and make their report to his majesty in council, by whom the judgment is finally given.

Anciently, to strike in the house of a privy-counsellor, or elsewhere in his presence, was grievously punished: by 3 Hen. VII. cap. 14. if any of the king's servants of his household conspire or imagine to take away the life of a privy-counsellor, it is felony, though nothing shall be done upon it; and by 9 Ann. cap. 16. it is enacted, that any persons who shall unlawfully attempt to kill, or shall unlawfully assault, and strike, or wound, any privy counsellor in the execution of his office, shall be felons, and suffer death as such. With advice of this council, the king issues proclamations that bind the subject, provided they be not contrary to law. In debates, the lowest delivers his opinion first, the king last; and thereby determines the matter. A council is never held without the presence of a secretary of state.

The dissolution of the privy-council depends upon the king's pleasure; and he may, whenever he thinks proper, discharge any particular member, or the whole of it, and appoint another. By the common law also it was dissolved *ipso facto* by the king's demise, as deriving all its authority from him. But now, to prevent the inconveniencies of having no council in being at the accession of a new prince, it is enacted, by 6 Ann. cap. 7. that the privy-council shall continue for six months after the demise of the crown, unless sooner determined by the successor. *Blackst. Com.* book 1. p. 229, &c.

The officers of the privy-council are four clerks of the council in ordinary, three clerks extraordinary, a keeper of the records, and two keepers of the council-chamber. See President.

Privy Seal, a seal which the king uses previously to such grants, &c. as are afterwards to pass the great seal.

The privy seal is also sometimes used in matters of less consequence, which do not require the great seal.

Lord Privy Seal. See *Keeper of the Privy Seal.*

Clerks of the Privy Seal. See Clerk.

Privy Chamber. See Chamber.

PRIZE, or Prise, in maritime affairs, a vessel taken at sea from the enemies of a state, or from pirates; and that either by a man of war, a privateer, &c. having a commission for that purpose.

Vessels are looked on as prize, if they fight under any other standard than that of the state from which they have their commission; if they have no charter-party, invoice, or bill of lading abroad; if loaded with effects belonging to the king's enemies, or with contraband goods.

In ships of war, the prizes are to be divided among the officers, seamen, &c. as his majesty shall appoint by proclamation; but among privateers, the division is according to the agreement between the owners.

By stat. 13 Geo. II. c. 4. judges and officers, failing of their duty in respect to the condemnation of prizes, forfeit 500l. with full costs of suit; one moiety to the king, and the other to the informer.

PROA, Flying, in navigation, is a name given to a vessel used in the South seas, because with a brisk trade-wind trade-wind it sails near 20 miles an hour. In the construction of the proa, the head and stern are exactly alike, but the sides are very different; the side intended to be always the lee-side being flat; and the windward side made rounding, in the manner of other vessels; and, to prevent her over-setting, which, from her small breadth, and the straight run of her leeward side, would, without this precaution, infallibly happen, there is a frame laid out from her to windward, to the end of which is fastened a log, fashioned into the shape of a small boat, and made hollow. The weight of the frame is intended to balance the proa, and the small boat is by its buoyancy (as it is always in the water) to prevent her oversetting to windward; and this frame is usually called an outrigger. The body of the vessel is made of two pieces joined endwise, and sewed together with bark, for there is no iron used about her; she is about two inches thick at the bottom, which, at the gunwale, is reduced to less than one. The sail is made of matting, and the mast, yard, boom, and outriggers, are all made of bamboo. See *Anson's Voyage*, quarto, p. 341.

PROBABILITY, is a word of nearly the same import with likelihood. It denotes the appearance of truth, or that evidence arising from the preponderation of argument which produces opinion. (See OPINION). Locke classes all arguments under the heads of *demonstrative* and *probable*: Hume with greater accuracy divides them into *demonstrations*, *proofs*, and *probabilities*. Demonstration produces *science*; proof, *belief*; and probability, *opinion*.

Hardly any thing is susceptible of strict demonstration besides the mathematical sciences, and a few propositions in metaphysical theology. Physics rest upon principles, capable, some of them, of complete proof by experience, and others of nothing more than probability by analogical reasoning. What has *uniformly* happened, we expect with the fullest confidence to happen again in similar circumstances; what has *frequently* happened, we likewise expect to happen again; but our expectation is not confident. Uniform experience is proof; frequent experience is probability. The strongest man has *always* been able to lift the greatest weight; and, therefore, knowing that one man is stronger than another, we expect, with confidence, that the former will lift more than the latter. The best disciplined army has *generally* proved victorious, when all other circumstances were equal. We therefore expect that an army of veterans will, upon fair ground, defeat an equal number of new levied troops: but as sudden panics have sometimes seized the oldest soldiers, this expectation is accompanied with doubt, and the utmost that we can say of the expected event is, that it is *probable*; whereas in the competition between the two men, we look upon it as *morally certain*. (See METAPHYSICS, Part I. chap. vii. sec. 3.). When two or three persons of known veracity attest the same thing as consistent with their knowledge, their testimony amounts to *proof*, if not contradicted by the testimony of others; if contradicted, it can, at the utmost, amount only to probability. In common language we talk of *circumstantial* proofs and *presumptive* proofs; but the expressions are improper, for such evidence amounts to nothing more than probability. Of probability there are indeed various degrees, from the confines of certainty down to the confines of impossibility; and a variety of circumstances tending to the same point, though they amount not to what, in strictness of language, should be called *proof*, afford to the mind a very high degree of evidence, upon which, with the addition of one direct testimony, the laws of many countries take away the life of a man.

PROBABILITY *of an Event*, in the *Doctrine of Chances*, is greater or less according to the number of chances by which it may happen or fail. (See EXPECTATION). The *probability of life* is liable to rules of computation. In the *Encyclopedie Methodique*, we find a table of the probabilities of the duration of life, constructed from that which is to be found in the seventh volume of the *Supplemens à l'Histoire de M. de Buffon*; of which the following is an abridgement.

Of 23994 children born at the same time there will probably die

$\frac{1}{3}$	In one - -	7998
$\frac{2}{3}$	Remaining $\frac{2}{3}$ or 15996	
$\frac{1}{2}$	In eight years - -	11997
$\frac{1}{2}$	Remaining $\frac{1}{2}$ or 11997	
$\frac{2}{3}$	In thirty-eight years -	15996
$\frac{1}{3}$	Remaining $\frac{1}{3}$ or 7998	
$\frac{3}{4}$	In fifty years - -	17994
$\frac{1}{4}$	Remaining $\frac{1}{4}$ or 5998	
$\frac{5}{6}$	In sixty-one years -	19995
$\frac{1}{6}$	Remaining $\frac{1}{6}$ or 3999	
$\frac{9}{10}$	In seventy years - -	21595
$\frac{1}{10}$	Remaining $\frac{1}{10}$ or 2399	
$\frac{39}{40}$	In eighty years - -	22395
$\frac{1}{40}$	Remaining $\frac{1}{40}$ or 599	
$\frac{299}{300}$	In ninety years - -	23914
$\frac{1}{300}$	Remaining $\frac{1}{300}$ or 80	
	In a hundred years -	23992
	Remaining $\frac{1}{10000}$ or 2.	

See *Bills of* MORTALITY.

PROBATE of a will or testament, in *Law*, is the exhibiting and proving of last wills and testaments before the ecclesiastical judge delegated by the bishop, who is ordinary of the place where the party died.

PROBATION, in the universities, is the examination and trial of a student who is about to take his degrees.

PROBATION, in a monastic sense, signifies the year of a novitiate, which a religious must pass in a convent, to prove his virtue and vocation, and whether he can bear the severities of the rule.

PROBATION, in *Scots Law*. See LAW *Index*.

PROBATIONER, in the church of Scotland, a student in divinity, who bringing a certificate from a professor in an university of his good morals, and his having performed his exercises to approbation, is admitted to undergo several trials; and, upon his acquitting himself properly in these, receives a licence to preach.

PROBATUM EST *(It is proved)*, a term frequently subjoined to a receipt for the cure of some disease.

PROBE, a surgeon's instrument for examining the circumstances of wounds, ulcers, and other cavities, searching for stones in the bladder, &c.

PROBITY means honesty, sincerity, or veracity; and consists in the habit of actions useful to society, and in the constant observance of the laws which justice and

and conscience impose on us. The man who obeys all the laws of society with an exact punctuality is not therefore a man of probity; laws can only respect the external and definite parts of human conduct, but probity respects our more private actions, and such as it is impossible in all cases to define; and it appears to be in morals what charity is in religion. Probity teaches us to perform in society those actions which no external power can oblige us to perform, and is that quality in the human mind from which we claim the performance of the *rights* commonly called *imperfect*. See MORAL PHILOSOPHY.

PROBLEM, in *Logic*, is a proposition that neither appears absolutely true nor false; and, consequently, may be asserted either in the affirmative or negative.

PROBLEM, in *Geometry*, is a proposition, wherein some operation or construction is required; as to divide a line or angle, erect or let fall perpendiculars, &c. See GEOMETRY.

PROBOSCIS, in *Natural History*, is the trunk or snout of an elephant, and some other animals and insects.

Flies, gnats, &c. are furnished with a proboscis or trunk; by means of which they suck the blood of animals, the juice of vegetables, &c. for their food.

PROBUS, MARCUS AURELIUS, was the son of a gardener, and became, by his great valour as a soldier, and his eminent virtues, emperor of Rome, to which dignity he was raised by the army. Having subdued the barbarous nations who made incursions into different parts of the empire, where they committed horrid cruelties, he managed the affairs of government with great wisdom and clemency. He was massacred in the year 282, and the 7th of his reign, by some soldiers who were weary of the public works at which he made them labour.

PROCATARCTIC CAUSE, in *Medicine*, the pre-existing, or predisposing cause or occasion of a disease.

PROCELEUSMATICUS, in the ancient poetry, a foot consisting of four short syllables, or two pyrrhychiuses; as *hominibus*.

PROCELLARIA, a genus of birds, belonging to the order of anseres. See ORNITHOLOGY *Index*. Clusius makes the procellaria pelagica or stormy petrel the Camilla of the sea.

> *Vel mare per medium fluctu suspensa tumenti*
> *Ferret iter, celeres nec tingeret æquore plantas.* VIRG.

> She swept the seas; and, as she skimm'd along
> Her flying feet unbath'd on billows hung. DRYDEN.

These birds are the *cypselli* of Pliny, which he places among the *apodes* of Aristotle; not because they wanted feet, but were κακοποδα, or had bad or useless ones; an attribute he gives to these species, on a supposition that they were almost always on the wing.

PROCESS, in *Law*, denotes the proceedings in any cause, real or personal, civil or criminal, from the original writ to the end thereof.

In a more limited sense, process denotes that by which a man is called first into any temporal court.

It is the next step for carrying on the suit, after suing out the original writ. See SUIT and WRIT.

It is the method taken by the law to compel a compliance with the original writ, of which the primary step is by giving the party notice to obey it. This notice is given upon all real *præcipes;* and also upon all personal writs for injuries not against the peace, by *summons;* which is a warning to appear in court at the return of the original writ, given to the defendant by two of the sheriff's messengers called *summoners*, either in person, or left at his house or land: in like manner as in the civil law the first process is by personal citation, *in jus vocando*. This warning on the land is given, in real actions, by erecting a white stick or wand on the defendant's grounds (which stick or wand among the northern nations is called the *baculus nunciatorius*), and by statute 31 Eliz. c. 3. the notice must also be proclaimed on some Sunday before the door of the parish-church.

Blackst. Comment.

If the defendant disobeys this verbal monition, the next process is by writ of *attachment*, or *pone;* so called from the words of the writ, *pone per vadium et salvos plegios*, "put by gage and safe pledges A. B. the defendant," &c. This is a writ not issuing out of chancery, but out of the court of common-pleas, being grounded on the non-appearance of the defendant at the return of the original writ; and thereby the sheriff is commanded to attach him, by taking *gage*, that is, certain of his goods, which he shall forfeit if he doth not appear; or by making him find *safe pledges* or sureties, which shall be amerced in case of his non-appearance. This is also the first and immediate process, without any previous summons, upon actions of trespass *vi et armis*, or for other injuries, which though not forcible, are yet trespasses against the peace, as *deceit* and *conspiracy;* where the violence of the wrong requires a more speedy remedy, and therefore the original writ commands the defendant to be at once attached, without any precedent warning.

If, after attachment, the defendant neglects to appear, he not only forfeits this security, but is moreover to be farther compelled by writ of *distringas*, or distress infinite: which is a subsequent process issuing from the court of common-pleas, commanding the sheriff to distrain the defendant from time to time, and continually afterwards, by taking his goods and the profits of his lands, which are called *issues*, and which he forfeits to the king if he doth not appear. But the issues may be sold, if the court shall so direct, in order to defray the reasonable costs of the plaintiff. In like manner, by the civil law, if the defendant absconds, so that the citation is of no effect, *mittitur adversarius in possessionem bonorum ejus*.

And here, by the common as well as the civil law, the process ended in case of injuries without force: the defendant if he had any substance, being gradually stripped of it all by repeated distresses, till he rendered obedience to the king's writ; and, if he had no substance, the law held him incapable of making satisfaction, and therefore looked upon all farther process as nugatory. And besides, upon feodal principles, the person of a feudatory was not liable to be attached for injuries merely civil, lest thereby his lord should be deprived of his personal services. But, in cases of injury accompanied with force, the law, to punish the breach of the peace and prevent its disturbance for the future, provided also a process against the defendant's person, in case he neglected to appear upon the former process of attachment, or had no substance whereby to be attached; subjecting

Process. jecting his body to imprisonment by the writ of *capias ad respondendum*. But this immunity of the defendant's person, in case of peaceable though fraudulent injuries, producing great contempt of the law in indigent wrong-doers, a *capias* was also allowed, to arrest the person in actions of account, though no breach of the peace be suggested, by the statutes of Marlbridge, 52 Hen. III. c. 23. and Westm. 2. 13. Edw. I. c. 11. in actions of debt and detinue, by statute 25 Edw. III. c. 17. and in all actions on the case, by statute 19 Hen. VII. c. 9. Before which last statute a practice had been introduced of commencing the suit by bringing an original writ of trespass *quare clausum fregit*, by breaking the plaintiff's close, *vi et armis*; which by the old common law subjected the defendant's person to be arrested by writ of *capias:* and then afterwards, by connivance of the court, the plaintiff might proceed to prosecute for any other less forcible injury. This practice (through custom rather than necessity, and for saving some trouble and expence, in suing out a special original adapted to the particular injury) still continues in almost all cases, except in actions of debt; though now, by virtue of the statutes above cited and others, a *capias* might be had upon almost every species of complaint.

If therefore the defendant, being summoned or attached, makes default, and neglects to appear; or if the sheriff returns a *nihil*, or that the defendant hath nothing whereby he may be summoned, attached, or distrained, the *capias* now usually issues: being a writ commanding the sheriff to take the body of the defendant, if he may be found in his bailiwick or county, and him safely to keep, so that he may have him in court on the day of the return, to answer to the plaintiff of a plea of debt, or trespass, &c. as the case may be. This writ, and all others subsequent to the original writ, not issuing out of chancery, but from the court into which the original was returnable, and being grounded on what has passed in that court in consequence of the sheriff's return, are called *judicial*, not *original*, writs; they issue under the privy seal of that court, and not under the great seal of England; and are *tested*, not in the king's name, but in that of the chief justice only. And these several writs being grounded on the sheriff's return, must respectively bear date the same day on which the writ immediately preceding was returnable.

This is the regular and orderly method of process. But it is now usual in practice to sue out the *capias* in the first instance, upon a supposed return of the sheriff; especially if it be suspected that the defendant, upon notice of the action, will abscond; and afterwards a fictitious original is drawn up, with a proper return thereupon, in order to give the proceedings a colour of regularity. When this *capias* is delivered to the sheriff, he by his under-sheriff grants a warrant to his inferior officers or bailiffs to execute it on the defendant. And, if the sheriff of Oxfordshire (in which county the injury is supposed to be committed and the action is laid) cannot find the defendant in his jurisdiction, he returns that he is not found, *non est inventus*, in his bailiwick: whereupon another writ issues, called a *testatum capias*, directed to the sheriff of the county where the defendant is supposed to reside, as of Berkshire, reciting the former writ, and that it is testified, *testatum est*, that the defendant lurks or wanders in his bailiwick, where he is commanded to take him, as in the former *capias*. But here also, when the action is brought in one county and the defendant lives in another, it is usual, for saving trouble, time, and expence, to make out a *testatum capias* at the first; supposing not only an original, but also a former *capias*, to have been granted; which in fact never was. And this fiction, being beneficial to all parties, is readily acquiesced in, and is now become the settled practice; being one among many instances to illustrate that maxim of law, that *in fictione juris consistit æquitas*.

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But where a defendant absconds, and the plaintiff would proceed to an outlawry against him, an original writ must then be sued out regularly, and after that a *capias*. And if the sheriff cannot find the defendant upon the first writ of *capias*, and returns a *non est inventus*, there issues out an *alias* writ, and after that a *pluries*, to the same effect as the former: only after these words "we command you," this clause is inserted, "as we have formerly," or, "as we have often commanded you;"—"*sicut* alias," or, "*sicut* pluries *præcipimus*." And if a *non est inventus* is returned upon all of them, then a writ of *exigent* or *exigi facias* may be sued out, which requires the sheriff to cause the defendant to be proclaimed, required or exacted, in five county-courts successively, to render himself; and if he does, then to take him, as in a *capias:* but if he does not appear, and is returned *quinto exactus*, he shall then be outlawed by the coroners of the county. Also by statute 6 Hen. VIII. c. 4. and 31 Eliz. c. 3. whether the defendant dwells within the same or another county than that wherein the *exigent* is sued out, a *writ of proclamation* shall issue out at the same time with the *exigent*, commanding the sheriff of the county, wherein the defendant dwells, to make three proclamations thereof in places the most notorious, and most likely to come to his knowledge, a month before the outlawry shall take place. Such outlawry is putting a man out of the protection of the law, so that he is incapable to bring an action for redress of injuries; and it is also attended with a forfeiture of all one's goods and chattels to the king. And therefore, till some time after the conquest, no man could be outlawed but for felony: but in Bracton's time, and somewhat earlier, process of outlawry was ordained to lie in all actions for trespasses *vi et armis*. And since, by a variety of statutes (the same which allow the writ of *capias* before mentioned) process of outlawry doth lie in divers actions that are merely civil; providing they be commenced by original and not by bill. If after outlawry the defendant appears publicly, he may be arrested by a writ of *capias utlagatum*, and committed till the outlawry be reversed. Which reversal may be had by the defendants appearing personally in court (and in the king's bench without any personal appearance, so that he appears by attorney, according to statute 4 & 5 W. & M. c. 18.); and any plausible cause, however slight, will in general be sufficient to reverse it, it being considered only as a process to compel an appearance. But then the defendant must pay full costs, and put the plaintiff in the same condition as if he had appeared before the writ of *exigi facias* was awarded.

Such is the first process in the court of common pleas. In the king's bench they may also (and frequently do) proceed in certain causes, particularly in actions of ejectment and trespass, by *original* writ, with *attachment* and *capias* thereon; returnable, not at Westminster, where the

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the common pleas are now fixed in consequence of *magna charta*, but *ubicunque fuerimus in Anglia*, wheresoever the king shall then be in England; the king's bench being removeable into any part of England at the pleasure and discretion of the crown. But the more usual method of proceeding therein is without any original, but by a peculiar species of process entitled a *bill of Middlesex;* and therefore so entitled, because the court now sits in that county; for if it sat in Kent, it would then be a bill of Kent. For though, as the justices of this court have, by its fundamental constitution, power to determine all offences and trespasses, by the common law and custom of the realm, it needed no original writ from the crown to give it cognizance of any misdemesnor in the county wherein it resides; yet as, by this court's coming into any county, it immediately superseded the ordinary administration of justice by the general commissioners of *eyre* and of *oyer and terminer*, a process of its own became necessary, within the county where it sat, to bring in such persons as were accused of committing any forcible injury. The bill of Middlesex (which was formerly always founded on a plaint of trespass *quare clausum fregit*, entered on the records of the court) is a kind of *capias*, directed to the sheriff of that county, and commanding him to take the defendant, and have him before our lord the king at Westminster on a day prefixed, to answer to the plaintiff of a plea of trespass. For this accusation of trespass it is that gives the court of king's bench jurisdiction in other civil causes, since, when once the defendant is taken into custody of the marshal, or prison-keeper of this court, for the supposed trespass, he, being then a prisoner of this court, may here be prosecuted for any other species of injury. Yet, in order to found this jurisdiction, it is not necessary that the defendant be actually the marshal's prisoner; for, as soon as he appears, or puts in bail, to the process, he is deemed by so doing to be in such custody of the marshal as will give the court a jurisdiction to proceed. And, upon these accounts, in the bill or process, a complaint of trespass is always suggested, whatever else may be the real cause of action. This bill of Middlesex must be served on the defendant by the sheriff, if he finds him in that county: but if he returns, *non est inventus*, then there issues out a writ of *latitat*, to the sheriff of another county, as Berks: which is similar to the *testatum capias* in the common pleas, and recites the bill of Middlesex and the proceedings thereon, and that it is testified that the defendant *latitat et discurrit*, lurks and wanders about in Berks; and therefore commands the sheriff to take him, and have his body in court on the day of the return. But as in the common pleas the *testatum capias* may be sued out upon only a supposed, and not an actual preceding, *capias;* so in the king's bench a *latitat* is usually sued out upon only a supposed, and not an actual, bill of Middlesex. So that, infact, a *latitat* may be called the first process in the court of king's bench, as the *testatum capias* is in the common pleas. Yet, as in the common pleas, if the defendant lives in the county wherein the action is laid, a common *capias* suffices; so in the king's bench likewise, if he lives in Middlesex, the process must still be by bill of Middlesex only.

In the exchequer the first process is by writ of *quo minus*, in order to give the court jurisdiction over pleas between party and party. In which writ the plaintiff is alleged to be the king's farmer or debtor, and that the defendant hath done him the injury complained of, *quo minus sufficiens existit*, by which he is the less able to pay the king his rent or debt. And upon this the defendant may be arrested as upon a *capias* from the common pleas.

Thus differently do the three courts set out at first, in the commencement of a suit, in order to entitle the two courts of king's bench and exchequer to hold plea in subjects causes, which by the original constitution of Westminster-hall they were not empowered to do. Afterwards, when the cause is once drawn into the respective courts, the method of pursuing it is pretty much the same in all of them.

If the sheriff had found the defendant upon any of the former writs, the *capias latitat*, &c. he was anciently obliged to take him into custody, in order to produce him in court upon the return, however small and minute the cause of action might be. For, not having obeyed the original summons, he had shown a contempt of the court, and was no longer to be trusted at large. But when the summons fell into disuse, and the *capias* became in fact the first process, it was thought hard to imprison a man for a contempt which was only supposed: and therefore, in common cases, by the gradual indulgence of the courts (at length authorised by statute 12 Geo. I. c. 29. which was amended by statute 5 Geo. II. c. 27. and made perpetual by statute 21 Geo. II. c. 3.) the sheriff or his officer can now only personally serve the defendant with the copy of the writ or process, and with notice in writing to appear by his attorney in court to defend this action; which in effect reduces it to a mere summons. And if the defendant think proper to appear upon this notice, his appearance is recorded, and he puts in sureties for his future attendance and obedience; which sureties are called *common bail*, being the same two imaginary persons that were pledges for the plaintiff's prosecution, John Doe and Richard Roe. Or, if the defendant does not appear upon the return of the writ, or within four (or in some cases eight) days after, the plaintiff may enter an appearance for him, as if he had really appeared; and may file common bail in the defendant's name, and proceed thereupon as if the defendant had done it himself.

But if the plaintiff will make affidavit, or assert upon oath, that the cause of action amounts to ten pounds or upwards, then in order to arrest the defendant, and make him put in substantial sureties for his appearance, called *special bail*, it is required by statute 13 Car. II. stat. 2. c. 2. that the true cause of action should be expressed in the body of the writ or process; else no security can be taken in a greater sum than 40l. This statute (without any such intention in the makers) had like to have ousted the king's bench of all its jurisdiction over civil injuries without force; for as the bill of Middlesex was framed only for actions of trespass, a defendant could not be arrested and held to bail thereupon for breaches of civil contracts. But to remedy this inconvenience, the officers of the king's bench devised a method of adding what is called a clause of *ac etiam* to the usual complaint of trespass; the bill of Middlesex commanding the defendant to be brought in to answer the plaintiff of a plea of trespass, *and also* to a bill of debt: the complaint or trespass giving cognizance to the court, and that of debt authorising the arrest.

rest. In imitation of which, lord chief justice North, a few years afterwards, in order to save the suitors of his court the trouble and expence of suing out special originals, directed, that in the common pleas, besides the usual complaint of breaking the plaintiff's close, a clause of *ac etiam* might be also added to the writ of *capias*, containing the true cause of action; as, "that the said Charles the defendant may answer to the plaintiff of a plea of trespass in breaking his close: and also, *ac etiam* may answer him, according to the custom of the court, in a certain plea of trespass upon the case, upon promises, to the value of 20l. &c." The sum sworn to by the plaintiff is marked upon the back of the writ; and the sheriff, or his officer the bailiff, is then obliged actually to arrest or take into custody the body of the defendant, and, having so done, to return the writ with a *cepi corpus* indorsed thereon. See ARREST.

When the defendant is regularly arrested, he must either go to prison, for safe custody; or put in *special bail* to the sheriff. For, the intent of the arrest being only to compel an appearance in court at the return of the writ, that purpose is equally answered, whether the sheriff detains his person, or takes sufficient security for his appearance, called *bail* (from the French word *bailer*, "to deliver)," because the defendant is bailed, or delivered, to his sureties, upon their giving security for his appearance; and is supposed to continue in their friendly custody instead of going to gaol. See BAIL. The method of putting in bail to the sheriff is, by entering into a bond or obligation, with one or more sureties, (not fictitious persons, as in the former case of common bail, but real, substantial, responsible bondsmen), to insure the defendant's appearance at the return of the writ; which obligation is called the *bail-bond*. The sheriff, if he pleases, *may* let the defendant go without any sureties; but that is at his own peril: for, after once taking him, the sheriff is bound to keep him safely, so as to be forthcoming in court; otherwise an action lies against him for an escape. But on the other hand, he is obliged, by statute 23 Hen. VI. c. 10. to take (if it be tendered) a sufficient bail-bond; and, by statute 12 Geo. I. c. 29. the sheriff shall take bail for no other sum than such as is sworn to by the plaintiff, and indorsed on the back of the writ.

Upon the return of the writ, or within four days after, the defendant must *appear* according to the exigency of the writ. This *appearance* is effected by putting in and justifying bail *to the action;* which is commonly called *putting in bail above*. If this be not done, and the bail that were taken by the sheriff *below* are responsible persons, the plaintiff may take an assignment from the sheriff of the bail-bond (under the statute 4 and 5 Ann. c. 16.) and bring an action thereupon against the sheriff's bail. But if the bail so accepted by the sheriff be insolvent persons, the plaintiff may proceed against the sheriff himself, by calling upon him, first to return the writ (if not already done), and afterwards to bring in the body of the defendant. And if the sheriff does not then cause sufficient bail to be put in *above*, he will himself be responsible to the plaintiff.

The bail *above*, or bail *to the action*, must be put in either in open court, or before one of the judges thereof; or else, in the country, before a commissioner appointed for that purpose by virtue of the statute 4 W. and M. c. 4. which must be transmitted to the court. These bail, who must at least be two in number, must enter into a recognizance in court, or before the judge or commissioner, whereby they do jointly and severally undertake, that if the defendant be condemned in the action, he shall pay the costs and condemnation, or render himself a prisoner, or that they will pay it for him: which recognizance is transmitted to the court in a slip of parchment, intitled a *bail-piece*. And, if required, the bail must *justify* themselves in court, or before the commissioner in the country, by swearing themselves housekeepers, and each of them to be worth double the sum for which they are bail, after payment of all their debts. This answers in some measure to the *stipulatio* or *satisdatio* of the Roman laws, which is mutually given by each litigant party to the other: by the plaintiff that he will prosecute his suit, and pay the costs if he loses his cause; in like manner as our law still requires nominal pledges of prosecution from the plaintiff: by the defendant, that he shall continue in court, and abide the sentence of the judge, much like our special bail; but with this difference, that the *fidejussores* were there absolutely bound *judicatum solvere*, to see the costs and condemnation paid at all events: whereas our special bail may be discharged, by surrendering the defendant into custody within the time allowed by law; for which purpose they are at all times entitled to a warrant to apprehend him.

Special bail is required (as of course) only upon actions of debt, or actions on the case in trover, or for money due, where the plaintiff can swear that the cause of action amounts to ten pounds: but in actions where the damages are precarious, being to be assessed *ad libitum* by a jury, as in actions for words, ejectment, or trespass, it is very seldom possible for a plaintiff to swear to the amount of his cause of action; and therefore no special bail is taken thereon, unless by a judge's order, or the particular directions of the court, in some particular species of injuries, as in cases of mayhem or atrocious battery; or upon such special circumstances as make it absolutely necessary that the defendant should be kept within the reach of justice. Also in actions against heirs, executors, and administrators, for debts of the deceased, special bail is not demandable; for the action is not so properly against them in person, as against the effects of the deceased in their possession. But special bail is required even of them, in actions for a *devastavit*, or wasting the goods of the deceased; that wrong being of their own committing.

Thus much for *process;* which is only meant to bring the defendant into court, in order to contest the suit, and abide the determination of the law. When he appears either in person as a prisoner, or out upon bail, then follow the *pleadings* between the parties. See PLEADINGS.

PROCESS upon an Indictment. See PROSECUTION. The proper process on an indictment for any petty misdemeanor, or on a penal statute, is a writ of *venire fascias*, which is in the nature of a summons to cause the party to appear. And if by the return to such *venire* it appears that the party hath lands in the county whereby he may be distrained, then a *distress infinite* shall be issued from time to time till he appears. But if the sheriff returns, that he hath no lands in his bailiwick, then (upon his non-appearance) a writ of *capias* shall issue, which commands the sheriff to take his body, and have

Process. have him at the next assizes; and if he cannot be taken upon the first *capias*, a second and a third shall issue, called an *alias* and a *pluries capias*. But, on indictments for treason or felony, a *capias* is the first process: and, for treason or homicide, only one shall be allowed to issue, or two in the case of other felonies, by statute 25 Edw. III. c. 14. though the usage is to issue only one in any felony; the provisions of this statute being in most cases found impracticable. And so in the case of misdemesnors, it is now the usual practice for any judge of the court of king's bench, upon certificate of an indictment found, to award a writ of *capias* immediately, in order to bring in the defendant. But if he absconds, and it is thought proper to pursue him to an outlawry, then a greater exactness is necessary. For, in such case, after the several writs have issued in a regular number, according to the nature of the respective crimes, without any effect, the offender shall be put in the *exigent* in order to his outlawry: that is, he shall be exacted, proclaimed, or required, to surrender at five county-courts; and if he be returned *quinto exactus*, and does not appear at the fifth exaction or requisition, then he is adjudged to be *outlawed*, or put out of the protection of the law; so that he is incapable of taking the benefit of it in any respect, either by bringing actions or otherwise.

The punishment for outlawries upon indictments for misdemesnors, is the same as for outlawries upon civil actions; viz. forfeiture of goods and chattels. But an outlawry in treason or felony amounts to a conviction and attainder of the offence charged in the indictment, as much as if the offender had been found guilty by his country. His life is, however, still under the protection of the law, as hath elsewhere been observed; (see HOMICIDE): that though anciently an outlawed felon was said to have *caput lupinum*, and might be knocked on the head like a wolf, by any one that should meet him; because, having renounced all law, he was to be dealt with as in a state of nature, when every one that should find him might slay him: yet now, to avoid such inhumanity, it is holden that no man is intitled to kill him wantonly or wilfully; but in so doing is guilty of murder, unless it happens in the endeavour to apprehend him. For any person may arrest an outlaw on a criminal prosecution, either of his own head, or by writ or warrant of *capias utlagatum*, in order to bring him to execution. But such outlawry may be frequently reversed by writ of error, the proceedings therein being (as it is fit they should be) exceedingly nice and circumstantial; and if any single minute point be omitted or misconducted, the whole outlawry is illegal, and may be reversed; upon which reversal the party accused is admitted to plead to, and defend himself against, the indictment.

Thus much for process to bring in the offender after indictment found; during which stage of the prosecution it is that writs of *certiorari facias* are usually had, though they may be had at any time before trial, to certify and remove the indictment, with all the proceedings thereon, from any inferior court of criminal jurisdiction into the court of king's bench; which is the sovereign ordinary court of justice in causes criminal. And this is frequently done for one of these four purposes; either, 1. To consider and determine the validity of appeals or indictments and the proceedings thereon; and to quash or confirm them as there is cause; or, 2. Where it is surmised that a partial or insufficient trial will probably be had in the court below, the indictment is removed, in order to have the prisoner or defendant tried at the bar of the court of king's bench, or before the justices of *nisi prius*: or, 3. It is so removed, in order to plead the king's pardon there: or, 4. To issue process of outlawry against the offender, in those counties or places where the process of the inferior judges will not reach him. Such writ of *certiorari*, when issued and delivered to the inferior court for removing any record or other proceeding, as well upon indictment as otherwise, supersedes the jurisdiction of such inferior court, and makes all subsequent proceedings therein entirely erroneous and illegal; unless the court of king's bench remands the record to the court below, to be there tried and determined. A *certiorari* may be granted at the instance of either the prosecutor or the defendant: the former as a matter of right, the latter as a matter of discretion; and therefore it is seldom granted to remove indictments from the justices of gaol-delivery, or after issue joined, or confession of the fact in any of the courts below.

At this stage of prosecution also it is, that indictments found by the grand jury against a peer, must in consequence of a writ of *certiorari*, be certified and transmitted into the court of parliament, or into that of the lord high steward of Great Britain; and that, in places of exclusive jurisdiction, as the two universities, indictments must be delivered (upon challenge and claim of cognizance) to the courts therein established by charter, and confirmed by act of parliament, to be there respectively tried and determined. See PLEA.

PROCESS, in *Chemistry*, the whole course of an experiment or series of operations, tending to produce something new.

PROCESS, in *Anatomy*, denotes any protuberance or eminence in a bone.

PROCESSION, a ceremony in the Romish church, consisting of a formal march of the clergy and people, putting up prayers, &c. and in this manner visiting some church, &c. They have also processions of the host or sacrament, &c. See HOST.

PROCHEIN AMY, in *Law*, the person next a-kin to a child in non-age, and who, in that respect, is allowed to act for him, and be his guardian, &c. if he hold land in soccage.

To sue, an infant is not allowed to make an attorney; but the court will admit his next friend as plaintiff, or his guardian as defendant.

PROCKIA, a genus of plants belonging to the polyandria class; and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

PROCLAMATION, a public notice given of any thing of which the king thinks proper to advertise his subjects.

Proclamations are a branch of the king's prerogative *; and have then a binding force, when (as Sir Edward Coke observes) they are grounded upon and enforce the laws of the realm. For though the making of laws is entirely the work of a distinct part, the legislative branch of the sovereign power, yet the manner, time, and circumstances of putting those laws in execution, must frequently be left to the discretion of the executive magistrate. And therefore his constitutions or edicts, concerning those points which we call *Proclamations*,

* See Prerogative.

Proclamations, are binding upon the subject, where they do not either contradict the old laws, or tend to establish new ones; but only enforce the execution of such laws as are already in being, in such manner as the king shall judge necessary. Thus the established law is, that the king may prohibit any of his subjects from leaving the realm: a proclamation therefore forbidding this in general for three weeks, by laying an embargo upon all shipping in time of war, will be equally binding as an act of parliament, because founded upon a prior law. But a proclamation to lay an embargo in time of peace upon all vessels laden with wheat, (though in the time of a public scarcity), being contrary to law, and particularly to statute 22 Car. II. c. 13. the advisers of such a proclamation, and all persons acting under it, found it necessary to be indemnified by a special act of parliament, 7 Geo. III. c. 7. A proclamation for disarming Papists is also binding, being only in execution of what the legislature has first ordained: but a proclamation for allowing arms to Papists, or for disarming any Protestant subjects, will not bind; because the first would be to assume a dispensing power, the latter a legislative one; to the vesting of either of which in any single person the laws of England are absolutely strangers. Indeed, by the stat. 31 Hen. VIII. c. 8. it was enacted, that the king's proclamations should have the force of acts of parliament; a statute, which was calculated to introduce the most despotic tyranny: and which must have proved fatal to the liberties of this kingdom, had it not been luckily repealed in the minority of his successor, about five years after. By a late act of parliament the king is empowered to raise regiments of Roman Catholics to serve in the present war.

PROCLUS, surnamed DIADOCUS, a Greek philosopher and mathematician, was born in Lycia, and lived about the year 500. He was the disciple of Syrianus, and had a great share in the friendship of the emperor Anastasius. It is said, that when Vitalian laid siege to Constantinople, Proclus burnt his ships with large brazen speculums. This philosopher was a Pagan, and wrote against the Christian religion. There are still extant his Commentaries on some of Plato's books, and other of his works written in Greek.

PROCONSUL, a Roman magistrate, sent to govern a province with consular authority.

The proconsuls were appointed out of the body of the senate; and usually as the year of any one's consulate expired, he was sent proconsul into some province.

The proconsuls decided cases of equity and justice, either privately in their pretorium or palace, where they received petitions, heard complaints, granted writs under their seal, and the like; or else publicly, in the common hall, with the usual formalities observed in the court of judicature at Rome. They had besides, by virtue of their edicts, the power of ordering all things relating to the tributes, taxes, contributions, and provisions of corn and money, &c. Their office lasted only a year. See CONSUL.

PROCOPIUS, a famous Greek historian, born in Cæsaria, acquired great reputation by his works in the reign of Justinian, and was secretary to Belisarius during all the wars carried on by that general in Persia, Africa, and Italy. He at length became senator, obtained the title of *illustrious*, and was made pretor of Constantinople.

PROCREATION, the begetting and bringing forth young. See GENERATION and SEMEN.

PROCTOR, a person commissioned to manage another person's cause in any court of the civil or ecclesiastical law.

PROCTOR, in the English universities. See UNIVERSITY.

PROCURATION, an act or instrument by which a person is empowered to treat, transact, receive, &c. in another person's name.

PROCURATOR. See PROCTOR.

PROCYON, in *Astronomy*, a fixed star of the second magnitude, situated in canis minor, or the little dog.

PRODIGALITY, means extravagance, profusion, waste, or excessive liberality, and is the opposite extreme to the vice of parsimony. By the Roman law, if a man by notorious prodigality was in danger of wasting his estate, he was looked upon as *non compos*, and committed to the care of curators, or tutors, by the prætor. And by the laws of Solon, such prodigals were branded with perpetual infamy.

PRODUCT, in *Arithmetic* and *Geometry*, the factum of two or more numbers, or lines, &c. into one another: thus $5 \times 4 = 20$ the product required.

PROEDRI, among the Athenians, were magistrates, who had the first seats in the public assemblies, and whose office it was to propose at each assembly the things to be deliberated upon and determined. Their office always ended with the meeting. Their number was nine, so long as the tribes were ten in number.

PROFANATION, the acting disrespectfully to sacred things.

PROFANE, a term used in opposition to *holy*; and in general is applied to all persons who have not the sacred character, and to things which do not belong to the service of religion.

PROFESSION means a calling, vocation, or known employment. In Knox's *Essays*, vol. i. page 234, we find an excellent paper on the choice of a profession, which that elegant writer concludes thus: "All the occupations of life (says he) are found to have their advantages and disadvantages admirably adapted to preserve the just equilibrium of happiness. This we may confidently assert, that, whatever are the inconveniences of any of them, they are all preferable to a life of inaction; to that wretched listlessness, which is constrained to pursue pleasure as a business, and by rendering it the object of severe and unvaried attention, destroys its very essence."

Among the Romanists profession denotes the entering into a religious order, whereby a person offers himself to God by a vow of inviolably observing obedience, chastity, and poverty.

PROFESSOR, in the universities, a person who teaches or reads public lectures in some art or science from a chair for that purpose.

PROFILE, in *Architecture*, the draught of a building, fortification, &c. wherein are expressed the several heights, widths, and thicknesses, such as they would appear were the building cut down perpendicularly from the roof to the foundation. Whence the profile is also called the *section*, sometimes *orthographical section*, and by Vitruvius also *sciagraphy*.

Profile ‖ Prognostic.

Profile, in this sense, amounts to the same with *elevation*; and stands opposed to *plan* or *ichnography*.

PROFILE is also used for the contour or outline of a figure, building, member of architecture, or the like; as a base, a cornice, &c. Hence *profiling* is sometimes used for designing, or describing the member with rule, compass, &c.

PROFILE, in sculpture and painting.—A head, a portrait, &c. are said to be in *profile*, when they are represented sidewise, or in a side-view; as, when in a portrait there is but one side of the face, one eye, one cheek, &c. shown, and nothing of the other.—On almost all medals, the faces are represented in *profile*.

PROFLUVIUM, in *Medicine*, denotes a flux, or liquid evacuation of any thing.

PROGNOSTIC, among physicians, signifies a judgement concerning the event of a disease; as whether it shall end in life or death, be short or long, mild or malignant, &c.

Prognostic ‖ Progression.

PROGRAMMA, anciently signified a letter sealed with the king's seal.

Programma is also an university term for a billet or advertisement, posted up or given into the hand, by way of invitation to an oration, &c. containing the argument, or so much as is necessary for understanding thereof.

PROGRESSION, in general, denotes a regular advancing, or going forwards, in the same course and manner.

PROGRESSION, in *Mathematics*, is either arithmetical or geometrical. Continued arithmetic proportion is, where the terms do increase and decrease by equal differences, and is called *arithmetic progression*:

$$\text{Thus}\left\{\begin{array}{l} a,\ a+d,\ a+2d,\ a+3d,\ \text{\&c. increasing} \\ a,\ a-d,\ a-2d,\ a-3d,\ \text{\&c. decreasing}\end{array}\right\}\text{by the difference } d.$$

$$\text{In numbers}\left\{\begin{array}{l} 2,\ 4,\ 6,\ 8,\ 10,\ \text{\&c. increasing} \\ 10,\ 8,\ 6,\ 4,\ \ 2,\ \text{\&c. decreasing}\end{array}\right\}\text{by the difference } 2.$$

Geometric Progression, or *Continued Geometric Proportion*, is when the terms do increase or decrease by equal ratios: thus,

$$\left.\begin{array}{r} a,\ ar,\ arr,\ arrr,\ \text{\&c. increasing} \\ a,\ \frac{a}{r},\ \frac{a}{rr},\ \frac{a}{rrr},\ \text{\&c. decreasing}\end{array}\right\}\text{from a continual}\left\{\begin{array}{l}\text{multiplication}\\ \text{division}\end{array}\right\}\text{by } r$$

$$\left.\begin{array}{r} 2,\ 4,\ 8,\ 16,\ 32,\ 64,\ \text{increasing} \\ 64,\ 32,\ 16,\ 8,\ 4,\ 2,\ \text{decreasing}\end{array}\right\}\text{from a continual}\left\{\begin{array}{l}\text{multiplication}\\ \text{division}\end{array}\right\}\text{by } 2.$$

See the articles FLUXIONS, GEOMETRY, and SERIES.

PROJECTILES.

1 Object of the science.

THIS is the name for that part of mechanical philosophy which treats of the motion of bodies anyhow projected from the surface of this earth, and influenced by the action of terrestrial gravity.

2 Effect of gravity on projected bodies.

It is demonstrated in the physical part of astronomy, that a body so projected must describe a conic section, having the centre of the earth in one focus; and that it will describe round that focus areas proportional to the times. And it follows from the principles of that science, that if the velocity of projection exceeds 36700 feet in a scond, the body (if not resisted by the air) would describe a hyperbola; if it be just 36700, it would describe a parabola; and if it be less than this, it would describe an ellipsis. If projected directly upwards, in the first case, it would never return, but proceed for ever; its velocity continually diminishing, but never becoming less than an assignable portion of the excess of the initial velocity above 36700 feet in a second; in the second case, it would never return, its velocity would diminish without end, but never be extinguished. In the third case, it would proceed till its velocity was reduced to an assignable portion of the difference between 36700 and its initial velocity; and would then return, regaining its velocity by the same degrees, and in the same places, as it lost it. These are necessary consequences of a gravity directed to the centre of the earth, and inversely proportional to the square of the distance. But in the greatest projections that we are able to make, the gravitations are so nearly equal, and in directions so nearly parallel, that it would be ridiculous affectation to pay any regard to the deviations from equality and parallelism. A bullet rising a mile above the surface of the earth loses only $\frac{1}{1000}$ of its weight, and a horizontal range of 4 miles makes only 4′ of deviation from parallelism.

Let us therefore assume gravitation as equal and parallel. The errors arising from this assumption are quite insensible in all the uses which can be made of this theory.

The theory itself will ever be regarded with some veneration and affection by the learned. It was the first fruits of mathematical philosophy. Galileo was the first who applied mathematical knowledge to the motions of free bodies, and this was the subject on which he exercised his fine genius.

3 Constant or uniform.

Gravity must be considered by us as a constant or uniform accelerating or retarding force, according as it produces the descent, or retards the ascent, of a body. A constant or invariable accelerating force is one which produces an uniform acceleration; that is, which in equal times produces equal increments of velocity, and therefore produces increments of velocity proportional to the times in which they are produced. Forces are of themselves imperceptible, and are seen only in their effects; and they have no measure but the effect, or what *measures* the effect; and every thing which we can discover with regard to those measures, we must affirm with regard to the things of which we assume them as the measures. Therefore,

The

4 **Consequences of this fact.** The motion of a falling body, or of a body projected directly downwards, is uniformly accelerated; and that of a body projected directly upwards is uniformly retarded: that is, the acquired velocities are as the times in which they are acquired by falling, and the extinguished velocities are as the times in which they are extinguished.

5 **Corollaries drawn from it.** *Cor.* 1. If bodies simply fall, not being projected downwards by an external force, the times of the falls are proportional to the final velocities; and the times of ascents, which terminate by the action of gravity alone, are proportional to the initial velocities.

2. The spaces described by a heavy body falling from rest are as the squares of the acquired velocities; and the differences of these spaces are as the differences of the squares of the acquired velocities: and, on the other hand, the heights to which bodies projected upwards will rise, before their motions be extinguished, are as the squares of the initial velocities.

3. The spaces described by falling bodies are proportional to the squares of the times from the beginning of the fall; and the spaces described by bodies projected directly upwards are as the squares of the times of the ascents.

4. The space described by a body falling from rest is one half of the space which the body would have uniformly described in the same time, with the velocity acquired by the fall.—And the height to which a body will rise, in opposition to the action of gravity, is one half of the space which it would uniformly describe in the same time with the initial velocity.

In like manner the difference of the spaces which a falling or rising body describes in any equal successive parts of its fall or rise, is one half of the space which it would uniformly describe in the same time with the difference of the initial and final velocities.

This proposition will be more conveniently expressed for our purpose thus:

A body moving uniformly during the time of any fall with the velocity acquired thereby, will in that time describe a space double of that fall; and a body projected directly upwards will rise to a height which is one half of the space which it would, uniformly continued, describe in the time of its ascent with the initial velocity of projection.

These theorems have been already demonstrated in a popular way, in the article GUNNERY. But we would recommend to our readers the 39th prop. of the first book of Newton's *Principia*, as giving the most general investigation of this subject; equally easy with these more loose methods of demonstration, and infinitely superior to them, by being equally applicable to every variation of the accelerating force. See an excellent application of this proposition by Mr Robins, for defining the motion of a ball discharged from a cannon, in the article GUNNERY, N° 15.

6 **The force of gravity in falling bodies can be ascertained.** 5. It is a matter of observation and experience, that a heavy body falls 16 feet and an inch English measure in a second of time; and therefore acquires the velocity of 32 feet 2 inches per second. This cannot be ascertained directly, with the precision that is necessary. A second is too small a portion of time to be exactly measured and compared with the space described; but it is done with the greatest accuracy by comparing the motion of a falling body with that of a pendulum. The time of a vibration is to the time of falling through half the length of the pendulum, as the circumference of a circle is to its diameter. The length of a pendulum can be ascertained with great precision; and it can be lengthened or shortened till it makes just 86,400 vibrations in a day: and this is the way in which the space fallen through in a second has been accurately ascertained.

As all other forces are ascertained by the accelerations which they produce, they are conveniently measured by comparing their accelerations with the acceleration of gravity. This therefore has been assumed by all the later and best writers on mechanical philosophy, as the unit by which every other force is measured. It gives us a perfectly distinct notion of the force which retains the moon in its orbit, when we say it is the 3600th part of the weight of the moon at the surface of the earth. We mean by this, that if a bullet were here weighed by a spring steelyard, and pulled it out to the mark 3600; if it were then taken to the distance of the moon, it would pull it out only to the mark 1. And we make this assertion on the authority of our having observed that a body at the distance of the moon falls from that distance $\frac{1}{3600}$ part of 16 feet in a second. We do not, therefore, compare the *forces*, which are imperceptible things; we compare the accelerations, which are their indications, effects, and measures.

This has made philosophers so anxious to determine with precision, the fall of heavy bodies, in order to have an exact value of the accelerating power of terrestrial gravity. Now we must here observe, that this measure may be taken in two ways: we may take the space through which the heavy body falls in a second; or we may take the velocity which it acquires in consequence of gravity having acted on it during a second. The last is the proper measure; for the last is the immediate effect on the body. The action of gravity has changed the state of the body—in what way? By giving it a determination to motion downwards, this both points out the kind and the degree or intensity of the force of gravity. The space described in a second by falling, is not an invariable measure; for, in the successive seconds, the body falls through 16, 48, 80, 112, &c. feet, but the changes of the body's state in each second is the same. At the beginning it had no determination to move with any appreciable velocity; at the end of the first second it had a determination by which it would have gone on for ever (had no subsequent force acted on it) at the rate of 32 feet per second. At the end of the second second, it had a determination by which it would have moved for ever, at the rate of 64 feet per second. At the end of the third second, it had a determination by which it would have moved for ever, at the rate of 96 feet per second, &c. &c. The difference of these determinations is a determination to the rate of 32 feet per second. This is therefore constant, and the indication and proper measure of the constant or invariable force of gravity. The space fallen through in the first second is of use only as it is one half of the measure of this determination; and as halves have the proportion of their wholes, different accelerating forces may be safely affirmed to be in the proportion of the spaces through which they uniformly impel bodies in the same time. But we should always recollect, that this is but one half of the true measure of the accelerating force. Mathematicians of the first rank have

7 **Two modes of determining the fall of heavy bodies.**

8 **Mistakes of mathematicians on this subject.**

have committed great mistakes by not attending to this; and it is necessary to notice it just now, because cases will occur in the prosecution of this subject, where we shall be very apt to confound our reasonings by a confusion in the use of those measures. Those mathematicians who are accustomed to the geometrical consideration of curvilineal motions, are generally disposed to take the *actual deflection* from the tangent as the measure of the deflecting force; while those who treat the same subject algebraically, by the assistance of fluxions, take *the change of velocity*, which is measured by *twice* the deflection. The reason is this: when a body passes through the point B of a curve ABC, fig. 1. if the deflecting force were to cease at that instant, the body would describe the tangent BD in the same time in which it describes the arch BC of the curve, and DC is the deflection, and is therefore taken for the measure of the deflecting force. But the algebraist is accustomed to consider the curve by means of an equation between the abscissæ H a, H b, H c, and their respective ordinates A a, B b, C c; and he measures the deflections by the changes made on the increments of the ordinates. Thus the increment of the ordinate A a, while the body describes the arch AB of the curve, is BG. If the deflecting force were to cease when the body is at B, the next increment would have been equal to BG, that is, it would have been EF; but in consequence of the deflection, it is only CF: therefore he takes EC for the measure of the deflection, and of the deflecting force. Now EC is ultimately twice DC; and thus the measure of the algebraist (derived solely from the nature of the differential method, and without any regard to physical considerations) happens to coincide with the true physical measure. There is therefore great danger of mixing these measures. Of this we cannot give a more remarkable instance than Leibnitz's attempt to demonstrate the elliptical motion of the planets in the Leipsic Acts, 1689. He first considers the subject mechanically, and takes the deflection or DC for the measure of the deflecting force. He then introduces his differential calculus, where he takes the difference of the increments for the measure; and thus brings himself into a confusion, which luckily compensates for the false reasoning in the preceding part of his paper, and gives his result the appearance of a demonstration of Newton's great discovery, while, in fact, it is a confused jumble of assumptions, self-contradictory, and inconsistent with the very laws of mechanics which are used by him in the investigation. Seventeen years after this, in 1706, having been criticised for his bad reasoning, or rather accused of an envious and unsuccessful attempt to appropriate Newton's invention to himself, he gives a correction of his paralogism, which he calls a correction of language. But he either had not observed where the paralogism lay, or would not let himself down by acknowledging a mistake in what he wished the world to think his own calculus (fluxions); he applied the correction where no fault had been committed, for he had measured both the centrifugal force and the solicitation of gravity in the same way, but had applied the fluxionary expression to the last and not to the first, and, by so doing, he completely destroyed all coincidence between his result and the planetary motions. We mention this instance, not only as a caution to our mathematical readers, but also as a very curious literary anecdote. This dissertation of Leibnitz is one of the most obscure of his obscure writings, but deserves the attention of an intelligent and curious reader, and cannot fail of making an indelible impression on his mind, with relation to the modesty, candour, and probity of the author. It is preceded by a dissertation on the subject which we are now entering upon, the motion of projectiles in a resisting medium. Newton's *Principia* had been published a few years before, and had been reviewed in a manner shamefully slight, in the Leipsic Acts. Both these subjects make the capital articles of that immortal work. Mr Leibnitz published these dissertations, without (says he) having seen Newton's book, in order to show the world that he had, some years before, discovered the same theorems. Mr Nicholas Fatio carried a copy of the *Principia* from the author to Hanover in 1686, where he expected to find Mr Leibnitz; he was then absent, but Fatio saw him often before his return to France in 1687, and does not say that the book was not given him. Read along with these dissertations Dr Keill's letter to John Bernoulli and others, published in the *Journal Literaire de la Hayeé* 1714, and to John Bernoulli in 1719.

Plate CCCCXLI. fig. 1.

9
Particularly of Leibnitz.

10
Newton accused of a similar mistake by J. Bernoulli.

Newton has been accused of a similar oversight by John Bernoulli, (who indeed calls it a mistake in principle) in his Proposition x. book 2. on the very subject we are now considering. But Dr Keill has shown it to be only an oversight, in drawing the tangent on the wrong side of the ordinate. For in this very proposition Newton exhibits, in the strictest and most beautiful manner, the difference between the geometrical and algebraical manner of considering the subject; and expressly warns the reader, that *his* algebraical symbol expresses the deflection only, and not the variation of the increment of the ordinate. It is therefore in the last degree improbable that he would make this mistake. He most expressly does not; and as to the real mistake, which he corrected in the second edition, the writer of this article has in his possession a manuscript copy of notes and illustrations on the whole Principia, written in 1693 by Dr David Gregory, Savilian professor of astronomy at Oxford, at the desire of Mr Newton, as preparatory for a new edition, where he has rectified this and several other mistakes in that work, and says that Mr Newton had seen and approved of the amendments. We mention these particulars, because Mr Bernoulli published an elegant dissertation on this subject in the Leipsic Acts in 1713; in which he charges Newton (though with many protestations of admiration and respect) with this mistake in principle; and says, that he communicated his correction to Mr Newton, by his nephew Nicholas Bernoulli, that it might be corrected in the new edition, which he heard was in the press. And he afterwards adds, that it appears by some sheets being cancelled, and new ones substituted in this part of the work, that the mistake would have continued, had be not corrected it. We would desire our readers to consult this dissertation, which is extremely elegant, and will be of service to us in this article; and let them compare the civil things which is here said of the *vir incomparabilis*, the *omni laude major*, the *summus Newtonus*, with what the same author, in the same year, in the Leipsic Acts, but under a borrowed name, says of him. Our readers will have no hesitation in ascribing this letter to this author. For, after praising John Bernoulli as *summus geometra*, *natus*

11
But falsely.

12
Insincerity of Bernoulli with respect to Newton.

natus ad summorum geometarum paralogismos corrigendos, summi candoris ut et modestiæ, he betrays himself by an unguarded warmth, when defending J. B.'s demonstration of the inverse problem of centripetal forces, by calling it MEAM *demonstrationem*.

Let our readers now consider the scope and intention of this dissertation on projectiles, and judge whether the author's aim was to instruct the world, or to acquire fame, by correcting Newton. The dissertation does not contain one theorem, one corollary, nor one step of argument, which is not to be found in Newton's first edition; nor has he gone farther than Newton's single proposition the xth. To us it appears an exact companion to his proposition on centripetal forces, which he boasts of having first demonstrated, although it is in every step a transcript of the 42d of the first Book of Newton's Principia, the geometrical language of Newton being changed into algebraic, as he has in the present case changed Newton's algebraic analysis into a very elegant geometrical one.

We hope to be forgiven for this long digression. It is a very curious piece of literary history, and shows the combination which envy and want of honourable principle had formed against the reputation of our illustrious countryman; and we think it our duty to embrace any opportunity of doing it justice.—To return to our subject:

13 Accurate measure of the accelerative power of gravity.

The accurate measure of the accelerative power of gravity, is the *fall* $16\frac{1}{12}$ feet, if we measure it by the space, or the *velocity* of $32\frac{1}{6}$ feet per second, if we take the velocity. It will greatly facilitate calculation, and will be sufficiently exact for all our purposes, if we take 16 and 32, supposing that a body falls 16 feet in a second, and acquires the velocity of 32 feet per second. Then, because the heights are as the squares of the times, and as the squares of the acquired velocities, a body will fall one foot in one fourth of a second, and will acquire the velocity of eight feet per second. Now let h express the height in feet, and call it the PRODUCING HEIGHT; v the velocity in feet per second, and call it the PRODUCED VELOCITY, the velocity DUE; and t the time in seconds.—We shall have the following formulæ, which are of easy recollection, and will serve, without tables, to answer all questions relative to projectiles.

14 General formulæ deduced.

$$\text{I. } v=8\sqrt{h},=8\times 4t,=32t$$

$$\text{II. } t=\frac{\sqrt{h}}{4},=\frac{v}{32}$$

$$\text{III. } \sqrt{h}=\frac{v}{8},=4t$$

$$\text{IV. } h=\frac{v^2}{64},=16t^2.$$

15 Examples of their use in falling bodies.

To give some examples of their use, let it be required,

1. To find the time of falling through 256 feet. Here $h=256$, $\sqrt{256}=16$, and $\frac{16}{4}=4$. Answer 4″.

2. To find the velocity acquired by falling four seconds. $t=4 \,.\, 32\times 4=128$ feet per second.

3. To find the velocity acquired by falling 625 feet. $h=625 \,.\, \sqrt{h}=25 \,.\, 8\sqrt{h}=200$ feet per second.

4. To find the height to which a body will rise when projected with the velocity of 56 feet per second, or the height through which a body must fall to acquire this velocity.

16 In bodies projected upwards,

$$v=56 \,.\, \frac{56}{8}=7,=\sqrt{h} \,.\, 7^2=h,=49 \text{ feet.}$$

$$\text{or } 56^2=3136 \,.\, \frac{3136}{64}=49 \text{ feet.}$$

17 and directly downwards.

5. Suppose a body projected directly downwards with the velocity of 10 feet per second; what will be its velocity after four seconds? In four seconds it will have acquired, by the action of gravity, the velocity of 4×32, or 128 feet, and therefore its whole velocity will be 138 feet per second.

6. To find how far it will have moved, compound its motion of projection, which will be 40 feet in four seconds, with the motion which gravity alone would have given it in that time, which is 256 feet; and the whole motion will be 296 feet.

7. Suppose the body projected as already mentioned, and that it is required to determine the time it will take to go 296 feet downwards, and the velocity it will have acquired.

Find the height x, through which it must fall to acquire the velocity of projection, 10 feet, and the time y of falling from this height. Then find the time z of falling through the height $296+x$, and the velocity v acquired by this fall. The time of describing the 296 feet will be $z-y$, and v is the velocity required.

From such examples, it is easy to see the way of answering every question of the kind.

18 More general formulæ.

Writers on the higher parts of mechanics always compute the actions of other accelerating and retarding forces by comparing them with the acceleration of gravity, and in order to render their expressions more general, use a symbol, such as g for gravity, leaving the reader to convert it into numbers. Agreeably to this view, the general formulæ will stand thus:

$$\text{I. } v=\sqrt{2gh}, \text{ i. e. } \sqrt{2}\sqrt{g}\sqrt{h},=gt,$$

$$\text{II. } t=\frac{v}{g}=\frac{\sqrt{4h}}{\sqrt{2g}},=\sqrt{\frac{4h}{2g}},=\sqrt{\frac{2h}{g}}$$

$$\text{IIII. } h=\frac{v^2}{2g},=\frac{gt^2}{2}.$$

In all these equations, gravity, or its accelerating power, is estimated, as it ought to be, by the change of velocity which it generates in a particle of matter in an unit of time. But many mathematicians, in their investigations of curvilineal and other varied motions, measure it by the deflection which it produces in this time from the tangent of the curve, or by the increment by which the space described in an unit of time exceeds the space described in the preceding unit. This is but one half of the increment which gravity would have produced, had the body moved through the whole moment with the acquired addition of velocity. In this sense of the symbol g, the equations stand thus:

$$\text{I. } v=2\sqrt{gh}\,|=2gt$$

$$\text{II. } t=\sqrt{\frac{h}{g}},=\frac{v}{2g}$$

$$\text{IV. } h=\frac{v^2}{4g},=gt^2, \text{ and } \sqrt{h}=\frac{v}{2\sqrt{g}}.$$

It is also very usual to consider the accelerating force of of gravity as the unit of comparison. This renders the expressions much more simple. In this way, v expresses not the velocity, but the height necessary for acquiring it, and the velocity itself is expressed by $\sqrt{v}$. To reduce such an expression of a velocity to numbers, we must multiply it by $\sqrt{2g}$, or by $2\sqrt{g}$, according as we make g to be the generated velocity, or the space fallen through in the unit of time.

19 Bodies projected obliquely.

This will suffice for the perpendicular ascents or descents of heavy bodies, and we proceed to consider their motions when projected obliquely. The circumstance which renders this an interesting subject, is, that the flight of cannon shot and shells are instances of such motion, and the art of gunnery must in a great measure depend on this doctrine.

Fig. 2.

Let a body B (fig. 2.), be projected in any direction BC, not perpendicular to the horizon, and with any velocity. Let AB be the height producing this velocity; that is, let the velocity be that which a heavy body would acquire by falling freely through AB. It is required to determine the path of the body, and all the circumstances of its motion in this path?

1. It is evident, that by the continual action of gravity, the body will be continually deflected from the line BC, and will describe a curve line BVG, concave towards the earth.

20 Describes a parabola.

2. This curve line is a parabola, of which the vertical line ABE is a diameter, B the vertex of this diameter, and BC a tangent in B.

Through any two points V, G of the curve draw VC, GH parallel to AB, meeting BC in C and H, and draw VE, GK parallel to BC, meeting AB in E, K. It follows, from the composition of motions, that the body would arrive at the points V, G of the curve in the same time that it would have uniformly described BC, BH, with the velocity of projection; or that it would have fallen through BE, BK, with a motion uniformly accelerated by gravity; therefore the times of describing BC, BH, uniformly, are the same with the times of falling through BE, BK. But, because the motion along BH is uniform, BC is to BH as the time of describing BC to the time of describing BH, which we may express thus, BC : BH $=$ T, BC : T, BH, $=$ T, BE : T, BK. But, because the motion along BK is uniformly accelerated, we have BE : BK $=$ T^2 BE : T^2, BK, $=$ BC^2 : BH^2, $=$ EV^2 : KG^2; therefore the curve BVG is such, that the abscissæ BE, BK are as the squares of the corresponding ordinates EV, KG; that is, the curve BVG is a parabola, and BC, parallel to the ordinates, is a tangent in the point B.

3. If through the point A there be drawn the horizontal line ADd, it is the directrix of the parabola.

Let BE be taken equal to AB. The time of falling through BE is equal to the time of falling through AB; but BC is described with the velocity acquired by falling through AB: and therefore by N° 4. of perpendicular descents, BC is double of AB, and EV is double of BE; therefore EV^2 $=$ 4 BE^2, $=$ 4 BE $\times$ AB, $=$ BE $\times$ 4 AB, and 4 AB is the parameter or *latus rectum* of the parabola BVG, and AB being one-fourth of the parameter, AD is the directrix.

4. The times of describing the different arches BV, VG of the parabola are as the portions BC, BH of the tangent, or as the portions AD, Ad of the directrix, intercepted by the same vertical lines AB, CV, HG; for the times of describing BV, BVG are the same with those of describing the corresponding parts BC, BH of the tangent, and are proportional to these parts, because the motion along BH is uniform; and BC, BH are proportional to AD, Ad.

Therefore the motion estimated horizontally is uniform.

5. The velocity in any point G of the curve is the same with that which a heavy body would acquire by falling from the directrix along dG. Draw the tangent GT, cutting the vertical AB in T; take the points a, f, equidistant from A and d, and extremely near them, and draw the verticals ab, fg; let the points a, f, continually approach A and d, and ultimately coincide with them. It is evident that Bb will ultimately be to gG, in the ratio of the velocity at B to the velocity at G; for the portions of the tangent ultimately coincide with the portions of the curve, and are described in equal times; but Bb is to gG as BH to TG: therefore the velocity at B is to that at G as BH to TG. But, by the properties of the parabola, BH^2 is to TG^2 as AB to dG; and AB is to dG as the square of the velocity acquired by falling through AB to the square of the velocity acquired by falling through dG; and the velocity in BH, or in the point B of the parabola, is the velocity acquired by falling along AB; therefore the velocity in TG, or in the point G of the parabola, is the velocity acquired by falling along dG.

21 The parabolic theory ingenious, but of little use in practice.

These few simple propositions contain all the theory of the motion of projectiles in vacuo, or independent on the resistance of the air; and being a very easy and neat piece of mathematical philosophy, and connected with very interesting practice, and a very respectable profession, they have been much commented on, and have furnished matter for many splendid volumes. But the air's resistance occasions such a prodigious diminution of motion in the great velocities of military projectiles, that this parabolic theory, as it is called, is hardly of any use. A musket ball, discharged with the ordinary allotment of powder, issues from the piece with the velocity of 1670 feet per second: this velocity would be acquired by falling from the height of eight miles. If the piece be elevated to an angle of 45°, the parabola should be of such extent that it would reach 16 miles on the horizontal plain; whereas it does not reach above half a mile. Similar deficiencies are observed in the ranges of cannon shot.

22 A short view of it.

We do not propose, therefore, to dwell much on this theory, and shall only give such a synoptical view of it as shall make our readers understand the more general circumstances of the theory, and be masters of the language of the art.

Fig. 3.

Let OB (fig. 3.) be a vertical line. About the centres A and B, with the distance AB, describe the semicircles ODB, AHK, and with the axis AB, and semiaxis GE, equal to AB, describe the semi-ellipse AEB: with the focus B, vertex A, diameter AB, and tangent AD, parallel to the horizon, describe the parabola APS.

Let a body be projected from B, in any direction BC

BC, with the velocity acquired by falling through AB. By what has already been demonstrated, it will describe a parabola BVPM. Then,

1. ADL parallel to the horizon is the directrix of every parabola which can be described by a body projected from B with this velocity. This is evident.

2. The semicircle AHK is the locus of all the foci of these parabolas: For the distance BH of a point B of any parabola from the directrix AD is equal to its distance BF from the focus F of that parabola; therefore the foci of all the parabolas which pass through B, and have AD for their directrix, must be in the circumference of the circle which has AB for its radius, and B for its centre.

3. If the line of direction BC cut the upper semicircle in C, and the vertical line CF be drawn, cutting the lower semicircle in F, F is the focus of the parabola BVPM, described by the body which is projected in the direction BC, with the velocity acqired by falling through BA: for drawing AC, BF, it is evident that ACFB is a rhombus, and that the angle ABF is bisected by BC, and therefore the focus lies in the line BF; but it also lies in the circumference AFK, and therefore in F.

If C is in the upper quadrant of ODB, F is in the upper quadrant of AFK; and if C be in the lower quadrant of ODB (as when BC is the line of direction) then the focus of the corresponding parabola B v M is in the lower quadrant of AHK, as at f.

4. The ellipsis AEB is the focus of the vertex of all the parabolas, and the vertex V of any one of them BVPM is in the intersection of this ellipsis with the vertical CF: for let this vertical cut the horizontal lines AD, GE, BN, in θ, λ, N. Then it is plain that Nλ is half of Nθ, and λV is half of Cθ; therefore NV is half of NC, and V is the vertex of the axis.

If the focus is in the upper or lower quadrant of the circle AHK, the vertex is in the upper or the lower quadrant of the ellipse AEG.

5. If BFP be drawn through the focus of any one of the parabolas, such as BVM, cutting the parabola APS in P, the parabola BVM touches the parabola APS in P: for drawing P$\delta$$\varkappa$ parallel to AB, cutting the directrix O$\varkappa$ of the parabola APS in $\varkappa$, and the directrix AL of the parabola BVM in δ, then PB=P$\varkappa$; but BF=BA, =AO, =$\varkappa\delta$: therefore Pδ=PF, and the point P is in the parabola BVM. Also the tangents to both parabolas in P coincide, for they bisect the angle $\varkappa$ PB; therefore the two parabolas having a common tangent, touching each other in P.

Cor. All the parabolas which can be described by a body projected from B, with the velocity acquired by falling through AB, will touch the concavity of the parabola APS, and lie wholly within it.

6. P is the most distant point of the line BP which can be hit by a body projected from B with the velocity acquired by falling through AB. For if the direction is more elevated than BC, the focus of the parabola described by the body will lie between F and A, and the parabola will touch APS in some point between P and A; and being wholly within the parabola APS, it must cut the line BP in some point within P. The same thing may be shown when the direction is less elevated than BC.

7. The parabola APS is the focus of the greatest ranges on any planes BP, BS, &c. and no point lying without this parabola can be struck.

8. The greatest range on any plane BP is produced when the line of direction BC bisects the angle OBP formed by that plane with the vertical: for the parabola described by the body in this case touches APS in P, and its focus is in the line BP, and therefore the tangent BC bisects the angle OBP.

Cor. The greatest range on a horizontal plane is made with an elevation of 45°.

9. A point M in any plane BS, lying between B and S, may be struck with two directions, BC and Bc; and these directions are equidistant from the direction Bt, which gives the greatest range on that plane: for if about the centre M, with the distance ML from the directrix AL, we describe a circle LFf, it will cut the circle AHK in two points F and f, which are evidently the foci of two parabolas BVM, BvM, having the directrix AL and diameter ABK. The intersection of the circle ODB, with the verticals FC, fc, determine the directions BC, Bc of the tangents. Draw At parallel to BS, and join tB, Cc Ff: then OBt $=\frac{1}{2}$ GBS, and Bt is the direction which gives the greatest range on the plane BS: but because Ff is the chord of the circles described round the centres B and M, Ff is perpendicular to BM, and Cc to At, and the arches Ct, ct are equal; and therefore the angles CBt, cBt are equal.

Thus we have given a general view of the subject, which shows the connection and dependence of every circumstance which can influence the result; for it is evident that to every velocity of projection there belongs a set of parabolas, with their directions and ranges; and every change of velocity has a line AB corresponding to it, to which all the others are proportional. As the height necessary for acquiring any velocity increases or diminishes in the duplicate proportion of that velocity, it is evident that all the ranges with given elevations will vary in the same proportion, a double velocity giving a quadruple range, a triple velocity giving a noncuple range, &c. And, on the other hand, when the ranges are determined beforehand (which is the usual case), the velocities are in the subduplicate proportion of the ranges. A quadruple range will require a double velocity, &c.

23 Experience principally directs the practical gunner.

On the principles now established is founded the ordinary theory of gunnery, furnishing rules which are to direct the art of throwing shot and shells, so as to hit the mark with a determined velocity.

But we must observe, that this theory is of little service for directing us in the practice of cannonading. Here it is necessary to come as near as we can to the object aimed at, and the hurry of service allows no time for geometrical methods of pointing the piece after each discharge. The gunner either points the cannon directly to the object, when within 200 or 300 yards of it, in which case he is said to shoot point blank (*pointer au blanc*, i. e. at the white mark in the middle of the gunners target); or, if at a greater distance, he estimates to the best of his judgment the deflection corresponding to his distance, and points the cannon accordingly. In this he is aided by the greater thickness at the breech of a piece of ordnance. Or lastly, when the intention is not to batter, but to rake along a line occupied

occupied by the enemy, the cannon is elevated at a considerable angle, and the shot discharged with a small force, so that it drops into the enemy's post, and bounds along the line. In all these services the gunner is directed entirely by trial, and we cannot say that this parabolic theory can do him any service.

The principal use of it is to direct the bombardier in throwing shells. With these it is proposed to break down or set fire to buildings, to break through the vaulted roofs of magazines, or to intimidate and kill troops by bursting among them. These objects are always under cover of the enemy's works, and cannot be touched by a direct shot. The bombs and carcasses are therefore thrown upwards, so as to get over the defences and produce their effect.

These shells are of very great weight, frequently exceeding 200 lbs. The mortars from which they are discharged must therefore be very strong, that they may resist the explosion of gunpowder which is necessary for throwing such a mass of matter to a distance; they are consequently unwieldy, and it is found most convenient to make them almost a solid and immoveable lump. Very little change can be made in their elevation, and therefore their ranges are regulated by the velocities given to the shell. These again are produced by the quantities of powder in the charge; and experience (confirming the best theoretical notions that we can form of the subject) has taught us, that the ranges are nearly proportional to the quantities of powder employed, only not increasing quite so fast. This method is much easier than by differences of elevation; for we can select the elevation which gives the greatest range on the given plane, and then we are certain that we are employing the smallest quantity of powder with which the service can be performed: and we have another advantage, that the deviations which unavoidable causes produce in the real directions of the bomb will then produce the smallest possible deviation from the intended range. This is the case in most mathematical maxima.

24 The moving force in theory different from that in practice.

In military projectiles the velocity is produced by the explosion of a quantity of gunpowder; but in our theory it is conceived as produced by a fall from a certain height, by the proportions of which we can accurately determine its quantity. Thus a velocity of 1600 feet per second is produced by a fall from the height of 4000 feet, or 1333 yards.

Fig. 4. The height CA (fig. 4.) for producing the velocity of projection is called, in the language of gunnery, the IMPETUS. We shall express it by the symbol h.

The distance AB to which the shell goes on any plane AB is called the AMPLITUDE of the RANGE, r.

The angle DBA, made by the vertical line and the plane AB, may be called the angle of POSITION of that plane, p.

The angle DAB, made by the axis or direction of the piece, and the direction of the object, may be called the angle of ELEVATION of the piece above the plane AB, e.

The angle ZAD, made by the vertical line, and the direction of the piece, may be called the ZENITH distance, z.

The relations between all the circumstances of velocity, distance, position, elevation, and time, may be included in the following propositions.

25 Relations between the velocity, distance, &c.

I. Let a shell be projected from A, with the velocity acquired by falling through CA, with the intention of hitting the mark B situated in the given line AB.

Make ZA=4AC, and draw BD perpendicular to the horizon. Describe on ZA an arch of a circle ZDA, containing an angle equal to DBA, and draw AD to the intersection of this circle with DB; then will a body projected from A, in the direction AD, with the velocity acquired by falling through CA, hit the mark B.

For, produce CA downwards, and draw BF parallel to AD, and draw ZD. It is evident from the construction that AB touches the circle in B, and that the angles ADZ, DBA, are equal, as also the angles AZD, DAB; therefore the triangles ZAD, ADB are similar.

$$\begin{aligned}&\text{Therefore } BD : DA = DA : AZ,\\ &\text{And } DA^2 = BD \times AZ;\\ &\text{Therefore } BF^2 = AF \times AZ, = AF \times 4AC.\end{aligned}$$

Therefore a parabola, of which AF is a diameter, and AZ its parameter, will pass through B, and this parabola will be the path of the shell projected as already mentioned.

Remark. When BD cuts this circle, it cuts it in two points D, d; and there are two directions which will solve the problem. If B′D′ only touches the circle in D′, there is but one direction, and AB′ is the greatest possible range with this velocity. If the vertical line through B does not meet the circle, the problem is impossible, the velocity being too small. When B′D′ touches the circle, the two directions AD′ and Ad coalesce into one direction, producing the greatest range, and bisecting the angle ZAB; and the other two directions AD, Ad, producing the same range AB, are equidistant from AD′, agreeably to the general proposition.

$$\begin{aligned}&\text{It is evident that } AZ : AD = S,ADZ : S,AZD, = S,DBA : S,DAB, = S,p : S,e\\ &\text{And } AD : DB = S,DBA : S,DAB, = S,p : S,e\\ &\text{And } DB : AB = S,DAB : S,ADB, = S,e : S,z\\ &\text{Therefore } AZ : AB = S^2,p \times S,e : S^2,e \times S,z; = S^2,p : S,e \times S,z\\ &\text{Or } 4h : r = S^2,p : S,e \times S,z, \text{ and } 4h \times S,e \times S,z = r \times S^2,p\end{aligned}$$

Hence we obtain the relations wanted.

Thus $h = \frac{r \times S^2,p}{4S,e \times S,z}$, and $r = \frac{4h \times S,e \times S,z}{S^2,p}$

And S, $z = \frac{r \times S^2 p}{4h \times S,e}$, and S, $e = \frac{r \times S^2,p,}{4h \times S,z}$.

The only other circumstance in which we are interested is the time of the flight. A knowledge of this is necessary for the bombardier, that he may cut the fuses of his shells to such lengths as that they may burst at the very instant of their hitting the mark.

26 To calculate the time of flight.

Now AB : DB = Sin, ADB : Sin, DAB, = S, z : S, e, and DB = $\frac{r \times S,e}{S,z}$. But the time of the flight is the

the same with the time of falling through DB, and 16 feet : DB $=1'' : t''^2$. Hence $t''^2 = \frac{r \times S,e}{16\,S,z}$, and we have the following easy rule.

From the sum of the logarithms of the range, and of the sine of elevation, subtract the sum of the logarithms of 16, and of the sine of the zenith distance, half the remainder is the logarithm of the time in seconds.

This becomes still easier in practice; for the mortar should be so elevated that the range is a maximum: in which case AB$=$DB, and then half the difference of the logarithms of AB and of 16 is the logarithm of the time in seconds.

27 The theory of gunnery compared with experiment.

Such are the deductions from the general propositions which constitute the ordinary theory of gunnery. It remains to compare them with experiment.

In such experiments as can be performed with great accuracy in a chamber, the coincidence is as great as can be wished. A jet of water, or mercury, gives us the finest example, because we have the whole parabola exhibited to us in the simultaneous places of the succeeding particles. Yet even in these experiments a deviation can be observed. When the jet is made on a horizontal plane, and the curve carefully traced on a perpendicular plane held close by it, it is found that the distance between the highest point of the curve and the mark is less than the distance between it and the spout, and that the descending branch of the curve is more perpendicular than the ascending branch. And this difference is more remarkable as the jet is made with greater velocity, and reaches to a greater distance. This is evidently produced by the resistance of the air, which diminishes the velocity, without affecting the gravity of the projectile. It is still more sensible in the motion of bombs. These can be traced through the air by the light of their fuzes; and we see that their highest point is always much nearer to the mark than to the mortar on a horizontal plane.

The greatest horizontal range on this plane should be when the elevation is 45°. It is always found to be much lower.

The ranges on this plane should be as the sines of twice the elevation.

A ball discharged at the elev.	19°. 5′	ranged	448 yards
at	9. 45		330
It should have ranged by theory			241

The range at an elevation of 45° should be twice the impetus. Mr Robins found that a musket-ball, discharged with the usual allotment of powder, had the velocity of 1700 feet in a second. This requires a fall of 45156 feet, and the range should be 90312, or 17⅛ miles; whereas it does not much exceed half a mile. A 24 pound ball discharged with 16 pounds of powder should range about 16 miles; whereas it is generally short of 3 miles.

28 ... com- ...son ...s the ...iency ...e ...y.

Such facts show incontrovertibly how deficient the parabolic theory is, and how unfit for directing the practice of the artillerist. A very simple consideration is sufficient for rendering this obvious to the most uninstructed. The resistance of the air to a very light body may greatly exceed its weight. Any one will feel this in trying to move a fan very rapidly through the air; therefore this resistance would occasion a greater deviation from uniform motion than gravity would *in that body*. Its path, therefore, through the air may differ more from a parabola than the parabola itself deviates from the straight line.

It is for such cogent reasons that we presume to say, that the voluminous treatises which have been published on this subject are nothing but ingenious amusements for young mathematicians. Few persons who have been much engaged in the study of mechanical philosophy have missed this opportunity in the beginning of their studies. The subject is easy. Some property of the parabola occurs, by which they can give a neat and systematic solution of all the questions; and at this time of study it seems a considerable essay of skill. They are tempted to write a book on the subject; and it finds readers among other young mechanicians, and employs all the mathematical knowledge that most of the young gentlemen of the military profession are possessed of. But these performances deserve little attention from the practical artillerist. All that seems possible to do for his education is, to multiply judicious experiments on real pieces of ordnance, with the charges that are used in actual service, and to furnish him with tables calculated from such experiments.

These observations will serve to justify us for having given so concise an account of this doctrine of the parabolic flight of bodies.

29 Causes of this deficiency.

But it is the business of a philosopher to inquire into the causes of such a prodigious deviation from a well-founded theory, and having discovered them, to ascertain precisely the deviations they occasion. Thus we shall obtain another theory, either in the form of the parabolic theory corrected, or as a subject of independent discussion. This we shall now attempt.

30 Effect of the atmosphere,

The motion of projectiles is performed in the atmosphere. The air is displaced, or put in motion. Whatever motion it requires must be taken from the bullet. The motion communicated to the air must be in the proportion of the quantity of air put in motion, and of the velocity communicated to it. If, therefore, the displaced air be always *similarly displaced*, whatever be the velocity of the bullet, the motion communicated to it, and lost by the bullet, must be proportional to the square of the velocity of the bullet and to the density of the air jointly. Therefore the diminution of its motion must be greater when the motion itself is greater, and in the very great velocity of shot and shells it must be prodigious. It appears from Mr Robins's experiments that a globe of 4½ inches in diameter, moving with the velocity of 25 feet in a second, sustained a resistance of 315 grains, nearly ¾ of an ounce. Suppose this ball to move 800 feet in a second, that is 32 times faster, its resistance would be 32×32 times ¾ of an ounce, or 768 ounces or 48 pounds. This is four times the weight of a ball of cast iron of this diameter; and if the initial velocity had been 1600 feet per second, the resistance would be at least 16 times the weight of the ball. It is indeed much greater than this.

31 compared with that of gravity,

This resistance, operating constantly and uniformly on the ball, must take away four times as much from its velocity as its gravity would do in the same time. We know that in one second gravity would reduce the velocity 800 to 768 if the ball were projected straight upwards. This resistance of the air would therefore reduce it in one second to 672, if it operated uniformly; but as the velocity diminishes continually by the resistance, and the resistance diminishes along with the velocity,

city, the real diminution will be somewhat less than 128 feet. We shall, however, see afterwards that in one second its velocity will be reduced fram 800 to 687. From this simple instance, we see that the resistance of the air must occasion great deviation from parabolic motion.

32 and considered as a retarding force.

In order to judge accurately of its effect, we must consider it as a retarding force, in the same way as we consider gravity. The weight W of a body is the aggregate of the action of the force of gravity g on each particle of the body. Suppose the number of equal particles, or the quantity of matter, of a body to be M, then W is equivalent to g M. In like manner, the resistance R, which we observe in any experiment, is the aggregate of the action of a retarding force R′ on each particle, and is equivalent to R′M: and as g is equal to $\frac{W}{M}$, so R′ is equal to $\frac{R}{M}$. We shall keep this distinction in view, by adding the differential mark ′ to the letter R or r, which expresses the aggregate resistance.

33 The resistance of the air not uniform.

If we, in this manner, consider resistance as a retarding force, we can compare it with any other such force by means of the retardation which it produces in similar circumstances. We would compare it with gravity by comparing the diminution of velocity which its uniform action produces in a given time with the diminution produced in the same time by gravity. But we have no opportunity of doing this directly; for when the resistance of the air diminishes the velocity of a body, it diminishes it gradually, which occasions a gradual diminution of its own intensity. This is not the case with gravity, which has the same action on a body in motion or at rest. We cannot, therefore, observe the uniform action of the air's resistance as a retarding force. We must fall on some other way of making the comparison. We can state them both as dead pressures. A ball may be fitted to the rod of a spring stillyard, and exposed to impulse of the wind. This will compress the stillyard to the mark 3, for instance. Perhaps the weight of the ball will compress it to the mark 6. We know that half this weight would compress it to 3. We account this equal to the pressure of the air, because they balance the same elasticity of the spring. And in this way we can estimate the resistance by weights, whose pressures are equal to its pressure, and we can thus compare it with other resistances, weights, or any other pressures. In fact, we are measuring them all by the elasticity of the spring. This elasticity in its different positions is supposed to have the proportions of the weights which keep it in these positions. Thus we reason from the nature of gravity, no longer considered as a dead pressure, but as a retarding force; and we apply our conclusions to resistances which exhibit the same pressures, but which we cannot make to act uniformly. This sense of the words must be carefully remembered whenever we speak of resistances in pounds and ounces.

34 Gravity and resistance compared when they are equal.

The most direct and convenient way of stating the comparison between the resistance of the air and the accelerating force of gravity, is to take a case in which we know that they are equal. Since the resistance is here assumed as proportional to the square of the velocity, it is evident that the velocity may be so increased that the resistance shall equal or exceed the weight of the body. If a body be already moving downwards with this velocity, it cannot accelerate; because the accelerating force of gravity is balanced by an equal retarding force of resistance. It follows from this remark, that this velocity is the greatest that a body can acquire by the force of gravity only. Nay, we shall afterwards see that it never can completely attain it; because as it approaches to this velocity, the remaining accelerating force decreases faster than the velocity increases. It may therefore be called the limiting or TERMINAL velocity by gravity.

Let a be the height through which a heavy body must fall, in vacuo, to acquire its terminal velocity in air. If projected directly upwards with this velocity, it will rise again to this height, and the height is half the space which it would describe uniformly, with this velocity, in the time of its ascent. Therefore the resistance to this velocity being equal to the weight of the body, it would extinguish this velocity, by its *uniform* action, in the same time, and after the same distance, that gravity would.

Now let g be the velocity which gravity generates or extinguishes during an unit of time, and let u be the terminal velocity of any particular body. The theorems for perpendicular ascents give us $g=\frac{u^2}{2a}$, u and a being both numbers representing units of space; therefore, in the present case, we have $r'=\frac{u^2}{2a}$. For the whole resistance r, or r'M, is supposed equal to the weight, or to g M; and therefore r' is equal to g, $=\frac{u^2}{2a}$, and $2a=\frac{u^2}{g}$. There is a consideration which ought to have place here. A body descends in air, not by the whole of its weight, but by the excess of its weight above that of the air which it displaces. It descends by its *specific* gravity only as a stone does in water. Suppose a body 32 times heavier than air, it will be buoyed up by a force equal to $\frac{1}{32}$ of its weight; and instead of acquiring the velocity of 32 feet in a second, it will only acquire a velocity of 31, even though it sustained no resistance from the *inertia* of the air. Let p be the weight of the body and π that of an equal bulk of air: the accelerative force of relative gravity on each particle will be $g\times\overline{1-\frac{\pi}{p}}$; and this relative accelerating force might be distinguished by another symbol γ. But in all cases in which we have any interest, and particularly in military projectiles, $\frac{\pi}{p}$ is so small a quantity that it would be pedantic affectation to attend to it. It is much more than compensated when we make $g=32$ feet instead of $32\frac{1}{12}$ which it should be.

Let e be the time of this ascent in opposition to gravity. The same theorems give us $eu=2a$; and since the resistance competent to this terminal velocity is equal to gravity, e will also be the time in which it would be extinguished by the uniform action of the resistance; for which reason we may call it the extinguishing time for this velocity. Let R and E mark the resistance and extinguishing time for the same body moving with the velocity 1.

Since the resistances are as the squares of the velocities, and the resistance to the volcity u is $\frac{u^2}{2a}$, R will be be $=\frac{1}{2a}$. Moreover, the times in which the same velocity will be extinguished by different forces, acting uniformly, are inversely as the forces, and gravity would extinguish the velocity 1 in the time $\frac{1}{g}$, $=$ (in these measures) to $\frac{1}{\frac{u^2}{2a}}$, $=\frac{2a}{u^2}$. Therefore we have the following proportion $\frac{1}{2a}(=\mathrm{R}):\frac{u^2}{2a}(=g)=\frac{2a}{u^2}:2a$, and $2a$ is equal to E, the time in which the velocity 1 will be extinguished by the uniform action of the resistance competent to this velocity.

The velocity 1 would in this case be extinguished after a motion uniformly retarded, in which the space described is one-half of what would be uniformly described during the same time with the constant velocity 1. Therefore the space thus described by a motion which begins with the velocity 1, and is uniformly retarded by the resistance competent to this velocity, is equal to the height through which *this* body must fall *in vacuo* in order to acquire *its* terminal velocity in air.

All these circumstances may be conceived in a manner which, to some readers, will be more familiar and palpable. The terminal velocity is that where the resistance of the air balances and is equal to the weight of the body. The resistance of the air to any particular body is as the square of the velocity; therefore let R be the whole resistance to the body moving with the velocity 1, and r the resistance to its motion with the terminal velocity u; we must have $r=\mathrm{R}\times u^2$, and this must be $=$W the weight. Therefore, to obtain the terminal velocity, divide the weight by the resistance to the velocity 1, and the quotient is the square of the terminal velocity, or $\frac{\mathrm{W}}{\mathrm{R}}=u^2$: And this is a very expeditious method of determining it, if R be previously known.

Then the common theorems give a, the fall necessary for producing this velocity *in vacuo* $=\frac{u^2}{2g}$, and the time of the fall $=\frac{u}{g}=e$, and $eu=2a$, $=$ the space uniformly described with the velocity u during the time of the fall, or its equal, the time of the extinction by the uniform action of the resistance r; and, since r extinguishes it in the time e, R, which is u^2 times smaller, will extinguish it in the time u^2e, and R will extinguish the velocity 1, which is u times less than u, in the time $u\,e$, that is, in the time $2a$; and the body, moving uniformly during the time $2a$, $=$E, with the velocity 1, will describe the space $2a$; and, if the body begin to move with the velocity 1, and be uniformly opposed by the resistance R, it will be brought to rest when it has described the space a; and the space in which the resistance to the velocity 1 will extinguish that velocity by its uniform action, is equal to the height through which that body must fall *in vacuo* in order to acquire its terminal velocity in air. And thus every thing is regulated by the time E in which the velocity 1 is extinguished by the uniform action of the corresponding resistance, or by $2a$, which is the space uniformly described during this time, with the velocity 1. And E and $2a$ must be expressed by the same number. It is a number of units, of time, or of length.

Having ascertained these leading circumstances for an unit of velocity, weight, and bulk, we proceed to deduce the similar circumstances for any other magnitude; and, to avoid unnecessary complications, we shall always suppose the bodies to be spheres, differing only in diameter and density. 35 The comparison made general.

First, then, let the velocity be increased in the ratio of 1 to v.

The resistance will now be $\frac{v^2}{2a}$, $=r$.

The extinguishing time will be $\frac{\mathrm{E}}{v}$, $=e$, $=\frac{2a}{v}$, and $e\,v=2a$; so that the rule is general, that the space along which *any* velocity will be extinguished by the uniform action of the corresponding resistance, is equal to the height necessary for communicating the terminal velocity to *that* body by gravity. For $e\,v$ is twice the space through which the body moves while the velocity v is extinguished by the uniform resistance.

In the 2d place, let the diameter increase in the proportion of 1 to d. The aggregate of the resistance changes in the proportion of the surface similarly resisted, that is, in the proportion of 1 to d^2. But the quantity of matter, or number of particles among which this resistance is to be distributed, changes in the proportion of 1 to d^3. Therefore the retarding power of the resistance changes in the proportion of 1 to $\frac{1}{d}$. When the diameter was 1, the resistance to a velocity 1 was $\frac{1}{2a}$. It must now be $\frac{1}{2ad}$. The time in which this diminished resistance will extinguish the velocity 1 must increase in the proportion of the diminution of force, and must now be E d, or $2\,a\,d$, and the space uniformly described during this time with the initial velocity 1 must be $2\,a\,d$; and this must still be twice the height necessary for communicating the terminal velocity w to *this* body. We must still have $g=\frac{w^2}{2\,a\,d}$; and therefore $w^2=2gad$, and $w=\sqrt{2gad}=\sqrt{2ga}\sqrt{d}$. But $u=\sqrt{2ga}$. Therefore the terminal velocity w for this body is $=u\sqrt{d}$; and the height necessary for communicating it is $a\,d$. Therefore the terminal velocity varies in the subduplicate ratio of the diameter of the ball, and the fall necessary for producing it varies in the simple ratio of the diameter. The extinguishing time for the velocity v must now be $\frac{\mathrm{E}\,d}{v}$.

If, in the 3d place, the density of the ball be increased in the proportion of 1 to m, the number of particles among which the resistance is to be distributed is increased in the same proportion, and therefore the retarding force of the resistance is equally diminished; and if the density of the air is increased in the proportion of 1 to n, the retarding force of the resistance increases in the same proportion: hence we easily deduce these *general* expressions.

The terminal velocity $=a\sqrt{d\frac{m}{n}}=\sqrt{2\,g\,a\,d\frac{m}{n}}$.

The producing fall *in vacuo* $=a\,d\,\frac{m}{n}$.

The

The retarding power of resistance to any velocity $=$

$$r', = \frac{v^2}{2\,a\,d\,\frac{m}{n}}.$$

The extinguishing time for any velocity $n = \frac{E\,d\,m}{v\,n}$.

And thus we see that the chief circumstances are regulated by the terminal velocity, or are conveniently referred to it.

36
Units necessary by which the quantities may be measured.

To render the deductions from these premises perspicuous, and for communicating distinct notions or ideas, it will be proper to assume some convenient units, by which all these quantities may be measured; and, as this subject is chiefly interesting in the case of military projectiles, we shall adapt our units to this purpose. Therefore, let a second be the unit of time, a foot the unit of space and velocity, an inch the unit of diameter of a ball or shell, and a pound avoirdupois the unit of pressure, whether of weight or of resistance; therefore g is 32 feet.

The great difficulty is to procure an absolute measure of r, or u, or a; any one of these will determine the others.

37
Sir Isaac Newton's endeavours in this way

Sir Isaac Newton has attempted to determine r by theory, and employs a great part of the second book of the *Principia* in demonstrating, that the resistance to a sphere moving with any velocity, is to the force which would generate or destroy its whole motion in the time that it would uniformly move over $\frac{8}{3}$ of its diameter with this velocity, as the density of the air is to the density of the sphere. This is equivalent to demonstrating that the resistance of the air to a sphere moving through it with any velocity, is equal to half the weight of a column of air having a great circle of the sphere for its base, and for its altitude the height from which a body must fall in *vacuo* to acquire this velocity. This appears from Newton's demonstration; for, let the specific gravity of the air be to that of the ball as 1 to m; then, because the times in which the same velocity will be extinguished by the uniform action of different forces are inversely as the forces, the resistance to this velocity would extinguish it in the time of describing $\frac{8}{3}\,m\,d$, d being the diameter of the ball. Now 1 is to m as the weight of the displaced air to the weight of the ball, or as $\frac{2}{3}$ of the diameter of the ball to the length of a column of air of equal weight. Call this length a; a is therefore equal to $\frac{2}{3}\,m\,d$. Suppose the ball, to fall from the height a in the time t, and acquire the velocity u. If it moved uniformly with this velocity during this time, it would describe a space $=2a$, or $\frac{4}{3}\,m\,d$. Now its weight would extinguish this velocity, or destroy this motion, in the same time, that is, in the time of describing $\frac{4}{3}\,m\,d$; but the resistance of the air would do this in the time of describing $\frac{8}{3}\,m\,d$; that is, in twice the time. The resistance therefore is equal to half the weight of the ball, or to half the weight of the column of air whose height is the height producing the velocity. But the resistances to different velocities are as the squares of the velocities, and therefore, as their producing heights; and, in general, the resistance of the air to a sphere moving with any velocity, is equal to the half weight of a column of air of equal section, and whose altitude is the height producing the velocity. The result of this investigation has been acquiesced in by all Sir Isaac Newton's commentators. Many faults have indeed been found with his reasoning, and even with his principles; and it must be acknowledged that although this investigation is by far the most ingenious of any in the *Principia*, and sets his acuteness and address in the most conspicuous light, his reasoning is liable to serious objections, which his most ingenious commentators have not completely removed. However, the conclusion has been acquiesced in, as we have already stated, but as if derived from other principles, or by more logical reasoning. We cannot, however, say that the reasonings or assumptions of these mathematicians are much better than Newton's: and we must add, that all the causes of deviation from the duplicate ratio of the velocities, and the causes of increased resistance, which the latter authors have valued themselves for discovering and introducing into their investigations, were pointed out by Sir Isaac Newton, but purposely omitted by him, in order to facilitate the discussion *in re difficillima*. (See *Schol.* prop. 37. book ii.).

38
His result just, but his reasoning erroneous.

It is known that the weight of a cubic foot of water is $62\frac{1}{2}$ pounds, and that the medium density of the air is $\frac{1}{840}$ of water; therefore, let a be the height producing the velocity (in feet), and d the diameter of the ball (in inches), and π the periphery of a circle whose diameter is 1; the resistance of the air will be $= \frac{62\frac{1}{2}}{840} \times \frac{\pi}{4} \times \frac{1}{144} \times \frac{a}{2} \times d^2 = \frac{a\,d^2}{4928\frac{1}{2}}$ pounds, very nearly, $= \frac{v^2}{4928\frac{1}{2} \times 64}a^2, = \frac{v^2\,d^2}{315417}$ pounds.

We may take an example. A ball of cast iron weighing 12 pounds, is $4\frac{1}{2}$ inches in diameter. Suppose this ball to move at the rate of $25\frac{1}{10}$ feet in a second (the reason of this choice will appear afterwards). The height which will produce this velocity in a falling body is $9\frac{7}{8}$ feet. The area of its great circle is 0.11044 feet, or $\frac{11044}{100000}$ of one foot. Suppose water to be 840 times heavier than air, the weight of the air incumbent on this great circle, and $9\frac{7}{8}$ feet high, is 0.081151 pounds: half of this is 0.0405755 or $\frac{405755}{10000000}$, or nearly $\frac{1}{25}$ of a pound. This should be the resistance of the air to this motion of the ball.

39
Necessity of experiment.

In all matters of physical discussion, it is prudent to confront every theoretical conclusion with experiment. This is particularly necessary in the present instance, because the theory on which this proposition is founded is extremely uncertain. Newton speaks of it with the most cautious diffidence, and secures the justness of the conclusions by the conditions which he assumes in his investigation. He describes with the greatest precision the state of the fluid in which the body must move, so as that the demonstrations may be strict, and leaves it to others to pronounce, whether this is the real constitution of our atmosphere. It must be granted that it is not; and that many other suppositions have been introduced by his commentators and followers, in order to suit his investigation (for we must assert that little or nothing has been added to it) to the circumstances of the case.

40
Newton's experiments.

Newton himself, therefore, attempted to compare his propositions with experiment. Some were made by dropping balls from the dome of St Paul's cathedral; and all these showed as great a coincidence with his theory as they did with each other: but the irregulari-

ties

ties were too great to allow him to say with precision what was the resistance. It appeared to follow the proportion of the squares of the velocities with sufficient exactness; and though he could not say that the resistance was equal to the weight of the column of air having the height necessary for communicating the velocity, it was always equal to a determinate part of it; and might be stated $= n\,a$, n being a number to be fixed by numerous experiments.

One great source of uncertainty in his experiments seems to have escaped his observation: the air in that dome is almost always in a state of motion. In the summer season there is a very sensible current of air downwards, and frequently in winter it is upwards: and this current bears a very great proportion to the velocity of the descents. Sir Isaac takes no notice of this.

He made another set of experiments with pendulums; and has pointed out some very curious and unexpected circumstances of their motions in a resisting medium. There is hardly any part of his noble work in which his address, his patience, and his astonishing penetration, appear in greater lustre. It requires the utmost intenseness of thought to follow him in these disquisitions; and we cannot enter on the subject at present; some notice will be taken of these experiments in the article *Resistance of fluids*. Their results were much more uniform, and confirmed his general theory; and as we have said above, it has been acquiesced in by the first mathematicians of Europe.

41 **Inutility of the theory in practice.**

But the deductions from this theory were so inconsistent with the observed motions of military projectiles, when the velocities are prodigious, that no application could be made which could be of any service for determining the path and motion of cannon shot and bombs;

42 **The attempts of various mathematicians, &c.**

and although Mr John Bernoulli gave, in 1718, a most elegant determination of the trajectory and motion of a body projected in a fluid which resists in the duplicate ratio of the velocities (a problem which even Newton did not attempt), it has remained a dead letter. Mr Benjamin Robins, equally eminent for physical science and mathematical genius, was the first who suspected the true cause of the imperfection of the usually received theories; and in 1737 he published a small tract, in which he showed clearly, that even the Newtonian theory of resistance must cause a cannon ball, discharged with a full allotment of powder, to deviate farther from the parabola, in which it would move *in vacuo*, than the parabola deviates from a straight line. But he farther asserted, on the authority of good reasoning, that in such great velocities the resistance must be much greater than this theory assigns; because, besides the resistance arising from the *inertia* of the air which is put in motion by the ball, there must be a resistance arising from a condensation of the air on the anterior surface of the ball, and a rarefaction behind it: and there must be a third resistance, arising from the statical pressure of the air on its anterior part, when the motion is so swift that there is a vacuum behind. Even these causes of disagreement with the theory had been foreseen and mentioned by Newton (see the Scholium to prop. 37. book ii. *Princip.*); but the subject seems to have been little attended to. The eminent mathematicians had few opportunities of making experiments; and the professional men, who were in the service of princes, and had their countenance and aid in this matter, were generally too deficient in mathematical knowledge to make a proper use of their opportunities. The numerous and splendid volumes which these gentlemen have been enabled to publish by the patronage of sovereigns are little more than prolix extensions of the same theory of Galileo. Some of them, however, such as St Remy, Antonini, and Le Blond, have given most valuable collections of experiments, ready for the use of the profound mathematician.

43 **Observations of Mr Robins on velocity and resistance,**

Two or three years after this first publication, Mr Robins hit upon that ingenious method of measuring the great velocities of military projectiles, which has handed down his name to posterity with great honour. And having ascertained these velocities, he discovered the prodigious resistance of the air, by observing the diminution of velocity which it occasioned. This made him anxious to examine what was the real resistance to any velocity whatever, in order to ascertain what was the law of its variation; and he was equally fortunate in this attempt. His method of measuring the resistance has been fully described in the article Gunnery, N° 9, &c.

It appears (Robins's *Math. Works*, vol. i. page 205.) that a sphere of $4\frac{1}{2}$ inches in diameter, moving at the rate of $25\frac{1}{3}$ feet in a second, sustained a resistance of 0.04914 pounds, or $\frac{4914}{100000}$ of a pound. This is a greater resistance than that of the Newtonian theory, which gave $\frac{405755}{10000000}$ in the proportion of 1000 to 1211, or very nearly in the proportion of five to six in small numbers. And we may adopt as a rule in all moderate velocities, that the resistance to a sphere is equal to $\frac{61}{100}$ of the weight of a column of air having the great circle of the sphere for its base, and for its altitude the height through which a heavy body must fall *in vacuo* to acquire the velocity of projection.

This experiment is peculiarly valuable, because the ball is precisely the size of a 12 pound shot of cast iron; and its accuracy may be depended on. There is but one source of error. The whirling motion must have occasioned some whirl in the air, which would continue till the ball again passed through the same point of its revolution. The resistance observed is therefore probably somewhat less than the true resistance to the velocity of $25\frac{1}{3}$ feet, because it was exerted in a relative velocity which was less than this, and is, in fact, the resistance competent to this relative and smaller velocity.

44 **and of Mr Rouse and De Borda.**

—Accordingly, Mr Smeaton, a most sagacious naturalist, places great confidence in the observations of a Mr Rouse of Leicestershire, who measured the resistance by the effect of the wind on a plane properly exposed to it. He does not tell us in what way the velocity of the wind was ascertained; but our deference for his great penetration and experience disposes us to believe that this point was well determined.

45 **They differ widely in their conclusions.**

The resistance observed by Mr Rouse exceeds that resulting from Mr Robins's experiments nearly in the proportion of 7 to 10. Chevalier de Borda made experiments similar to those of Mr Robins, and his results exceed those of Robins in the proportion of 5 to 6. These differences are so considerable, that we are at a loss what measure to abide by. It is much to be regretted, that in a subject so interesting both to the philosopher and the man of the world, experiments have not been multiplied. Nothing would tend so much to perfect the science of of gunnery; and indeed till this be done, all the labours of mathematicians are of no avail. Their investigations must remain an unintelligible cipher, till this key be supplied. It is to be hoped that Dr Charles Hutton of Woolwich, who has so ably extended Mr Robins's Examination of the Initial Velocities of Military Projectiles, will be encouraged to proceed to this part of this subject. We should wish to see, in the first place, a numerous set of experiments for ascertaining the resistances in moderate velocities; and, in order to avoid all error from the resistance and inertia of the machine, which is necessarily blended with the resistance of the ball, in Mr Robins's form of the experiment, and is separated with great uncertainty and risk of error, we would recommend a form of experiment somewhat different.

46 A new form of experiment recommended.

Let the axis and arm which carries the ball be connected with wheelwork, by which it can be put in motion, and gradually accelerated. Let the ball be so connected with a bent spring, that this shall gradually compress it as the resistance increases, and leave a mark of the degree of compression; and let all this part of the apparatus be screened from the air except the ball. The velocity will be determined precisely by the revolutions of the arm, and the resistance by the compression of the spring. The best method would be to let this part of the apparatus be made to slide along the revolving arm, so that the ball can be made to describe larger and larger circles. An intelligent mechanician will easily contrive an apparatus of this kind, held at any distance from the axis by a cord, which passes over a pulley in the axis itself, and is then brought along a perforation in the axis, and comes out at its extremity, where it is fitted with a swivel, to prevent it from snapping by being twisted. Now let the machine be put in motion. The centrifugal force of the ball and apparatus will cause it to fly out as far as it is allowed by the chord; and if the whole is put in motion by connecting it with some mill, the velocity may be most accurately ascertained. It may also be fitted with a bell and hammer like Gravesande's machine for measuring centrifugal forces. Now by gradually veering off more cord, the distance from the centre, and consequently the velocity and resistance increase, till the hammer is disengaged and strikes the bell.

Another great advantage of this form of the experiment is, that the resistance to very great velocities may be thus examined, which was impossible in Mr Robins's way. This is the great desideratum, that we may learn in what proportion of the velocities the resistances increase.

In the same manner, an apparatus, consisting of Dr Lynd's Anemometer, described in the article PNEUMATICS, N° 311, &c. might be whirled round with prodigious rapidity, and the fluid on it might be made clammy, which would leave a mark at its greatest elevation, and thus discover the resistance of the air to rapid motions.

Nay, we are of opinion that the resistance to very rapid motions may be measured directly in the conduit pipe of some of the great cylinder bellows employed in blast furnaces: the velocity of the air in this pipe is ascertained by the capacity of the cylinder and the strokes of the piston. We think it our duty to point out, to such as have the opportunities of trying them, methods which promise accurate results for ascertaining this most desirable point.

47 The result of Robins's experiments as yet most to be depended on.

We are the more puzzled what measure to abide by, because Mr Robins himself, in his practical propositions, does not make use of the result of his own experiments, but takes a much lower measure. We must content ourselves, however, with this experimental measure, because it is as yet the only one of which any account can be given, or well-founded opinion formed.

48 Applied to the formulæ.

Therefore, in order to apply our formulæ, we must reduce this experiment, which was made on a ball of $4\frac{1}{2}$ inches diameter, moving with the velocity of $25\frac{1}{5}$ feet per second, to what would be the resistance to a ball of one inch, having the velocity 1 foot. This will evidently give us $R = \frac{0.04914}{4,5^2 \times 25.2^2}$, being diminished in the duplicate ratio of the diameter and velocity. This gives us $R = 0,00000381973$ pounds, or $\frac{3.81973}{1000000}$ of a pound. The logarithm is 4.58204. The resistance here determined is the same whatever substance the ball be of; but the retardation occasioned by it will depend on the proportion of the resistance to the *vis insita* of the ball; that is, to its quantity of motion. This in similar velocities and diameters is as the density of the ball. The balls used in military service are of cast iron or of lead, whose specific gravities are 7,207 and 11,37 nearly, water being 1. There is considerable variety in cast iron, and this density is about the medium. These data will give us

		For Iron.	For Lead
W, or weight of a ball 1 inch in diameter - -	lbs.	0.13648	0.21533
Log. of W - -		9.13509	9.33310
E″ - - -		1116″.6	1761″.6
Log. of E - - -		3.04790	3.24591
u, or terminal velocity -		189.03	237.43
Log. u - - - -		2.27653	2.37553
a, or producing height -		558.3	880.8

These numbers are of frequent use in all questions on this subject.

Mr Robins gives an expeditious rule for readily finding a, which he calls F (see the article GUNNERY), by which it is made 900 feet for a cast iron ball of an inch diameter. But no theory of resistance which he professes to use will make this height necessary for producing the terminal velocity. His F therefore is an *empirical* quantity, analogous indeed to the producing height, but accommodated to his theory of the trajectory of cannon-shot, which he promised to publish, but did not live to execute. We need not be very anxious about this; for all our quantities change in the same proportion with R, and need only a correction by a multiplier or divisor, when R shall be accurately established.

We may illustrate the use of these formulæ by an example or two.

49 Examples of their use.

1. Then, to find the resistance to a 24 pound ball moving with the velocity of 1670 feet in a second, which is nearly the velocity communicated by 16lbs. of powder. The diameter is 5,603 inches.

Log.

Log. R - - -	$+\bar{4}.58204$
Log. d^2 - - -	$+1.49674$
Log. 1670^2 - - -	$+6.44548$
Log. 334.4 lbs.$=r$ - -	2.52426

But it is found, by unequivocal experiments on the retardation of such a motion, that it is 504 lbs. This is owing to the causes often mentioned, the additional resistance to great velocities, arising from the condensation of the air, and from its pressure into the vacuum left by the ball.

2. Required the terminal velocity of this ball?

Log. R - - -	$+4.58204$
Log. d^2 - - -	$+1.49674$
Log. resist. to veloc. 1 - -	$6.07878=a$
Log. W. - - -	$1.38021=b$
Diff. of a and b,$=$log. u^2 -	5.30143
Log. 447.4 $=u$ - -	2.65071

50 Table of terminal velocity according to Newton and Robins.

As the terminal velocity u, and its producing height a, enter into all computations of military projectiles, we have inserted the following Table for the usual sizes of cannon-shot, computed both by the Newtonian theory of resistance, and by the resistances observed in Robin's experiments.

Lb. Ball.	Newton.		Robins.		Diam: Inch.
	u Term Vel.	2 a.	Term. Vel.	2 a.	
1	289.9	2626.4	263.4	2168.6	1.94
2	324.9	3298.5	295.2	2723.5	2.45
3	348.2	3788.2	316.4	3127.9	2.80
4	365.3	4170.3	331.9	3442.6	3.08
6	390.8	4472.7	355.1	3940.7	3.52
9	418.1	5463.5	379.9	4511.2	4.04
12	438.6	6010.6	398.5	4962.9	4.45
18	469.3	6883.3	426.5	5683.5	5.09
24	492.4	7576.3	447.4	6255.7	5.61
32	512.6	8024.8	465.8	6780.4	6.21
	540.5	9129.9	491.5	7538.3	6.75

51 Mr Muller's theory altogether erroneous.

Mr Muller, in his writings on this subject, gives a much smaller measure of resistance, and consequently a much greater terminal velocity: but his theory is a mistake from beginning to end (See his *Supplement to* his *Treatise of Artillery*, art. 150, &c.). In art. 148. he assumes an algebraic expression for a principle of mechanical argument; and from its consequence draws erroneous conclusions. He makes the resistance of a cylinder one third less than Newton *supposes* it; and his reason is false. Newton's measure is demonstrated by his commentators Le Seur and Jaquier to be even a little too small, upon his own principles, (Not. 277. Prop. 36. B. II.). Mr Muller then, without any seeming reason, introduces a new principle, which he makes the chief support of his theory, in opposition to the theories of other mathematicians. The principle is false, and even absurd, as we shall have occasion to show by and by. In consequence, however, of this principle, he is enabled to compare the results with many experiments, and the agreement is very flattering. But we shall soon see that little dependence can be had on such comparisons. We notice these things here, because Mr Muller being head of the artillery school in Britain, his publications have become a sort of text-books. We are miserably deficient in works on this subject, and must have recourse to the foreign writers.

52 The motions considered through their whole course.

We now proceed to consider these motions through their whole course; and we shall first consider them as affected by the resistance only; then we shall consider the perpendicular ascents and descents of heavy bodies through the air; and, lastly, their motion in a curvilineal trajectory, when projected obliquely. This must be done by the help of the abstruser parts of fluxionary mathematics. To make it more conspicuous, we shall, by way of introduction, consider the simply resisted rectilineal motions geometrically, in the manner of Sir Isaac Newton. As we advance, we shall quit this track, and prosecute it algebraically, having by this time acquired distinct ideas of the algebraic quantities.

53 Preliminary observations.

We must keep in mind the fundamental theorems of varied motions.

1. The momentary variation of the velocity is proportional to the force and the moment of time jointly, and may therefore be represented by $\pm\dot{v}=f\dot{t}$, where $\dot{v}$ is the momentary increment or decrement of the velocity v, f the accelerating or retarding force, and $\dot{t}$ the moment or increment of the time t.

2. The momentary variation of the square of the velocity is as the force, and as the increment or decrement of the space jointly; and may be represented by $\pm v\dot{v}=f\dot{s}$. The first proposition is familiarly known. The second is the 39th of Newton's *Principia*, B. I. It is demonstrated in the article OPTICS, and is the most extensively useful proposition in mechanics.

54 The motions as affected by resistance only. Fig. 5.

These things being premised, let the straight line AC (fig. 5) represent the initial velocity V, and let CO, perpendicular to AC, be the time in which this velocity would be extinguished by the uniform action of the resistance. Draw through the point A an equilateral hyperbola A e B, having OF, OCD for its assymptotes; then let the time of the resisted motion be represented by the line CB, C being the first instant of the motion. If there be drawn perpendicular ordinates κc, gf, DB, &c. to the hyperbola, they will be proportional to the velocities of the body at the instants κ, g, D, &c. and the hyperbolic areas ACκe, ACgf, ACDB, &c. will be proportional to the spaces described during the times Cκ, Cg, CB, &c.

For, suppose the time divided into an indefinite number of small and equal moments, Cc, Dd, &c. draw the ordinates ac, bd, and the perpendiculars $b\beta$, $a\alpha$. Then, by the nature of the hyperbola, AC : ac=Oc : OC; and AC$-ac$: ac=O$c-$OC : OC, that is, Aα : ac=Cc : OC, and Aα : Cc=ac : OC=AC$\cdot ac$: AC$\cdot$OC; in like manner, Bβ : Dd=BD$\cdot bd$: BD$\cdot$OD. Now Dd=Cc, because the moments of time were taken equal, and the rectangles AC$\cdot$CO, BD$\cdot$DO, are equal, by the nature of the hyperbola; therefore Aα : Bβ=AC$\cdot ac$: BD$\cdot bd$: but as the points c, d continually approach, and ultimately coincide with C, D, the ultimate ratio of AC$\cdot ac$ to BD$\cdot bd$ is that of AB^2 to BD^2; therefore the momentary decrements of AC

AC and BD are as AC^2 and BD^2. Now, because the resistance is measured by the momentary diminution of velocity, these diminutions are as the squares of the velocities; therefore the ordinates of the hyperbola and the velocities diminish by the same law; and the initial velocity was represented by AC: therefore the velocities at all the other instants x, g, D, are properly represented by the corresponding ordinates. Hence,

1. Since the abscissæ of the hyperbola are as the times, and the ordinates are as the velocities, the areas will be as the spaces described, and AC$x e$ is to Acgf as the space described in the time Cx to the space described in the time Cg (1st Theorem on varied motions).

2. The rectangle ACOF is to the area ACDB as the space formerly expressed by $2a$, or E to the space described in the resisting medium during the time CD: for AC being the velocity V, and OC the extinguishing time e, this rectangle is $=e$ V, or E, or $2a$, of our former disquisitions; and because all the rectangles, such as ACOF, BDOG, &c. are equal, this corresponds with our former observation, that the space uniformly described with any velocity during the time in which it would be uniformly extinguished by the corresponding resistance is a constant quantity, viz. that in which we always had $cv=$ E, or $2a$.

3. Draw the tangent Ax; then, by the hyperbola Cx=CO: now Cx is the time in which the resistance to the velocity AC would extinguish it; for the tangent coinciding with the elemental arc Aa of the curve, the first impulse of the uniform action of the resistance is the same with the first impulse of its varied action. By this the velocity AC is reduced to ac. If this operated uniformly like gravity, the velocities would diminish uniformly, and the space described would be represented by the triangle ACx.

This triangle, therefore, represents the height through which a heavy body must fall in vacuo, in order to acquire the terminal velocity.

4. The motion of a body resisted in the duplicate ratio of the velocity will continue without end, and a space will be described which is greater than any assignable space, and the velocity will grow less than any that can be assigned; for the hyperbola approaches continually to the assymptote, but never coincides with it. There is no velocity BD so small, but a smaller ZP will be found beyond it; and the hyperbolic space may be continued till it exceeds any surface that can be assigned.

5. The initial velocity AC is to the final velocity BD as the sum of the extinguishing time and the time of the retarded motion, is to the extinguishing time alone: for AC : BD=OD (or OC+CD) : OC; or V : $v=e : e+t$.

6. The extinguishing time is to the time of the retarded motion as the final velocity is to the velocity lost during the retarded motion: for the rectangles AFOC, BDOG are equal; and therefore AVGF and BVCD are equal, and VC : VA=VG : VB; therefore $t=e\frac{V-v}{v}$, and $e=t\frac{v}{V-v}$.

7. Any velocity is reduced in the proportion of m to n in the time $e\frac{m-n}{n}$. For, let AC : BD=$m:n$; then DO : CO=$m:n$, and DC : CO=$m-n:n$, and DC=$\frac{m-n}{n}$CO, or $t=e\frac{m-n}{n}$. Therefore any velocity is reduced to one half in the time in which the initial resistance would have extinguished it by its uniform action.

Thus may the chief circumstances of this motion be determined by means of the hyperbola, the ordinates and abscissæ exhibiting the relations of the times and velocities, and the areas exhibiting the relations of both to the spaces described. But we may render the conception of these circumstances infinitely more easy and simple, by expressing them all by lines, instead of this combination of lines and surfaces. We shall accomplish this purpose by constructing another curve LKP, having the line ML∂, parallel to OD, for its abscissa, and of such a nature, that if the ordinates to the hyperbola AC, ex, fg, BD, &c. be produced till they cut this curve in L, p, n, K, &c. and the abscissa in L, s, h, ∂, &c. the ordinates sp, h, n, ∂K, &c. may be proportional to the hyperbolic areas eACx, fACg, ∂AcK. Let us examine what kind of curve this will be. Another mode of determining this motion.

Make OC : Ox=Ox : Og; then (Hamilton's *Conics*, IV. 14. Cor.), the areas ACxe, $exgf$ are equal: therefore drawing ps, nt perpendicular to OM, we shall have (by the assumed nature of the curve LpK), M$s=st$; and if the abscissa OD be divided into any number of small parts in geometrical progression (reckoning the commencement of them all from O), the axis Vi of this curve will be divided by its ordinates into the same number of equal parts; and this curve will have its ordinates LM, ps, nt, &c. in geometrical progression, and its abscissæ in arithmetical progression.

Also, let KN, MV touch the curve in K and L, and let OC be supposed to be to Oc, as OD to Od, and therefore Cc to Dd as OC to OD; and let these lines Cc, Dd be indefinitely small; then (by the nature of the curve) Lo is equal to Kr: for the areas aACc, bBDd are in this case equal. Also ko is to kr, as LM to KI, because cC : dD=CO : DO:

Therefore IN : IK=rK : rk
IK : ML=rk : ol
ML : MV=ol : oL
and IN : MN=rK : oL

That is, the subtangent IN, or MV, is of the same magnitude, or is a constant quantity in every part of the curve.

Lastly, the subtangent IN, corresponding to the point K of the curve, is to the ordinate K∂ as the rectangle BDOG or ACOF to the parabolic area BDCA.

For let $fghn$ be an ordinate very near to BD∂K; and let hn cut the curve in n, and the ordinate KI in q; then we have

Kq : qn=KI : IN, or
Dg : qn=DO : IN;
but BD : AC=CO : DO;
therefore B D . Dg : AC . qn=CO : IN.

Therefore the sum of all the rectangles BD . Dg is to the sum of all the rectangles AC . qn, as CO to IN: but

but the sum of the rectangles BD . Dg is the space ACDB; and, because AC is given, the sum of the rectangles AC . $q\,n$ is the rectangle of AC and the sum of all the lines $q\,n$; that is, the rectangle of AC and RL: therefore the space ACDB : AC . RL = CO : IN, and ACDB × IN = AC . CO . RL; and therefore IN : RL = AC . CO : ACDB.

Hence it follows that QL expresses the area BVA, and in general, that the part of the line parallel to OM, which lies between the tangent KN and the curve LpK, expresses the corresponding area of the hyperbola which lies without the rectangle BDOG.

And now, by the help of this curve, we have an easy way of convincing and computing the motion of a body through the air. For the subtangent of our curve now represents twice the height through which the ball must fall in vacuo, in order to acquire the terminal velocity; and therefore serves for a scale on which to measure all the other representatives of the motion.

56 The whole reduced to simple arithmetical computation.

But it remains to make another observation on the curve L p K, which will save us all the trouble of graphical operations, and reduce the whole to a very simple arithmetical computation. It is of such a nature, that when MI is considered as the abscissa, and is divided into a number of equal parts, and ordinates are drawn from the points of division, the ordinates are a series of lines in geometrical progression, or are continual proportionals. Whatever is the ratio between the first and second ordinate, there is the same between the second and third, between the third and fourth, and so on; therefore the number of parts into which the abscissa is divided is the number of these equal ratios which is contained in the ratio of the first ordinate to the last: For this reason, this curve has got the name of the *logistic* or *logarithmic* curve; and it is of immense use in the modern mathematics, giving us the solution of many problems in the most simple and expeditious manner, on which the genius of the ancient mathematicians had been exercised in vain. Few of our readers are ignorant, that the numbers called *logarithms* are of equal utility in arithmetical operations, enabling us not only to solve common arithmetical problems with astonishing dispatch, but also to solve others which are quite inaccessible in any other way. Logarithms are nothing more than the numerical measures of the abscissa of this curve, corresponding to ordinates, which are measured on the same or any other scale by the natural numbers; that is, if ML δ be divided into equal parts, and from the points of division lines be drawn parallel to MI, cutting the curve L p K, and from the points of intersection ordinates be drawn to MI, these will divide MI into portions, which are in the same proportion to the ordinates that the logarithms bear to their natural numbers.

In constructing this curve we were limited to no particular length of the line LR, which represented the space ACDB; and all that we had to take care of was, that when OC, Ox, O g were taken in geometrical progression, M s, M t should be in arithmetical progression. The abscissæ having ordinates equal to ps, $n\,t$, &c. might have been twice as long, as is shown in the dotted curve which is drawn through L. All the lines which serve to measure the hyperbolic spaces would then have been doubled. But NI would also have been doubled, and our proportions would have still held good; because this subtangent is the scale of measurement of our figure, as E or $2a$ is the scale of measurement for the motions.

Since then we have tables of logarithms calculated for every number, we may make use of them instead of this geometrical figure, which still requires considerable trouble to suit it to every case. There are two sets of logarithmic tables in common use. One is called a table of hyperbolic or natural logarithms. It is suited to such a curve as is drawn in the figure, where the subtangent is equal to that ordinate $\pi\,\upsilon$ which corresponds to the side π O of the square $\pi\,\theta\,\lambda$ O inserted between the hyperbola and its assymptotes. This square is the unit of surface, by which the hyperbolic areas are expressed; its side is the unit of length, by which the lines belonging to the hyperbola are expressed; $\pi\,\upsilon$ is $=1$, or the unit of numbers to which the logarithms are suited, and then IN is also 1. Now the square $\theta\pi$Oλ being unity, the area BACD will be some number; πO being also unity, OD is some number: Call it x. Then, by the nature of the hyperbola, OB : O π = $\pi\,\theta$: DB: That is, $x : 1 = 1 : \frac{1}{x}$, so that DB is $\frac{1}{x}$. Now calling D $d\,\dot{x}$, the area BD $d\,b$, which is the fluxion (ultimately) of the hyperbolic area, is $\frac{\dot{x}}{x}$. Now in the curve L p K, MI has the same ratio to NI that BACD has to $\theta\lambda$Oπ: Therefore, if there be a scale of which NI is the unit, the number on this scale corresponding to MI has the same ratio to 1 which the number measuring BACD has to 1; and I i, which corresponds to BD $d\,b$, is the fluxion (ultimately) of MI: Therefore, if MI be called the logarithm of x, $\frac{\dot{x}}{x}$ is properly represented by the fluxion of MI. In short the line MI is divided precisely as the line of numbers on a Gunter's scale, which is therefore a line of logarithms; and the numbers called logarithms are just the lengths of the different parts of this line measured on a scale of equal parts. Therefore, when we meet with such an expression as $\frac{\dot{x}}{x}$ viz. the fluxion of a quantity divided by the quantity itself, we consider it as the fluxion of the logarithm of that quantity, because it is really so when the quantity is a number; and it is therefore strictly true that the fluent of $\frac{\dot{x}}{x}$ is the hyperbolic logarithm of x.

Certain reasons of convenience have given rise to another set of logarithms; these are suited to a logistic curve whose subtangent is only $\frac{43429}{100000}$ of the ordinate $\pi\,\upsilon$, which is equal to the side of the hyperbolic square, and which is assumed for the unit of number. We shall suit our applications of the preceding investigation to both these, and shall first use the common logarithms whose subtangent is 0,43429.

The whole subject will be best illustrated by taking an example of the different questions which may be proposed. 57 Illustrated by examples.

Recollect that the rectangle ACOF is $=2\,a$, or $\frac{v^2}{g}$, or

E,

E, for a ball of cast-iron one inch diameter, and if it has the diameter d, it is $\frac{u^2 d}{g}$, or $2\,a\,d$, or E d.

I. It may be required to determine what will be the space described in a given time t by a ball setting out with a given velocity V, and what will be its velocity v at the end of that time.

Here we have NI : MI=ACOF : BDCA ; now NI is the subtangent of the logistic curve ; MI is the difference between the logarithms of OD and OC ; that is, the difference betweeen the logarithms of $e+t$ and e ;

ACOF is $2\,a\,d$, or $\frac{u^2 d}{g}$, or E d.

Therefore by common logarithms 0,43429 : log. $e+t$—log. $e=2ad$: S, = space described,

or 0,43429 : log. $\frac{e+t}{e}=2ad$: S,

and $S.=\frac{2ad}{0{,}43429}\times \text{log.}\frac{e+t}{e}$,

by hyperbolic logarithms $S=2ad\times\text{log.}\frac{e+t}{e}$.

Let the ball be a 12 pounder, and the initial velocity be 1600 feet, and the time 20 seconds. We must first find e, which is $\frac{2ad}{V}$.

Therefore, log. 2 a	+3.03236
log. d (4,5)	+0.65321
log. V. (1600)	—3.20415
Log. of 3″,03,=e	0.48145
And $e+t$ is 23″03, of which the log. is	1.36229
from which take the log. of e	0.48145
remains the log. of $\frac{e+t}{e}$	0.88084

This must be considered as a common number by which we are to multiply $\frac{2ad}{0.43429}$.

Therefore add the logarithms of $2\,a\,d$	+ 3.68557
log. $\frac{e+t}{e}$	+ 9.94490
log. 0.43429	— 9.63778
Log. S. 9833 feet	3.99269

For the final velocity,

OD : OC=AC : BD, or $e+t$: e=V : v.

23″,03 : 3″,03=1600 : $210\frac{1}{7}$, =v.

The ball has therefore gone 3278 yards, and its velocity is reduced from 1600 to 210.

It may be agreeable to the reader to see the gradual progress of the ball during some seconds of its motion.

T.	S.	Diff.	V.	Diff.
1″	1383		1203	397
2″	2456	1073	964	239
3″	3336	880	804	160
4″	4080	744	690	114
5″	4725	645	604	86
6″	5294	569	537	67

The first column is the time of the motion, the second is the space described, the third is the differences of the spaces, showing the motion during each successive second ; the fourth column is the velocity at the end of the time t ; and the last column is the differences of velocity, showing its diminution in each successive second. We see that at the distance of 1000 yards the velocity is reduced to one half, and at the distance of less than a mile it is reduced to one-third.

II. It may be required to determine the distance at which the initial velocity V is reduced to any other quantity v. This question is solved in the very same manner, by substituting the logarithms of V and v for those of $e+t$ and e; for AC : BD=OD : OC, and therefore log. $\frac{AC}{BD}$=log. $\frac{OD}{OC}$, or log. $\frac{V}{v}$= log. $\frac{e+t}{e}$.

Thus it is required to determine the distance in which the velocity 1780 of a 24 pound ball (which is the medium velocity of such a ball discharged with 16 pounds of powder) will be reduced to 1500.

Here d is 5.68, and therefore the logarithm of $2ad$ is	+3.78671
Log. $\frac{V}{v}$=0.07433, of which the log. is	+8.87116
Log. 0.43429	—9.63778
Log. 1047.3 feet, or 349 yards	3.02009

This reduction will be produced in about $\frac{7}{8}$ of a second.

III. Another question may be to determine the time which a ball, beginning to move with a certain velocity, employs in passing over a given space, and the diminution of velocity which it sustains from the resistance of the air.

We may proceed thus :

$2ad$: S=0,43429 : log. $\frac{e+t}{e}$, =t. Then to log. $\frac{e+t}{e}$ add log. e, and we obtain log. $e+t$, and $e+t$; from which if we take e we have t. Then to find v, say $e+t$: e =V : v.

We shall conclude these examples by applying this last rule to Mr Robins's experiment on a musket bullet of $\frac{3}{4}$ of an inch in diameter, which had its velocity reduced from 1670 to 1425 by passing through 100 feet of air. This we do in order to discover the resistance which it sustained, and compare it with the resistance to a velocity of 1 foot per second. 58 Application of an experiment of Mr Robins. See Robins's Math. Works, vol. i p. 135.

We must first ascertain the first term of our analogy. The ball was of lead, and therefore $2a$ must be multiplied by d and by m, which expresses the ratio of the density of lead to that of cast iron. d is 0.75, and m is $\frac{11.37}{7.21}=1.577$. Therefore

log.	$2\,a$	3.03236
	d	9.87506
	m	0.19782
Log.	$2adm$	3.10524

and $2adm$=1274.2

Now 1274.2 : 100=0.43429 : 0.03408=log. $\frac{e+t}{e}$.

But $e=\frac{2adm}{V}$=0.763, and its logarithm =9.88252, which, added to 0.03408, gives 9.91660, which is the log. of $e+t$, =0.825, from which take e, and there remains

remains $t=$, $0''.062$, or $\frac{62}{1000}$ of a second, for the time of passage. Now, to find the remaining velocity, say $825 : .763 = 1670 : 1544, = v$.

But in Mr Robins's experiment the remaining velocity was only 1425, the ball having lost 245; whereas by this computation it should have lost only 126. It appears, therefore, that the resistance is double of what it would have been if the resistance increased in the duplicate proportion of the velocity. Mr Robins says it is nearly triple, But he supposes the resistance to slow motions much smaller than his own experiment, so often mentioned, fully warrants.

The time e, in which the resistance of the air would extinguish the velocity is $0''.763$. Gravity, or the weight of the bullet, would have done it in $\frac{1670}{32}$ or $52''$; therefore the resistance is $\frac{52}{0.763}$ times, or nearly 68 times its weight, by this theory, or 5.97 pounds. If we calculate from Mr Robins's experiment, we must say log. $\frac{V}{v} : 0.43429 = 100 : e\,V$, which will be 630.23, and $e = \frac{630.23}{1670} = 0''.3774$, and $\frac{52}{0.3774}$ gives 138 for the proportion of the resistance to the weight, and makes the resistance 12.07 pounds, fully double of the other.

It is to be observed that with this velocity, which greatly exceeds that with which the air can rush into a void, there must be a statical pressure of the atmosphere equal to $6\frac{1}{4}$ pounds. This will make up the difference, and allows us to conclude that the resistance arising solely from the motion communicated to the air follows very nearly the duplicate proportion of the velocity.

The next experiment, with a velocity of 1690 feet, gives a resistance equal to 157 times the weight of the bullet, and this bears a much greater proportion to the former than 1690^2 does to 1670^2, which shows, that although these experiments clearly demonstrate a prodigious augmentation of resistance, yet they are by no means susceptible of the precision which is necessary for discovering the law of this augmentation, or for a good foundation of practical rules; and it is still greatly to be wished that a more accurate mode of investigation could be discovered.

59 Recapitulation.

Thus we have explained, in great detail, the principles and the process of calculation for the simple case of the motion of projectiles through the air. The learned reader will think that we have been unreasonably prolix, and that the whole might have been comprised in less room by taking the algebraic method. We acknowledge that it might have been done even in a few lines. But we have observed, and our observation has been confirmed by persons well versed in such subjects, that in all cases where the fluxionary process introduces the fluxion of a logarithm, there is a great want of distinct ideas to accompany the hand and eye. The solution comes out by a sort of magic or legerdemain, we cannot tell either *how* or *why*. We therefore thought it our duty to furnish the reader with distinct conceptions of the things and quantities treated of. For this reason, after showing, in Sir Isaac Newton's manner, how the spaces described in the retarded motion of a projectile followed the proportion of the hyperbolic areas, we shewed the nature of another curve, where lines could be found which increase in the very same manner as the path of the projectile increases; so that a point describing the abscissa MI of this curve moves precisely as the projectile does. Then, discovering that this line is the same with the line of logarithms on a Gunter's scale, we shewed how the logarithm of a number really represents the path or space described by the projectile.

Having thus, we hope, enabled the reader to conceive distinctly the quantities employed, we shall leave the geometrical method, and prosecute the rest of the subject in a more compendious manner.

60 Of the perpendicular ascents of heavy projectiles.

We are, in the next place, to consider the perpendicular ascents and descents of *heavy* projectiles, where the resistance of the air is combined with the action of gravity: and we shall begin with the descents.

Let u, as before, be the terminal velocity, and g the accelerating power of gravity: When the body moves with the velocity u, the resistance is equal to g; and in every other velocity v, we must have $u^2 : v^2 = g : \frac{g\,v^2}{u^2}, = r$, for the resistance to that velocity. In the descent the body is urged by gravity g, and opposed by the resistance $\frac{g\,v^2}{u^2}$: therefore the remaining accelerating force, which we shall call f, is $g - \frac{g\,v^2}{u^2}$, or $\frac{g\,u^2 - g\,v^2}{u^2}$, or $\frac{g(u^2 - v^2)}{u^2}, = f$.

Now the fundamental theorem for varied motions is $f\dot{s} = u\dot{v}$, and $\dot{s} = \frac{v\dot{v}}{f}, = \frac{u^2}{g} \times \frac{v\dot{v}}{u^2 - v^2}$, and $s = \frac{u^2}{g} \times \int \frac{v\dot{v}}{u^2 - v^2} + C$. Now the fluent of $\frac{v\dot{v}}{u^2 - v^2}$ is $= -$ hyperb. log. of $\sqrt{u^2 - v^2}$. For the fluxion of $\sqrt{u^2 - v^2}$ is $\frac{-v\dot{v}}{\sqrt{u^2 - v^2}}$, and this divided by the quantity $\sqrt{u^2 - v^2}$, of which it is the fluxion, gives precisely $\frac{u\dot{v}}{u^2 - v^2}$, which is therefore the fluxion of its hyperbolic logarithm. Therefore $S = -\frac{u^2}{g} \times L\sqrt{u^2 - v^2} + C$. Where L means the hyperbolic logarithm of the quantity annexed to it, and λ may be used to express its common logarithm. (See article Fluxions).

The constant quantity C for completing the fluent is determined from this consideration, that the space described is o, when the velocity is o: therefore $C - \frac{u^2}{g} \times L\sqrt{u^2} = o$, and $C = \frac{u^2}{g} \times L\sqrt{u^2}$, and the complete fluent $S = \frac{u^2}{g} \times \overline{L\sqrt{u^2} - L\sqrt{u^2 - v^2}}$, $= \frac{u^2}{g} \times L\sqrt{\frac{u^2}{u^2 - v^2}}, = \frac{u^2}{0.43429\,g} \times \lambda\sqrt{\frac{u^2}{u^2 - v^2}}$, or (putting M for 0.43429, the modulus or subtangent of the common logistic curve) $= \frac{u^2}{Mg} \times \lambda\sqrt{\frac{u^2}{u^2 - v^2}}$.

This

This equation establishes the relation between the space fallen through, and the velocity acquired by the fall. We obtain by it $\frac{gS}{u^2}=L\sqrt{\frac{u^2}{u^2-v^2}}$, and $\frac{2gS}{u^2}=L.\frac{u^2}{u^2-v^2}$, or, which is still more convenient for us, $\frac{M\times 2gS}{u^2}=\lambda\frac{u^2}{u^2-v^2}$, that is, equal to the logarithm of a certain number: therefore having found the natural number corresponding to the fraction $\frac{M\times 2gS}{u^2}$, consider it as a logarithm, and take out the number corresponding to it: call this n. Then, since n is equal to $\frac{u^2}{u^2-v^2}$, we have $nu^2-nv^2=u^2$, and $nu^2-u^2=nv^2$, or $nv^2=u^2\times\overline{n-v}$, and $v^2=\frac{u^2\times\overline{n-1}}{n}$.

To expedite all the computations on this subject, it will be convenient to have multipliers ready computed for $M\times 2g$, and its half,

viz. 27,794, whose log. is	- -	1.44396
and 13,897	- - - -	1.14293.

But v may be found much more expeditiously by observing that $\sqrt{\frac{u^2}{u^2-v^2}}$ is the secant of an arch of a circle whose radius is u, and whose sine is v, or whose radius is unity and sine $=\frac{v}{u}$: therefore, considering the above fraction as a logarithmic secant, look for it in the tables, and then take the sine of the arc of which this is the secant, and multiply it by u; the product is the velocity required.

We shall take an example of a ball whose terminal velocity is $689\frac{1}{3}$ feet, and ascertain its velocity after a fall of 1848 feet. Here,

$u^2=475200$	and its log. -	$=5.67688$
$u=689\frac{1}{3}$	- - - -	2.83844
$g=32$	- - - - -	1.50515
$S=1848$	- - - -	3.26670
Then log. 27,794	- - -	$+$ 1.44396
log. S	- - -	$+$ 5.26670
log. u^2	- - -	$-$ 5.67688
Log. of 0,10809 = log. n	- -	9.03378

0,10809 is the logarithm of $1,2826=n$, and $n-1=0,2826$, and $\frac{u^2\times\overline{n-1}}{n}=323,6^2$, $=v^2$, and $v=323,6$.

In like manner, 0,054045 (which is half of 0,10809) will be found to be the logarithmic secant of 28°, whose sine 0,46947 multiplied by $689\frac{1}{3}$ gives 324 for the velocity.

The process of this solution suggests a very perspicuous manner of conceiving the law of descent; and it may be thus expressed:

M is to the logarithm of the secant of an arch whose sine is $\frac{v}{u}$, and radius 1, as $2a$ is to the height through which the body must fall in order to acquire the velocity v. Thus, to take the same example.

1. Let the height h be sought which will produce the velocity 323,62 the terminal velocity of the ball being 689,44. Here $2a$, or $\frac{u^2}{g}$ is 14850, and $\frac{323,62}{689,34}=$ 0,46947, which is the sine of 28°. The logarithmic secant of this arch is 0,05407. Now M or 0,43429 : 0,05407 = 14850 : 1848, the height wanted.

2. Required the velocity acquired by the body by falling 1848 feet. Say 14850 : 1848 = 0,43429 : 0,05407. Look for this number among the logarithmic secants. It will be found at 28°, of which the logarithmic sine is

garithmic sine is	- - -	9.67161
Add to this the log. of u	- -	2.83844
The sum	- - -	2.51005

is the logarithm of 323,62, the velocity required.

We may observe, from these solutions, that the acquired velocity continually approaches to, but never equals, the terminal velocity. For it is always expressed by the sine of an arch of which the terminal velocity is the radius. We cannot help taking notice here of a very strange assertion of Mr Muller, late professor of mathematics and director of the royal academy at Woolwich. He maintains, in his Treatise on Gunnery, his Treatise of Fluxions, and in many of his numerous works, that a body cannot possibly move through the air with a greater velocity than this; and he makes this a fundamental principle, on which he establishes a theory of motion in a resisting medium, which he asserts with great confidence to be the only just theory; saying, that all the investigations of Bernoulli, Euler, Robins, Simpson, and others, are erroneous. We use this strong expression, because, in his criticisms on the works of those celebrated mathematicians, he lays aside good manners, and taxes them not only with ignorance, but with dishonesty; saying, for instance, that it required no small dexterity in Robins to confirm by his experiments a theory founded on false principles; and that Thomas Simpson, in attempting to conceal his obligations to him for some valuable propositions, by changing their form, had ignorantly fallen into gross errors.

61 Erroneous assertion of Mr Muller.

Nothing can be more palpably absurd than this assertion of Mr Muller. A blown bladder will have but a small terminal velocity; and when moving with this velocity, or one very near it, there can be no doubt that it will be made to move much swifter by a smart stroke. Were the assertion true, it would be impossible for a portion of air to be put into motion through the rest, for its terminal velocity is nothing. Yet this author makes this assertion a principle of argument, saying, that it is impossible that a ball can issue from the mouth of a cannon with a greater velocity than this; and that Robins and others are grossly mistaken, when they give them velocities three or four times greater, and resistances which are 10 or 20 times greater than is possible; and by thus compensating his small velocities by still smaller resistances, he confirms his theory by many experiments adduced in support of the others. No reason whatever can be given for the assertion. Newton, or perhaps Huygens, was the first who observed that there was a limit to the velocity which gravity could communicate to a body; and this limit was found by his commentators to be a term to which it was vastly convenient to refer all its other motions. It therefore became

became an object of attention; and Mr Muller, through inadvertency, or want of discernment, has fallen into this mistake, and with that arrogance and self-conceit which mark all his writings, has made this mistake a fundamental principle, because it led him to establish a novel set of doctrines on this subject. He was fretted at the superior knowledge and talents of Mr Simpson, his inferior in the academy, and was guilty of several mean attempts to hurt his reputation. But they were unsuccessful.

62 Motion of a body projected downwards.

We might proceed to consider the motion of a body projected downwards. While the velocity of projection is less than the terminal velocity, the motion is determined by what we have already said: for we must compute the height necessary for acquiring this velocity in the air, and suppose the motion to have begun there. But if the velocity of projection be greater, this method fails. We pass it over (though not in the least more difficult than what has gone before), because it is of mere curiosity, and never occurs in any interesting case. We may just observe, that since the motion is swifter than the terminal velocity, the resistance must be greater than the weight, and the motion will be retarded. The very same process will give us for the space described $S = \frac{u^2}{g} \times L\sqrt{\frac{V^2-u^2}{v^2-u^2}}$, V being the velocity of projection, greater than u. Now as this space evidently increases continually (because the body always falls), but does not become infinite in any finite time, the fraction $\frac{V^2-u^2}{v^2-u^2}$ does not become infinite; that is, v^2 does not become equal to u^2: therefore although the velocity V is continually diminished, it never becomes so small as u. Therefore u is a limit of diminution as well as of augmentation.

63 Relation between the time of descent and space described, &c.

We must now ascertain the relation between the time of the descent and the space described, or the velocity acquired. For this purpose we may use the other fundamental proposition of varied motions $f\dot{t} = \dot{v}$, which, in the present case, becomes $g\frac{u^2-v^2}{u^2}\dot{t} = \dot{v}$; therefore $\dot{t} = \frac{u^2}{g} \times \frac{\dot{v}}{u^2-v^2}, = \frac{u}{g} \times \frac{u\dot{v}}{u^2-v^2}$, and $t = \frac{u}{g} \times \int \frac{u\dot{v}}{u^2-v^2}$. Now (article FLUXIONS) $\int \frac{u\dot{v}}{u^2-v^2} = L\sqrt{\frac{u+v}{u-v}}$. Therefore $t = \frac{u}{g} \times L\sqrt{\frac{u+v}{u-v}}, = \frac{u}{Mg} \times \lambda\sqrt{\frac{u+v}{u-v}}$. This fluent needs no constant quantity to complete it, or rather $C = o$; for t must be $= o$ when $v = o$. This will evidently be the case: for then $L\sqrt{\frac{u+v}{u-v}}$ is $L\sqrt{\frac{u}{u}}, = L\,1, = o$.

But how does this quantity $\frac{u}{Mg} \times \lambda\sqrt{\frac{u+v}{u-v}}$ signify a time? Observe, that in whatever numbers, or by whatever units of space and time, u and g are expressed, $\frac{u}{g}$ expresses the number of units of time in which the velocity u is communicated or extinguished by gravity; and $L\sqrt{\frac{u+v}{u-v}}$, or $\frac{\lambda}{M}\sqrt{\frac{u+v}{u-v}}$, is always an abstract number, multiplying this time.

We may illustrate this rule by the same example. In what time will the body acquire the velocity 323,62? Here $u + v = 1012{,}96$, $u - v = 365{,}72$; therefore $\lambda\sqrt{\frac{u+v}{u-v}} = 0.22122$, and $\frac{u}{g}$ (in feet and seconds) is $21'',542$. Now, for greater perspicuity, convert the equation $t = \frac{u}{Mg} \times \lambda\sqrt{\frac{u+v}{u-v}}$ into a proportion: thus $M : \lambda\sqrt{\frac{u+v}{u-v}} = \frac{u}{g} : t$, and we have $0{,}43429 : 0{,}22122 = 21'', 542 : 10'',973$ the time required.

This is by far the most distinct way of conceiving the subject; and we should always keep in mind that the numbers or symbols which we call logarithms are really parts of the line MI in the figure of the logistic curve, and that the motion of a point in this line is precisely similar to that of the body. The Marquis Poleni, in a dissertation published at Padua in 1725, has with great ingenuity constructed logarithmics suited to all the cases which can occur. Herman, in his *Phoronomia*, has borrowed much of Poleni's methods, but has obscured them by an affectation of language geometrically precise, but involving the very obscure notion of abstract ratios.

It is easy to see that $\sqrt{\frac{u+v}{u-v}}$ is the cotangent of the $\frac{1}{2}$ complement of an arch, whose radius is 1, and whose sine is $\frac{v}{u}$: For let KC (fig. 6.) be $= u$, and BE $= v$; then KD $= u + v$, and DA $= u - v$. Join KB and BA, and draw CG parallel to KB. Now GA is the tangent of $\frac{1}{2}$ BA, $= \frac{1}{2}$ complement of HB. Then, by similarity of triangles, GA : AC $=$ AB $=$: BK $=$ $\sqrt{AD} : \sqrt{DK} = \sqrt{u-v} : \sqrt{u+v}$ and $\frac{AC}{GA}$ ($=$ cotan. $\frac{1}{2}$BA) $= \sqrt{\frac{u+v}{u-v}}$; therefore look for $\frac{v}{u}$ among the natural sines, or for log. $\frac{v}{u}$ among the logarithmic sines, and take the logarithmic cotangent of the half complement of the corresponding arch. This, considered as a common number, will be the second term of our proportion. This is a shorter process than the former. Fig. 6.

By reversing this proportion we get the velocity corresponding to a given time.

64 Fall of a body in air compared with that of one in vacuo.

To compare this descent of 1848 feet in the air with the fall of the body *in vacuo* during the same time, say $\overline{21'',542}^2 : \overline{10'',973}^2 = 1848 : 1926{,}6$, which makes a difference of 79 feet.

Cor. 1. The time in which the body acquires the velocity u by falling through the air, is to the time of acquiring the same velocity by falling *in vacuo*, as u. $L\sqrt{\frac{u+v}{u-v}}$ to v; for it would acquire this velocity *in vacuo*

vacuo during the time $\frac{v}{g}$, and it acquires it in the air in the time $\frac{u}{g}\mathrm{L}\sqrt{\frac{u+v}{u-v}}$.

2. The velocity which the body acquires by falling through the air in the time $\frac{u}{g}\mathrm{L}\sqrt{\frac{u+v}{u-v}}$, is to the velocity which it would acquire *in vacuo* during the same time, as v to $u\,\mathrm{L}\sqrt{\frac{u+v}{u-v}}$: For the velocity which it would acquire *in vacuo* during the time $\frac{u}{g}$ $\mathrm{L}\sqrt{\frac{u+v}{u-v}}$ must be $u\,\mathrm{L}\sqrt{\frac{u+v}{u-v}}$ (because in any time $\frac{w}{g}$ the velocity w is acquired).

65 Time of the ascent of a body projected perpendicularly.

In the next place, let a body, whose terminal velocity is u, be projected perpendicularly upwards, with any velocity V. It is required to determine the height to which it ascends, so as to have any remaining velocity v, and the time of its ascent; as also the height and time in which its whole motion will be extinguished.

We have now $\frac{g(u^2+v^2)}{u^2}$ for the expression of f; for both gravity and resistance act now in the same direction, and retard the motion of the ascending body: therefore $\frac{g(u^2+v^2)}{u^2}\dot{s}=-v\dot{v}$, and $\dot{s}=-\frac{u^2}{g}\times\frac{v\dot{v}}{u^2+v^2}$, and $s=-\frac{u^2}{g}\times\int\frac{v\dot{v}}{u^2+v^2}+\mathrm{C}, =-\frac{u^2}{g}\times\mathrm{L}\sqrt{u^2+v^2}+$ C (see art. FLUXIONS). This must be $=o$ at the beginning of the motion, that is, when $v=\mathrm{V}$, that is $-\frac{u^2}{g}\times\mathrm{L}\sqrt{u^2+\mathrm{V}^2}+\mathrm{C}=o$, or $\mathrm{C}=\frac{u^2}{g}\times\mathrm{L}\sqrt{u^2+v^2}$, and the complete fluent will be $s=\frac{u^2}{g}\times\mathrm{L}\sqrt{u^2+\mathrm{V}^2}-$ $\mathrm{L}\sqrt{u^2+v^2})=\frac{u^2}{g}\times\mathrm{L}\sqrt{\frac{u^2+\mathrm{V}^2}{u^2+v^2}}=\frac{u^2}{\mathrm{M}g}\times\lambda\sqrt{\frac{u^2+\mathrm{V}^2}{u^2+v^2}}$.

Let h be the greatest height to which the body will rise. Then $s=h$ when $v=o$; and $h=\frac{u^2}{g}\times$ $\mathrm{L}\sqrt{\frac{u^2+\mathrm{V}^2}{u^2}}=\frac{u^2}{\mathrm{M}g}\times\lambda\sqrt{\frac{u^2+\mathrm{V}^2}{u^2}}$. We have $\lambda\sqrt{\frac{u^2+\mathrm{V}^2}{u^2+v^2}}=s\frac{mg}{u^2}$; therefore $\lambda\left(\frac{u^2+\mathrm{V}^2}{u^2+v^2}\right)=\frac{2\mathrm{M}gs}{u^2}$. Therefore let n be the number whose common logarithm is $\frac{2\mathrm{M}gs}{u^2}$; we shall have $n=\frac{u^2+\mathrm{V}^2}{u^2+v^2}$, and $v^2=\frac{u^2+\mathrm{V}^2}{n}$ $-u^2$; and thus we obtain the relation of s and v, as in the case of descents: but we obtain it still easier by observing that $\sqrt{u^2+\mathrm{V}^2}$ is the secant of an arch whose radius is u, and whose tangent is V, and that $\sqrt{u^2+v^2}$ is the secant of another arch of the same circle, whose tangent is v.

Let the same ball be projected upwards with the velocity 411,05 feet per second. Required the whole height to which it will rise?

Here $\frac{\mathrm{V}}{u}$ will be found the tangent of 30.48½, the logarithmic secant of which is 0,06606. This, multiplied by $\frac{u^2}{\mathrm{M}g}$, gives 2259 feet for the height. It would have risen 2640 feet in a void.

Suppose this body to fall down again. We can 66 Velocity of projection compared with that with which it reaches the ground.
compare the velocity of projection with the velocity with which it again reaches the ground. The ascent and descent are equal: therefore $\sqrt{\frac{u^2+\mathrm{V}^2}{u^2}}$, which multiplies the constant factor in the ascent, is equal to $\sqrt{\frac{u^2}{u^2-v^2}}$, the multiplier in the descent. The first is the secant of an arch whose tangent is V; the other is the secant of an arch whose sine is v. These secants are equal, or the arches are the same; therefore the velocity of projection is to the final returning velocity as the tangent to the sine, or as the radius to the cosine of the arch. Thus suppose the body projected with the terminal velocity, or $\mathrm{V}=u$; then $v=\frac{u}{\sqrt{2}}$. If $\mathrm{V}=689$, $v=487$.

We must in the last place ascertain the relation of the space and the time.

Here $\frac{g(u^2+v^2)}{u^2}\dot{t}=-\dot{v}$, and $\dot{t}=-\frac{u^2}{g}\times\frac{\dot{v}}{u^2+v^2}$, $=$ $-\frac{u}{g}\times\frac{u\dot{v}}{u^2+v^2}$, and $t=\frac{-u}{g}\times\int\frac{u\dot{v}}{u^2+v^2}+\mathrm{C}$. Now (art. FLUXIONS) $\int\frac{u\dot{v}}{u^2+v^2}$ is an arch whose tangent $=\frac{v}{u}$ and radius 1; therefore $t=-\frac{u}{g}\times\text{arc. tan.}\frac{v}{u}+\mathrm{C}$. This must be $=o$ when $v=\mathrm{V}$, or $\mathrm{C}-\frac{u}{g}\times\text{arc. tan.}$ $\frac{\mathrm{V}}{u}=o$, and $\mathrm{C}=\frac{u}{g}\times\text{arc. tan.}\frac{\mathrm{V}}{g}$, and the complete fluent is $t=\frac{u}{g}\times\left(\text{arc. tan.}\frac{\mathrm{V}}{u}-\text{arc. tan.}\frac{v}{u}\right)$. The quantities within the brackets express a portion of the arch of a circle whose radius is unity; and are therefore abstract numbers, multiplying $\frac{u}{g}$, which we have shown to be the number of units of time in which a heavy body falls *in vacuo* from the height a, or in which it acquires the velocity u.

67 Time of ascent limited.

We learn from this expression of the time, that however great the velocity of projection, and the height to which this body will rise, may be, the time of its ascent is limited. It never can exceed the time of falling from the height a *in vacuo* in a greater proportion than that of a quadrantal arch to the radius, nearly the proportion of 8 to 5. A 24 pound iron ball cannot continue rising above 14 seconds, even if the resistance to quick motions did not increase faster than the square of the velocity. It probably will attain its greatest height in less than 12 seconds, let its velocity be ever so great.

In the preceding example of the whole ascent, $v=o$, and

and the time $t = \frac{u}{g} \times$ arc. tan. $\frac{V}{u}$, or $\frac{u}{g}$ arc. $30^{\circ}.\ 48'$. Now $30^{\circ}.\ 48' = 1848'$, and the radius 1 contains 3438; therefore the arch $= \frac{1848}{3438}, = 0{,}5376$; and $\frac{u}{g} = 21'',54$. Therefore $t = 21'',54 \times 0{,}5376, = 11'',58$, or nearly $11\frac{1}{2}$ seconds. The body would have risen to the same height in a void in $10\frac{1}{4}$ seconds.

68 This time compared in bodies projected in air and in vacuo.

Cor. 1. The time in which a body, projected in the air with any velocity V, will attain its greatest height, is to that in which it would attain its greatest height *in vacuo*, as the arch whose tangent expresses the velocity is to the tangent; for the time of the ascent in the air is $\frac{u}{g} \times$ arch; the time of the ascent *in vacuo* is $\frac{V}{g}$. Now $\frac{V}{g}$ is $=$ tan. and $V = u \times$ tan. and $\frac{V}{g} = \frac{u}{g} \times$ tan.

Fig. 6.

It is evident, by inspecting fig. 6. that the arch AI is to the tangent AG as the sector ICA to the triangle GCA; therefore the time of attaining the greatest height in the air is to that of attaining the greatest height *in vacuo* (the velocities of projection being the same), as the circular sector to the corresponding triangle.

If therefore a body be projected upwards with the terminal velocity, the time of its ascent will be to the time of acquiring this velocity *in vacuo* as the area of a circle to the area of the circumscribed square.

2. The height H to which a body will rise in a void, is to the height h to which it would rise through the air when projected with the same velocity V as $M \cdot V^2$ to $u^2 \times \lambda \frac{u^2 + V^2}{u^2}$: for the height to which it will rise *in vacuo* is $\frac{V^2}{2g}$, and the height to which it rises in the air is

$$\frac{u^2}{Mg} \lambda \sqrt{\frac{u^2 + V^2}{u^2}}; \text{ therefore } H : h = \frac{V^2}{2g} : \frac{u^2}{Mg} \lambda \sqrt{\frac{u^2 + V^2}{u^2}}, = V^2 : \frac{u^2}{M} \times 2\lambda \sqrt{\frac{u^2 + V^2}{u^2}}, = V^2 : \frac{u^2}{M} \times \lambda \frac{u^2 \times V^2}{u^2}, = M \cdot V^2 : u^2 \times \lambda \frac{u^2 + V^2}{u^2}.$$

Therefore if the body be projected with its terminal velocity, so that $V = u$, the height to which it will rise in the air is $\frac{30103}{43429}$ of the height to which it will rise *in vacuo*, or $\frac{5}{7}$ in round numbers.

We have been thus particular in treating of the perpendicular ascents and descents of heavy bodies through the air, in order that the reader may conceive distinctly the quantities which he is thus combining in his algebraic operations, and may see their connection in nature with each other. We shall also find that, in the present state of our mathematical knowledge, this simple state of the case contains almost all that we can determine with any confidence. On this account it were to be wished that the professional gentlemen would make many experiments on these motions. There is no way that promises so much for assisting us in forming accurate notions of the air's resistance. Mr Robins's method with the pendulum is impracticable with great shot; and the experiments which have been generally resorted to for this purpose, viz. the ranges of shot and shells on a horizontal plane, are so complicated in themselves, that the utmost mathematical skill is necessary for making any inferences from them; and they are subject to such irregularities, that they may be brought to support almost any theory whatever on this subject. But the perpendicular flights are affected by nothing but the initial velocity and the resistance of the air; and a considerable deviation from their intended direction does not cause any sensible error in the consequences which we may draw from them for our purpose.

69 [N]ecessity [of] further [ex]peri[me]nts.

70 Of oblique projection.

But we must now proceed to the general problem, to determine the motion of a body projected in any direction, and with any velocity. Our readers will believe beforehand that this must be a difficult subject, when they see the simplest cases of rectilineal motion abundantly abstruse: it is indeed so difficult, that Sir Isaac Newton has not given a solution of it, and has thought himself well employed in making several approximations, in which the fertility of his genius appears in great lustre. In the tenth and subsequent propositions of the second book of the *Principia*, he shows what state of density in the air will comport with the motion of a body in any curve whatever: and then, by applying this discovery to several curves which have some similarity to the path of a projectile, he finds one which is not very different from what we may suppose to obtain in our atmosphere. But even this approximation was involved in such intricate calculations, that it seemed impossible to make any use of it. In the second edition of the *Principia*, published in 1713, Newton corrects some mistakes which he had committed in the first, and carries his approximations much farther, but still does not attempt a direct investigation of the path which a body will describe in our atmosphere. This is somewhat surprising. In prop. 14. &c. he shows how a body, actuated by a centripetal force, in a medium of a density varying according to certain laws, will describe an eccentric spiral, of which he assigns the properties, and the law of description. Had he supposed the density constant, and the difference between the greatest and least distances from the centre of centripetal force exceedingly small in comparison with the distances themselves, his spiral would have coincided with the path of a projectile in the air of uniform density, and the steps of his investigation would have led him immediately to the complete solution of the problem. For this is the real state of the case. A heavy body is not acted on by equal and parallel gravity, but by a gravity inversely proportional to the square of the distance from the centre of the earth, and in lines tending to that centre nearly; and it was with the view of simplifying the investigation, that mathematicians have adopted the other hypothesis.

71 This problem not solved by Newton.

72 Disputes among British and foreign mathematicians.

Soon after the publication of this second edition of the *Principia*, the dispute about the invention of the fluxionary calculus became very violent, and the great promoters of that calculus upon the continent were in the habit of proposing difficult problems to exercise the talents of the mathematician. Challenges of this kind frequently passed between the British and foreigners.

Dr

Dr Keill of Oxford had keenly espoused the claim of Sir Isaac Newton to this invention, and had engaged in a very acrimonious altercation with the celebrated John Bernoulli of Basle. Bernoulli had published in the *Acta Eruditorum Lipsiæ* an investigation of the law of forces, by which a body moving in a resisting medium might describe any proposed curve, reducing the whole to the simplest geometry. This is perhaps the most elegant specimen which he has given of his great talents. Dr Keill proposed to him the particular problem of the trajectory and motion of a body moving through the air, as one of the most difficult. Bernoulli very soon solved the problem in a way much more general than it had been proposed, viz. without any limitation either of the law of resistance, the law of the centripetal force, or the law of density, provided only that they were regular, and capable of being expressed algebraically. Dr Brook Taylor, the celebrated author of the Method of Increments, solved it at the same time, in the limited form in which it was proposed. Other authors since that time have given other solutions. But they are all (as indeed they must be) the same in substance with Bernoulli's. Indeed they are all (Bernoulli's not excepted) the same with Newton's first approximations, modified by the steps introduced into the investigation of the spiral motions mentioned above; and we still think it most strange that Sir Isaac did not perceive that the *variation of curvature*, which he introduced in that investigation, made the whole difference between his approximations and the complete solution. This we shall
73 Bernoulli's solution. point out as we go along. And we now proceed to the problem itself, of which we shall give Bernoulli's solution, restricted to the case of uniform density and a resistance proportional to the square of the velocity. This solution is more simple and perspicuous than any that has since appeared.

PROBLEM. To determine the trajectory, and all the circumstances of the motion of a body projected
Fig. 7. through the air from A (fig. 7.) in the direction AB, and resisted in the duplicate ratio of the velocity.

Let the arch AM be put$=z$, the time of describing it t, the abscissa AP$=x$, the ordinate PM$=y$. Let the velocity in the point M$=v$, and let MN$=\dot{z}$, be described in the moment $\dot{t}$; let r be the resistance of the air, g the force of gravity, measured by the velocity which it will generate in a second; and let a be the height through which a heavy body must fall *in vacuo* to acquire the velocity which would render the resistance of the air equal to its gravity: so that we have $r=\frac{v^2}{2a}$; because, for any velocity u, and producing height h, we have $g=\frac{u^2}{2h}$.

Let M m touch the curve in M; draw the ordinate p N m, and draw M o, N n perpendicular to N p and M m. Then we have MN $=\dot{z}$, and M $o=\dot{x}$, also $m\,o$ is ultimately $=\dot{y}$ and M m is ultimately$=$MN or $\dot{z}$.
74 Action of gravity in a given time. Lastly, let us suppose $\dot{x}$ to be a constant quantity, the elementary ordinates being supposed equidistant.

The action of gravity during the time $\dot{t}$ may be measured by m N, which is half the space which it would cause the body to describe uniformly in the time $\dot{t}$ with the velocity which it generates in that time. Let this be resolved into n N, by which it deflects the body into a curvilineal path, and $m\,n$, by which it retards the ascent and accelerates the descent of the body along the tangent. The resistance of the air acts solely in retarding the motion, both in ascending and descending, and has no deflective tendency. The whole action of gravity then is to its accelerating or retarding tendency as m N to $m\,n$, or (by similarity of triangles) as m M to $m\,o$. Or $\dot{z}:\dot{y}=g:\frac{g\dot{y}}{\dot{z}}$, and the whole retardation in the ascent will be $r+\frac{g\dot{y}}{\dot{z}}$. The same fluxionary symbol will express the retardation during the descent, because in the descent the ordinates decrease, and $\dot{y}$ is a negative quantity.

The diminution of velocity is $-\dot{v}$. This is proportional to the retarding force and to the time of its action jointly, and therefore $-\dot{v}=\overline{r+\frac{g\dot{y}}{\dot{z}}}\times\dot{t}$; but the time $\dot{t}$ is as the space $\dot{z}$ divided by the velocity v; therefore $-\dot{v}=\overline{r+\frac{g\dot{y}}{\dot{z}}}\times\frac{\dot{z}}{v},=-\frac{r\dot{z}+g\dot{y}}{v}$, and $-v\dot{v}=-r\dot{z}-g\dot{y}=\frac{v^2\dot{z}}{2a}-g\dot{y}$. Because m N is the deflection by gravity, it is as the force g and the square of the time $\dot{t}$ jointly (the momentary action being held as uniform), We have therefore m N, or $-\ddot{y}=g\dot{t}^2$. (Observe that m N is in fact only the half of$-\ddot{y}$; but g being twice the fall of a heavy body in a second, we have $-\ddot{y}$ strictly equal to $g\dot{t}^2$). But $\dot{t}^2=\frac{\dot{z}^2}{v^2}$; therefore $-\ddot{y}=\frac{g\dot{z}^2}{v^2}$, and $v^2=\frac{g\dot{z}^2}{-\ddot{y}}$ and $-v^2\ddot{y}=g\dot{z}^2$. The fluxion of this equation is $-v^2\dddot{y}-2v\ddot{y}\dot{v}=2g\dot{z}\ddot{z}$; but, because $\dot{z}:\dot{y}=m$ M $:m\,o,=m$ N $:m\,n,=\ddot{y}:\ddot{z}$, we have $\dot{z}\ddot{z}=\dot{y}\ddot{y}$. Therefore $2g\dot{y}\ddot{y}=2g\dot{z}\ddot{z},=-v^2\dddot{y}-2v\ddot{y}\dot{v}$, and $-2v\dot{v}\ddot{y}=v^2\dddot{y}-2g\dot{y}\ddot{y}$, and $-v\dot{v}=\frac{v^2\dddot{y}}{2\ddot{y}}-g\dot{y}$. But we have already $-v\dot{v}=\frac{v^2\dot{z}}{2a}-g\dot{y}$; therefore $\frac{v^2\dddot{y}}{\ddot{y}}=\frac{v^2\dot{z}}{a}$, and finally $\frac{\dddot{y}}{\ddot{y}}=\frac{\dot{z}}{a}$, or $a\dddot{y}=\dot{z}\ddot{y}$, for the fluxionary equation of the curve.

If we put this into the form of a proportion, we have $a:\dot{z}=\ddot{y}:\dddot{y}$. Now this evidently establishes a relation between the length of the curve and its variation of curvature; and between the curve itself and its evoluta, which are the very circumstances introduced by Newton 75 Relation between the length of the curve and its variation of curvature.

Newton into his investigation of the spiral motions. And the equation $\frac{\dot{z}}{a}=\frac{\dddot{y}}{\ddot{y}}$ is evidently an equation connected with the logarithmic curve and the logarithmic spiral. But we must endeavour to reduce it to a lower order of fluxions, before we can establish a relation between z, x, and y.

Let p express the ratio of $\dot{y}$ to $\dot{x}$, that is, let p be $=\frac{\dot{y}}{\dot{x}}$, or $p\,\dot{x}=\dot{y}$. It is evident that this expresses the inclination of the tangent at M to the horizon, and that p is the tangent of this inclination, radius being unity. Or it may be considered merely as a number, multiplying $\dot{x}$, so as to make it $=\dot{y}$. We now have $\dot{y}^2=p^2\dot{x}^2$, and since $\dot{z}^2=\dot{x}^2+\dot{y}^2$, we have $\dot{z}^2=\dot{x}^2+p^2\dot{x}^2$, $=\overline{1+p^2}\times\dot{x}^2$, and $\dot{z}=\dot{x}\sqrt{1+p^2}$.

Moreover, because we have supposed the abscissa x to increase uniformly, and therefore $\dot{x}$ to be constant, we have $\ddot{y}=\dot{x}\,\dot{p}$, and $\dddot{y}=\dot{x}\,\ddot{p}$. Now let q express the ratio of $\dot{p}$ to $\dot{x}$, that is, make $\frac{\dot{p}}{\dot{x}}=q$, or $q\,\dot{x}=\dot{p}$. This gives us $\dot{x}\,\dot{q}=\ddot{p}$, and $\dot{x}^2\dot{q}=\dot{x}\,\ddot{p}$, $=\dddot{y}$.

By these substitutions our former equation $a\,\dddot{y}=\dot{z}\,\ddot{y}$ changes to $a\,\dot{x}^2\dot{q}=\dot{x}\sqrt{\overline{1+p^2}}\,\dot{x}\,\dot{p}$, or $a\,\dot{q}=\dot{p}\sqrt{1+p^2}$, and, taking the fluent on both sides, we have $a\,q=\int\dot{p}\sqrt{1+p^2}+C$, C being the constant quantity required for completing the fluent according to the limiting conditions of the case. Now $\dot{x}=\frac{\dot{p}}{q}$, and $\frac{1}{q}=$

$$\int,\frac{a}{\dot{p}\sqrt{\overline{1+p^2}}+C}.\ \text{Therefore}\ \dot{x}=\int,\frac{a\,\dot{p}}{\dot{p}\sqrt{\overline{1+p^2}}+C}.$$

Also, since $\dot{y}=p\,\dot{x}$, $=\frac{p\dot{p}}{q}$, we have $\dot{y}=$

$$\int,\frac{a\,p\,\dot{p}}{\dot{p}\sqrt{\overline{1+p^2}}+C}.$$

Also $\dot{z}=\dot{x}\sqrt{\overline{1+p^2}}=\frac{a\,\dot{p}\sqrt{\overline{1+p^2}}}{\int,\dot{p}\sqrt{\overline{1+p^2}}+C}.$

The values of $\dot{x}$, $\dot{y}$, $\dot{z}$, give us

$$x=\int,\frac{a\,\dot{p}}{\int,\dot{p}\sqrt{\overline{1+p^2}}+C},=a\int\frac{\dot{p}}{\int\dot{p}\sqrt{\overline{1+p^2}}+C}.$$

$$y=\int\frac{a\,p\,\dot{p}}{\int,\dot{p}\sqrt{\overline{1+p^2}}+C},=a\int\frac{p\,\dot{p}}{\int\dot{p}\sqrt{\overline{1+p^2}}+C}.$$

$$z=\int,\frac{a\sqrt{\overline{1+p^2}}\,\dot{p}}{\int,\dot{p}\sqrt{\overline{1+p^2}}+C},=a\int\frac{\dot{p}\sqrt{\overline{1+p^2}}}{\int,\dot{p}\sqrt{\overline{1+p^2}}+C}.$$

The process therefore of describing the trajectory is, 1st, to find q in terms of p by the area of the curve whose abscissa is p and the ordinate is $\sqrt{1+p^2}$.

2d, We get x by the area of another curve whose abscissa is p, and the ordinate is $\frac{1}{q}$.

3d, We get y by the area of a third curve whose abscissa is p, and the ordinate is $\frac{p}{q}$.

The problem of the trajectory is therefore completely solved, because we have determined the ordinate, abscissa, and arch of the curve for any given position of 76
its tangent. It now only remains to compute the magnitudes of these ordinates and abscissæ, or to draw them by a geometrical construction. But in this consists the difficulty. The areas of these curves, which express the lengths of x and y, can neither be computed nor exhibited geometrically, by any accurate method *yet* discovered, and we must content ourselves with approximations. These render the description of the trajectory exceedingly difficult and tedious, so that little advantage has as yet been derived from the knowledge we have got of its properties. It will however greatly assist our conception of the subject to proceed some length in this construction; for it must be acknowledged that very few distinct notions accompany a mere algebraic operation, especially if in any degree complicated, which we confess is the case in the present question.

To compute the magnitude of the ordinate and abscissa.

Let B m NR (fig. 8.) be an equilateral hyperbola, of which B is the vertex, BA the semitransverse axis, which we shall assume for the unity of length. Let AV be the semiconjugate axis = BA, = unity, and AS the assymptote, bisecting the right angle BAV. Let PN, $p\,n$ be two ordinates to the conjugate axis, exceedingly near to each other. Join BP, AN, and draw Bβ, Nν perpendicular to the assymptote, and BC parallel to AP. It is well known that BP is equal to NP. Therefore $PN^2=BA^2+AP^2$. Now since BA=1, if we make AP=p of our formulæ, PN is $\sqrt{1+p^2}$, and Pp is $=\dot{p}$, and the area BAPNB$=\int,\dot{p}\sqrt{\overline{1+p^2}}$: That is to say, the number $\int,\dot{p}\sqrt{1+p^2}$ (for it is a number) has the same proportion to unity of number that the area BAPNB has to BCVA, the unit of surface. This area consists of two parts, the triangle APN, and the hyperbolic sector ABN. APN $=\frac{1}{2}$ AP $\times$ PN, $=\frac{1}{2}p\sqrt{1+p^2}$, and the hyperbolic sector ABN=BN$\nu\beta$, which is equivalent to the hyperbolic logarithm of the number represented by Aν when Aβ is unity. Therefore it is equal to $\frac{1}{2}$ the logarithm of $p+\sqrt{1+p^2}$. Hence we see by the bye that $\int,\dot{p}\sqrt{1+p^2}=\frac{1}{2}p\sqrt{1+p^2}+\frac{1}{2}$ hyperbolic logarithm $\overline{p+\sqrt{1+p^2}}$.

Plate CCCCXLII. fig. 8.

Now let AMD be another curve, such that its ordinates V m, PD, &c. may be proportional to the areas AB m V, ABNP and may have the same proportion to AB, the unity of length, which these areas have to ABCV, the unity of surface. Then VM : VC = V m BA : VCBA, and PD : P ɔ = PNBA : VCBA, &c. These ordinates will now represent $\int,\dot{p}\sqrt{\overline{1+p^2}}$ with reference to a linear unit, as the areas to the hyperbola represented it in reference to a superficial unit.

Again,

Again, in every ordinate make $PD : P\delta = P\delta : PO$, and thus we obtain a reciprocal to PD, or to $\int, \dot{p}\sqrt{1+p^2}$, or equivalent to $\int, \frac{1}{\dot{p}\sqrt{1+p^2}}$. This will evidently be $\frac{\dot{x}}{a\dot{p}}$, and $POop$ will be $\frac{\dot{x}}{a}$, and the area contained between the lines AF, AW, and the curve GEOH, and cut off by the ordinate PO, will represent $\frac{x}{a}$.

Lastly, make $PO : PQ = AV : AP, = 1 : p$; and then $PQqp$ will represent $\frac{\dot{y}}{a}$, and the area ALEQP will represent $\frac{y}{a}$.

But we must here observe, that the fluents expressed by these different areas require what is called the *correction* to accommodate them to the circumstances of the case. It is not indifferent from what ordinate we begin to reckon the areas. This depends on the initial direction of the projectile, and that point of the abscissa AP must be taken for the commencement of all the areas which gives a value of p suited to the initial direction. Thus, if the projection has been made from A (fig. 7.) at an elevation of 45°, the ratio of the fluxions $\dot{x}$ and $\dot{y}$ is that of equality; and therefore the point E of fig. 8. where the two curves intersect and have a common ordinate, evidently corresponds to this condition. The ordinate EV passes through V, so that AV or $p = AB, = 1, =$ tangent 45°, as the case requires. The values of x and of y corresponding to any other point of the trajectory, such as that which has AP for the tangent of the angle which it makes with the horizon, are now to be had by computing the areas VEOP, VEQP.

Fig. 7.

Fig. 8.

Another curve might have been added, of which the ordinates would exhibit the fluxions of the arch of the trajectory $\dot{z} = \frac{a\dot{p}\sqrt{1+p^2}}{\int, \dot{p}\sqrt{1+p^2}|+C}$, and of which the area would exhibit the arch itself. And this would have been very easy, for it is $\dot{z} = a\frac{\dot{p}\sqrt{1+p^2}}{\int, \dot{p}\sqrt{1+p^2}|+C}$, which is evidently the fluxion of the hyperbolic logarithm of $\int, \dot{p}\sqrt{1+p^2}|$. But it is needless, since $\dot{z} = \dot{x}\sqrt{1+p^2}$, and we have already got $\dot{x}$. It is only increasing PO in the ratio of BA to BP.

77 Consequences of knowing the form of the trajectory.

And thus we have brought the investigation of this problem to considerable length, having ascertained the *form* of the trajectory. This is surely done when the ratio of the arch, abscissa, and ordinate, and the position of its tangent, is determined in every point. But it is still very far from a solution, and much remains to be done before we can make any practical application of it. The only general consequence that we can deduce from the premises is, that in every case where the resistance in any point bears the same proportion to the force of gravity, the trajectory will be similar. Therefore, two balls, of the same density, projected in the same direction, will describe similar trajectories if the velocities are in the subduplicate ratio of the diameters. This we shall find to be of considerable practical importance. But let us now proceed to determine the velocity in the different points of the trajectory; and the time of describing its several portions.

78 To determine the velocity in different points.

Recollect, therefore, that $v^2 = \frac{-g\dot{x}^2}{\ddot{y}}$, and that $\dot{z}^2 = \dot{x}^2\overline{1+p^2}$ and $\ddot{y} = \dot{x}\dot{p}$. This gives $v^2 = \frac{-g\dot{x}\overline{1+p^2}}{\dot{p}}$. But $\dot{p} = q\dot{x}$. Therefore $v^2 = \frac{-g\times\overline{1+p^2}}{q}, = \frac{-ag\overline{1+p^2}}{\int, \dot{p}\sqrt{1+p^2}|+C}$, and $v = \sqrt{\frac{-g\overline{1+p^2}}{q}}, = \frac{\sqrt{a}\sqrt{-g}\sqrt{1+p^2}}{\sqrt{\int\dot{p}\sqrt{1+p^2}|+C}}$.

Also $\dot{t}$ was found $= \frac{\dot{z}}{v}, = \frac{\dot{x}\sqrt{1+p^2}}{v}, = \frac{\dot{p}\sqrt{1+p^2}}{qv}$. If we now substitute for v its value just found, we obtain $\dot{t} = \frac{\dot{p}}{\sqrt{-gq}}$, and $t = \int\frac{\dot{p}}{\sqrt{-gq}}, = \int\frac{\dot{p}\sqrt{a}}{\sqrt{-g\int\dot{p}\sqrt{1+p^2}|+C}}, = \frac{\sqrt{a}}{\sqrt{-g}}\times \int\frac{\dot{p}}{\sqrt{\int\dot{p}\sqrt{1+p^2}|+C}}$.

79 Difficulty of accommodating the formulæ to particular cases.

The greatest difficulty still remains, viz. the accommodating these formulæ, which appear abundantly simple, to the particular cases. It would seem at first sight, that all trajectories are similar; since the ratio of the fluxions of the ordinate and abscissa corresponding to any particular angle of inclination to the horizon seems the same in them all: but a due attention to what has been hitherto said on the subject will show us that we have as yet only been able to ascertain the velocity in the point of the trajectory, which has a certain inclination to the horizon, indicated by the quantity p, and the time (reckoned from some assigned beginning) when the projectile is in that point.

To obtain absolute measures of these quantities, the term of commencement must be fixed upon. This will be expressed by the constant quantity C, which is assumed for completing the fluent of $\dot{p}\sqrt{1+p^2}$, which is the basis of the whole construction. We there found $q = \frac{\int, \dot{p}\sqrt{1+p^2}}{a}$. This fluent is in general $q = \frac{C+\int, \dot{p}\sqrt{1+p^2}}{a}$, and the constant quantity C is to be accommodated to some circumstances of the case. Different authors have selected different circumstances. Euler, 80 Euler, in his Commentary on Robins, and in a dissertation in the Memoirs of the Academy of Berlin published in 1753, takes the vertex of the curve for the beginning of his abscissa and ordinate. This is the simplest method of any, for C must then be so chosen that the whole fluent may vanish when $p=o$, which is the case in the vertex of the curve, where the tangent is parallel to the horizon. We shall adopt this method.

Euler's method the simplest.

Fig. 9. Therefore, let AP (fig. 9.) $=x$, PM $=y$, AM $=z$. Put the quantity C which is introduced into the fluent equal to $\frac{n}{a}$. It is plain that n must be a number; for it must be homologous with $\dot p\sqrt{1+p^2}$, which is a number. For brevity's sake let us express the fluent of $\dot p\sqrt{1+p^2}$ by the single letter P; and thus we shall have $x=a\times\int\frac{\dot p}{n+\mathrm{P}}$, $y=a\times\int\frac{p\dot p}{n+\mathrm{P}}$, $z=a\times\int\frac{\dot p\sqrt{1+p^2}}{n+\mathrm{P}}$. And $v^2=\frac{-ag(1+p^2)}{n+\mathrm{P}}$. Now the height h necessary for communicating any velocity v is $\frac{v^2}{2g}=\frac{-ag(1+p^2)}{2g(n+\mathrm{P})},=\frac{-\frac{1}{2}a(1+p^2)}{n+p}$. And lastly, $t=\frac{\sqrt{}}{\sqrt{g}}\int\frac{\dot p}{\sqrt{n+\mathrm{P}}}$.

These fluents, being all taken so as to vanish at the vertex, where the computation commences, and where p is $=o$ (the tangent being parallel to the horizon), we obtain in this case $h=\frac{\frac{1}{2}a}{n}=\frac{a}{2n}$, and $n=\frac{a}{2h}$.

Hence we see that the circumstance which modifies all the curves, distinguishing them from each other, is the velocity (or rather its square) in the highest point of the curve. For h being determined for any body whose terminal velocity is u, n is also determined; and this is the modifying circumstance. Considering it geometrically, it is the area which must be cut off from the area DMAP of fig. 8. in order to determine the ordinates of the other curves.

We must further remark, that the values now given relate only to that part of the area where the body is descending from the vertex. This is evident; for, in order that y may increase as we recede from the vertex, its fluxion must be taken in the opposite sense to what it was in our investigation. *There* we supposed y to increase as the body ascended, and then to diminish during the descent; and therefore the fluxion of y was first positive and then negative.

The same equations, however, will serve for the ascending branch CNA of the curve, only changing the sign of P; for if we consider y as decreasing during the ascent, we must consider q as expressing $\frac{\dot p}{\dot x}$, and therefore P, or $\int\dot p\sqrt{1+p^2}$, which is $=\frac{q}{a}$, must be taken negatively. Therefore, in the ascending branch, we have AQ or x (increasing as we recede from A)— $a\times\int\frac{\dot p}{n-\mathrm{P}}$, QN or $y=a\times\int\frac{p\dot p}{n-p}$, AN or $z=a\times\int\frac{\dot p\sqrt{1+p^2}}{n-\mathrm{P}}$, $t=\frac{\sqrt{a}}{\sqrt{g}}\times\int\frac{\dot p}{\sqrt{1-\mathrm{P}}}$, and the height producing the velocity at N$=\frac{\frac{1}{2}a(1+p^2)}{n-\mathrm{P}}$.

Hence we learn by the bye, that in no part of the ascending branch can the inclination of the tangent be such that P shall be greater than n; and that if we suppose P equal to n in any point of the curve, the velocity in that point will be infinite. That is to say, there is a certain assignable elevation of the tangent which cannot be exceeded in a curve which has this velocity in the vertex. The best way for forming a conception of this circumstance in the nature of the curve, is to invert the motion, and suppose an accelerating force, equal and opposite to the resistance, to act on the body in conjunction with gravity. It must describe the same curve, and this branch ANC must have an assymptote LO, which has this limiting position of the tangent. For, as the body descends in this curve, its velocity increases to infinity by the joint action of gravity and this *accelerating* force, and yet the tangent never approaches so near the perpendicular position as to make P$=n$. This remarkable property of the curve was known to Newton, as appears by his approximations, which all lead him to curves of a hyperbolic form, having one assymptote inclined to the horizon. Indeed it is pretty obvious: For the resistance increasing faster than the velocity, there is no velocity of projection so great but that the curve will come to deviate so from the tangent, that in a finite time it will become parallel to the horizon. Were the resistance proportional to the velocity, then an infinite velocity would produce a rectilineal motion, or rather a deflection from it less than any that can be assigned. 81

Remarkable property of the curve or trajectory.

We now see that the particular form and magnitude of this trajectory depends on two circumstances, a and n. a affects chiefly the magnitude. Another circumstance might indeed be taken in, viz. the diminution of the accelerating force of gravity by the statical effect of the air's gravity. But, as we have already observed, this is too trifling to be attended to in military projectiles. 82

On what its form and magnitude depends.

$\frac{\dot y}{\dot x}$ was made equal to p. Therefore the radius of curvature, determined by the ordinary methods, is $\frac{\dot x(1+p^2)(\sqrt{1+p^2})}{\dot p}$ *, and, because $\frac{\dot x}{\dot p}$ is $=\frac{a}{n+\mathrm{P}}$ for the descending branch of the curve, the radius of curvature at M is $\frac{a\times\overline{1+p^2}\times\sqrt{1+p^2}}{n+\mathrm{P}}$, and, in the ascending branch at N, it is $\frac{a\times\overline{1+p^2}\times\sqrt{1+p^2}}{n-\mathrm{P}}$.

* Simpson's Fluxions, § 68, &c.

On both sides, therefore, when the velocity is infinitely great, and P by this means supposed to equal or exceed n, the radius of curvature is also infinitely great. We also see that the two branches are unlike each other, and that when p is the same in both, that is, when the tangent is equally inclined to the horizon, the radius of curvature, the ordinate, the absciss, and the arch, are all greater in the ascending branch. This is pretty obvious.

vious. For as the resistance acts entirely in diminishing the velocity, and does not affect the deflection occasioned by gravity, it must allow gravity to incurvate the path so much the more (with the same inclination of its line of action) as the velocity is more diminished. The curvature, therefore, in those points which have the same inclination of the tangent, is greatest in the descending branch, and the motion is swiftest in the ascending branch. It is otherwise in a void, where both sides are alike. Here u becomes infinite, or there is no terminal velocity; and n also becomes infinite, being $= \frac{a}{2h}$.

It is therefore in the quantity P, or $\int \dot{p}\sqrt{1+p^2}$, that the difference between the trajectory in a void and in a resisting medium consists; it is this quantity which expresses the accumulated change of the ratio of the increments of the ordinate and absciss. In vacuo the second increment of the ordinate is constant when the first increment of the abscissa is so, and the whole increment of the ordinate is as $1+p$. And this difference is so much the greater as P is greater in respect of n. P is nothing at the vertex, and increases along with the angle M'TP; and when this is a right angle, P is infinite. The trajectory in a resisting medium will come therefore to deviate infinitely from a parabola, and may even deviate farther from it than the parabola deviates from a straight line. That is, the distance of the body in a given moment from that point of its parabolic path where it would have been in a void, is greater than the distance between that point of the parabola from the point of the straight line where it would have been, independent of the action of gravity. This must happen whenever the resistance is greater than the weight of the body, which is generally the case in the beginning of the trajectory in military projectiles; and this (were it now necessary) is enough to show the inutility of the parabolic theory.

83 **Several properties of it ascertained.**

Although we have no method of describing this trajectory, which would be received by the ancient geometers, we may ascertain several properties of it, which will assist us in the solution of the problem. In particular, we can assign the absolute length of any part of it by means of the logistic curve. For because P $=\int \dot{p}\sqrt{1+p^2}$, we have $\dot{p}\sqrt{1+p^2} = \dot{P}$, and therefore z, which was $= a \times \int \frac{\dot{p}\sqrt{1+p^2}}{\int \dot{p}\sqrt{1+p^2}} + C$, or $= a \times \int \frac{\dot{P}}{n+P}$, may be expressed by logarithms; or $z = a \times$ hyp. log. of $\frac{n+P}{n}$, since at the vertex A, where z must be $= o$, P is also $= o$.

Being able, in this way, to ascertain the length AM of the curve (counted from the vertex), corresponding to any inclination p of the tangent at its extremity M, we can ascertain the length of any portion of it, such as Mm, by first finding the length of the part Am, and then of the part AM. This we do more expeditiously thus. Let p express the position of the tangent in M, and q its position at m; then AM $= a \times$ log. $\frac{n+P}{n}$ and Am $= a \times$ log. $\frac{n+Q}{n}$, and therefore Mm is $= a \times$ log. $\frac{n+Q}{n+P}$. Thus we can find the values of a great number of small portions and the inclination of the tangents at their extremities. Then to each of these portions we can assign its proportion of the abscissa and ordinate, without having recourse to the values of x and y. For the portion of absciss corresponding to the arch Mm, whose middle point is inclined to the horizon in the angle b, will be Mm $\times$ cosine b, and the corresponding portion of the ordinate will be Mm $\times$ sin. b. Then we obtain the velocity in each part of the curve by the equation $h = \frac{1}{2}a \times \frac{\overline{1+p^2}}{n+p}$; or, more directly the velocity v at M will be $= \sqrt{ag\frac{\sqrt{1+p^2}}{\sqrt{n+P}}}$. Lastly, divide the length of the little arch by this, and the quotient will be the time of describing Mm very nearly. Add all these together, and we obtain the whole time of describing the arch AM, but a little too great, because the motion in the small arch is not perfectly uniform. The error, however, may be as small as we please, because we may make the arch as small as we please; and for greater accuracy, it will be proper to take the p by which we compute the velocity, a medium between the p for the beginning and that for the end of the arch.

84 **Euler's method preferred.**

This is the method followed by Euler, who was one of the most expert analysts, if not the very first, in Europe. It is not the most elegant, and the methods of some other authors, who approximate directly to the areas of the curves which determine the values of x and y, have a more scientific appearance; but they are not ultimately very different: For, in some methods, these areas are taken piecemeal, as Euler takes the arch; and by the methods of others, who give the value of the areas by Newton's method of describing a curve of the parabolic kind through any number of given points, the ordinates of these curves, which express $\dot{x}$ and $\dot{y}$, must be taken singly, which amounts to the same thing, with the great disadvantage of a much more complicated calculus, as any one may see by comparing the expressions of $\dot{x}$ and $\dot{y}$ with the expressions of $\dot{z}$. As to those methods which approximate directly to the areas or values of x and y by an infinite series, they all, without exception, involve us in most complicated expressions, with coefficients of sines and tangents, and ambiguous signs, and engage us in a calculation almost endless. And we know of no series which converges fast enough to give us tolerable accuracy, without such a number of terms as is sufficient to deter any person from the attempt. The calculation of the arches is very moderate, so that a person tolerably versant in arithmetical operations may compute an arch with its velocity and time in about five minutes. We have therefore no hesitation in preferring this method of Euler's to all that we have seen, and therefore proceed to determine some other circumstances which render its application more general.

If

85 If there were no resistance, the smallest velocity would be at the vertex of the curve, and it would immediately increase by the action of gravity conspiring (in however small degree) with the motion of the body. But in a resisting medium, the velocity at the vertex is diminished by a quantity to which the acceleration of gravity in that point bears no assignable proportion. It is therefore diminished, upon the whole, and the point of smallest velocity is a little way beyond the vertex. For the same reasons, the greatest curvature is a little way beyond the vertex. It is not very material for our present purpose to ascertain the exact positions of those points.

Its application made more general.

The velocity in the descending branch augments continually: but it cannot exceed a certain limit, if the velocity at the vertex has been less than the terminal velocity; for when the curve is infinite, p is also infinite, and $h=\frac{\frac{1}{2}ap^2}{P}$, because n in this case is nothing in respect of P, which is infinite; and because p is infinite, the number hyp. log. $p\times\sqrt{1+p^2}$, though infinite, vanishes in comparison with $p\times\sqrt{1+p^2}$; so that in this case $P=\frac{1}{2}p^2$, and $h=a$, and $v=$ the terminal velocity.

If, on the other hand, the velocity at the vertex has been greater than the terminal velocity, it will diminish continually, and when the curve has become infinite, v will be equal to the terminal velocity.

In either case we see that the curve on this side will have a perpendicular assymptote. It would require a long and pretty intricate analysis to determine the place of this assymptote, and it is not material for our present purpose. The place and position of the other assymptote LO is of the greatest moment. It evidently distinguishes the kind of trajectory from any other. Its position depends on this circumstance, that if p marks the position of the tangent, $n-P$, which is the denominator of the fraction expressing the square of the velocity, must be equal to nothing, because the velocity is infinite: therefore, in this place, $P=n$, or $n=\frac{1}{2}p\sqrt{1+p^2}+\frac{1}{2}\log.\,p+\sqrt{1+p^2}$. In order, therefore, to find the point L, where the assymptote LO cuts the horizontal line AL, put $P=n$, then will $AL=x-\frac{y\dot{x}}{\dot{y}},=a\times\left(\int\frac{\dot{p}}{n-P}-\frac{1}{p}\int\frac{p\dot{p}}{n-P}\right)$.

Through the whole of this article $\int$ means fluent.

It is evident that the logarithms used in these expressions are the natural or hyperbolic. But the operations may be performed by the common tables, by making the value of the arch M m of the curve $=\frac{a}{M}\times\log.\frac{n+Q}{n+P}$, &c. where M means the subtangent of the common logarithms, or 0,43429; also the time of describing this arch will be expeditiously had by taking a medium μ between the values of $\frac{\sqrt{1+p^2}}{\sqrt{n+P}}$ and $\frac{\sqrt{1+q}}{\sqrt{n+Q}}$, and making the time $=\frac{\sqrt{a}}{M\mu\sqrt{g}}\times\log.\frac{n+Q}{n+P}$.

86 Such then is the process by which the form and magnitude of the trajectory, and the motion in it, may be determined. But it does not yet appear how this is to be applied to any question in practical artillery. In this process we have only learned how to compute the motion from the vertex in the descending branch till the ball has acquired a particular direction, and the motion to the vertex from a point of the ascending branch where the ball has another direction, and all this depending on the greatest velocity which the body can acquire by falling, and the velocity which it has in the vertex of the curve. But the usual question is, "What will be the motion of the ball projected in a certain direction with a certain velocity?"

Mode of applying this process to practice.

The mode of application is this: Suppose a trajectory computed for a particular terminal velocity, produced by the fall a, and for a particular velocity at the vertex, which will be characterized by n, and that the velocity at that point of the ascending branch where the inclination of the tangent is 30° is 900 feet per second. Then, we are certain, that if a ball, whose terminal velocity is that produced by the fall a, be projected with the velocity of 900 feet per second, and an elevation of 30°, it will describe this very trajectory, and the velocity and time corresponding to every point will be such as is here determined.

Now this trajectory will, in respect to form, answer an infinity of cases: for its characteristic is the proportion of the velocity in the vertex to the terminal velocity. When this proportion is the same, the number n will be the same. If, therefore, we compute the trajectories for a sufficient variety of these proportions, we shall find a trajectory that will nearly correspond to any case that can be proposed: and an approximation sufficiently exact will be had by taking a proportional medium between the two trajectories which come nearest to the case proposed.

Accordingly, a set of tables or trajectories have been computed by the English translator of Euler's Commentary on Robins's Gunnery. They are in number 18, distinguished by the position of the assymptote of the ascending branch. This is given for 5°, 10°, 15°, &c. to 85°, and the whole trajectory is computed as far as it can ever be supposed to extend in practice. The following table gives the value of the number n corresponding to each position of the assymptote. 87

Computed tables or trajectories.

OLB	n	OLB	n
1	0,00000	45	1,14779
5	0,08760	50	1,43236
10	0,17724	55	1,82207
15	0,27712	60	2,39033
20	0,37185	65	3,29040
25	0,48269	70	4,88425
30	0,60799	75	8,22357
35	0,75382	80	17,54793
40	0,92914	85	67,12291

Since the path of a projectile is much less incurvated, and more rapid in the ascending than in the descending branch, and the difference is so much the more remarkable in great velocities; it must follow, that the range on a horizontal or inclined plane depends most on the ascending branch: therefore the greatest range will not be made with that elevation which bisects the angle of position, but with a lower elevation; and the deviation from the bisecting elevation will be greater as the initial velocities

velocities are greater. It is very difficult to frame an exact rule for determining the elevation which gives the greatest range. We have subjoined a little table which gives the proper elevation (nearly) corresponding to the different initial velocities.

It was computed by the following approximation, which will be found the same with the series used by Newton in his Approximation.

Let e be the angle of elevation, a the height producing the terminal velocity, h the height producing the initial velocity, and c the number whose hyperbolic logarithm is 1 (i. e. the number 2,718). Then,

$$y = x \times \left(\tan. e + \frac{a}{2h. \cos. e}\right) - \frac{a^2}{2h}\left(C^{\frac{x}{a \cos. e.}} - 1\right),$$

&c. Make $y = v$, and take the maximum by varying e, we obtain $\frac{1}{\text{Sin.}^2 e + \frac{a \sin. e}{2h}} =$ hyperbol. log. $\left(1 + \frac{2h}{a \text{ sine } e}\right)$, which gives us the angle e.

The numbers in the first column, multiplied by the terminal velocity of the projectile, give us the initial velocity; and the numbers in the last column, being multiplied by the height producing the terminal velocity, and by 2,3026, give us the greatest ranges. The middle column contains the elevation. The table is not computed with scrupulous exactness, the question not requiring it. It may, however, be depended on within one part of 2000.

To make use of this table, divide the initial velocity by the terminal velocity u, and look for the quotient in the first column. Opposite to this will be found the elevation giving the greatest range; and the number in the last column being multiplied by $2,3026 \times a$ (the height producing the terminal velocity) will give the range.

Table of Elevations giving the greatest Range.

Initial vel. / u	Elevation.	Range. / 2,3026 a
0,6909	43°.40	0,1751
0,7820	43 .20	0,2169
0,8645	42 .50	0,2548
1,3817	41 .40	0,4999
1,5641	40 .20	0,5789
1,7291	40 .10	0,6551
2,0726	39 .50	0,7877
2,3461	37 .20	0,8967
2,5936	35 .50	0,9752
2,7635	35 .—	1,0319
3,1281	34 .40	1,1411
3,4544	34 .20	1,2298
3,4581	34 .20	1,2277
3,9101	33 .50	1,3371
4,1452	33 .30	1,3901
4,3227	33 .30	1,4274
4,6921	31 .50	1,5050
4,8631	31 .50	1,5341

88 Advantage to be derived from the solution of the problem.

Such is the solution which the present state of our mathematical knowledge enables us to give of this celebrated problem. It is exact in its principle, and the application of it is by no means difficult, or even operose. But let us see what advantage we are likely to derive from it.

In the first place it is very limited in its application. There are few circumstances of general coincidence, and almost every case requires an appropriated calculus. Perhaps the only general rules are the two following:

1. Balls of equal density, projected with the same elevation, and with velocities which are as the square roots of their diameters, will describe similar curves.—This is evident, because, in this case, the resistance will be in the ratio of their quantities of motion. Therefore all the homologous lines of the motion will be in the proportion of the diameters.

2. If the initial velocities of balls projected with the same elevation are in the inverse subduplicate ratio of the whole resistances, the ranges, and all the homologous lines of their track, will be inversely as those resistances.

These theorems are of considerable use: for by means of a proper series of experiments on one ball projected with different elevations and velocities, tables may be constructed which will ascertain the motions of an infinity of others.

89 Shown from various considerations to be very little.

But when we take a retrospective view of what we have done, and consider the conditions which were assumed in the solution of the problem, we shall find that much yet remains before it can be rendered of great practical use, or even satisfy the curiosity of the man of science The resistance is all along supposed to be in the duplicate ratio of the velocity; but even theory points out many causes of deviation from this law, such as the pressure and condensation of the air, in the case of very swift motions; and Mr Robins's experiments are sufficient to show us that the deviations must be exceedingly great in such cases. Mr Euler and all subsequent writers have allowed that it may be three times greater, even in cases which frequently occur; and Euler gives a rule for ascertaining with tolerable accuracy what this increase and the whole resistance may amount to. Let H be the height of a column of air whose weight is equivalent to the resistance taken in the duplicate ratio of the velocity. The whole resistance will be expressed by $H + \frac{H^2}{28845}$. This number 28845 is the height in feet of a column of air whose weight balances its elasticity. We shall not at present call in question his reasons for assigning this precise addition. They are rather reasons of arithmetical conveniency than of physical import. It is enough to observe, that if this measure of the resistance is introduced into the process of investigation, it is totally changed; and it is not too much to say, that with this complication it requires the knowledge and address of a Euler to make even a partial and very limited approximation to a solution.—Any law of the resistance, therefore, which is more complicated than what Bernoulli has assumed, namely, that of a simple power of the velocity, is abandoned by all the mathematicians, as exceeding their abilities; and they have attempted to avoid the error arising from the assumption of the duplicate ratio of the velocity, either by supposing the resistance throughout the whole trajectory to be greater than what it is in general, or they have divided the trajectory into different portions, and assigned different resistances to each, which vary

vary, through the whole of that portion, in the duplicate ratio of the velocities. By this kind of patchwork they make up a trajectory and motion which corresponds, in some tolerable degree, with what? With an accurate theory? No; but with a series of experiments. For, in the first place, every theoretical computation that we make, proceeds on a supposed initial velocity; and this cannot be ascertained with any thing approaching to precision, by any theory of the action of gunpowder that we are yet possessed of. In the next place, our theories of the resisting power of the air are entirely established on the experiments on the flights of shot and shells, and are corrected and amended till they tally with the most approved experiments we can find. We do not learn the ranges of a gun by theory, but the theory by the range of the gun. Now the variety and irregularity of all the experiments which are appealed to are so great, and the acknowledged difference between the resistance to slow and swift motions is also so great, that there is hardly any supposition which can be made concerning the resistance, that will not agree in its results with many of those experiments. It appears from the experiments of Dr Hutton of Woolwich, in 1784, 1785, and 1786, that the shots frequently deviated to the right or left of their intended track 200, 300, and sometimes 400 yards. This deviation was quite accidental and anomalous, and there can be no doubt but that the shot deviated from its intended and *supposed* elevation as much as it deviated from the intended vertical plane, and this without any opportunity of measuring or discovering the deviation. Now, when we have the whole range from one to three to choose among for our measure of resistance, it is evident that the confirmations which have been drawn from the ranges of shot are but feeble arguments for the truth of any opinion. Mr Robins finds his measures fully confirmed by the experiments at Metz and at Minorca. Mr Muller finds the same. Yet Mr Robins's measure both of the initial velocity and of the resistance are at least treble of Mr Muller's; but by compensation they give the same results. The Chevalier Borda, a very expert mathematician, has adduced the very same experiments in support of his theory, in which he abides by the Newtonian measure of the resistance, which is about $\frac{1}{3}$ of Mr Robins's, and about $\frac{2}{3}$ of Muller's.

90 Cause of its inutility. What are we to conclude from all this? Simply this, that we have hardly any knowledge of the air's resistance, and that even the solution given of this problem has not as yet greatly increased it. Our knowledge consists only in those experiments, and mathematicians are attempting to patch up some notion of the motion of a body in a resisting medium, which shall tally with them.

There is another essential defect in the conditions assumed in the solution. The density of the air is supposed uniform; whereas we are certain that it is less by one-fifth or one-sixth towards the vertex of the curve, in many cases which frequently occur, than it is at the beginning and end of the flight. This is another latitude given to authors in their assumptions of the air's resistance. The Chevalier de Borda has, with considerable ingenuity, accommodated his investigation to this circumstance, by dividing the trajectory into portions, and, without much trouble, has made one equation answer them all. We are disposed to think that his solution of the problem (in the Memoirs of the Academy of Paris for 1769) corresponds better with the physical circumstances of the case than any other. But this process is there delivered in too concise a manner to be intelligible to a person not perfectly familiar with all the resources of modern analysis. We therefore preferred John Bernoulli's, because it is elementary and rigorous.

After all, the practical artillerist must rely chiefly on the records of experiments contained in the books of practice at the academies, or those made in a more public manner. Even a perfect theory of the air's resistance can do him little service, unless the force of gunpowder were uniform. This is far from being the case even in the same powder. A few hours of a damp day will make a greater difference than occurs in any theory; and, in service it is only by trial that every thing is performed. If the first shell fall very much short of the mark, a little more powder is added; and, in cannonading, the correction is made by varying the elevation. 91 Necessity of attending to experiments.

We hope to be forgiven by the eminent mathematicians for these observations on their theories. They by no means proceed from any disrespect for their labours. We are not ignorant of the almost insuperable difficulty of the task, and we admire the ingenuity with which some of them have contrived to introduce into their analysis reasonable substitutions for those terms which would render the equations intractable. But we must still say, upon their own authority, that these are but ingenious guesses, and that experiment is the touchstone by which they mould these substitutions; and when they have found a coincidence, they have no motive to make any alteration. Now, when we have such a latitude for our measure of the air's resistance, that we may take it of any value, from one to three, it is no wonder that compensations of errors should produce a coincidence; but where is the coincidence? The theorist *supposes* the ball to set out with a certain velocity, and his theory gives a certain range; and this range agrees with observation—but how? Who knows the velocity of the ball in the experiment? This is concluded from a theory incomparably more uncertain than that of the motion in a resisting medium.

The experiments of Mr Robins and Dr Hutton show, in the most incontrovertible manner, that the resistance to a motion exceeding 1100 feet in a second, is almost *three times* greater than in the duplicate ratio to the resistance to moderate velocities. Euler's translator, in his comparison of the author's trajectories with experiment, supposes it to be *no* greater. Yet the coincidence is very great. The same may be said of the Chevalier de Borda's. Nay, the same may be said of Mr Robins's own practical rules: for he makes his F, which corresponds to our *a*, almost double of what these authors do, and yet his rules are confirmed by practice. Our observations are therefore well founded.

But it must not be inferred from all this, that the physical theory is of no use to the practical artillerist. It plainly shows him the impropriety of giving the projectile an enormous velocity. This velocity is of no effect after 200 or 300 yards at farthest, because it is so rapidly reduced by the prodigious resistance of the air. Mr Robins has deduced several practical maxims of the greatest importance from what we already know of this subject, and which could hardly have been even conjectured without this knowledge. See GUNNERY. 92 The theory is still of some use in practice.

And

93 And it must still be acknowledged, that this branch of physical science is highly interesting to the philosopher; nor should we despair of carrying it to a greater perfection. The defects arise almost entirely from our ignorance of the law of variation of the air's resistance. Experiments may be contrived much more conducive to our information here than those commonly resorted to. The oblique flights of projectiles are, as we have seen, of very complicated investigation, and ill fitted for instructing us; but numerous and well contrived experiments on the perpendicular ascents are of great simplicity, being affected by nothing but the air's resistance. To make them instructive, we think that the following plan might be pursued. Let a set of experiments be premised for ascertaining the initial velocities. Then let shells be discharged perpendicularly with great varieties of density and velocity, and let nothing be attended to but the height and the time; even a considerable deviation from the perpendicular will not affect either of these circumstances, and the effect of this circumstance can easily be computed. The height can be ascertained with sufficient precision for very valuable information by their light or smoke. It is evident that these experiments will give *direct* information of the air's retarding force; and every experiment gives us two measures, viz. the ascent and descent: and the comparison of the times of ascent and descent, combined with the observed height in one experiment made with a great initial velocity, will give us more information concerning the air's resistance than 50 ranges. If we should suppose the resistance as the square of the velocity, this comparison will give in each experiment an exact determination of the initial and final velocities, which no other method can give us. These, with experiments on the *time* of horizontal flights, with known initial velocities, will give us more instruction on this head than any thing that has yet been done; and till something of this kind is carefully done, we presume to say that the motion of bodies in a resisting medium will remain in the hands of the mathematicians as a matter of curious speculation. In the mean time, the rules which Mr Robins has delivered in his Gunnery are very simple and easy in their use, and seem to come as near the truth as any we have met with. He has not informed us upon what principles they are founded, and we are disposed to think that they are rather empirical than scientific. But we profess great deference for his abilities and penetration, and doubt not but that he had framed them by means of as scientific a discussion as his knowledge of this new and difficult subject enabled him to give it.

and may be brought to greater perfection.

94 We shall conclude this article, by giving two or three tables, computed from the principles established above, and which serve to bring into one point of view the chief circumstances of the motion in a resisting medium. Although the result of much calculation, as any person who considers the subject will readily see, they must not be considered as offering any very accurate results; or that, in comparison with one or two experiments, the differences shall not be considerable. Let any person peruse the published registers of experiments which have been made with every attention, and he will see such enormous irregularities, that all expectations of perfect agreement with them must cease. In the experiments at Woolwich in 1735, which were continued for several days, not only do the experiments of one day differ among themselves, but the mean of all the experiments of one day differs from the mean of all the experiments of another no less than one-fourth of the whole. The experiments in which the greatest regularity may be expected, are those made with great elevations. When the elevation is small, the range is more affected by a change of velocity, and still more by any deviation from the supposed or intended direction of the shot.

Tables calculated on the preceding principles.

The first table shows the distance in yards to which a ball projected with the velocity 1600 will go, while its velocity is reduced one-tenth, and the distance at which it drops 16 feet from the line of its direction. This table is calculated by the resistance observed in Mr Robins's experiments. The first column is the weight of the ball in pounds. The second column remains the same whatever be the initial velocity; but the third column depends on the velocity. It is here given for the velocity which is very usual in military service, and its use is to assist us in directing the gun to the mark.—If the mark at which a ball of 24 pounds is directed is 474 yards distant, the axis of the piece must be pointed 16 feet higher than the mark. These deflections from the line of direction are nearly as the squares of the distances.

I.	II.	III.
2	92	420
4	121	428
9	159	456
18	200	470
32	272	479

The next table contains the ranges in yards of a 1 pound shot, projected at an elevation of 45°, with the different velocities in feet per second, expressed in the first column. The second column contains the distances to which the ball would go in vacuo in a horizontal plane; and the third contains the distances to which it will go through the air. The fourth column is added, to show the height to which it rises in the air; and the fifth shows the ranges corrected for the diminution of the air's density as the bullet ascends, and may therefore be called the *corrected range*.

I.	II.	III.	IV.	V.
200	416	349	106	360
400	1664	1121	338	1150
600	3740	1812	606	1859
800	6649	2373	866	2435
1000	10300	2845	1138	2919
1200	14961	3259	1378	3343
1400	20364	3640	1606	3734
1600	26597	3950	1814	4050
1800	33663	4235	1992	4345
2000	41559	4494	2168	4610
2200	50286	4720	2348	4842
2400	59846	4917	2460	5044
2600		5106	2630	5238
2800		5293	2760	5430
3000		5455	2862	5596
3200				5732

The

Fig. 1.

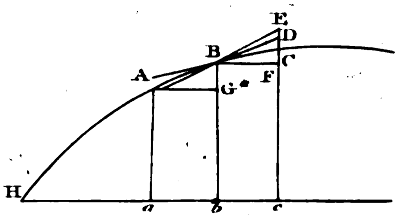


Fig. 2.

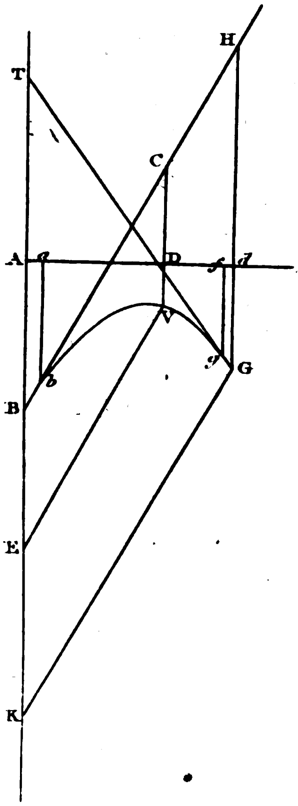


Fig. 3.

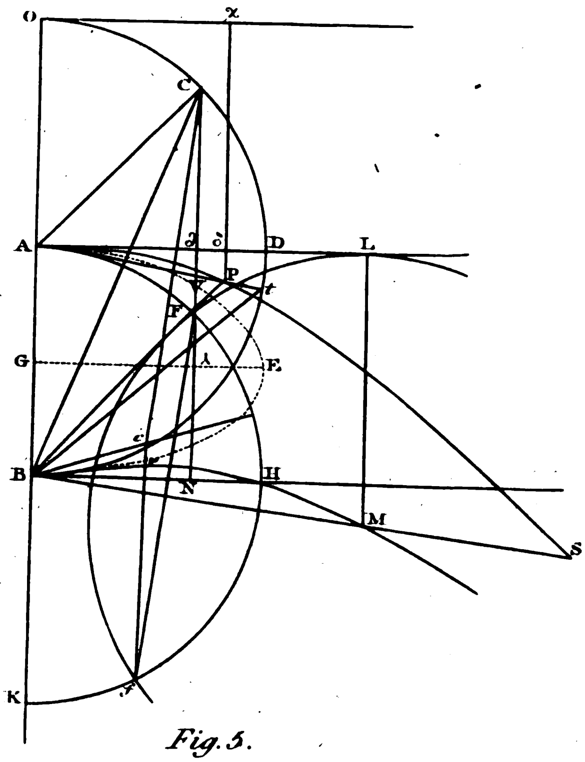


Fig. 4.

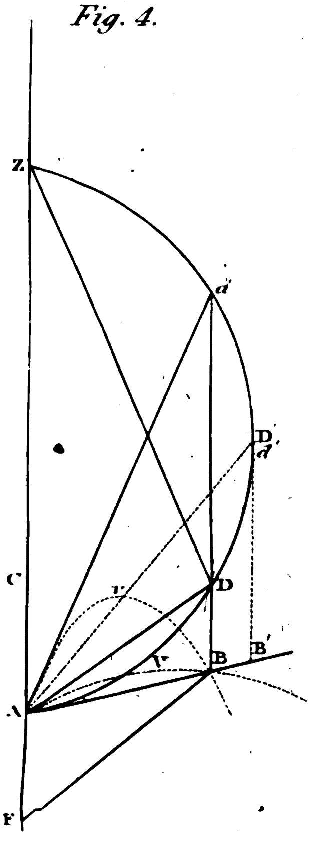


Fig. 5.

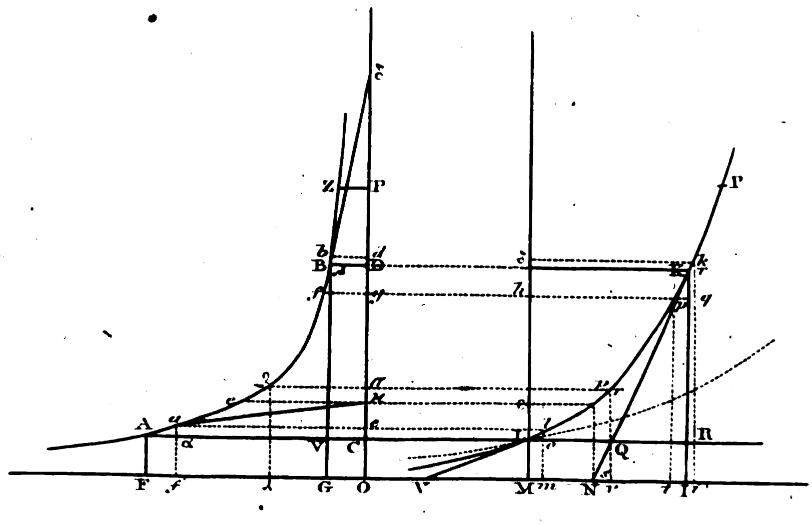


Fig. 6.

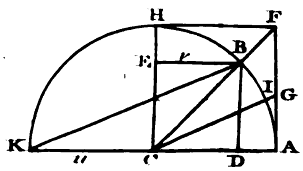
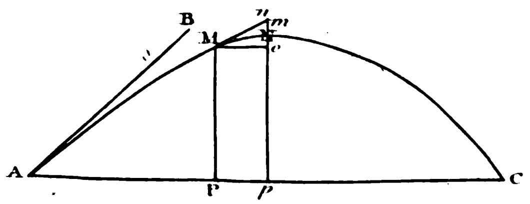


Fig. 7.



W. Archibald Sculp.

Fig. 8.

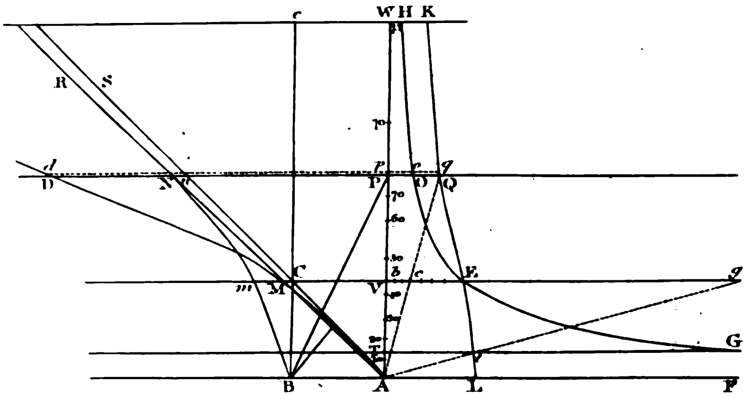


Fig. 9.

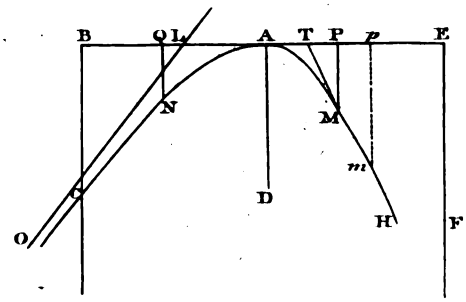
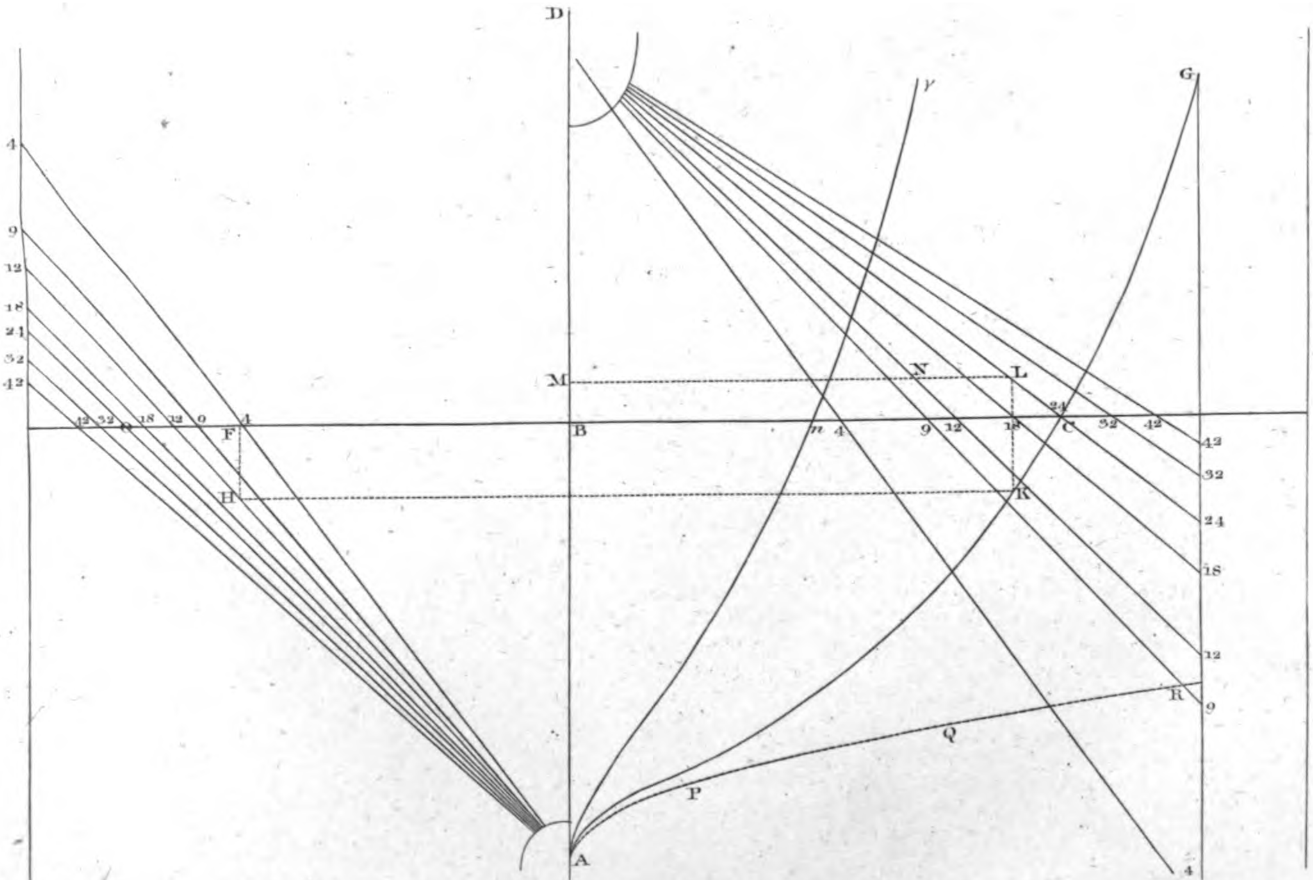


Fig. 10.



95 Use of the last table.

The initial velocities can never be pushed as far as we have calculated for in this table; but we mean it for a table of more extensive use than appears at first sight. Recollect, that while the proportion of the velocity at the vertex to the terminal velocity remains the same, the curves will be similar: therefore, if the initial velocities are as the square-roots of the diameters of the balls, they will describe similar curves, and the ranges will be as the diameters of the balls.

Therefore, to have the range of a 12 pound shot, if projected at an elevation of 45, with the velocity 1500; suppose the diameter of the 12-pounder to be d, and that of the 24-pounder D; and let the velocities be v and V: Then say, $\sqrt{d}:\sqrt{D}=1500$, to a fourth proportional V. If the 24-pounder be projected with the velocity V, it will describe a curve similar to that described by the 12-pounder, having the initial velocity 1500. Therefore find (by interpolation) the range of the 24-pounder, having the initial velocity V. Call this R. Then $D:d=R:r$, the range of the 12-pounder which was wanted, and which is nearly 3380 yards.

We see by this table the immense difference between the motions through the air and in a void. We see that the ranges through the air, instead of increasing in the duplicate ratio of the initial velocities, really increase slower than those velocities in all cases of military service; and in the most usual cases, viz. from 800 to 1600, they increase nearly as the square-roots of the velocities.

A set of similar tables, made for different elevations, would almost complete what can be done by theory, and would be much more expeditious in their use than Mr Euler's Trajectories, computed with great labour by his English translator.

The same table may also serve for computing the ranges of bomb-shells. We have only to find what must be the initial velocity of the 24 pound shot which corresponds to the proposed velocity of the shell. This must be deduced from the diameter and weight of the shell, by making the velocity of the 24-pounder such, that the ratio of its weight to the resistance may be the same as in the shell.

That the reader may see with one glance the relation of those different quantities, we have given this table, expressed in a figure (fig. 10.). The abscissa, or axis DA, is the scale of the initial velocities in feet per second, measured in a scale of 400 equal parts in an inch. The ordinates to the curve ACG express the yards of the range on a scale containing 800 yards in an inch. The ordinates to the curve $A\,x\,y$ express (by the same scale) the height to which the ball rises in the air.

Fig. 10. 96 Relation of the different quantities in it.

The ordinate BC (drawn through the point of the abscissa which corresponds to the initial velocity 2000) is divided on the points 4, 9, 12, 18, 24, 32, 42, in the ratio of the diameters of cannon-shot of different weights; and the same ordinate is produced on the other side of the axis, till BO be equal to BA; and then BO is divided in the subduplicate ratio of the same diameters. Lines are drawn from the point A, and from any point D of the abscissa, to these divisions.

We see distinctly by this figure how the effect of the initial velocity gradually diminishes, and that in very great velocities the range is very little increased by its augmentation. The dotted curve APQR, shows what the ranges in vacuo would be.

By this figure may the problems be solved. Thus, to find the range of the 12-pounder, with the initial velocity 1500. Set off 1500 from B to F; draw FH parallel to the axis, meeting the line 12 A in H; draw the ordinate HK, draw HL parallel to the axis, meeting 24 B in L; draw the ordinate LM, cutting 12 B in N. MN is the range required.

If curves, such as ACG, were laid down in the same manner for other elevations, all the problems might be solved with great dispatch, and with much more accuracy than the theory by which the curves are drawn can pretend to.

Note, that fig. 10. as given on Plate CCCCXLII, *is one-half less than the scale according to which it is described; but the practical mathematician will find no difficulty in drawing the figure on the enlarged scale to correspond to the description.*

PROJECTION OF THE SPHERE.

Stereographic Projection of the Sphere.

THE PROJECTION of the SPHERE is a perspective representation of the circles on the surface of the sphere; and is variously denominated according to the different positions of the eye and plane of projection.

There are three principal kinds of projection; the *stereographic*, the *orthographic*, and *gnomic*. In the tereographic projection the eye is supposed to be placed on the surface of the sphere; in the orthographic it is supposed to be at an infinite distance; and in the gnomic projection the eye is placed at the centre of the sphere. Other kinds of projection are, the *globular*, *Mercator's*, *scenographic*, &c. for which see the articles GEOGRAPHY, NAVIGATION, PERSPECTIVE, &c.

DEFINITIONS.

1. The plane upon which the circles of the sphere are described, is called the *plane of projection*, or the *primitive circle*. The pole of this circle is the *pole of projection*, and the place of the eye is the *projecting point*.

2. The *line of measures* of any circle of the sphere is that diameter of the primitive, produced indefinitely, which passes through the centre of the projected circle.

AXIOM.

The projection, or representation of any point, is where the straight line drawn from it to the projecting point intersects the plane of projection.

SECTION I.

Of the Stereographic Projection of the Sphere.

IN the stereographic projection of the sphere, the eye

Stereographic Projection of the Sphere.

eye is placed on the surface of the sphere in the pole of the great circle upon which the sphere is to be projected. The projection of the hemisphere opposite to the eye falls within the primitive, to which the projection is generally limited; it, however, may be extended to the other hemisphere, or that wherein the eye is placed, the projection of which falls without the primitive.

As all circles in this projection are projected either into circles or straight lines, which are easily described, it is therefore more generally understood, and by many preferred to the other projections.

Proposition I. Theorem I.

Every great circle which passes through the projecting point is projected into a straight line passing through the centre of the primitive; and every arch of it, reckoned from the other pole of the primitive, is projected into its semitangent.

Plate CCCCXLIII. fig. 1.

Let ABCD (fig. 1.) be a great circle passing through A, C, the poles of the primitive, and intersecting it in the line of common section BED, E being the centre of the sphere. From A, the projecting point, let there be drawn straight lines AP, AM, AN, AQ, to any number of points P, M, N, Q, in the circle ABCD: these lines will intersect BED, which is in the same plane with them. Let them meet it in the points p, m, n, q; then p, m, n, q, are the projections of P, M, N, Q: hence the whole circle ABCD is projected into the straight line BED, passing through the centre of the primitive.

Again, because the pole C is projected into E, and the point M into m; therefore the arch CM is projected into the straight line Em, which is the semitangent of the arch CM to the radius AE. In like manner, the arch CP is projected into its semitangent, Ep, &c.

Corollaries.

1. Each of the quadrants contiguous to the projecting point is projected into an indefinite straight line, and each of these that are remote into a radius of the primitive.

2. Every small circle which passes through the projecting point is projected into that straight line which is its common section with the primitive.

3. Every straight line in the plane of the primitive, and produced indefinitely, is the projection of some circle on the sphere passing through the projecting point.

4. The projection of any point in the surface of the sphere, is distant from the centre of the primitive, by the semitangent of the distance of that point from the pole opposite to the projecting point.

Proposition II. Theorem II.

Every circle on the sphere which does not pass through the projecting point is projected into a circle.

If the given circle be parallel to the primitive, then a straight line drawn from the projecting point to any point in the circumference, and made to revolve about the circle, will describe the surface of a cone; which being cut by the plane of projection parallel to the base, the section will be a circle. See *Conic-Sections*.

Fig. 2.

But if the circle MN (fig. 2.) be not parallel to the primitive circle BD, let the great circle ABCD, passing through the projecting point, cut it at right angles in the diameter MN, and the primitive in the diameter BD. Through M, in the plane of the great circle, let MF be drawn parallel to BD; let AM, AN be joined, and meet BD in m, n. Then, because AB, AD are quadrants, and BD, MF parallel, the arch AM is equal to AF, and the angle AMF or Amn is equal to ANM. Hence the conic surface described by the revolution of AM about the circle MN is cut by the primitive in a subcontrary position; therefore the section is in this case likewise a circle.

Corollaries.

1. The centres and poles of all circles parallel to the primitive have their projection in its centre.

2. The centre and poles of every circle inclined to the primitive have their projections in the line of measures.

3. All projected great circles cut the primitive in two points diametrically opposite; and every circle in the plane of projection, which passes through the extremities of a diameter of the primitive, or through the projections of two points that are diametrically opposite on the sphere, is the projection of some great circle.

4. A tangent to any circle of the sphere, which does not pass through the projecting point, is projected into a tangent to that circle's projection; also, the circular projections of tangent circles touch one another.

5. The extremities of the diameter, on the line of measures of any projected circle, are distant from the centre of the primitive by the semitangents of the least and greatest distances of the circle on the sphere, from the pole opposite to the projecting point.

6. The extremities of the diameter, on the line of measures of any projected great circle, are distant from the centre of the primitive by the tangent and cotangent of half the great circle's inclination to the primitive.

7. The radius of any projected circle is equal to half the sum, or half the difference of the semitangents of the least and greatest distances of the circle from the pole opposite to the projecting point, according as that pole is within or without the given circle.

Proposition III. Theorem III.

An angle formed by two tangents at the same point in the surface of the sphere, is equal to the angle formed by their projections.

Fig. 3.

Let FGI and GH (fig. 3.) be the two tangents, and A the projecting point; let the plane AGF cut the sphere in the circle AGL, and the primitive in the line BML. Also, let MN be the line of common section of the plane AGH with the primitive: then the angle FGH=LMN. If the plane FGH be parallel to the primitive BLD, the proposition is manifest. If not, through any point K in AG produced, let the plane FKH, parallel to the primitive, be extended to meet FGH in the line FH. Then, because the plane AGF meets the two parallel planes BLD, FKH, the lines of common section LM, FK are parallel; therefore

Stereographic Projection of the Sphere.

for the angle AML=AKF. But since A is the pole BLD, the chords, and consequently the arches AB AL, are equal, and the arch ABG is the sum of the arches AL, BG; hence the angle AML is equal to an angle at the circumference standing upon AG, and therefore equal to AGI or FGK; consequently the angle FGK=FKG, and the side FG=FK. In like manner HG=HK: hence the triangles GHF, KHF are equal, and the angle FGH=FKH=LMN.

Corollaries.

1. An angle contained by any two circles of the sphere is equal to the angle formed by their projections. For the tangents to these circles on the sphere are projected into straight lines, which either coincide with, or are tangents to, their projections on the primitive.

2. An angle contained by any two circles of the sphere is equal to the angle formed by the radii of their projections at the point of intersection.

Proposition IV. Theorem IV.

The centre of a projected great circle is distant from the centre of the primitive; the tangent of the inclination of the great circle to the primitive, and its radius, is the secant of its inclination.

Fig. 4. Let MNG (fig. 4.) be the projection of a great circle, meeting the primitive in the extremities of the diameter MN, and let the diameter BD, perpendicular to MN, meet the projection in F, G. Bisect FG in H, and join NH. Then, because any angle contained by two circles of the sphere is equal to the angle formed by the radii of their projections at the point of intersection; therefore the angle contained by the proposed great circle and the primitive is equal to the angle ENH, of which EH is the tangent, and NH the secant, to the radius of the primitive.

Corollaries.

1. All circles which pass through the points M, N, are the projections of great circles, and have their centres in the line BG; and all circles which pass through the points F, G, are the projections of great circles, and have their centres in the line HI, perpendicular to BG.

2. If NF, NH be continued to meet the primitive in L, F; then BL is the measure of the great circle's inclination to the primitive; and MT=2BL.

Proposition V. Theorem V.

The centre of projection of a less circle perpendicular to the primitive, is distant from the centre of the primitive, the secant of the distance of the less circle from its nearest pole; and the radius of projection is the tangent of that distance.

Fig. 5. Let MN (fig. 5.) be the given less circle perpendicular to the primitive, and A the projecting point. Draw AM, AN to meet the diameter BD produced in G and H; then GH is the projected diameter of the less circle: bisect GH in C, and C will be its centre; join NE, NC. Then because AE, NI are parallel, the angle INE=NEA; but NEA=2NMA =2NHG=NCG: hence ENC=INE+INC=NCG+INC = a right angle; and therefore NC is a tangent to the primitive at N; but the arch ND is the distance of the less circle from its nearest pole D: hence NC is the tangent, and EC the secant of the distance of the less circle from its pole to the radius of the primitive.

Proposition VI. Theorem VI.

The projection of the poles of any circle, inclined to the primitive, are, in the line of measures, distant from the centre of the primitive, the tangent, and cotangent, of half its inclination.

Fig. 6. Let MN (fig. 6.) be a great circle perpendicular to the primitive ABCD, and A the projecting point; then P, *p* are the poles of MN, and of all its parallels *m n*, &c. Let AP, A*p* meet the diameter BD in F*f*, which will therefore be the projected poles of MN and its parallels. The angle BEM is the inclination of the circle MEN, and its parallels, to the primitive: and because BC and MP are quadrants, and MC common to both; therefore PC=BM: and hence PEC is also the inclination of MN and its parallels. Now EF is the tangent of EAF, or of half the angle PEC the inclination; and E*f* is the tangent of the angle EA*f*; but EA*f* is the complement of EAF, and E*f* is the cotangent of half the inclination.

Corollaries.

1. The projection of that pole which is nearest to the projecting point is without the primitive, and the projection of the other within.

2. The projected centre of any circle is always between the projection of its nearest pole and the centre of the primitive; and the projected centres of all circles are contained between the projected poles.

Proposition VII. Theorem VII.

Equal arches of any two great circles of the sphere will be intercepted between two other circles drawn on the sphere through the remote poles of those great circles.

Fig. 7. Let AGB, CFD (fig. 7.) be two great circles of the sphere, whose remote poles are E, P; through which draw the great circle PBEC, and less circle PGE, intersecting the great circles AGB, CFD in the points B, G, and D, F; then the arch BG is equal to the arch DF.

Because E is the pole of the circle AGB, and P the pole of CFD, therefore the arches EB, PD are equal; and since BD is common to both, hence the arch ED is equal to the arch PB. For the same reason, the arches EF, PG are equal; but the angle DEF is equal to the angle BPG: hence these triangles are equal, and therefore the arch DF is equal to the arch BG.

Proposition VIII. Theorem VIII.

If from either pole of a projected great circle, two straight lines be drawn to meet the primitive and the projection, they will intercept similar arches of these circles.

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On the plane of projection AGB (fig. 7.) let the great circle CFD be projected into *cfd*, and its pole P into *p*; through *p* draw the straight lines *pd*, *pf*, then are the arches GB, *fd* similar.

Since *pd* lies both in the plane AGB and APBE, it is in their common section, and the point B is also in their common section; therefore *pd* passes through the point B. In like manner it may be shown that the line *pf* passes through G. Now the points D, F are projected into *d*, *f*: hence the arches FD, *fd* are similar; but GB is equal to FD, therefore the intercepted arch of the primitive GB is similar to the projected arch *fd*.

Corollary.

Hence, if from the angular point of a projected spherical angle two straight lines be drawn through the projected poles of the containing sides, the intercepted arch of the primitive will be the measure of the spherical angle.

Proposition IX. Problem I.

To describe the projection of a great circle through two given points in the plane of the primitive.

Let P and B be given points, and C the centre of the primitive.

Fig. 8. 1. When one point P (fig. 8.) is the centre of the primitive, a diameter drawn through the given points will be the great circle required.

Fig. 9. 2. When one point P (fig. 9.) is in the circumference of the primitive. Through P draw the diameter PD; and an oblique circle described through the three points P, B, D, will be the projection of the required great circle.

3. When the given points are neither in the centre nor circumference of the primitive. Through either of Fig. 10. the given points P (fig. 10.) draw the diameter ED, and at right angles thereto draw the diameter FG. From F through P draw the straight line FPH, meeting the circumference in H: draw the diameter HI, and draw the straight line FIK, meeting ED produced in K; then an arch, terminated by the circumference, being described through the three points, P, B, K, will be the great circle.

Proposition X. Problem II.

To describe the representation of a great circle about any given point as a pole.

Let P be the given pole, and C the centre of the primitive.

1. When P (fig. 8.) is in the centre of the primitive, then the primitive will be the great circle required.

Fig. 11. 2. When the pole P (fig. 11.) is in the circumference of the primitive. Through P draw the diameter PE, and the diameter AB drawn at right angles to PE will be the projected great circle required.

3. When the given pole is neither in the centre nor circumference of the primitive. Through the pole P

Plate CCCCXLIV. (fig. 12.) draw the diameter AB, and draw the diameter DE perpendicular to AB; through E and P draw the straight line EPF, meeting the circumference in F. Make FG equal to FD; through E and G draw the straight line EGH, meeting the diameter AB produced if necessary in H; then from the centre H, with the radius HE, describe the oblique circle DIE, and it will be the projection of the great circle required.

Or, make DK equal to FA; join EK, which intersects the diameter AB in I; then through the three points, D, I, E, describe the oblique circle DIE.

Proposition XI. Problem III.

To find the poles of a great circle.

1. When the given great circle is the primitive, its centre is the pole.

2. To find the pole of the right circle ACB (fig. 11.). Draw the diameter PE perpendicular to the given circle AB; and its extremities P, E are the poles of the circle ACB.

3. To find the pole of the oblique circle DEF (fig. 13.). Join DF, and perpendicular thereto draw the diameter AB, cutting the given oblique circle DEF in E. Draw the straight line FEG, meeting the circumference in G. Make GI, GH, each equal to AD; then FI being joined, cuts the diameter AB in P, the lower pole; through F and H draw the straight line FH*p*, meeting the diameter AB produced in *p*, which will be the opposite or exterior pole. Fig. 13.

Proposition XII. Problem IV.

To describe a less circle about any given point as a pole, and at any given distance from that pole.

1. When the pole of the less circle is in the centre of the primitive; then from the centre of the primitive, with the semitangent of the distance of the given circle from its pole, describe a circle, and it will be the projection of the less circle required.

2. If the given pole is in the circumference of the primitive, from C (fig. 14.) the centre of the primitive, Fig. 14. set off CE the secant of the distance of the less circle from its pole P; then from the centre E, with the tangent of the given distance, describe a circle, and it will be the less circle required. Or, make PG, PF each equal to the chord of the distance of the less circle from its pole. Through B, G draw the straight line BGD meeting CP produced in D: bisect GD in H, and draw HE perpendicular to GD, and meeting PD in E; then E is the centre of the less circle.

3. When the given pole is neither in the centre nor circumference of the primitive. Through P (fig. 15.), Fig. 15. the given pole, and C the centre of the primitive, draw the diameter AB, and draw the diameter DE perpendicular to AB; join EP, and produce it to meet the primitive in *p*; make *p*F, *p*G, each equal to the chord of the distance of the less circle from its pole; join EF which intersects the diameter AB in H; from E through G draw the straight line EGI, meeting the diameter AB produced in I; bisect HI in K: Then a circle described from the centre K, at the distance KH or KI, will be the projection of the less circle.

Proposition XIII. Problem V.

To find the poles of a given less circle.

The poles of a less circle are also those of its parallel great

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great circle. If therefore the parallel great circle be given, then its poles being found by Prob. III. will be those of the less circle. But if the parallel great circle be not given, let HMIN (fig. 15.) be the given less circle. Through its centre, and C the centre of the primitive, draw the line of measures IAHB; and draw the diameter DE perpendicular to it, also draw the straight line EHF meeting the primitive in F; make Fp equal to the chord of the distance of the less circle from its pole: join Ep, and its intersection P with the diameter AB is the interior pole. Draw the diameter p CL through E and L, draw ELq meeting the diameter AB produced in q; then q is the external pole. Or thus: Join EI intersecting the primitive in G; join also EH, and produce it to meet the primitive in F; bisect the arch GH in p; from E to p draw the straight line EPp, and P is the pole of the given less circle.

Fig. 15.

Proposition XIV. Problem. VI.

To measure any arch of a great circle.

1. Arches of the primitive are measured on the line of chords.

2. Right circles are measured on the line of semitangents, beginning at the centre of the primitive. Thus, the measure of the portion AC (fig. 16.) of the right circle DE, is found by applying it to the line of semitangents. The measure of the arch DB is found by subtracting that of BC from 90°: the measure of the arch AF, lying partly on each side of the centre, is obtained by adding the measures of AC and CF. Lastly, To measure the part AB, which is neither terminated at the centre or circumference of the primitive, apply CA to the line of semitangents; then CB, and the difference between the measures of these arches, will be that of AB.

Fig. 16.

Or thus: Draw the diameter GH perpendicular to DE; then from either extremity, as D, of this diameter, draw lines through the extremities of the arch intended to be measured; and the intercepted portion of the primitive applied to the line of chords will give the measure of the required arch. Thus IK applied to the line of chords will give the measure of AB.

3. To measure an arch of an oblique circle: draw lines from its pole through the extremities of the arch to meet the primitive, then the intercepted portion of the primitive applied to the line of chords will give the measure of the arch of the oblique circle. Thus, let AB (fig. 17.), be an arch of an oblique circle to be measured, and P its pole; from P draw the lines PAD, PBE meeting the primitive in B and E; then the arch DE applied to the line of chords will give the measure of the arch of the oblique circle AB.

Fig. 17.

Proposition XV. Problem VII.

To measure any arch of a less circle.

Let DEG (fig. 18.) be the given less circle, and DE the arch to be measured: find its internal pole P; and describe the circle AFI parallel to the primitive, and whose distance from the projecting point may be equal to the distance of the given less circle from its pole P: then join PD, PE, which produce to meet the parallel circle in A and F. Now AF applied to a line of chords will give the measure of the arch DE of the given less circle.

Fig. 18.

Proposition XVI. Problem VIII.

To measure any spherical angle.

1. If the angle is at the centre of the primitive, it is measured as a plane angle.

2. When the angular point is in the circumference of the primitive; let A (fig. 19.) be the angular point, and ABE an oblique circle inclined to the primitive. Through P, the pole of ABE, draw the line APp meeting the circumference in p: then the arch E p is the measure of the angle BAD, and the arch AFp is the measure of its supplement BAF: also p F is the measure of the angle BAC, and p ED that of its supplement.

Fig. 19.

3. If the angular point is neither at the centre nor circumference of the primitive. Let A (fig. 20.) be the angular point, and DAH, or GAF, the angle to be measured, P the pole of the oblique circle DAF, and p the pole of GAH: then from A, through the points Pp, draw the straight lines APM, A p N, and the arch MN will be the measure of the angle DAH; and the supplement of MN will be the measure of the angle HAF or DAG.

Fig. 20.

Proposition XVII. Problem IX.

To draw a great circle perpendicular to a projected great circle, and through a point given in it.

Find the pole of the given circle, then a great circle described through that pole and the given point will be perpendicular to the given circle. Hence if the given circle be the primitive, then a diameter drawn through the given point will be the required perpendicular. If the given circle is a right one, draw a diameter at right angles to it; then through the extremities of this diameter and the given point describe an oblique circle, and it will be perpendicular to that given. If the given circle is inclined to the primitive, let it be represented by BAD (fig. 21.), whose pole is P, and let A be the point through which the perpendicular is to be drawn: then, by Prob. I. describe a great circle through the points P and A, and it will be perpendicular to the oblique circle BAD.

Fig. 21.

Proposition XVIII. Problem X.

Through a point in a projected great circle, to describe another great circle to make a given angle with the former, provided the measure of the given angle is not less than the distance between the given point and circle.

Let the given circle be the primitive, and let A (fig. 19.) be the angular point. Draw the diameter AE, DF perpendicular to each other; and make the angle CAG equal to that given, or make CG equal to the tangent of the given angle; then from the centre G, with the distance GC, describe the oblique circle ABE, and it will make with the primitive an angle equal to that given.

If the given circle be a right one, let it be APB (fig. 22.) and let P be the given point. Draw the diameter GH

Fig. 22.

GH perpendicular to AB; join GP, and produce it to *a*; make H *b* equal to twice A *a*: and G *b* being joined intersects AB in C. Draw CD perpendicular to AB, and equal to the cotangent of the given angle to the radius PC; or make the angle CPD equal to the complement of that given: then from the centre D, with the radius DP, describe the great circle FPE, and the angle APF, or BPE, will be equal to that given.

Fig. 23. If APB (fig. 23.) is an oblique circle. From the angular point P, draw the lines PG, PC through the centres of the primitive and given oblique circle. Through C, the centre of APB, draw GCD at right angles to PG; make the angle GPD equal to that given; and from the centre D, with the radius DP, describe the oblique circle FPE, and the angle APF, or BPE, will be equal to that proposed.

Proposition XIX. Problem XI.

Any great circle cutting the primitive being given, to describe another great circle which shall cut the given one in a proposed angle, and have a given arch intercepted between the primitive and given circles.

Plate CCCCXLV fig. 24. If the given circle be a right one, let it be represented by APC (fig. 24.); and at right angles thereto draw the diameter BPM; make the angle BPF equal to the complement of the given angle, and PF equal to the tangent of the given arch; and from the centre of the primitive with the secant of the same arch describe the arch G*g*. Through F draw FG parallel to AC, meeting G*g* in G; then from the centre G, with the tangent PF, describe an arch *n o*, cutting APC in I, and join GI. Through G, and the centre P, draw the diameter HK; draw PL perpendicular to HK, and IL perpendicular to GI, meeting PL in L; then L will be the centre of the circle HIK, which is that required.

Fig. 25. But if the given great circle be inclined to the primitive, let it be ADB (fig. 25.), and E its centre: make the angle BDF equal to the complement of that given, and DF equal to the tangent of the given arch, as before. From P, the centre of the primitive, with the secant of the same arch, describe the arch G*g*, and from E, the centre of the oblique circle, with the extent EF, describe an arch intersecting G*g* in G. Now G being determined, the remaining part of the operation is performed as before.

When the given arch exceeds 90°, the tangent and secant of its supplement are to be applied on the line DF the contrary way, or towards the right; the former construction being reckoned to the left.

Proposition XX. Problem XII.

Any great circle in the plane of projection being given, to describe another great circle, which shall make given angles with the primitive and given circles.

Fig. 26. Let ADC (fig. 26.) be the given circle, and Q its pole. About P the pole of the primitive, describe an arch *m n*, at the distance of as many degrees as are in the angle which the required circle is to make with the primitive. About Q the pole of the circle ADC, and at a distance equal to the measure of the angle which the required circle is to make with the given circle ADC, describe an arch *o n*, cutting *m n* in *n*. Then about *n* as a pole, describe the great circle EDF, cutting the primitive and given circle in E and D, and it will be the great circle required.

Scholium.

It will hence be an easy matter to construct all the various spherical triangles. The reader is, however, referred to the article *Spherical* Trigonometry, for the method of constructing them agreeably to this projection; and also for the application to the resolution of problems of the sphere. For the method of projecting the sphere upon the plane of the meridian, and of the horizon, according to the stereographic projection, see the article Geography.

SECTION II.

Of the Orthographic Projection of the Sphere.

The orthographic projection of the sphere, is that in which the eye is placed in the axis of the plane of projection, at an infinite distance with respect to the diameter of the sphere; so that at the sphere all the visual rays are assumed parallel, and therefore perpendicular to the plane of projection.

Hence the orthographic projection of any point is where a perpendicular from that point meets the plane of projection; and the orthographic representation of any object is the figure formed by perpendiculars drawn from every point of the object to the plane of projection.

This method of projection is used in the geometrical delineation of eclipses, occultations, and transits. It is also particularly useful in various other projections, such as the analemma. See Geography, &c.

Proposition I. Theorem I.

Every straight line is projected into a straight line. If the given line be parallel to the plane of projection, it is projected into an equal straight line; but if it is inclined to the primitive, then the given straight line will be to its projection in the ratio of the radius to the cosine of inclination.

Let AB (fig. 27.) be the plane of projection, and let CD be a straight line parallel thereto: from the extremities C, D of the straight line CD, draw the lines CE, DF perpendicular to AB; then by 3. of xi. of Eucl. the intersection EF, of the plane CEFD, with the plane of projection, is a straight line: and because the straight lines CD, EF are parallel, and also CE, DF; therefore by 34. of i. of Eucl. the opposite sides are equal; hence the straight line CD, and its projection EF, are equal. Again, let GH be the proposed straight line, inclined to the primitive; then the lines GE, HF being drawn perpendicular to AB, the intercepted portion EF will be the projection of GH. Through G draw GI parallel to AB, and the angle IGH will be equal to the inclination of the given line to the plane of projection. Now GH being the radius, GI, or its equal EF, will be the cosine of IGH; hence the given line GH is to its projection EF as radius to the cosine or inclination. Fig. 27.

Corollaries.

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COROLLARIES.

1. A straight line perpendicular to the plane of projection is projected into a point.

2. Every straight line in a plane parallel to the primitive is projected into an equal and parallel straight line.

3. A plane angle parallel to the primitive is projected into an equal angle.

4. Any plane rectilineal figure parallel to the primitive is projected into an equal and similar figure.

5. The area of any rectilineal figure is to the area of its projection as radius to the cosine of its inclination.

PROPOSITION II. THEOREM II.

Every great circle, perpendicular to the primitive, is projected into a diameter of the primitive; and every arch of it, reckoned from the pole of the primitive, is projected into its sine.

Fig. 28. Let BFD (fig. 28.) be the primitive, and ABCD a great circle perpendicular to it, passing through its poles A, C; then the diameter BED, which is their line of common section, will be the projection of the circle ABCD. For if from any point, as G, in the circle ABC, a perpendicular GH fall upon BD, it will also be perpendicular to the plane of the primitive: therefore H is the projection of G. Hence the whole circle is projected into BD, and any arch AG into EH equal to GI its sine.

COROLLARIES.

1. Every arch of a great circle, reckoned from its intersection with the primitive, is projected into its versed sine.

2. Every less circle perpendicular to the primitive is projected into its line of common section with the primitive, which is also its own diameter: and every arch of the semicircle above the primitive, reckoned from the middle point, is projected into its sine.

3. Every diameter of the primitive is the projection of a great circle; and every chord the projection of a less circle.

4. A spherical angle at the pole of the primitive is projected into an equal angle.

PROPOSITION III. THEOREM III.

A circle parallel to the primitive is projected into a circle equal to itself, and concentric with the primitive.

Fig. 29. Let the less circle FIG (fig. 29.) be parallel to the plane of the primitive BND. The straight line HE, which joins their centres, is perpendicular to the primitive; therefore E is the projection of H. Let any radii HI and IN perpendicular to the primitive be drawn. Then IN, HE being parallel, are in the same plane; therefore IH, NE, the lines of common section of the plane IE, with two parallel planes, are parallel; and the figure IHEN is a parallelogram. Hence NE= IH, and consequently FIG is projected into an equal circle KNL, whose centre is E.

COROLLARY.

The radius of the projection is the cosine of the distance of the parallel circle from the primitive, or the sine of its distance from the pole of the primitive.

PROPOSITION IV. THEOREM IV.

An inclined circle is projected into an ellipse, whose transverse axis is the diameter of the circle.

1. Let ELF (fig. 30.) be a great circle inclined to the primitive EBF, and EF their line of common section. From the centre C, and any other point K, in EF, let the perpendicular CB, KI be drawn in the plane of the primitive, and CL, KN, in the plane of the great circle, meeting the circumference in L, N. Let LG, ND be perpendicular to CB, KI; then G, D are the projections of L, N. And because the triangles LCG, NKD are equiangular, $CL^2 : CG^2 :: NK^2 : DK^2$; or $EC^2 : CG^2 :: EKF : DK^2$: therefore the points G, D are in the curve of an ellipse, of which EF is the transverse axis, and CG the semiconjugate axis. Fig. 30.

COROLLARIES.

1. In a projected great circle, the semiconjugate axis is the cosine of the inclination of the great circle to the primitive.

2. Perpendiculars to the transverse axis intercept corresponding arches of the projection and the primitive.

3. The eccentricity of the projection is the sine of the inclination of the great circle to the primitive.

Case 2. Let AQB (fig. 31.) be a less circle, inclined to the primitive, and let the great circle LBM, perpendicular to both, intersect them in the lines AB, LM. From the centre O, and any other point N in the diameter AB, let the perpendiculars TOP, NQ, be drawn in the plane of the less circle, to meet its circumference in T, P, Q. Also from the points A, N, O, B, let AG, NI, OC, BH, be drawn perpendicular to LM; and from P, Q, T, draw PE, QD, TF, perpendicular to the primitive; then G, I, C, H, E, D, F, are the projections of these points. Because OP is perpendicular to LMB, and OC, PE, being perpendicular to the primitive, are in the same plane, the plane COPE is perpendicular to LBM. But the primitive is perpendicular to LBM; therefore the common section EC is perpendicular to LBM, and to LM. Hence CP is a parallelogram, and EC=OP. In like manner, FC, DI, are proved perpendicular to LM, and equal to OT, NQ. Thus ECF is a straight line, and equal to the diameter PT. Let QR, DK be parallel to AB, LM; then RO=NQ=DI=KC, and $PR \times RT = EK \times KF$. But AO : CG :: NO : CI; therefore $AO^2 : CG^2 :: QR^2 : DK^2$; and $EC^2 : CG^2 :: EKF : DK^2$. Fig. 31.

COROLLARIES.

1. The transverse axis is to the conjugate as radius to the cosine of the circle's inclination to the primitive.

2. Half the transverse axis is the cosine of half the sum of the greatest and least distances of the less circle from the primitive.

3. The extremities of the conjugate axis are in the line of measures, distant from the centre of the primitive by the cosines of the greatest and least distances of the less circle from the primitive.

4. If

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4. If from the extremities of the conjugate axis of any elliptical projection perpendiculars be drawn (in the same direction if the circle do not intersect the primitive, but if otherwise in opposite directions), they will intersect an arch of the primitive, whose chord is equal to the diameter of the circle.

Proposition V. Theorem V.

The projected poles of an inclined circle are in its line of measures distant from the centre of the primitive the sine of the inclination of the circle to the primitive.

Fig. 32. Let ABCD (fig. 32.) be a great circle, perpendicular both to the primitive and the inclined circle, and intersecting them in the diameters AC, MN. Then ABCD passes through the poles of the inclined circle: let these be P, Q; and let P p, Q q, be perpendicular to AC; p, q are the projected poles; and it is evident that p O = sine of BP, or MA, the inclination.

Corollaries.

1. The centre of the primitive, the centre of the projection, the projected poles, and the extremities of the conjugate axis, are all in one and the same straight line.

2. The distance of the centre of projection from the centre of the primitive, is to the cosine of the distance of the circle from its own pole, as the sine of the circle's inclination to the primitive is to the radius.

Proposition VI. Problem I.

To describe the projection of a circle perpendicular to the primitive, and whose distance from its pole is equal to a given quantity.

Fig. 33. Let PA p B (fig. 33.) be the primitive circle, and P, p the poles of the right circle to be projected. Then if the circle to be projected is a great circle, draw the diameter AB at right angles to the axis P p, and it will be that required. But if the required projection is that of a less circle, make PE, PF each equal to the chord of the distance of the less circle from its pole; join EF, and it will be the projection of the less circle required.

Proposition VII. Problem II.

Through a given point in the plane of the primitive to describe the projection of a great circle, having a given inclination to the primitive.

1. When the given inclination is equal to a right angle, a straight line drawn through the centre of the primitive, and the given point, will be the projection required.

2. When the given inclination is less than a right angle, and the given point in the circumference of the primitive. Let R (fig. 34). be a point given in the circumference of the primitive, through which it is required to draw the projection of a great circle, inclined to the primitive in an angle measured by the arch QP of the primitive. Fig. 34.

Through the given point R draw the diameter RCS, and draw GC g at right angles to it. Make the arch GV of the primitive equal to QP, and draw VA at right angles to GC; and in G g towards the opposite parts of C, take CB equal to AC; then, with the greater axis RS, and less axis AB, describe an ellipse, and it will be the projection of the oblique circle required.

3. When the distance of the given point from the primitive is equal to the cosine of the given inclination.

Every thing remaining as in the preceding case; let A be the given point, and AC the cosine of an arch GV, equal to the given arch QP; then drawing the diameter RCS at right angles to ACB, the ellipse described with the given axis RS, AB will be the projection of the inclined circle.

4. When the distance of the given point from the centre of the primitive is less than the semidiameter of primitive, but greater than the cosine of the given inclination.

Let D be the given point, through which draw the diameter IC i; and at the point D draw DL perpendicular to DC meeting the primitive in L; also draw LK, making with LD the angle DLK equal to the complement of the given inclination. Let LK meet DC in K; then will DK be less than DC. On DC as a diameter describe a circle, and make DH equal to DK; through H draw a diameter of the primitive RCS, and describe an ellipse through the points R, D, S, and it will be the projection of the inclined circle. Walker on the Sphere, p. 159.

Proposition VIII. Problem III.

Through two given points in the plane of the primitive to describe the projection of a great circle.

1. If the two given points and the centre of the primitive be in the same straight line, then a diameter of the primitive being drawn through these points will be the projection of the great circle required.

2. When the two given points are not in the same straight line with the centre of the primitive; and one of them is in the circumference of the primitive.

Let DR (fig. 34.) be the two given points, of which R is in the circumference of the primitive. Draw the diameters RCS, and GC g, FDH perpendicular to it, meeting the primitive in G g F. Divide GC, g C, in A, B, in the same proportion as FH is divided in D; and describe the ellipse whose axes are RS, AB, and centre C; and it will be the projection required.

3. When the given points are within the primitive, and not in the same straight line with its centre.

Let D, E (fig. 35.) be the two given points; through C the centre of the primitive draw the straight lines ID, KE i; draw DL perpendicular to I i, and EO perpendicular to K k, meeting the primitive in L, O. Through E, and towards the same parts of C, draw EP parallel to DC, and in magnitude a fourth proportional to LD, DC, OE. Draw the diameter CP meeting the primitive in R, S, and describe an ellipse through the points D and R, or S, and it will also pass through E. This ellipse will be the projection of the proposed inclined circle. Fig. 35.

Proposition IX. Problem IV.

To describe the projection of a less circle parallel to the primitive, its distance from the pole of the primitive being given.

From

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From the pole of the primitive, with the sine of the given distance of the circle from its pole, describe a circle, and it will be the projection of the given less circle.

Proposition X. Problem V.

About a given point as a projected pole to describe the projection of an inclined circle, whose distance from its pole is given.

Fig. 36. Let P (fig. 36.) be the given projected pole, through which draw the diameter G *g*, and draw the diameter H *b* perpendicular thereto. From P draw PL perpendicular to GP meeting the circumference in L; through which draw the diameter L *l*. Make LT, LK each equal to the chord of the distance of the less circle from its pole, and join TK, which intersects L *l*, in Q. From the points T, Q, K, draw the lines FA, QS, KB, perpendicular to G *g*; and make OR, OS, each equal to QT, or QK. Then an ellipse described through the points A, S, B, R will be the projection of the proposed less circle.

Proposition XI. Problem VI.

To find the poles of a given projected circle.

1. If the projected circle be parallel to the primitive, the centre of the primitive will be its pole.

2. If the circle be perpendicular to the primitive, then the extremities of a diameter of the primitive drawn at right angles to the straight line representing the projected circle, will be the poles of that circle.

3. When the projected circle is inclined to the primitive.

Fig. 37. Let ARBS (fig. 36, 37.) be the elliptical projection of any oblique circle; through the centre of which, and C the centre of the primitive, draw the line of measures CBA, meeting the ellipse in B, A, and the primitive in G, *g*. Draw CH, BK, AT perpendicular to G *g*, meeting the primitive in H, K, T. Bisect the arch KT in L, and draw LP perpendicular to G *g*; then P will be the projected pole of the circle, of which ARBS is the projection.

Proposition XII. Problem VII.

To measure any portion of a projected circle, and conversely.

1. When the given projection is that of a great circle.

Fig. 38. Let ADBE (fig. 38.) be the given great circle, either perpendicular or inclined to the primitive, of which the portion DE is to be measured, and let M *m* be the line of measures of the given circle. Through the points D, E, draw the lines EG, DF parallel to M *m*; and the arch FG of the primitive will be the measure of the arch DE of the great circle, and conversely.

2. When the projection is that of a less circle parallel to the primitive.

Plate CCCCXLVI. fig. 39. Let DE (fig. 39.) be the portion to be measured, of the less circle DEH parallel to the primitive. From the centre C draw the lines CD, CE, and produce them to meet the primitive in the points B, F. Then the intercepted portion BF of the primitive will be the measure of the given arch DE of the less circle DEH.

3. If the given less circle, of which an arch is to be measured, is perpendicular to the primitive.

Fig. 40. Let ADEB (fig. 40.) be the less circle, of which the measure of the arch DE is required. Through C, the centre of the primitive, draw the line of measures M *m*, and from the intersection O of the given right circle, and the line of measures, with the radius OA, or OB, describe the semicircle AFGB; through the points D, E, draw the lines DF, EG parallel to the line of measures, and the arch FG will be the measure of DE, to the radius AO. In order to find a similar arch in the circumference of the primitive, join OF, OG, and at the centre C of the primitive, make the angle *m* CH equal to FOG, and the arch *m* H to the radius C *m* will be the measure of the arch DE.

4. When the great projection is of a less circle inclined to the primitive.

Fig. 41. Let RDS (fig. 41.) be the projection of a less circle inclined to the primitive, and DE a portion of that circle to be measured. Through O the centre of the projected circle, and C the centre of the primitive, draw the line of measures M *m*; and from the centre O, with the radius OR, or OS, describe the semicircle RGFS; through the points D, E, draw the lines DF, EG parallel to the line of measures, and FG will be the measure of the arch DE to the radius OR, or OS. Join OF, OG, and make the angle *m* CH equal to FOG, and the arch *m* H of the primitive will be the measure of the arch DE of the inclined circle RDS.

The converse of this proposition, namely, to cut off an arch from a given projected circle equal to a given arch of the primitive, is obvious.

The above operation would be greatly shortened by using the line of signs in the sector.

It seems unnecessary to insist farther on this projection, especially as the reader will see the application of it to the projection of the sphere on the planes of the *Meridian*, *Equator*, and *Horizon*, in the article Geography; and to the delineation of *Eclipses* in the article Astronomy. The *Analemma*, Plate CCXXXV. in the article Geography, is also according to this projection; and the method of applying it to the solution of astronomical problems is there exemplified.

SECTION III.

Of the Gnomonic Projection of the Sphere.

In this projection the eye is in the centre of the sphere, and the plane of projection touches the sphere in a given point parallel to a given circle. It is named *gnomonic*, on account of its being the foundation of dialling: the plane of projection may also represent the plane of a dial, whose centre being the projected pole, the semiaxis of the sphere will be the stile or gnomon of the dial.

As the projection of great circles is represented by straight lines, and less circles parallel to the plane of projection are projected into concentric circles: therefore many problems of the sphere are very easily resolved. Other problems, however, become more intricate on account of some of the circles being projected into ellipses, parabolas, and hyperbolas.

Proposition

Gnomonic Projection of the Sphere.

Proposition I. Theorem I.

Every great circle is projected into a straight line perpendicular to the line of measures; and whose distance from the circle is equal to the cotangent of its inclination, or to the tangent of its nearest distance from the pole of the projection.

Fig. 42. Let BAD (fig. 42.) be the given circle, and let the circle CBED be perpendicular to BAD, and to the plane of projection; whose intersection CF with this last plane will be the line of measures. Now since the circle CBED is perpendicular both to the given circle BAD and to the plane of projection, the common section of the two last planes produced will therefore be perpendicular to the plane of the circle CBED produced, and consequently to the line of measures: hence the given circle will be projected into that section; that is, into a straight line passing through d, perpendicular to C d. Now C d is the cotangent of the angle C d A, the inclination of the given circle, or the tangent of the arch CD to the radius AC.

Corollaries.

1. A great circle perpendicular to the plane of projection is projected into a straight line passing through the centre of projection: and any arch is projected into its correspondent tangent.

2. Any point, as D, or the pole of any circle, is projected into a point d, whose distance from the pole of projection is equal to the tangent of that distance.

3. If two great circles be perpendicular to each other, and one of them passes through the pole of projection, they will be projected into two straight lines perpendicular to each other.

4. Hence if a great circle be perpendicular to several other great circles, and its representation pass through the centre of projection; then all these circles will be represented by lines parallel to one another, and perpendicular to the line of measures, for representation of that first circle.

Proposition II. Theorem II.

If two great circles intersect in the pole of projection, their representations will make an angle at the centre of the plane of projection, equal to the angle made by these circles on the sphere.

For since both these circles are perpendicular to the plane of projection, the angle made by their intersections with this plane is the same as the angle made by these circles.

Proposition III. Theorem III.

Any less circle parallel to the plane of projection is projected into a circle whose centre is the pole of projection, and its radius is equal to the tangent of the distance of the circle from the pole of projection.

Let the circle PI (fig. 42.) be parallel to the plane GF, then the equal arches PC, CI are projected into the equal tangents GC, CH; and therefore C the point of contact and pole of the circle PI and of the projection, is the centre of the representation G, H.

Corollary.

If a circle be parallel to the plane of projection, and 45 degrees from the pole, it is projected into a circle equal to a great circle of the sphere; and therefore may be considered as the primitive circle, and its radius the radius of projection.

Proposition IV. Theorem IV.

A less circle not parallel to the plane of projection is projected into a conic section, whose transverse axis is in the line of measures; and the distance of its nearest vertex from the centre of the plane of projection is equal to the tangent of its nearest distance from the pole of projection; and the distance of the other vertex is equal to the tangent of the greatest distance.

Any less circle is the base of a cone whose vertex is at A (fig. 43.); and this cone being produced, its intersection with the plane of projection will be a conic section. Thus the cone DAF, having the circle DF for its base, being produced, will be cut by the plane of projection in an ellipse whose transverse diameter is df; and C d is the tangent of the angle CAD, and Cf the tangent of CAF. In like manner, the cone AFE, having the side AE parallel to the line of measures df; being cut by the plane of projection, the section will be a parabola, of which f is the nearest vertex, and the point into which E is projected is at an infinite distance. Also the cone AFG, whose base is the circle FG, being cut by the plane of projection, the section will be a hyperbola; of which f is the nearest vertex; and GA being produced gives d the other vertex. Fig. 43.

Corollaries.

1. A less circle will be projected into an ellipse, a parabola or hyperbola, according as the distance of its most remote point is less, equal to, or greater than, 90 degrees.

2. If H be the centre, and K k, l the focus of the ellipse, hyperbola, or parabola; then $HK=\frac{A\,d-Af}{2}$ for the ellipse; $H\,k=\frac{A\,d+Af}{2}$ for the hyperbola; and $f\,n$ being drawn perpendicular to AE $f\,l=\frac{n\,E+F\,f}{2}$ for the parabola.

Proposition V. Theorem V.

Let the plane TW (fig. 44.) be perpendicular to the plane of projection TV, and BCD a great circle of the sphere in the plane TW. Let the great circle BED be projected into the straight line $b\,e\,k$. Draw CQS perpendicular to $b\,k$, and C m parallel to it and equal to CA, and make QS equal to Q m; then any angle QS t is the measure of the arch Q t of the projected circle. Fig. 44.

Join AQ: then because C m is equal to C A, the angle QC m equal to QCA, each being a right angle, and the side QC common to both triangles; therefore Q m, or its equal QS, is equal QA. Again, since the plane ACQ is perpendicular to the plane TV, and b Q to

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to the intersection CQ; therefore b Q is perpendicular both to AQ and QS: hence, since AQ and QS are equal, all the angles at S cut the line b Q in the same points as the equal angles at A. But by the angles at A the circle BED is projected into the line b Q. Therefore the angles at S are the measures of the parts of the projected circle b Q; and S is the dividing centre thereof.

Corollaries.

1. Any great circle b Q t is projected into a line of tangents to the radius SQ.

2. If the circle b C pass through the centre of projection, then the projecting point A is the dividing centre thereof, and C b is the tangent of its correspondent arch CB to CA the radius of projection.

Proposition VI. Theorem VI.

Fig. 44. Let the parallel circle GLH (fig. 44.) be as far from the pole of projection C as the circle FNI is from its pole; and let the distance of the poles C, P be bisected by the radius AO: and draw b AD perpendicular to AO; then any straight line b Q t drawn through b will cut off the arches h l, F n equal to each other in the representations of these equal circles in the plane of projection.

Let the projections of the less circles be described. Then, because BD is perpendicular to AO, the arches BO, DO are equal; but since the less circles are equally distant each from its respective pole, therefore the arches FO, OH are equal; and hence the arch BF is equal to the arch DH. For the same reason the arches BN, DL are equal; and the angle FBN is equal to the angle LDH; therefore, on the sphere, the arches FN, HL are equal. And since the great circle BNLD is projected into the straight line b Q n l, &c. therefore n is the projection of N, and l that of L; hence f n, h l, the projections of FN, HL respectively, are equal.

Proposition VII. Theorem VII.

Fig. 45. If F n k, h l g, (fig. 45.) be the projections of two equal circles, whereof one is as far from its pole P as the other from its pole C, which is the centre of projection; and if the distance of the projected poles C, p be divided in o, so that the degrees in C o, o p be equal, and the perpendicular o S be erected to the line of measures g h. Then the line p n, C l drawn from the poles C, p, through any point Q in the line o S, will cut off the arches F n, h l equal to each other, and to the angle Q C p.

The great circle A o perpendicular to the plane of the primitive is projected into the straight line o S perpendicular to g h, by Prop. i. cor. 3. Let Q be the projection of q; and since p Q, CQ are straight lines, they are therefore the representations of the arches P q, C q of great circles. Now since P q C is an isosceles spherical triangle, the angles PCQ, CPQ are therefore equal; and hence the arches P q, C q produced will cut off equal arches from the given circles FI, GH, whose representations F n, h l are therefore equal: and since the angle QC p is the measure of the arch h l, it is also the measure of its equal F n.

Corollary.

Hence, if from the projected pole of any circle a perpendicular be erected to the line of measures, it will cut off a quadrant from the representation of that circle.

Proposition VIII. Theorem VIII.

Let F n k (fig. 45.) be the projection of any circle FI, and p the projection of its pole P. If C g be the cotangent of CAP, and g B perpendicular to the line of measures g C, let CAP be bisected by A o, and the line o B drawn to any point B, and also p B cutting F n k in d; then the angle g o B is the measure of the arch F d. Fig. 45.

The arch PG is a quadrant, and the angle g o A= P A+o A P=g A C+o A P=g A C+C A o=g A o; therefore g A=g o; consequently o is the dividing centre of g B, the representation of GA; and hence, by Prop. v. the angle g o B is the measure of g B. But since p g represents a quadrant, therefore p is the pole of g B; and hence the great circle p d B passing through the pole of the circles g B and F n will cut off equal arches in both, that is F d=g B=angle g o B.

Corollary.

The angle g o B is the measure of the angle g p B. For the triangle g p B represents a triangle on the sphere, wherein the arch which g B represents is equal to the angle which the angle p represents; because g p is a quadrant; therefore g o B is the measure of both.

Proposition IX. Theorem I.

To draw a great circle through a given point, and whose distance from the pole of projection is equal to a given quantity.

Let ADB (fig. 46.) be the projection, C its pole or centre, and P the point through which a great circle is to be drawn: through the points P, C draw the straight line PCA, and draw CE perpendicular to it: make the angle CAE equal to the given distance of the circle from the pole of projection C; and from the centre C, with the radius CE, describe the circle EFG: through P draw the straight line PIK, touching the circle EFG in I, and it will be the projection of the great circle required. Fig. 46.

Proposition X. Problem II.

To draw a great circle perpendicular to a great circle which passes through the pole of projection, and at a given distance from that pole.

Let ADB (fig. 46.) be the primitive, and CI the given circle: draw CL perpendicular to CI, and make the angle CLI equal to the given distance: then the straight line KP, drawn through I parallel to CL, will be the required projection.

Proposition XI. Problem III.

At a given point in a projected great circle, to draw another great circle to make a given angle with the former; and, conversely, to measure the angle contained between two great circles.

Let P (fig. 47.) be the given point in the given great circle Fig. 47.

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circle PB, and C the centre of the primitive: through the points P, C draw the straight line PCG; and draw the radius of the primitive CA perpendicular thereto; join PA; to which draw AG perpendicular: through G draw BGD at right angles to GP, meeting PB in B; bisect the angle CAP by the straight line AO; join BO, and make the angle BOD equal to that given; then DP being joined, the angle BPD will be that required.

If the measure of the angle BPD be required, from the points B, D draw the lines BO, DO, and the angle BOD is the measure of BPD.

Proposition XII. Problem IV.

To describe the projection of a less circle parallel to the plane of projection, and at a given distance from its pole.

Fig. 46. Let ADB (fig. 46.) be the primitive, and C its centre: set the distance of the circle from its pole, from B to H, and from H to D; and draw the straight line AED, intersecting CE perpendicular to BC, in the point E: with the radius CR describe the circle EFG, and it is the projection required.

Proposition XIII. Problem V.

To draw a less circle perpendicular to the plane of projection.

Plate CCCCXLVII. fig. 48. Let C (fig. 48.) be the centre of projection, and TI a great circle parallel to the proposed less circle: at C make the angles ICN, TCO each equal to the distance of the less circle from its parallel great circle TI; let CL be the radius of projection, and from the extremity L draw LM perpendicular thereto; make CV equal to LM; or GF equal to CM: then with the vertex V and assymptotes CN, CO describe the hyperbola WVK *; or, with the focus F and CV describe the hyperbola, and it will be the perpendicular circle described.

* See *Conic Sections.*

Proposition XIV. Problem VI.

To describe the projection of a less circle inclined to the plane of projection.

Fig. 49. Draw the line of measures *dp* (fig. 49.); and at C, the centre of projection, draw CA perpendicular to *d p*, and equal to the radius of projection: with the centre A, and radius AC, describe the circle DCFG; and draw RAE parallel to *d p*: then take the greatest and least distances of the circle from the pole of projection, and set them from C to D and F respectively, for the circle DF; and from A, the projecting point, draw the straight lines AF*f*, and AD*d*; then *d f* will be the transverse axis of the ellipse; but if D fall beyond the line RE, as at G, then from G draw the line GAD*d*, and *d f* is the transverse axis of an hyperbola: and if the point D fall in the line RE, as at E, then the line AE will not meet the line of measures, and the circle will be projected into a parabola whose vertex is *f*: bisect *d f* in H, the centre, and for the ellipse take half the difference of the lines A*d*, A*f*, which laid from H will give K the focus: for the hyperbola, half the sum of A*d*, A*f* being laid from H, will give *k* its focus: then with the transverse axis *d f*, and focus K, or *k*, describe the ellipse *d* M *f*, or hyperbola *f m*, which will be the projection of the inclined circle: for the parabola, make EQ equal to F*f*, and draw *f n* perpendicular to AQ, and make *f k* equal to one half of *n* Q: then with the vertex *f*, and focus *k*, describe the parabola *f m*, for the projection of the given circle FE.

Proposition XV. Problem VII.

To find the pole of a given projected circle.

Let DMF (fig. 50.) be the given projected circle whose line of measures is DF, and C the centre of projection; from C draw the radius of projection CA, perpendicular to the line of measures, and A will be the projecting point: join AD, AF, and bisect the angle DAF by the straight line AP; hence P is the pole. If the given projection be an hyperbola, the angle *f* AG (fig. 49.), bisected, will give its pole in the line of measures; and in a parabola, the angle *f* AE bisected will give its pole. Fig. 50.

Proposition XVI. Problem VIII.

To measure any portion of a projected great circle, or to lay off any number of degrees thereon.

Let EP (fig. 51.) be the great circle, and IP a portion thereof to be measured: draw ICD perpendicular to IP; let C be the centre, and CB the radius of projection, with which describe the circle EBD; make IA equal to IB; then A is the dividing centre of EP; hence AP being joined, the angle IAP is the measure of the arch IP. Fig. 51.

Or, if IAP be made equal to any given angle, then IP is the correspondent arch of the projection.

Proposition XVII. Problem IX.

To measure any arch of a projected less circle, or to lay off any number of degrees on a given projected less circle.

Let F *n* (fig. 52.) be the given less circle, and P its pole: from the centre of projection C draw CA perpendicular to the line of measures GH, and equal to the radius of projection; join AP, and bisect the angle CAP by the straight line AO, to which draw AD perpendicular: describe the circle G *l* H, as far distant from the pole of projection C as the given circle is from its pole P; and through any given point *n*, in the projected circle F *n*, draw D *n l*, then H *l* is the measure of the arch F *n*. Fig. 52.

Or let the measure be laid from H to *l*, and the line D *l* joined will cut off F *n* equal thereto.

Proposition XVIII. Problem X.

To describe the gnomonic projection of a spherical triangle, when three sides are given; and to find the measures of either of its angles.

Let ABC (fig. 53.) be a spherical triangle whose three sides are given: draw the radius CD (fig. 54.) perpendicular to the diameter of the primitive EF; and at the point D make the angles CDA, CDG, ADI, equal respectively to the sides AC, BC, AB, of the spherical triangle ABC (fig. 53.), the lines DA, DG intersecting the diameter EF, produced if necessary in the points A and G: make DI equal to DG; then from the centre C, with the radius CG, describe an arch; and from A, with the distance AI, describe another arch, intersecting the former in B; join AB, CB, and ACB will be the projection of the spherical triangle (fig. 53.); and the rectilineal angle ACB is the measure of the spherical angle ACB (fig. 53.). Fig. 53. Fig. 54.

Proposition

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PROPOSITION XIX. PROBLEM XI.

The three angles of a spherical triangle being given, to project it, and to find the measures of the sides.

Fig. 55. Let ABC (fig. 55.) be the spherical triangle of which the angles are given: construct another spherical triangle EFG, whose sides are the supplements of the given angles of the triangle ABC; and with the sides of this supplemental triangle describe the gnomonic projection, &c. as before.

It may be observed, that the supplemental triangle EFG has also a supplemental part EF g; and when the sides GE, GF, which are substituted in place of the angles A, B, are obtuse, their supplements g E, g F are to be used in the gnomonic projection of the triangle.

PROPOSITION XX. PROBLEM XII.

Given two sides, and the included angle of a spherical triangle, to describe the gnomonic projection of that triangle, and to find the measures of the other parts.

Fig 56. Let the sides AC, CB, and the angle ACB (fig. 53.), be given; make the angles CDA, CDG (fig. 56.) equal respectively to the sides AC, CB (fig. 53.); also make the angle ACB (fig. 56.) equal to the spherical angle ACB (fig. 53.), and CB equal to CG, and ABC will be the projection of the spherical triangle.

To find the measure of the side AB: from C draw CL perpendicular to AB, and CM parallel thereto, meeting the circumference of the primitive in M; make LN equal to LM; join AN, BN, and the angle ANB will be the measure of the side AB.

To find the measure of either of the spherical angles, as BAC: from D draw DK perpendicular to AD, and make KH equal to KD: from K draw KI perpendicular to CK, and let AB produced meet KI in I, and join HI: then the rectilineal angle KHI is the measure of the spherical angle BAC. By proceeding in a similar manner, the measure of the other angle will be found.

PROPOSITION XXI. PROBLEM XIII.

Two angles and the intermediate side given, to describe the gnomonic projection of the triangle; and to find the measures of the remaining parts.

Let the angles CAB, ACB, and the side AC of the spherical triangle ABC (fig. 53.), be given: make the angle CDA (fig. 56.) equal to the measure of the given side AC (fig. 53.); and the angle ACB (fig. 56.) equal to the angle ACB (fig. 53.); produce AC to H, draw DK perpendicular to AD, and make KH equal to KD; draw KI perpendicular to CK, and make the angle KHI equal to the spherical angle CAB: from I, the intersection of KI, HI, to A draw IA, and let it intersect CB in B, and ACB will be the gnomonic projection of the spherical triangle ACB (fig. 53.). The unknown parts of this triangle may be measured by last problem.

PROPOSITION XXII. PROBLEM XIV.

Two sides of a spherical triangle, and an angle opposite to one of them given, to describe the projection of the triangle; and to find the measure of the remaining parts.

Let the sides AC, CB, and the angle BAC of the spherical triangle ABC (fig. 53.) be given: make the angles CDA, CDG (fig. 56.) equal respectively to the measures of the given sides AC, BC: draw DK perpendicular to AD, make KH equal to DK, and the angle KHI equal to the given spherical angle BAC: draw the perpendicular KI, meeting HI in I; join AI; and from the centre C, with the distance CG, describe the arch GB, meeting AI in B; join CB, and ABC will be the rectilineal projection of the spherical triangle ABC (fig. 53.) and the measures of the unknown parts of the triangle may be found as before.

PROPOSITION XXIII. PROBLEM XV.

Given two angles, and a side opposite to one of them, to describe the gnomonic projection of the triangle, and to find the measures of the other parts.

Let the angles A, B, and the side BC of the triangle ABC (fig. 55.) be given: let the supplemental triangle EFE be formed, in which the angles E, F, G, are the supplements of the sides BC, CA, AB, respectively, and the sides EF, FG, GE, the supplements of the angles C, A, B. Now at the centre C (fig. 56.) make the angles CDA, CDK equal to the measures of the sides GE, GF respestively, being the supplements of the angles B and A; and let the lines DA, DK intersect the diameter of the primitive EF in the points A and K: draw DG perpendicular to AD, make GH equal to DG, and at the point H make the angle GHI equal to the angle E, or to its supplement; and let EI, perpendicular to CH, meet HI in I, and join AI: then from the centre C, with the distance CG, describe an arch intersecting AI in B; join CB, and ABC will be the gnomonic projection of the given triangle ABC (fig. 55.): the supplement of the angle ACB (fig. 56.) is the measure of the side AB, (fig. 55.); the measures of the other parts are found as before.

It has already been observed, that this method of projection has, for the most part, been applied to dialling only. However, from the preceding propositions, it appears that all the common problems of the sphere may be more easily resolved by this than by either of the preceding methods of projection; and the facility with which these problems are resolved by this method has given it the preference in dialling. It may not perhaps be amiss in this place, to give a brief illustration of it in this particular branch of science.

In an horizontal dial, the centre of projection Z (fig. 57.) represents the zenith of the place for which Fig. 57. the dial is to be constructed; ZA the perpendicular height of the style: the angle ZPA, equal to the given latitude, determines the distance ZP of the zenith from the pole; and AP the edge of the style, which by its shadow gives the hour: the angle ZAP, equal also to the latitude, gives the distance of the equator EQ from the zenith: let E a be equal to EA, and a will be the dividing point of the equator. Hence if the angles E a I, E a II, &c. E a XI, E a X, &c. be made equal to 15°, 30°, &c. the equator will be divided into hours; and

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and lines drawn from P to these points of division will be hour lines.

If the dial is either vertical, or inclined to the horizon, then the point Z will be the zenith of that place whose horizon is parallel to the plane of the dial: ZE will be that latitude of the place; and the hours on the former dial will now be changed into others, by a quantity equal to the difference of longitude between the given place and that for which the dial is to be constructed. Thus, if it is noon when the shadow of the style falls on the line *PX*, then the difference of meridians is the angle E *a* X, or 30°. Hence, when a dial is to be constructed upon a given plane, either perpendicular or inclined to the horizon, the declination and inclination of that place must be previously found.

In an erect direct south dial, its zenith Z is the south point of the horizon, ZP is the distance of this point from the pole, and ZE its distance from the equator. If the dial is directed to the north, Z represents the north point of the horizon; PZ the distance of Z from the pole under the horizon; and ZE the elevation of the equator above the horizon.

If the dial is an erect east or west dial, the zenith Z is the east or west points of the horizon, accordingly, and the pole P is at an infinite distance, for the angle ZAP is a right angle; and therefore the line AP will not meet the meridian PZ. The line ZA produced is the equator, and is divided into hours by lines perpendicular to it.

If the plane of the dial is parallel to the equator, its zenith Z coincides with one of the poles of the equator P; and hence the hour lines of this dial are formed by drawing lines from the point Z, containing angles equal to 15°.

In the preceding methods of projection of the sphere, equal portions of a great circle on the sphere are represented by unequal portions in the plane of projection, and this inequality increases with the distance from the centre of projection. Hence, in projections of the earth, those places towards the circumference of the projection are very much distorted. In order to avoid this inconveniency, M. de la Hire* proposed, that the eye should be placed in the axis produced at the distance of the sine of 45° beyond the pole: In this case arches of the sphere and their projections are very nearly proportional to each other. Hence in a map of the earth agreeable to this construction, the axis, instead of being divided into a line of semitangents, is divided equally, in like manner as the circumference. The map of the world is constructed agreeable to this method of projection.

* Hist. de l'Academie Royal des Scien. 1701. See the article Geography.

P R O

Projection || Prolate.

PROJECTION, in *Perspective*, denotes the appearance, or representation of an object on the perspective plane.

The projection of a point is a point through which an optic ray passes from the objective point through the plane to the eye; or it is the point wherein the plane cuts the optic ray.

And hence may be easily conceived what is meant by the projection of a line, a plane, or a solid.

Projection, in *Alchemy*, the casting of a certain imaginary powder, called *powder of projection*, into a crucible, or other vessel, full of some prepared metal, or other matter; which is to be hereby presently transmuted into gold.

Powder of Projection, or of the philosophers stone, is a powder supposed to have the virtue of changing any quantity of an imperfect metal, as copper or lead, into a more perfect one, as silver or gold, by the admixture of a little quantity thereof.

The mark to which alchemists directed all their endeavours, was to discover this powder of projection. See *Philosophers Stone*, and Chemistry, *History of*.

PROJECTURE, in *Architecture*, the outjetting and prominency, or embossing, which the mouldings and other members have beyond the naked wall, column, &c.

PROLAPSUS, in *Surgery*, a prolapsion or falling out of any part of the body from its natural situation: thus we say, *prolapsus intestini*, "a prolapsion of the intestine," &c. See Surgery.

PROLATE, in *Geometry*, an epithet applied to a spheroid produced by the revolution of a semi-ellipsis about its larger diameter. See Spheroid.

Prolegomena | Prolific.

PROLEGOMENA, in *Philology*, certain preparatory observations or discourses prefixed to a book, &c. containing something necessary for the reader to be apprised of, to enable him the better to understand the book, or to enter deeper into the science, &c.

PROLEPSIS, a figure in *Rhetoric*, by which we anticipate or prevent what might be objected by the adversary. See Oratory, N° 80.

PROLEPTIC, an epithet applied to a periodical disease which anticipates, or whose paroxysm returns sooner and sooner every time; as is frequently the case in agues.

PROLIFER flos, (*proles*, "an offspring;" and *fero*, "to bear);" a prolific flower, or a flower which from its own substance produces another; a singular degree of luxuriance, to which full flowers are chiefly incident. See Botany.

PROLIFIC, something that has the qualities necessary for generating.

The prolific powers of some individuals among mankind are very extraordinary.—Instances have been found where children, to the number of six, seven, eight, nine, and sometimes sixteen, have been brought forth after one pregnancy. The wife of Emmanuel Gago, a labourer near Valladolid, was delivered, the 14th of June 1779, of five girls, the two first of whom were baptized: the other three were born in an hour after; two of them were baptized; but the last, when it came into the world, had every appearance of death. The celebrated Tarsin was brought to bed in the seventh month of her pregnancy, at Argenteuil near Paris, 17th July 1779, of three boys, each 14 inches and a half long, and of a girl 13 inches: they were all four baptized, but did not live 24 hours.

Fig. 1.

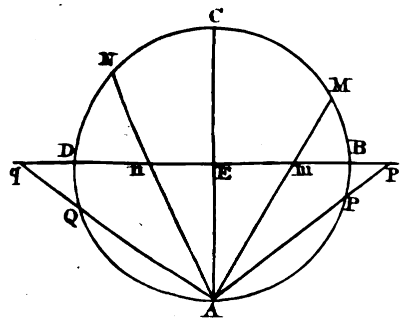
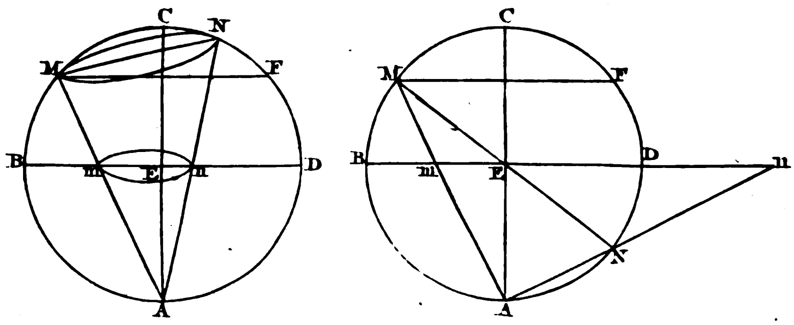


Fig. 2.



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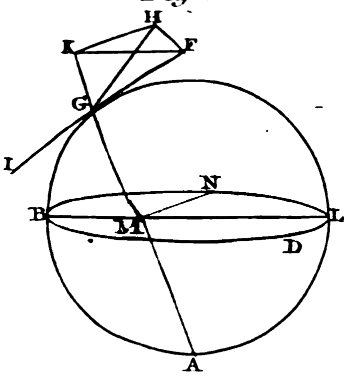

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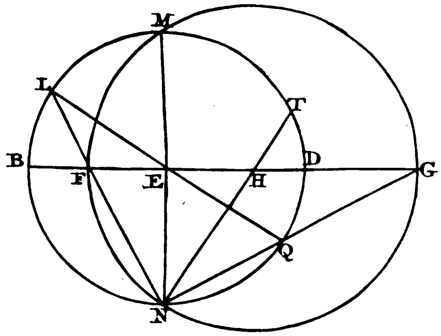

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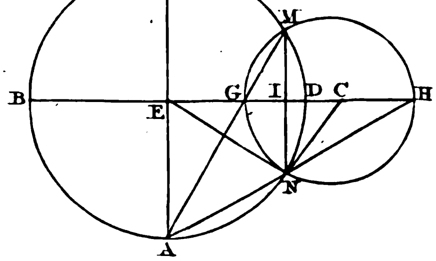

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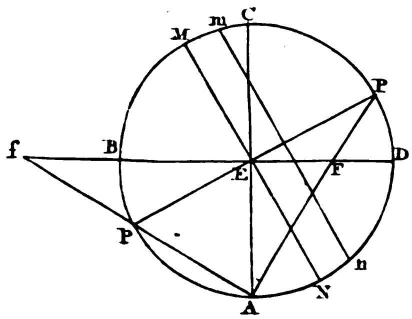

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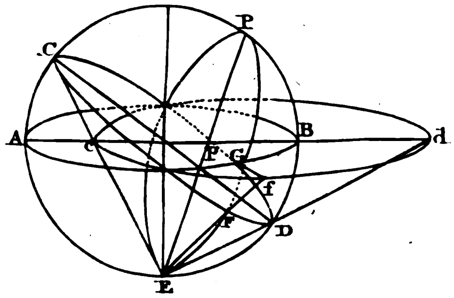

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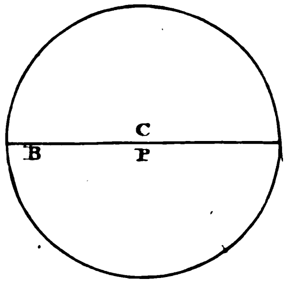

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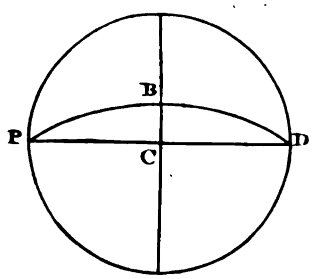

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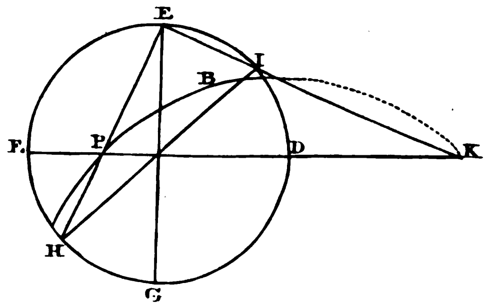

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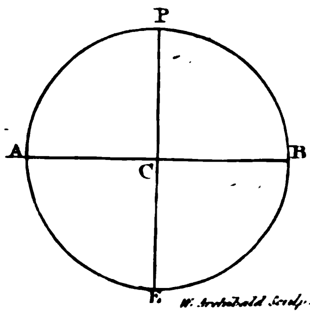
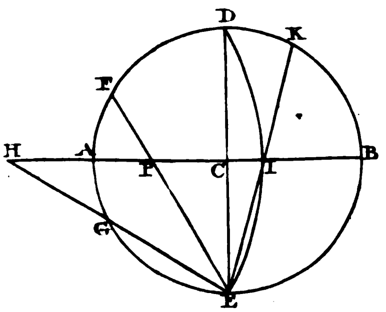


W. Archibald Sculp.

Fig. 12.



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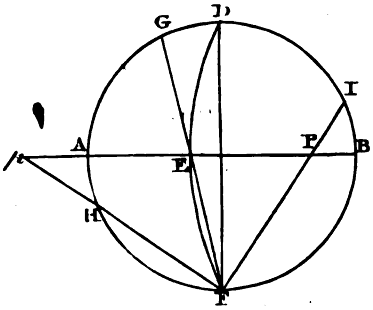

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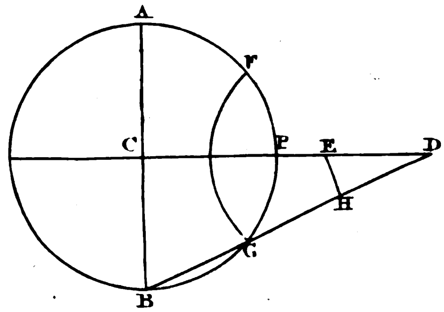

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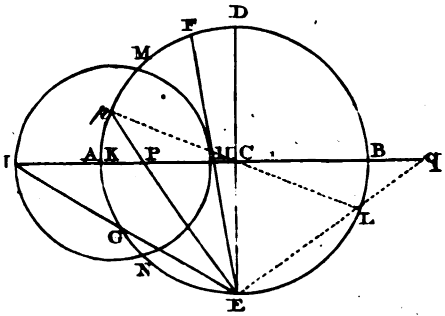

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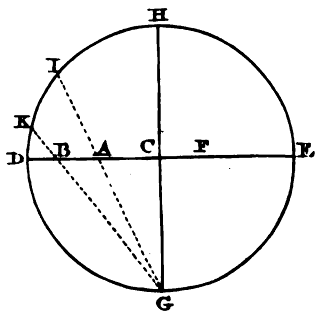

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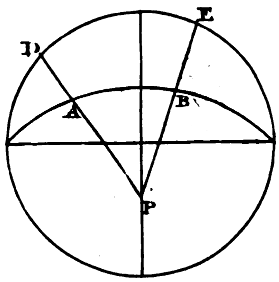

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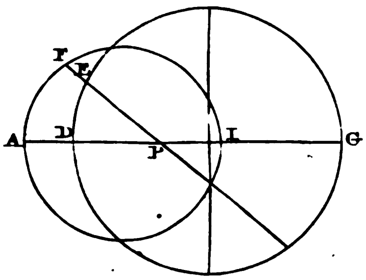

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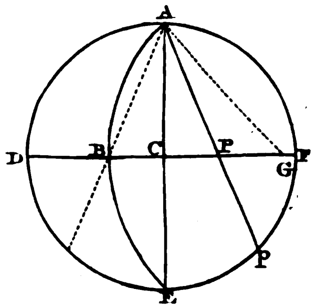

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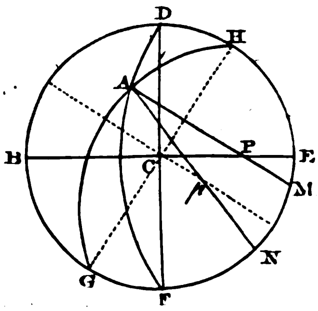

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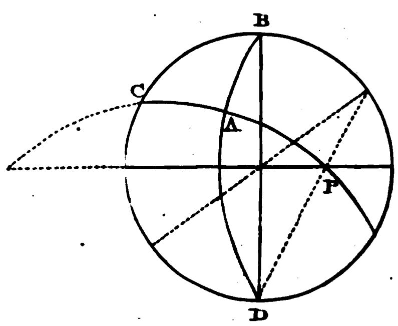

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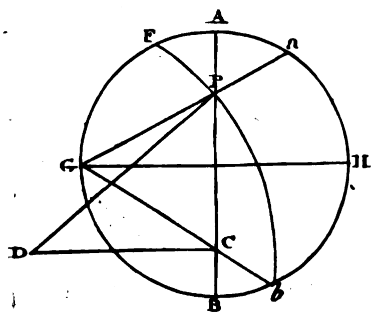

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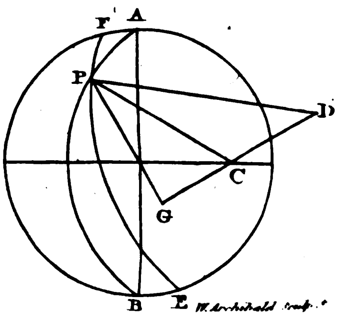
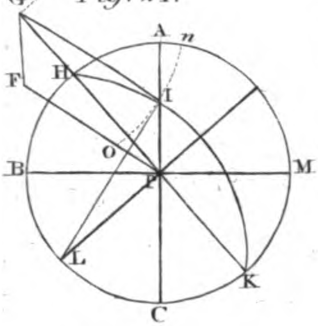


W. Archibald sculp.

Fig. 24.



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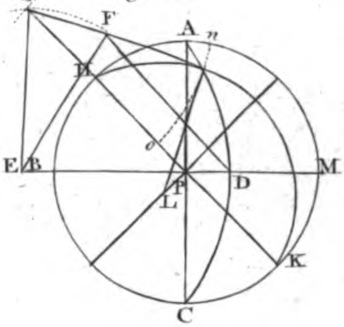

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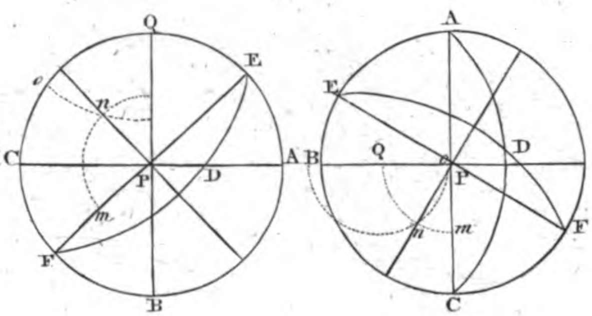

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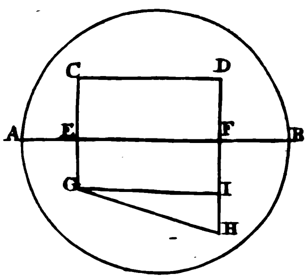

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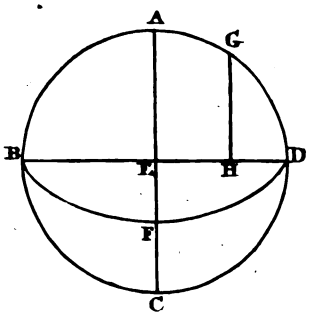

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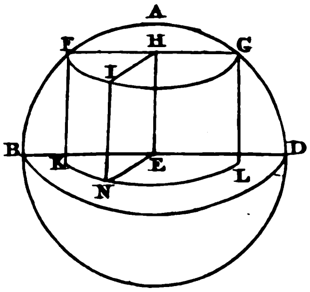

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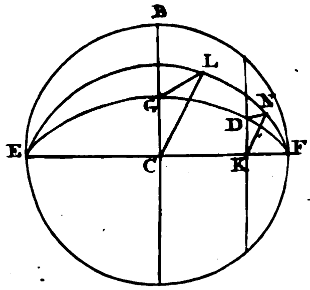

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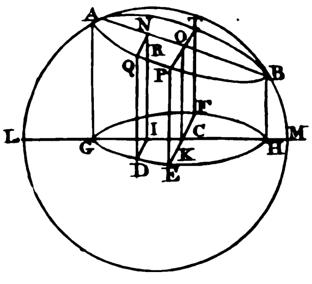

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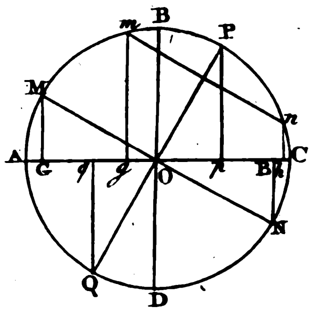

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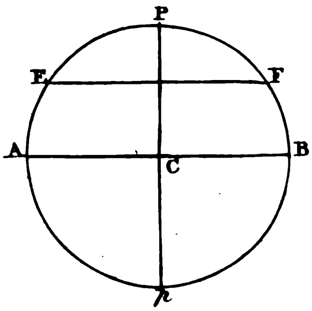

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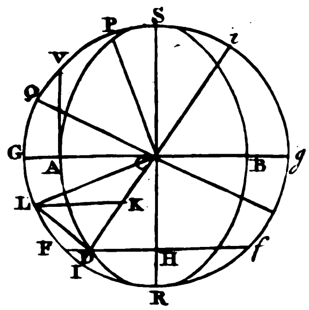

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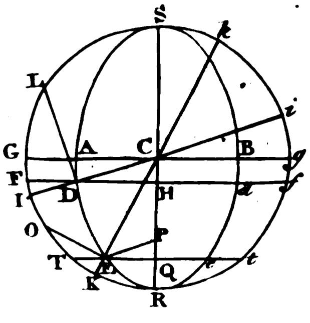

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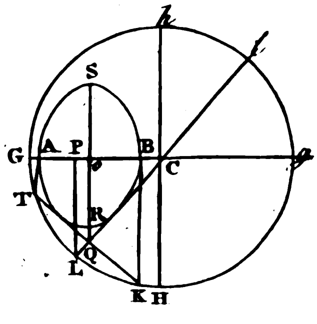

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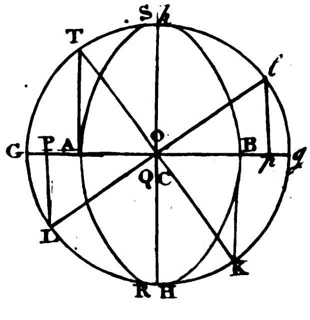

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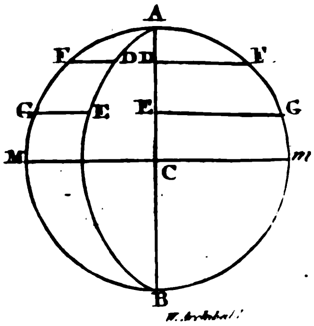

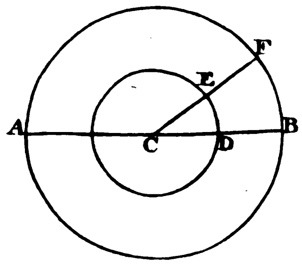

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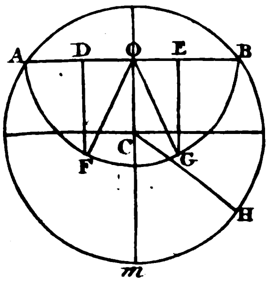

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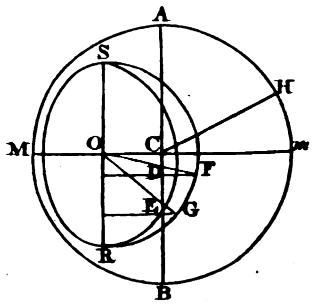

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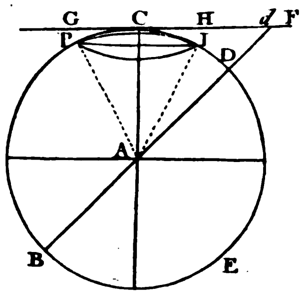

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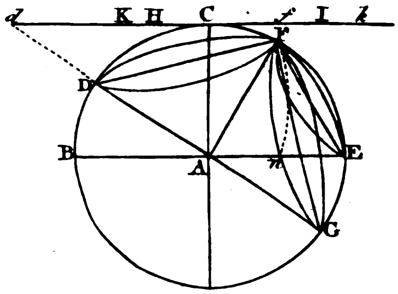

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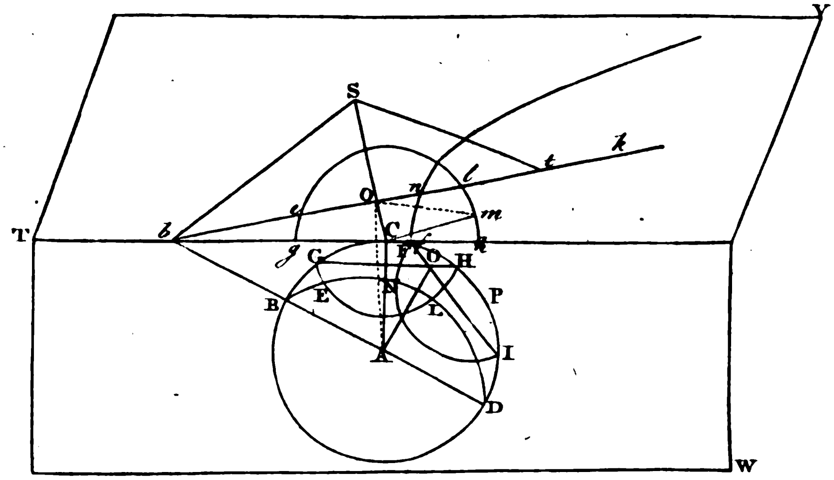

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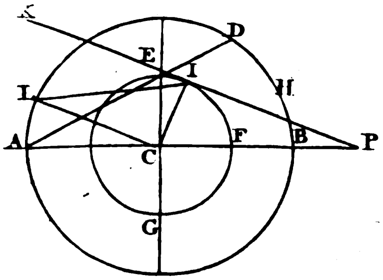

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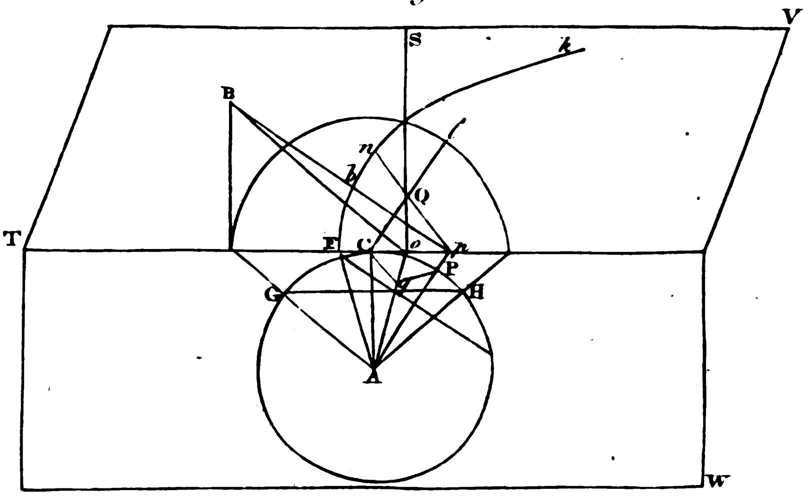

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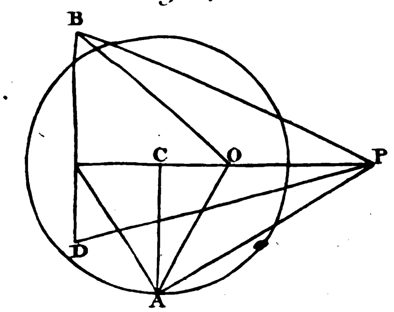

Fig. 47.

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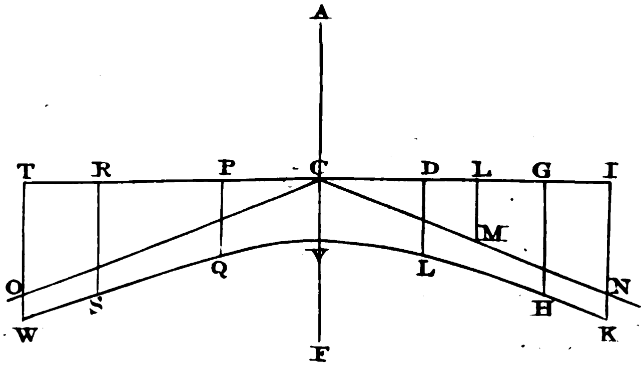

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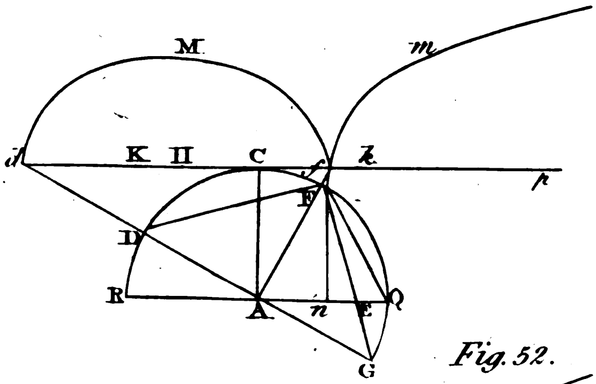

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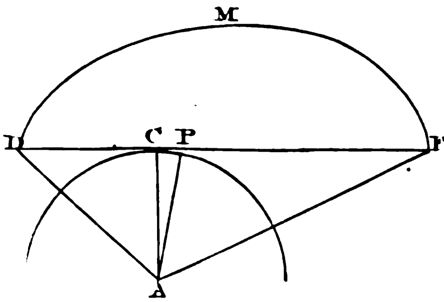

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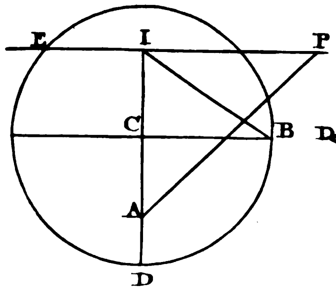

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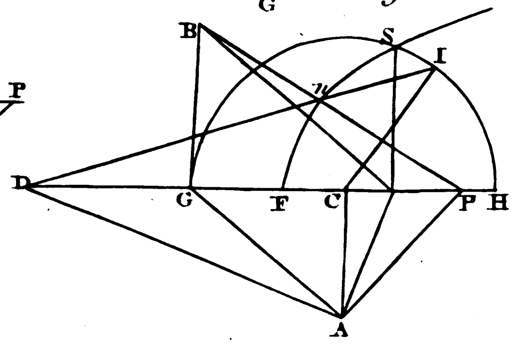

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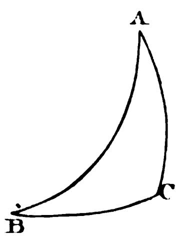

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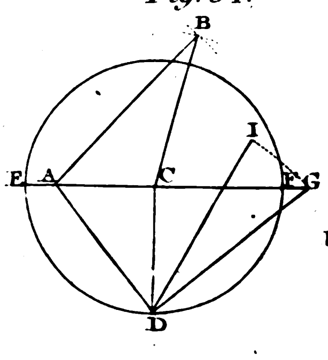

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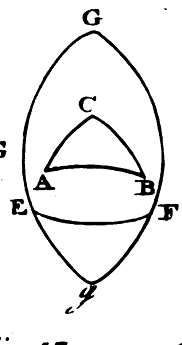

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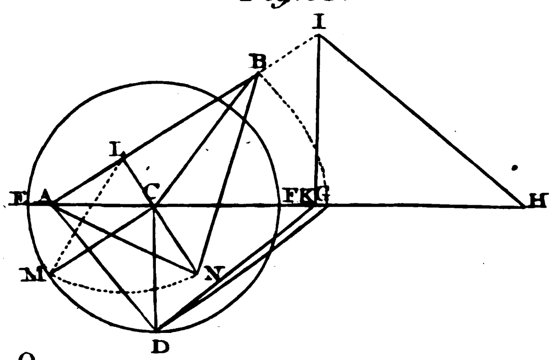

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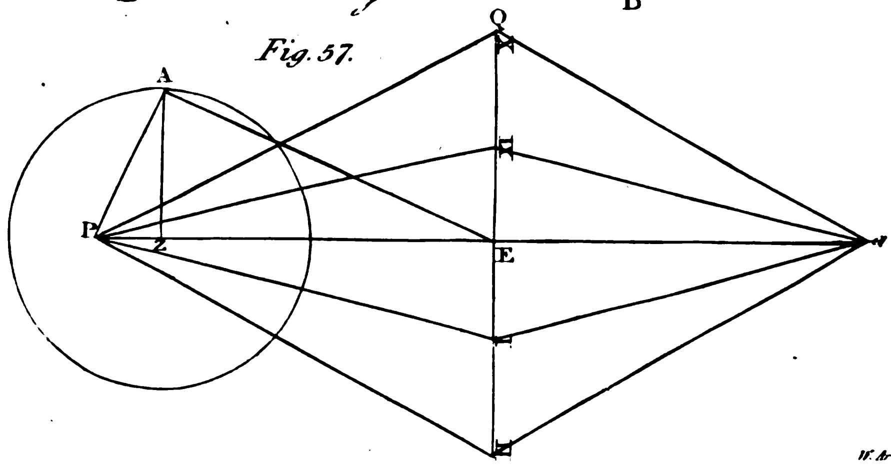

W. Archibald Sculp.

The public papers for the month of June 1779, made mention of one Maria Ruiz, of the district of Lucena in Andalusia, who was successively delivered of 16 boys, without any girls; and seven of them were still alive on the 17th of August thereafter. The following, though a recent fact, is almost incredible: In the year 1755, a Muscovite peasant, named *James Kyrloff*, and his wife, were presented to the empress of Russia. This peasant had been twice married, and was then 70 years of age. His first wife was brought to bed 21 times; namely, four times of four children each time; seven times of three, and ten times of two; making in all 57 children, who were then alive. His second wife, who accompanied him, had already been delivered seven times, once of three children, and six times of twins, which made 15 children for her share. Thus the Muscovite patriarch had already had 72 children by two marriages. We are assured that the sultan Mustapha III. had issue by his concubines 580 male children. What number of female children he had, and whether there were twins of both sexes, we are not informed. These facts suppose great fecundity; and whatever credit is given them, we must consider as entirely fabulous what is reported concerning a countess of Holland, who was delivered of 365 children, of a very small size.

PROLIXITY in discourse, the fault of entering into too minute a detail, or being too long, precise, and circumstantial, even to a degree of tediousness.

PROLOCUTOR of the convocation, the speaker or chairman of that assembly. See CONVOCATION.

PROLOGUE, in dramatic poetry, a discourse addressed to the audience before the drama or play begins. The original intention was to advertise the audience of the subject of the piece, and to prepare them to enter more easily into the action, and sometimes to make an apology for the poet.

PROMETHEUS, the son of Japetus, supposed to have been the first discoverer of the art of striking fire by flint and steel; which gave rise to the fable of his stealing fire from heaven: A renowned warrior; but whose history is involved in fable. He flourished about 1687 B. C. The poetical account is, that he formed a man of clay of such exquisite workmanship, that Pallas, charmed with his ingenuity, offered him whatever in heaven could contribute to finish his design; and for this purpose took him up with her to the celestial mansions, where he stole some fire from the chariot of the sun, which he used to animate his image. At this theft Jupiter was so enraged, that he ordered Vulcan to chain him down on Mount Caucasus, and sent an eagle or vulture to prey on his liver; which every night was renewed in proportion to the quantity eaten up in the daytime, until at last he was delivered by Hercules, who killed the vulture.

PROMETHEUS, in *Ancient Astronomy*, was the name of a constellation of the northern hemisphere, now called *Hercules Eugonasin*. See ASTRONOMY.

1 Promise defined.

PROMISE, in ordinary cases, is a declaration of some intention to be put in execution; but in morals is a solemn asseveration by which one pledges his veracity that he shall perform, or cause to be performed, the thing which he mentions.

As such a declaration excites expectations in the minds of those to whom it is made; and as to frustrate these expectations might rouse indignation, and be followed by consequences injurious to the person, the character, or interest, of him who made it—it becomes a matter of prudence in the promiser to keep his word. And farther, as a certain degree of confidence is found necessary to the very existence of civil society, and as others may have acted on the faith of his promise, it is now not a matter of prudence only to keep his word—it is a duty which he owes to all who have spent their time, their money, or their labour, in consequence of those expectations which he has warranted them to entertain.

2 How it comes to be binding.

It, then, being consonant to sound reason, necessary to the existence of civil society, and in general the interest of both the promiser and promisee, that the words of the promise should be fulfilled, it has become a maxim in morals that a man is obliged to perform his promise.

3 Interpretation of a promise sometimes difficult.

In many instances, the great difficulty concerning a promise is, how to explain it; for although the grounds of its obligation be those expectations which it has raised, a question will occur, Is the promiser bound to answer fully all the expectations to which the different constructions of his words may have given birth? Should I, for instance, desire a man to run with a letter to such a place, and engage to satisfy him upon his return; and if on his return I gave him double of the usual hire in like cases; but if he be not satisfied with less than the triple of such a sum, am I obliged to grant his demands? This will lead us to consider the rules by which a promise should be interpreted.

4 Whether the meaning of the promiser or promisee ought to be taken.

If a promise were always to be deemed obligatory in the sense in which the promisee receives it, a man would not know what he had promised; the promisee, from a difference of views, associations, and interests, might conceive a sense of which the promiser had never dreamed; might suppose engagements which were never intended, which could not be foreseen, and, although foreseen, could not be performed. For these reasons it is natural to think that the sense of the promiser should rather direct the interpretation. He knows precisely what it is he has undertaken, and is unquestionably the best judge of what meaning he affixed to his words. His explanation should therefore be admitted, if information alone could give him a title to decide in the affair.

But something more than mere information, or a knowledge of the cause, is expected from a judge, as integrity is equally essential to his character. Doubts may arise when the words will admit of various meanings, whether the promiser will be so candid as impartially to own the precise meaning which he had actually annexed to his expressions: At any rate, if he wishes to deceive, he might purposely use an ambiguous phraseology, and perform the promise in a sense of his own, without satisfying the reasonable hopes of the promisee.

When the daughter of Tarpeius bargained with Tatius to betray the citadel for what he and his Sabines wore on their left hands, meaning their rings and their golden bracelets, Tatius probably performed his promise in the way which he intended, when he caused her to be buried under their shields, which they carried also on their left hands. But who will say that here were not treachery and a dishonourable abuse of that confidence which had been reposed in him?

It

Promise.

5 In doubtful cases the interpretation of neither is to be trusted.

It must therefore be obvious, that the import of a promise, where its meaning is disputed, is not to be determined by the sense of the promiser nor by the expectations of the promisee; and if it was said that the obligation of a promise arose from those expectations which had been raised by it, the assertion now must be limited to those expectations which were intentionally raised by the promiser, or those which to his knowledge the promisee was induced to entertain in consequence of that declaration which had been made to him. Should there still be a doubt about what expectations were intentionally raised, and what should have been reasonably entertained, recourse must be had to the judgment of those who are allowed to be persons of candour, and who are acquainted with the characters of the men, and with those circumstances in which the promise was made.

6 Cases where a promise is not binding.

The following are some of the cases in which a promise is not binding. As the obligation to perform the promise arises from those expectations which are intentionally raised by the promiser; it is plain that no promise can be binding before acceptance, before the promise has been communicated to the promisee, and before he has entertained hopes of its performance. The case is similar where a promise is released, that is, where the performance is dispensed with by the promisee, and where he entertains no expectations on account of any

7 When it is released by the promisee.

thing than the promiser has said to him. Should a third person entertain hopes on account of the promise, he is to cherish these hopes at his own hazard, having no encouragement from the promiser to do so: yet if this person has been warranted to hope by the promisee, the promisee has renounced his privilege of releasing the promise, and along with the promiser becomes bound for its performance.

8 Where its performance is unlawful.

A promise is not binding where the performance is unlawful; and the performance is unlawful where it is contrary to former promises, or to any moral and religious precept, which from the beginning to the end of time is of perpetual and unalterable obligation. Thus no man is bound by his promise to give to me what he has already promised to another; and no man is bound by his promise to blaspheme God, to commit murder, or to criminate the innocent. Such promises are unlawfully made, and cannot be otherwise than unlawfully performed.

9 A case where doubts have arisen.

Some have even carried their scruples so far as to doubt, whether any promise unlawfully made, can be lawfully performed. Should a man, during the lifetime of his wife, happen to promise marriage to another, such a man (they say) by the Christian religion has already committed adultery in his heart: and should he afterwards become a widower, he is not bound, and he even ought not, to fulfil his engagements, as this would be putting his criminal intention into execution. This species of reasoning, we must confess, is to us unintelligible.—As the wife is dead, what now should prevent the man from marrying the object of his affections? Why, say the casuists, he already is under a promise to marry her, and his promise was made at a time when it should not have been made. It is true, the performance, considered by itself, is opposed by no law human or divine; but then it originated in what was wrong; and however much the Supreme Being and the bulk of the creation may be out of the secret, we have discovered by the ingenious logic of casuistry, that evil can never spring out of good, nor good out of evil; but that the means and the end, the motive and the action, are always of the same complexion in morals.

10 Erroneous promises.

When a promise is made, the particular circumstances in which it is to be deemed obligatory are sometimes mentioned. "I promise (for instance) to lend my friend 200 pounds within three days, provided a certain creditor which I name do not make a demand on me before that time. In other cases no circumstance is foreseen by the promiser to prevent the fulfilling of his engagement; and hence we have erroneous promises, which proceed on the supposition that things are true, possible, and lawful, which are not so. An erroneous promise, which proceeds on the false representation of the promisee, is not binding.

A London gentleman lately purchased an estate in the south of England at a public sale, believing the description which he saw in the newspapers, and which likewise was given by the auctioneer, to be true; but finding afterwards that the estate nowise corresponded to the description, the law freed him from his engagement, because the seller had evidently been guilty of a breach of promise in not satisfying those expectations which he had intentionally and even studiously excited in the buyers.

11 A promise not binding when the performance is impossible.

An erroneous promise, whose performance is impossible, is not binding. Before the conclusion of the late war, a planter of Tobago, promised to send to his friend in England 12 hogsheads of sugar from the next year's produce of his estate; but before that time Tobago fell into the hands of the French, and the West Indian found it impossible to answer the expectations of his friend in England.

12 nor when it is unlawful.

An erroneous promise, whose performance is unlawful, or, to speak more precisely, whose performance is contrary to a prior promise, or to any moral or religious obligation, is not binding. A father, believing the accounts from abroad of his son's death, soon after bequeathes his fortune to his nephew: but the son, the report of whose death had been false, returns home, and the father is released from the promise to his nephew, because it was contrary to a prior promise, which he had tacitly come under to his son. This prior promise was implied in the whole of the father's conduct, and was expressed in signs as emphatic and as unequivocal as those of language. It had all the effect too of the most solemn promise on the son, who, to his father's knowledge, was induced in consequence of this promise to entertain the most sanguine hopes of succeeding to his father, if he survived. The world likewise could bear testimony that these expectations were not rashly cherished. He was brought into existence by means of his father, who was thereby understood to love him affectionately; he was ushered into society as the representative of his family, and was therefore supposed to be the heir of its wealth. Religion itself supported his pretensions, pronouncing the father worse than an infidel who neglects to show that attention to his children which the world naturally expects from a parent.—That the father's promise was not released from the mere circumstance that the mistake was known to his nephew the promisee, will appear plain from the following circumstance. Suppose the father a landed proprietor, that the lease of one of his farms has expired, and that he has long been expecting

Promise.

to let it at 200l.; suppose that this sum is refused, and that he agrees with the present tenant to grant a new lease at 150l.—the obligation here to perform his promise is not dissolved by an after offer of 200l. though the tenant knew that 200l. had been expected, and that only from despairing of that sum his landlord had granted the new lease at 150l.: the promise is binding, because the performance is every way lawful, contrary to no prior engagement, and opposed to no principle in morals. The law of the land, were the proprietor reluctant, would enfore the obligation, and exact obedience in the tone of authority; because breaches of faith, were they permitted in such cases, would destroy all confidence, and annihilate the bonds of social union:

> Men live and prosper but in mutual trust;
> A confidence of one another's truth. *Oroonoko.*

13
Utility no criterion whereby to judge of the validity of promises.

The great difficulty which many have to encounter in determining when errroneous promises ought or ought not to be kept, arises from their proceeding on a principle of whose consequences they do not seem to be always aware. There is seldom, they perceive, a virtuous action that is not attended with some happy effects; and it will, perhaps, be generally allowed, that the comparative merit of similar virtues may safely be estimated by their utility: But to make utility, as some do, the criterion of virtue, and pronounce an action vicious or virtuous merely on account of those consequences which they see may flow from it, is a dangerous maxim. Evil has often sprung out of good, and good out of evil; and good and evil have frequently sprung from the same action. In Mandeville's *Hive*,

14
This principle would give a sanction to vice and falsehood.

> That root of evil Avarice,
> That damn'd ill-natur'd baneful vice,
> Was slave to Prodigality,
> That noble sin; whilst Luxury
> Employ'd a million of the poor,
> And odious Pride a million more.
> Envy itself and Vanity
> Were ministers of Industry:
> That darling folly, Fickleness,
> In diet, furniture, and dress,
> That strange ridiculous vice, was made
> The very wheel that turn'd the trade.

The description here is not altogether false; and these indeed may be some of the consequences that flow from avarice, luxury, pride, vanity, and envy: but these are not all.—To see at once all the consequences that spring from an action, the good and the bad, the particular and general, the immediate and remote, would require sometimes the foresight of Omniscience, and at all times a knowledge superior to what is human. In the Fable of the Bees, the author's object was to show that private vices are public benefits; and he therefore was naturally led by his argument to consider only such consequences of vice as favoured his hypothesis. He wanted candour. And that artifice which runs through his Fable happens to remind us, that while the remote and the general effects of an action may not be seen, the particular and immediate, which fall within our notice, are apt to be viewed through the medium of passion, interest, or opinion. For these reasons, it appears surprising how any person should ever imagine that the obligation to perform a promise should depend entirely upon the ideas which the promiser apprehended of its utility.

The best refutation of such an opinion are the singular conclusions to which it leads.

15
The consequences that flow from it ridiculous and absurd.

A late writer on political justice, who appears to have embraced it, gets into reasoning not very common. In a part of his system he looks on morals as an article of trade: virtue and vice, in his Chapter of *Promises*, are but antiquated terms for profit and loss; and right and wrong are used to express what is beneficial and what is hurtful, in his apprehension, to himself and the community.—With respect to veracity, those "rational and intelligent beings," by whom he wishes the affairs of the world to be carried on, may, while they act as rational and intelligent, break or perform their promises at pleasure. He thinks it "essential to various circumstances of human intercourse, that we should be known to bestow a steady attention upon the quantities of convenience or inconvenience, of good or evil, that might arise to others from our conduct." After this attention, the disappointment of the promise is not to be minded, though the expectations excited by these "rational and intelligent beings" may have "altered the nature of his situation, and engaged him in undertakings from which he would otherwise have abstained." What the promiser takes to be the general utility and the fitness of things is to be his guide. And a breach of promise will be attended with the following advantages: "The promisee, and all other men, will be taught to depend more upon their own exertions, and less upon the assistance of others, which caprice may refuse or justice withhold. He and all others will be taught to acquire such merit and to engage in such pursuits, as shall oblige any honest man to come to their succour if they should stand in need of assistance. This breach of promise, with a view to the general utility, will, so far from being criminal, form a part of that resolute execution of justice which would in a thousand ways increase the independence, the energies, and the virtue of mankind *."

Such are the views which determined this author to consider "the validity of promises" as "inconsistent with justice," and as "foreign to general good." From one, however, who relies with so much confidence on the promiser, it would certainly be desirable to know, whether the person, who violates his faith for the public utility, is always to be candid. Where breach of faith promotes his own interest, ought he alone to decide on the validity of his promise? or where promises are broken for the general good, is he to be guided by his own visionary schemes of utility? Is he to act as trustee for the public without any delegated power? and shall the community submit to his decisions without so much as putting the question, Who hath made thee a ruler over us? When a writer thus deviates so far from the path of reason, it is natural to ask, what was the *ignis fatuus* that misled him? In the present case it is pretty obvious. Being something of opinion with the celebrated Turgot †, that romances are the only books in which moral principles are treated in an impartial manner, this gentleman, in his Chapter of *Promises*, seems to have borrowed a part of his morality from

* *Godwin's Inquiry concerning Political Justice,* book iii. chap. 3.

16
A private individual has no right to intrude his schemes of utility on the public.

† See Note book iii. chap. 6.

Promise.

from the doggerels of Butler; and having adopted, though from different motives, the political principles of Sir Hudibras's squire, that obedience to civil government is not due because it is promised, he has come to exactly the same conclusion with respect to the obligation of keeping one's word. But Ralph has reasoned with more ingenuity; and has shewn not only that the public good, but the glory of the Lord, may be sometimes promoted by a breach of faith.

The saints*, whom oaths and vows oblige,
Know little of their privilege;
Farther, I mean, than carrying on
Some self-advantage of their own:
For if the dev'l, to serve his turn,
Can tell truth, why the saints should scorn,
When it serves theirs, to swear and lie,
I think there's little reason why:
Else h' has a greater pow'r than they,
Which 'twere impiety to say:
W' are not commanded to forbear,
Indefinitely, at all to swear;
But to swear idly, and in vain,
Without self-interest and gain;
For breaking of an oath and lying
Is but a kind of self-denying,
A saint-like virtue; and from hence
Some have broke oaths by Providence:
Some, to the glory of the Lord,
Perjur'd themselves and broke their word:——
For saints may do the same thing by
The spirit, in sincerity,
Which other men are tempted to,
And at the devil's instance do.

HUDIBRAS, *Canto II.*

* The saints are Godwin's rational and intelligent beings.

Here are new views of utility; which, were they to be considered as of any weight, would increase the difficulty of determining when an erroneous promise ought to be kept.

17
Views of utility an unsafe guide in morals.

But should views of utility be laid aside, and should it be made an invariable rule that truth is on no account to be violated, that deceit is never to be practised, and that moral obligations are not to be dissolved for the prospect of any physical advantage; those doubts which arise concerning the validity of erroneous promises will soon disappear. Disagreeable perhaps and ridiculous consequences may sometimes arise to a few individuals from an honest and conscientious adherence to their promise; but will any assert that the general good, *that burden of the song*, will ever be endangered by too much veracity.

So numerous inconveniences arise daily from the regular operation of those great physical laws, which are under the immediate direction of Providence, that those philosophers who have adopted the principle of utility, and are much surprised to see the universe so awkwardly planned for the ease and comfort of them and their species, have been under the necessity of imputing many events in nature to the malignity of some evil independent being; or of allowing that things have degenerated since they first came from the hands of the Creator, and that they must now be exceedingly altered from what they had been when He chose to pronounce them all very good. Thus, absurdity or impiety must always be the consequence of judging of the vice and virtue of an action by its utility, and of estimating its utility by our limited views and erroneous conceptions.

As for extorted promises, it is curious to observe how this question should always be started, whether or not they ought to be kept? and another question should seldom be thought of, whether or not they ought to be made? Fortitude was one of the cardinal virtues among the ancients; and is deemed of such importance in the Christian system, that the fearful are classed with the unbelievers, and are thought unworthy of the favour of the Deity, as being incapable of supporting those trials to which heaven exposes the faithful as the truest test of Christian virtue.—If a person should want the necessary fortitude to be virtuous, it will be a poor excuse for his baseness, that he has added deceit to his cowardice: and surely it is not the business of morality, when it has found him guilty of one crime, to grant him a dispensation for committing two. The laws of jurisprudence, it will readily be allowed, cannot favour the claims of the promisee; because they ought never to lend their support to oppression and violence. But their acquital, should he violate his faith, will by no means vindicate the character of the promise. Their acquitting a woman from the charge of adultery, goes a short way in restoring the fair reputation of her innocence.

18
Extorted promises.

19
Whether binding or not.

Let jurisprudence decide as it will, the man of honour and the generous patriot can never be brought to respect the person who, struck with a panic, could betray either himself or his friends. The magnanimous spirits who could die for the truth will view with contempt his pitiful deceit. Those unfortunate men who may suffer from that very distrust which the breach of his faith has begotten, will always detest him as a traitor and enemy; and heaven itself cannot be supposed to reward that soldier who deserts her cause, and relinquishes the post which she has assigned him, at the sight of danger.

If we once begin to accommodate morality to the dispositions and humours of mankind, it is hard to say where this species of complaisance will end The degrees of timidity are so various, and some tempers by nature so yielding, that repeated importunity or an earnest request will extort a promise.

20
The laws of morality are not to be accommodated to the humours and interests of mankind.

A young lady was frequently pressed by her dying husband to grant him a promise that she would not marry after his death. For some time she was able to resist with becoming spirit his absurd request; but upon his declaring oftener than once that he could not otherwise die in peace, she complied and promised. Too young, however, for this effort of continence, she afterwards listened to the addresses of a second lover, and found her heart insensibly engaged before she adverted to the impropriety of a new attachment. But proposals of marriage could scarcely fail to remind her of her promise and awaken her scruples. These she soon communicated to her lover, with her firm resolution to remain a widow, if the contrary measure, which she greatly preferred, and on which her earthly happiness depended, were not removed by some spiritual counsellor.

Upon this declaration it was agreed to take the advice of their own minister, who was an eminent dissenting clergyman

clergyman in the diocese of Oxford: but this gentleman, unwilling to decide in a matter of such importance, proposed to refer it to Dr Secker, who was then bishop of that see. This prelate too declined to give any judgement in the case; but, as was his way, mustered up a number of arguments on each side of the question, and committed them to a letter, which a learned gentleman of our acquaintance had some time ago an opportunity of seeing in manuscript.

If the sentiments to which the bishop was inclined could have been inferred from his statement of arguments, he seemed to think that the promise was binding. In our opinion, he ought to have a given positive decision. It was no matter whether the promise was extorted or not: the promise was made; and the question was now, whether or not was the performance lawful? That it was lawful appears evident. The lady was under a moral obligation to remain a widow; and no moral obligation, so far as we know, required her to marry.

To be fruitful and multiply, indeed, is declared in Scripture, and is found, to the woful experience of many, to be one of the general laws of our nature. But of all those laws intended by nature to regulate the conduct of inferior intelligences, the moral, which were meant to be checks and correctors of those abuses to which
21 Moral laws superior to physical in point of obligation.
the physical are apt to be carried, are certainly the most sacred and obligatory. To procreate his species, a man is not then to be guilty of adultery, or of fornication, or to listen to the lewd calls of incontinency. St Paul's observation, that it is better to marry than burn, cannot be allowed in this instance to have much weight. He has not defined what degree of amorous inflammation constitutes burning, nor in what cases this burning would be a sufficient warrant for marrying. In the present instance he does not even consider marriage as a duty; he compares it with burning, and thinks it only the least of the two evils. Not that marriage is evil of itself; for he that marrieth doth well: but there are circumstances in which it would be inconvenient to marry, and in which he that marrieth not is said to do better. But if those inconveniences be reasons sufficient to deter from marrying, is that person to be held excusable who, in order to gratify an animal passion, somewhat refined, should violate an oath, and trample on a sacred moral obligation?

The young lady might indeed declare that her earthly happiness was at an end if she were not permitted to marry again: but what circumstance prevented her from marrying? It was not the opinion of her own pastor, or the bishop of Oxford: the truth is, it was certain scruples of her own, which being unable of herself to overcome, she had piously solicited the assistance of others. It is certainly a misfortune that a devotional and amorous turn should always be so closely connected in the females. Both, however, cannot always be indulged. Who will say, that the motive is rational which inclines one to cherish a passion which conscience disapproves? The virtue of continency might indeed have borne hard on this lady's constitution, and in her way to immortal happiness might have formed a gate so strait and narrow as it might be difficult for her to pass through: but after all, her case was not harder than that of nuns, who take the vows of perpetual chastity, and endure sufferings of a similar nature, and in some instances even perhaps greater than hers; yet doing it cheerfully, from the supposition that the Omniscient is well acquainted with the nature of the great sacrifice which they make, and that after death he will study to requite them; and bestow on them something like an equivalent, which in their opinion can scarcely be less than a happiness in heaven as ample as their wishes and as lasting as their souls.

Every promise, therefore, which is not released, nor fraudulently obtained by the promisee, is to be held binding if the performance be lawful and possible. 22

A promise of a similar nature with an oath.
The Christian cannot, and a man of honour will scarcely venture to reject this maxim, that a good man ought not to change though he swear to his hurt. Yet a simple promise and a promissory oath are not very different in point of obligation. Most people know, and where any moral duty is concerned, they ought particularly to reflect, that this world is governed by an Almighty Being, who knows all things, who lives always, and who is just to reward and to punish. The person who makes a promissory oath does it avowedly under an immediate sense of these truths; the person who makes a simple promise, though he certainly ought, yet may not reflect on these at the time. The former, when he violates his oath, exhibits, only to outward appearance, a greater contempt of the Divine power, knowledge, and justice, than he who violates a simple promise under an impression of the same truths. To Him who knows the secrets of the heart, the breach of the promise must appear as criminal as the breach of the oath. See ASSUMPSIT and OATH.

PROMONTORY, in *Geography*, a high point of land or rock projecting into the sea; the extremity of which towards the sea is called a *cape* or *headland*. See GEOGRAPHY *Index*.

PROMPTER, in the drama, an officer posted behind the scenes, whose business it is to watch attentively the actors speaking on the stage, in order to suggest and put them forward when at a stand, to correct them when amiss, &c. in their parts.

PROMULGATED, or PROMULGED, something published or proclaimed, and generally applied to a law, to denote the publishing or proclaiming it to the people.

PRONAOS, in ancient architecture, a porch to a church, palace, or other spacious building. See the article PORCH.

PRONATION, among anatomists. The radius of the arm has two kinds of motion, the one called *pronation*, the other *supination*. Pronation is that whereby the palm of the hand is turned downwards; and supination, the opposite motion thereto, is that whereby the back of the hand is turned downwards. The peculiar muscles whereby pronation is performed, are called *pronatores*, as those by which supination is performed are termed *supinatores*. See ANATOMY, *Table of the Muscles*, and *Plates*.

PRONG-HOE, in husbandry, a term used to express an instrument used to hoe or break the ground near and among the roots of plants.

The ordinary contrivance of the hoe is very defective, it being only made for scraping on the surface; but the great use of hoeing being to break and open the ground, beside the killing of the weeds, which the ancients, and many among us, have thought the only use of the hoe, this

this dull and blunt instrument is by no means calculated for the purposes it is to serve. The prong-hoe consists of two hooked points of five or seven inches long, and when struck into the ground will stir and remove it the same depth as the plough does, and thus answer both the ends of cutting up the weeds and opening the land. It is useful even in the horse-hoeing husbandry, because the hoe-plough can only come within three or four inches of the rows of the corn, turnips and the like; whereas this instrument may be used afterwards, and with it the land may be raised and stirred even to the very stalk of the plant. See Agriculture.

PRONOUN, Pronomen, in *Grammar*, a declinable part of speech, which being put instead of a noun, points out some person or thing. See Grammar.

PRONUNCIATION, in *Grammar*, the manner of articulating or sounding the words of a language.

Pronunciation makes the most difficult part of written grammar; in regard that a book expressing itself to the eyes, in a manner that wholly concerns the ears, seems next akin to that of teaching the blind to distinguish colours: hence it is that there is no part so defective in grammar as that of pronunciation, as the writer has frequently no term whereby to give the reader an idea of the sound he would express; for want of a proper term, therefore, he substitutes a vicious and precarious one. To give a just idea of the pronunciation of a language, it seems necessary to fix as nearly as possible all the several sounds employed in the pronunciation of that language. Cicero tells us, that the pronunciation underwent several changes among the Romans: and indeed it is more precarious in the living languages, being, as Du Bos tells us, subservient to fashion in these. The French language is clogged with a difficulty in pronunciation from which most others are free; and it consists in this, that most of their words have two different pronunciations, the one in common prose, the other in verse.

As to the pronunciation of the English language, the ingenious Mr Martin, in his Spelling-Book of Arts and Sciences, lays down the following rules: 1. The final (*e*) lengthens the sound of the foregoing vowel; as in *can, cane; rob, robe; tun, tune*, &c. 2. The final (*e*), in words ending in *re*, is sounded before the *r* like *u*; as *massacre, massa-cur; lucre, lu-cur*, &c. 3. The Latin diphthongs *æ*, *œ*, are sounded like *e*; as *Ætna, Etna; œconomy, economy*, &c.: but at the end of the words *oe* sounds like *o*; as in *toe, foe*, &c. 4. Also the English improper diphthongs, *ea, eo, eu, ue*, sound only the *e* and *u*; as *tea* or *te; feoffee*, or *feffee; due* or *du; true* or *tru*, &c. though sometimes *eo* and *ea* are pronounced like *ee*, as in *people, fear, near*, &c. 5. Sometimes the diphthong (*ie*) is pronounced like *e* in *ceiling*, like *ee* in *field*, and, at the end of words, always like *y*, as in *lie*, &c.; and *ei* is pronounced either like *e* or *ai*, as in *deceit, reign*, &c. 6. The triphthong *eau* is pronounced like *o*, in *beau* and *jet d'eau*; and *ieu* sounds like *u* in *lieu, adieu*, &c. The sound of *c* is hard before the vowels *a, o, u*, as in *call, cold, cup*, &c.; also sometimes before *h*, as in *chart, chord*, &c.; and before *l* and *r*, as in *clear, creep*, &c. It is otherwise generally soft, as in *city, cell, cyder, child*, &c. 8. In French words *ch* is sounded like *sh*, as in *chagreen, machine;* and sometimes like *qu*, as in *choir*. 9. The sound of *g* is hard before *a, o, u, l, r*, as in *gall, go, gum, glean, grope;* also before *ui*, as in *guilt, guild*, &c.; and before *h*, as in *ghost;* sometimes before *i*, as in *gibbous, gibberish*. It is also generally hard before *e*, as in *get, geld*, &c.; but soft in many words derived from the Greek and Latin, as in *geometry, genealogy, genus*, &c. Two *gg* are always hard, as in *dagger*, &c. The sound of *g*, when soft, is like that of *j*. 10. In any part of a word, *ph* sounds like *f*, as in *philosophy*, &c. 11. The sound of *qu*, at the end of French words, is like *k*, as in *risque*, &c. 12. The syllables *ti* and *ci*, if followed by a vowel, sound like *si* or *shi;* as in *fiction, logician*, &c. 13. When *cc* occurs before *i*, the first is hard and the latter is soft; as in *flaccid*, &c. 14. The letter *p* is not pronounced at the beginning of syllables before *s* and *t;* as in *psalm, ptarmics*, &c. As to other peculiarities regarding the pronunciation of single letters, many of them have been taken notice of at the beginning of each, in the course of this work.

But it is not enough to know the just pronunciation of single letters, but also of words: in order to which, the accenting of words ought to be well understood; since nothing is more harsh and disagreeable to the ear, than to hear a person speak or read with wrong accents. And indeed in English the same word is often both a noun and a verb, distinguished only by the accent, which is on the first syllable of the noun, and on the last of the verb, as *fèrment* and *fermènt; rècord* and *recòrd*, &c. We are to observe also, that in order to a just expression of words, some require only a single accent on the syllable, as in *tòrment*, &c.; but in others it should be marked double, as in *anˈˈmal*, because it is pronounced as if the letter was wrote double, viz. *anni-mal*.

Mr Sheridan's Dictionary will be found extremely useful as a directory in acquiring the pronunciation of the English language; but care must be taken to avoid his provincial brogue, which has certainly misled him in several instances. Mr Walker's Pronouncing Dictionary, lately published, will likewise deserve the student's attention. It is a work of great labour and merit, and is highly useful. It has indeed some faults and inaccuracies, but it is notwithstanding, in all probability, the best of the kind.

Pronunciation is also used for the fifth and last part of rhetoric, which consists in varying and regulating the voice agreeably to the matter and words, so as most effectually to persuade and touch the hearers. See Oratory, Part IV.

PROOF, in *Law* and *Logic*, is that degree of evidence which carries conviction to the mind. It differs from demonstration, which is applicable only to those truths of which the contrary is inconceivable. It differs likewise from probability, which produces for the most part nothing more than opinion, while proof produces belief. See Probability.

The *proof* of crimes was anciently effected among our ancestors divers ways; viz. by duel or combat, fire, water, &c. See Duel and Ordeal.

Proof *of Artillery and Small Arms*, is a trial whether they stand the quantity of powder allotted for that purpose. The rule of the board of ordnance is, that all guns, under 24-pounders, be loaded with powder as much as their shot weighs; that is, a brass 24-pounder with 21 lb. a brass 32-pounder with 26 lb. 12 oz. and a 42-pounder with 31 lb. 8 oz.; the iron 24-pounder with 18 lb. the 32-pounder with 21 lb. 8 oz. and the 42-pounder with 25 lb.

The

Proof.

The brass light field-pieces are proved with powder that weighs half as much as their shot, except the 24-pounder which is loaded with 10 lb. only.

Government allows 11 bullets of lead in the pound for the proof of muskets and 14,5, or 29 in two pounds, for service; 17 in the pound for the proof of carabines, and 20 for service; 28 in the pound for the proof of pistols, and 34 for service.

When guns of a new metal, or of lighter construction, are proved; then, besides the common proof, they are fired 200 or 300 times, as quick as they can be, loaded with the common charge given in actual service. Our light 6-pounders were fired 300 times in 3 hours 27 minutes, loaded with 1 lb. 4 oz. without receiving any damage.

Proof of Powder, is in order to try its goodness and strength. See Gunpowder.

Proof of Cannon, is made to ascertain their being well cast, their having no cavities in their metal, and, in a word, their being fit to resist the effort of their charge of powder. In making this proof, the piece is laid upon the ground, supported only by a piece of wood in the middle, of about 5 or 6 inches thick, to raise the muzzle a little; and then the piece is fired against a solid butt of earth.

Tools used in the Proof of Cannon, are as follows:

Searcher, an iron socket with branches, from 4 to 8 in number, bending outwards a little, with small points at their ends: to this socket is fixed a wooden handle, from 8 to 12 feet long, and 1½ inch in diameter. This searcher is introduced into the gun after each firing, and turned gently round to discover the cavities within: if any are found, they are marked on the outside with chalk; and then the

Searcher with one point is introduced: about which point a mixture of wax and tallow is put, to take the impression of the holes; and if any are found of one-fourth of an inch deep, or of any considerable length, the gun is rejected as unserviceable to the government.

Reliever, is an iron ring fixed to a handle, by means of a socket, so as to be at right angles; it serves to disengage the first searcher, when any of its points are retained in a hole, and cannot otherwise be got out. When guns are rejected by the proof-masters, they order them to be marked × thus, which the contractors generally alter *WP* thus; and after such alteration, dispose of them to foreign powers for Woolwich proof.

The most curious instrument for finding the principal defects in pieces of artillery, was lately invented by Lieutenant-general Desaguliers, of the royal regiment of artillery. This instrument, grounded on the truest mechanical principles, is no sooner introduced into the hollow cylinder of the gun, than it discovers its defects, and more particularly that of the piece not being truly bored; which is a very important one, and to which most of the disasters happening to pieces of artillery are in a great measure to be imputed; for, when a gun is not truly bored, the most expert artillerist will not be able to make a good shot.

Proof of Mortars and Howitzers, is made to ascertain their being well cast, and of strength to resist the effort of their charge. For this purpose the mortar or howitzer is placed upon the ground, with some part of their trunnions or breech sunk below the surface, and resting on wooden billets, at an elevation of about 70 degrees.

Proof, Propagation.

The mirror is generally the only instrument to discover the defects in mortars and howitzers. In order to use it, the sun must shine; the breech must be placed towards the sun, and the glass over-against the mouth of the piece: it illuminates the bore and chamber sufficiently to discover the flaws in it.

Proof of Foreign Brass-Artillery. 1st, The Prussians. Their battering-train and garrison artillery are proved with a quantity of powder equal to $\frac{1}{7}$ the weight of the shot, and fired 75 rounds as fast as in real service; that is, 2 or 3 rounds in a minute. Their light field-train, from a 12-pounder upwards, are proved with a quantity of powder = 1-3d of the weight of the shot, and fired 150 rounds, at 3 or 4 rounds in a minute. From a 12-pounder downwards, are proved with a quantity of powder = 1-5th of the shot's weight, and fired 300 rounds, at 5 or 6 rounds each minute, properly spunged and loaded. Their mortars are proved with the chambers full of powder, and the shells loaded. Three rounds are fired as quick as possible.

2d, The Dutch prove all their artillery by firing each piece 5 times; the two first rounds with a quantity of powder = 2-3ds of the weight of the shot; and the three last rounds with a quantity of powder = $\frac{1}{7}$ the weight of the shot.

3d, The French the same as the Dutch.

Proof, in brandy and other spirituous liquors, is a little white lather which appears on the top of the liquor when poured into a glass. This lather, as it diminishes, forms itself into a circle called by the French the *chapelet*, and by the English the *bead* or *bubble*.

Proofs of Prints, were anciently a few impressions taken off in the course of an engraver's process. He proved a plate in different states, that he might ascertain how far his labours had been successful, and when they were complete. The excellence of such early impressions, worked with care, and under the artist's eye, occasioning them to be greedily sought after, and liberally paid for, it has been customary among our modern print-sellers to take off a number of them, amounting perhaps, to hundreds, from every plate of considerable value; and yet their want of rareness has by no means abated their price. On retouching a plate, it has been also usual, among the same conscientious fraternity, to cover the inscription, which was immediately added after the first proofs were obtained, with slips of paper, that a number of secondary proofs might also be created. *Nichols's Life of Hogarth.*

Proof, in the sugar trade. See Sugar.

Proofs, in printing. See Printing.

PROPAGATION, the act of multiplying the kind. See Generation.

Propagation of Plants. The most natural and the most universal way of propagating plants is by seeds. See Plants. But they may also be propagated by *sets*, *pieces*, or *cuttings*, taken from the parent plant. Willows are very easily propagated by sets: such as rise to be considerable timber trees being raised from sets seven or eight feet long, sharpened at their larger ends, which are thrust into the ground by the sides of ditches, on the banks of rivers, or in any moist soil. The sallow trees are raised from sets only three feet long. The plane tree, mint, &c. may be propagated in the same way. In providing

Propagation ‖ Property.

viding the slips, sprigs, or cuttings, however, care must be taken to cut off such branches as have knots or joints two or three inches beneath them: small top sprigs of two or three years growth are the best for this operation. Plants are also propagated by parting their roots, each part of which, properly managed, sends out fresh roots. Another mode of propagating plants is by layering or laying the tops of the branches in the ground.

The method of layering is this: Dig a ring-trench round the stool, of a depth suitable to the nature of the plant; and having pitched upon the shoots to be layered, bend them to the bottom of the trench (either with or without plashing, as may be found most convenient), and there *peg* them fast; or, putting some mould upon them, *tread* them hard enough to prevent their springing up again—fill in the mould—place the top of the layer in an upright posture, treading the mould hard behind it; and cut it carefully off above the first, second or third eye. Plants are also propagated by their bulbs.

The number of vegetables that may be propagated from an individual is very remarkable, especially in the most minute plants. The annual product of one seed even of the common mallow has been found to be no less than 200,000; but it has been proved, by a strict examination into the more minute parts of the vegetable world, that the common wall moss produces a much more numerous offspring. In one of the little heads of this plant there have been counted 13,824 seeds. Now allotting to a root of this plant eight branches, and to each branch six heads, which appears to be a very moderate computation, the produce of one seed is $6 \times 13824 = 82944$; and 8×82944 gives 663,552 seeds as the annual produce of one seed, and that so small that 13824 of them are contained in a capsule, whose length is but one-ninth of an inch, its diameter but one 23d of an inch, and its weight but the 13th part of a grain.

For the propagation or culture of particular plants, see AGRICULTURE.

PROPER, something natural and essentially belonging to any thing.

PROPERTIUS, SEXTUS AURELIUS, a celebrated Latin poet, born at Mevania, a city of Umbria, now called *Bevagna*, in the duchy of Spoletto. He went to Rome after the death of his father, a Roman knight, who had been put to death by order of Augustus, for having followed Antony's party during the triumvirate. Propertius in a short time acquired great reputation by his wit and abilities, and had a considerable share in the esteem of Mæcenas and Cornelius Gallus. He had also Ovid, Tibullus, Bassus, and the other ingenious men of his time for his friends. He died at Rome 19 B. C. He is printed with almost all the editions of Tibullus and Catullus: but the best edition of him is that which was given separately by Janus Brouckhusius at Amsterdam, 1702, in 4to, and again in 1714, 4to, *cum curis secundis ejusdem*. We have four books of his Elegies or Amours with a lady called *Hostia*, or *Hostilia*, to whom he gave the name of *Cynthia*.

PROPERTY, in a general sense, is a particular virtue or quality which nature has bestowed on some things exclusive of all others: thus, colour is a property of light; extension, figure, divisibility, and impenetrability, are properties of body.

Property.

PROPERTY, in *Law*, is described to be the highest right which a person has or can have to any thing.

1 Definition.

There is nothing which so generally strikes the imagination, and engages the affections of mankind, as the right of property; or that sole and despotic dominion which one man claims and exercises over certain external things of the world, in total exclusion of the right of any other individual in the universe. And yet there are very few that will give themselves the trouble to consider the original and foundation of this right. Pleased as we are with the possession, we seem afraid to look back to the means by which it was acquired, as if fearful of some defect in our title; or at best we rest satisfied with the decision of the laws in our favour, without examining the reason or authority upon which those laws have been built. We think it enough that our title is derived by the grant of the former proprietor, by descent from our ancestors, or by the last will and testament of the dying owner: not caring to reflect, that (accurately and strictly speaking) there is no foundation in nature or in natural law, why a set of words upon parchment should convey the dominion of land; why the son should have a right to exclude his fellow creatures from a determinate spot of ground, because his father had done so before him; or why the occupier of a particular field or of a jewel, when lying on his death-bed and no longer able to maintain possession, should be entitled to tell the rest of the world which of them should enjoy it after him. These inquiries, it must be owned, would be useless and even troublesome in common life. It is well if the mass of mankind will obey the laws when made, without scrutinizing too nicely into the reasons of making them. But when law is to be considered not only as a matter of practice, but also as a rational science, it cannot be improper or useless to examine more deeply the rudiments and grounds of these positive constitutions of society.

2 The original foundation of the right to property not generally considered.

3 This right arises from a divine grant.

In the beginning of the world, we are informed by holy writ, that the all-bountiful Creator gave to man "dominion over all the earth; and over the fish of the "sea, and over the fowl of the air, and over every li-"ving thing that moveth upon the earth." This is the only true and solid foundation of man's dominion over external things, whatever airy metaphysical notions may have been started by fanciful writers upon this subject. The earth, therefore, and all things therein, are the general property of all mankind, exclusive of other beings, from the immediate gift of the Creator. And, while the earth continued thinly inhabited, it is reasonable to suppose, that all was in common among them, and that every one took from the public stock to his own use such things as his immediate necessities required.

4 The state of property in the early ages of the world.

These general notions of property were then sufficient to answer all the purposes of human life; and might perhaps still have answered them, had it been possible for mankind to have remained in a state of primæval simplicity: as may be collected from the manners of many American nations, when first discovered by the Europeans; and from the ancient method of living among the first Europeans themselves, if we may credit either the memorials of them preserved in the golden age of the poets, or the uniform accounts given by historians of those times wherein *erant omnia communia et indivisa omnibus, veluti unum cunctis patrimonium esset*. Not that this communion of goods seems ever to have been applicable,

Blackst. Comment.

even

Property. even in the earliest ages, to aught but the *substance* of the thing; nor could it be extended to the *use* of it. For, by the law of nature and reason, he who first began to use it, acquired therein a kind of transient property, that lasted so long as he was using it, and no longer: or, to speak with greater precision, the *right* of possession continued for the same time only that the *act* of possession lasted. Thus the ground was in common, and no part of it was the permanent property of any man in particular; yet whoever was in the occupation of any determinate spot of it, for rest, for shade, or the like, acquired for the time a sort of ownership, from which it would have been unjust, and contrary to the law of nature, to have driven him by force; but the instant that he quitted the use or occupation of it, another might seize it without injustice. Thus also a vine or other tree might be said to be in common, as all were equally entitled to its produce; and yet any private individual might gain the sole property of the fruit, which he had gathered for his own repast. A doctrine well illustrated by Cicero, who compares the world to a great theatre, which is common to the public, and yet the place which any man has taken is for the time his own.

5 Rise of permanent property in various things.

But when mankind increased in number, craft, and ambition, it became necessary to entertain conceptions of more permanent dominion; and to appropriate to individuals, not the immediate *use* only, but the very *substance* of the thing to be used: otherwise innumerable tumults must have arisen, and the good order of the world been continually broken and disturbed, while a variety of persons were striving who should get the first occupation of the same thing, or disputing which of them had actually gained it. As human life also grew more and more refined, abundance of conveniencies were devised to render it more easy, commodious, and agreeable; as habitations for shelter and safety, and raiment for warmth and decency. But no man would be at the trouble to provide either, so long as he had only an usufructuary property in them, which was to cease the instant that he quitted possession;—if, as soon as he walked out of his tent, or pulled off his garment, the next stranger who came by would have a right to inhabit the one and to wear the other. In case of habitations in particular, it was natural to observe, that even the brute creation, to whom every thing else was in common, maintained a permanent property in their dwellings, especially for the protection of their young; that the birds of the air had nests, and the beasts of the field had caverns, the invasion of which they esteemed a very flagrant injustice, and would sacrifice their lives to preserve them. Hence a property was soon established in every man's house and home-stall; which seem to have been originally mere temporary huts or moveable cabins, suited to the design of Providence for more speedily peopling the earth, and suited to the wandering life of their owners, before any extensive property in the soil or ground was established. And there can be no doubt, but that moveables of every kind became sooner appropriated than the permanent substantial soil: partly because they were more susceptible of a long occupancy, which might be continued for months together without any sensible interruption, and at length by usage ripen into an established right; but principally because few of them could be fit for use, till improved and meliorated by the bodily labour of the occupant; which bodily labour, bestowed upon any subject which before lay in common to all men, is universally allowed to give the fairest and most reasonable title to an exclusive property therein. Property.

6 In food and other necessary articles.

The article of food was a more immediate call, and therefore a more early consideration. Such as were not contented with the spontaneous product of the earth sought for a more solid refreshment in the flesh of beasts, which they obtained by hunting. But the frequent disappointments incident to that method of provision induced them to gather together such animals as were of a more tame and sequacious nature; and to establish a permanent property in their flocks and herds, in order to sustain themselves in a less precarious manner, partly by the milk of their dams, and partly by the flesh of the young. The support of these their cattle made the article of *water* also a very important point. And therefore the book of Genesis (the most venerable monument of antiquity, considered merely with a view to history) will furnish us with frequent instances of violent contentions concerning wells; the exclusive property of which appears to have been established in the first digger or occupant, even in such places where the ground and herbage remained yet in common. Thus we find Abraham, who was but a sojourner, asserting his right to a well in the country of Abimelech, and exacting an oath for his security, "because he had digged that well." And Isaac, about 90 years afterwards, reclaimed this his father's property; and, after much contention with the Philistines, was suffered to enjoy it in peace.

7 Nature of patriarchal property.

All this while the soil and pasture of the earth remained still in common as before, and open to every occupant: except perhaps in the neighbourhood of towns, where the necessity of a sole and exclusive property in lands (for the sake of agriculture) was earlier felt, and therefore more readily complied with. Otherwise, when the multitude of men and cattle had consumed every convenience on one spot of ground, it was deemed a natural right to seize upon and occupy such other lands as would more easily supply their necessities. This practice is still retained among the wild and uncultivated nations that have never been formed into civil states, like the Tartars and others in the east; where the climate itself, and the boundless extent of their territory, conspire to retain them still in the same savage state of vagrant liberty, which was universal in the earliest ages, and which Tacitus informs us continued among the Germans till the decline of the Roman empire. We have also a striking example of the same kind in the history of Abraham and his nephew Lot. When their joint substance became so great, that pasture and other conveniencies grew scarce, the natural consequence was, that a strife arose between their servants; so that it was no longer practicable to dwell together. This contention Abraham endeavoured to compose: "Let there be no strife, I pray thee, between thee and me. Is not the whole land before thee? Separate thyself, I pray thee, from me: if thou wilt take the left hand, then I will go to the right; or if thou depart to the right hand, then I will go to the left." This plainly implies an acknowledged right, in either, to occupy whatever ground he pleased, that was not pre-occupied by other tribes. "And Lot lifted up his eyes, and beheld all the plain of Jordan, that it was well watered every where, even as the garden of the Lord. Then Lot chose him all the plain of Jordan, and journeyed east; and Abraham dwelt in the land of Canaan."

Property.

Upon the same principle was founded the right of migration, or sending colonies to find out new habitations, when the mother-country was overcharged with inhabitants; which was practised as well by the Phœnicians and Greeks, as the Germans, Scythians, and other northern people. And, so long as it was confined to the stocking and cultivation of desert uninhabited countries, it kept strictly within the limits of the law of nature.

8 Necessity of property and of laws respecting it.

But as the world by degrees grew more populous, it daily became more difficult to find out new spots to inhabit, without encroaching on former occupants; and by constantly occupying the same individual spot, the fruits of the earth were consumed, and its spontaneous produce destroyed, without any provision for a future supply or succession. It therefore became necessary to pursue some regular method of providing a constant subsistence; and this necessity produced, or at least promoted and encouraged, the art of agriculture. And the art of agriculture, by a regular connection and consequence, introduced and established the idea of a more permanent property in the soil than had hitherto been received and adopted. It was clear that the earth would not produce her fruits in sufficient quantities without the assistance of tillage; but who would be at the pains of tilling it, if another might watch an opportunity to seize upon and enjoy the product of his industry, art, and labour? Had not therefore a separate property in lands, as well as moveables, been vested in some individuals, the world must have continued a forest, and men have been mere animals of prey; which, according to some philosophers, is the genuine state of nature. Whereas now (so graciously has Providence interwoven our duty and our happiness together) the result of this very necessity has been the ennobling of the human species, by giving it opportunities of improving in *rational* faculties, as well as of exerting its *natural*. Necessity begat property: and in order to insure that property, recourse was had to civil society, which brought along with it a long train of inseparable concomitants; states, government, laws, punishments, and the public exercise of religious duties. Thus connected together, it was found that a part only of society was sufficient to provide, by their manual labour, for the necessary subsistence of all; and leisure was given to others to cultivate the human mind, to invent useful arts, and lay the foundation of science.

9 Property acquired first by occupancy.

The only question remaining is, How this property became actually vested; or what it is that gave a man an exclusive right to retain in a permanent manner that specific land which before belonged generally to every body, but particularly to nobody? And as we before observed, that *occupancy* gave the right to the temporary *use* of the soil; so it is agreed upon all hands, that occupancy gave also the original right to the permanent property in the *substance* of the earth itself, which excludes every one else but the owner from the use of it. There is indeed some difference among the writers on natural law, concerning the reason why occupancy should convey this right, and invest one with this absolute property: Grotius and Puffendorf insisting, that this right of occupancy is founded upon a tacit and implied assent of all mankind, that the first occupant should become the owner; and Barbeyrac, Titius, Mr Locke, and others, holding that there is no such implied assent, neither is it necessary that there should be; for that the very act of occupancy, alone, being a degree of bodily labour, is from a principle of natural justice, without any consent or compact, sufficient of itself to gain a title. A dispute that savours too much of nice and scholastic refinement. However, both sides agree in this, that occupancy is the thing by which the title was in fact originally gained; every man seizing to his own continued use such spots of ground as he found most agreeable to his own convenience, provided he found them unoccupied by any one else.

10 By what means it is preserved or lost.

Property, both in lands and moveables, being thus originally acquired by the first taker, which taking amounts to a declaration, that he intends to appropriate the thing to his own use, it remains in him, by the principle of universal law, till such time as he does some other act which shows an intention to abandon it; for then it becomes naturally speaking, *publici juris* once more, and is liable to be again appropriated by the next occupant. So if one is possessed of a jewel, and casts it into the sea or a public highway, this is such an express dereliction, that a property will be vested in the first fortunate finder that shall seize it to his own use. But if he hides it privately in the earth, or other secret place, and it is discovered, the finder acquires no property therein; for the owner had not by this act declared any intention to abandon it, but rather the contrary: and if he loses or drops it by accident, it cannot be collected from thence that he designed to quit the possession; and therefore in such cases the property still remains in the loser, who may claim it again of the finder. And this, we may remember, is the doctrine of the English law with relation to *Treasure-Trove*.

But this method of one man's abandoning his property, and another seizing the vacant possession, however well-founded in theory, could not long subsist in fact. It was calculated merely for the rudiments of civil society, and necessarily ceased among the complicated interests and artificial refinements of polite and established governments. In these it was found, that what became inconvenient or useless to one man, was highly convenient and useful to another; who was ready to give in exchange for it some equivalent that was equally desirable to the former proprietor. This mutual convenience introduced commercial traffic, and the reciprocal transfer of property by sale, grant, or conveyance: which may be considered either as a continuance of the original possession which the first occupant had; or as an abandoning of the thing by the present owner, and an immediate successive occupancy of the same by the new proprietor. The voluntary dereliction of the owner, and delivering the possession to another individual, amount to a transfer of the property; the proprietor declaring his intention no longer to occupy the thing himself, but that his own right of occupancy shall be vested in the new acquirer. Or, taken in the other light, if I agree to part with an acre of my land to Titius, the deed of conveyance is an evidence of my intending to abandon the property; and Titius, being the only or first man acquainted with such my intention, immediately steps in and seizes the vacant possession: thus the consent expressed by the conveyance gives Titius a good right against me; and possession or occupancy confirms that right against all the world besides.

11 How it goes on the death of the occupant.

The most universal and effectual way of abandoning property is by the death of the occupant: when, both the actual possession and intention of keeping possession

Property. sion ceasing, the property, which is founded upon such possession and intention, ought also to cease of course. For, naturally speaking, the instant a man ceases to be, he ceases to have any dominion: else, if he had a right to dispose of his acquisitions one moment beyond his life, he would also have a right to direct their disposal for a million of ages after him; which would be highly absurd and inconvenient (A). All property must therefore cease upon death, considering men as absolute individuals, and unconnected with civil society: for then, by the principles before established, the next immediate occupant would acquire a right in all that the deceased possessed. But as, under civilized governments, which are calculated for the peace of mankind, such a constitution would be productive of endless disturbances, the universal law of almost every nation (which is a kind of secondary law of nature) has either given the dying person a power of continuing his property, by disposing of his possessions by will; or, in case he neglects to dispose of it, or is not permitted to make any disposition at all, the municipal law of the country then steps in, and declares who shall be the successor, representative, or heir of the deceased; that is, who alone shall have a right to enter upon this vacant possession, in order to avoid that confusion which its becoming again common would occasion. And farther, in case no testament be permitted by the law, or none be made, and no heir can be found so qualified as the law requires, still, to prevent the robust title of *occupancy* from again taking place, the doctrine of escheats is adopted in almost every country; whereby the sovereign of the state, and those who claim under his authority, are the ultimate heirs, and succeed to those inheritances to which no other title can be formed.

12 Of the right of inheritance.

The right of inheritance, or descent to the children and relations of the deceased, seems to have been allowed much earlier than the right of devising by testament. We are apt to conceive at the first view that it has nature on its side; yet we often mistake for nature what we find established by long and inveterate custom. It is certainly a wise and effectual, but clearly a political, establishment; since the permanent right of property, vested in the ancestor himself, was no *natural*, but merely a *civil*, right. It is true, that the transmission of one's possessions to posterity has an evident tendency to make a man a good citizen and a useful member of society: it sets the passions on the side of duty, and prompts a man to deserve well of the public, when he is sure that the reward of his services will not die with himself, but be transmitted to those with whom he is connected by the dearest and most tender affections. Yet, reasonable as this foundation of the right of inheritance may seem, it is probable that its immediate original arose not from speculations altogether so delicate and refined, and, if not from fortuitous circumstances, at least from a plainer and more simple principle. A man's children or nearest relations are usually about him on his death-bed, and are the earliest witnesses of his decease. They became therefore generally the next immediate occupants, till at length in process of time this frequent usage ripened into general law. And therefore also in the earliest ages, on failure of children, a man's servants born under his roof were allowed to be his heirs; being immediately on the spot when he died. For we find the old patriarch Abraham expressly declaring, that "since God had given him no seed, his steward Eliezer, one born in his house, was his heir." Property.

13 Last wills or testaments

While property continued only for life, testaments were useless and unknown; and when it became inheritable, the inheritance was long indefeasible, and the children or heirs at law were incapable of exclusion by will. Till at length it was found, that so strict a rule of inheritance made heirs disobedient and headstrong, defrauded creditors of their just debts, and prevented many provident fathers from dividing or charging their estates as the exigence of their families required. This introduced pretty generally the right of disposing of one's property, or a part of it, by *testament;* that is, by written or oral instructions properly *witnessed* and authenticated, according to the *pleasure* of the deceased; which we therefore emphatically style his *will*. This was established in some countries much later than in others. In England, till modern times, a man could only dispose of one-third of his moveables from his wife and children; and in general, no will was permitted of lands till the reign of Henry VIII. and then only of a certain portion; for it was not till after the Restoration that the power of devising real property became so universal as at present.

14 are creatures of the civil or municipal laws.

Wills, therefore, and testaments, rights of inheritance, and successions, are all of them creatures of the civil or municipal laws, and accordingly are in all respects regulated by them; every distinct country having different ceremonies and requisites to make a testament completely valid; neither does any thing vary more than the right of inheritance under different national establishments. In England particularly, this diversity is carried to such a length, as if it had been meant to point out the power of the laws in regulating the succession to property, and how futile every claim must be that has not its foundation in the positive rules of the state. In personal estates, the father may succeed to his children; in landed property, he never can be their immediate heir by any the remotest possibility: in general, only the eldest son, in some places only the youngest, in others all the sons together, have a right to succeed to the inheritance: In real estates, males are preferred to females, and the eldest male will usually exclude the rest; in the division of personal estates, the females of equal degree are admitted together with the males, and no right of primogeniture is allowed. *Blackst. Comment.*

15 Scruples respecting heritable property removed.

This one consideration may help to remove the scruples of many well-meaning persons, who set up a mistaken conscience in opposition to the rules of law. If a man disinherits his son, by a will duly executed, and leaves his estate to a stranger, there are many who consider this proceeding as contrary to natural justice; while others so scrupulously adhere to the supposed intention of the deed, that if a will of lands be attested by only *two* witnesses instead of *three*, which the law requires,

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(A) This right, inconvenient as it certainly is, the law of Scotland gives to every man over his *real* estate, by authorising him to entail it on his heirs for ever. See LAW, clxxx. 9, 10, 11. and TAILZIE.

Property.

requires, they are apt to imagine that the heir is bound in conscience to relinquish his title to the devisee. But both of them certainly proceed upon very erroneous principles: as if, on the one hand, this son had by nature a right to succeed to his father's lands; or as if, on the other hand, the owner was by nature entitled to direct the succession of his property after his own decease. Whereas the law of nature suggests, that on the death of the possessor, the estate should again become common, and be open to the next occupant, unless otherwise ordered, for the sake of civil peace, by the positive law of society. The positive law of society, which is with us the municipal laws of England and Scotland, directs it to vest in such person as the last proprietor shall by will, attended with certain requisites, appoint; and, in defect of such appointment, to go to some particular person, who from the result of certain local constitutions, appears to be the heir at law. Hence it follows, that, where the appointment is regularly made, there cannot be a shadow of right in any one but the person appointed; and, where the necessary requisites are omitted, the right of the heir is equally strong, and built upon as solid a foundation, as the right of the devisee would have been, supposing such requisites were observed.

16
Of things that are still in common.

But, after all, there are some few things, which notwithstanding the general introduction and continuance of property, must still unavoidably remain in common; being such wherein nothing but an usufructuary property is capable of being had: and therefore they still belong to the first occupant, during the time he holds possession of them, and no longer. Such (among others) are the elements of light, air, and water; which a man may occupy by means of his windows, his gardens, his mills, and other conveniences; such also are the generality of those animals which are said to be *feræ naturæ*, or of a wild and untameable disposition; which any man may seize upon and keep for his own use or pleasure. All these things, so long as they remain in possession, every man has a right to enjoy without disturbance; but if once they escape from his custody, or he voluntarily abandons the use of them, they return to the common stock, and any other man has an equal right to seize and enjoy them afterwards.

17
Of similar things which have been appropriated.

Again, there are other things in which a permanent property may subsist not only as to the temporary use, but also the solid substance; and which yet would be frequently found without a proprietor, had not the wisdom of the law provided a remedy to obviate this inconvenience. Such are forests and other waste grounds, which were omitted to be appropriated in the general distribution of lands: such also are wrecks, estrays, and that species of wild animals, which the arbitrary constitutions of positive law have distinguished from the rest by the well-known appellation of *game*. With regard to these and some others, as disturbances and quarrels would frequently arise among individuals contending about the acquisition of this species of property by first occupancy, the law has therefore wisely cut up the root of dissension, by vesting the things themselves in the sovereign of the state; or else in his representatives appointed and authorised by him, being usually the lords of manors. And thus our legislature has universally promoted the grand ends of civil society, the peace and security of individuals, by steadily pursuing that wise and orderly maxim, of assigning to every thing capable of ownership a legal and determinate owner.

Property. Prophecy.

18
The reasoning of those who contend for an equalization of property.

In this age of paradox and innovation, much has been said of *liberty* and *equality*; and some few have contended for an equalization of property. One of the wildest declaimers on this subject, who is for abolishing property altogether, has (inadvertently we suppose) given a complete confutation, not only of his own arguments, but also of the arguments of all who have written, or, we think, can write, on the same side of the question. After labouring to prove that it is gross injustice in any man to retain more than is absolutely necessary to supply him with food, clothes, and shelter, this zealous reformer states an objection to his theory, arising from the well-known allurements of sloth, which, if the accumulation of property were not permitted, would banish industry from the whole world. The objection he urges fairly, and answers it thus: "It may be observed, that the equality for which we are pleading is an equality that would succeed to a state of great intellectual improvement. So bold a revolution cannot take place in human affairs, till the general mind has been highly cultivated. The present age of mankind is greatly enlightened; but it is to be feared is not yet enlightened enough. Hasty and undigested tumults may take place, under the idea of an equalization of property; but it is only a calm and clear conviction of justice, of justice mutually to be rendered and received, of happiness to be produced by the *desertion of our most rooted habits*, that can introduce an invariable system of this sort. Attempts without this preparation will be productive only of confusion. Their effect will be momentary, and a new and more barbarous inequality will succeed. Each man with unaltered appetite will watch his opportunity to gratify his love of power, or his love of distinction, by usurping on his inattentive neighbours."

19
The effect of ignorance of human nature.

These are just observations, and such as we have often made to ourselves on the various proposed reformations of government. The illumination which the author requires before he would introduce his abolition of property, would constitute men more than angels; for to be under the influence of no passion or appetite, and to be guided in every action by unmixed benevolence and pure intellect, is a degree of perfection which we can attribute to no being inferior to God. But it is the object of the greater part of this writer's book to prove that all men must arrive at such perfection before his ideal republic can contribute to their happiness; and therefore every one who is conscious of being at any time swayed by passion, and who feels that he is more attached to his wife or children than to strangers, will look without envy to the present inequalities of property and power, if he be an intelligent disciple of Mr Godwin.

Literary PROPERTY. See COPY-RIGHT.

1
Definition.

PROPHECY is a word derived from προφαίνω, and in its original import signifies the prediction of future events.

2
Prophecy proves a supernatural communion with the Deity.

As God alone can perceive with certainty the future actions of free agents, and the remote consequences of those laws of nature which he himself established, prophecy, when clearly fulfilled, affords the most convincing evidence of an intimate and supernatural communion between

between God and the person who uttered the prediction. Together with the power of working miracles, it is indeed the only evidence which can be given of such a communion.

3
The professors of all religions have pretended to it.

Hence among the professors of every religious system, except that which is called the religion of nature, there have been numberless pretenders to the gift of prophecy. The Pagan nations of antiquity had their oracles, augurs, and soothsayers. Modern idolaters have their necromancers and diviners; and the Jews, Christians, and Mahometans, have their seers and prophets.

The ill-founded pretensions of paganism, ancient and modern, have been exposed under various articles of this work. (See Divination, Magic, Necromancy, and Mythology). And the claims of the Arabian impostor are examined under the articles Alcoran and Mahometanism; so that at present we have only to consider the use, intent, and truth, of the Jewish and Christian prophecies.

4
The word in Scripture has various meanings.

Previous to our entering on this investigation, it may be proper to observe, that in the Scriptures of the Old and New Testaments, the signification of the word prophecy is not always confined to the foretelling of future events. In several instances it is of the same import with preaching, and denotes the faculty of illustrating and applying to present practical purposes the doctrines of prior revelation. Thus in Nehemiah it is said, "Thou hast appointed prophets to preach *;" and whoever speaketh unto men to edification, and exhortation, and comfort, is by St Paul called a *prophet* †. Hence it was that there were schools of prophets in Israel, where young men were instructed in the truths of religion, and fitted to exhort and comfort the people.

* Ch. vi. ver. 7.

† 1 Cor. ch. xiv. ver. 3.

In this article, however, it is chiefly of importance to confine ourselves to that kind of prophecy which, in declaring truths either past, present, or future, required the immediate inspiration of God.

5
Science and religion gradually acquired.

Every one who looks into the history of the world must observe, that the minds of men have from the beginning been gradually opened by a train of events still improving upon, and adding light to each other; as that of each individual is, by proceeding from the first elements and seeds of science, to more enlarged views, and a still higher growth. Mankind neither are nor ever have been capable of entering into the depths of knowledge at once; of receiving a whole system of natural or moral truths together; but must be let into them by degrees, and have them communicated by little and little, as they are able to bear it. That this is the case with respect to human science, is a fact which cannot be questioned; and there is as little room to question it with respect to the progress of religious knowledge among men, either taken collectively or in each individual. Why the case is thus in both, why all are not adult at once in body and mind, is a question which the religion of nature is equally called upon with revelation to answer. The fact may not be easily accounted for, but the reality of it is incontrovertible.

6
The revelations of Old Testament gradual.

Accordingly, the great object of the several revelations recorded in the Old Testament was evidently to keep alive a sense of religion in the minds of men, and to train them by degrees for the reception of those simple but sublime truths by which they were to be saved. The notions which the early descendants of Adam entertained of the Supreme Being, and of the relation in which they stood to him, were probably very gross; and we see them gradually refined by a series of revelations or prophecies, each in succession more explicit than that by which it was preceded, till the advent of him who was the way, the truth, and the life, and who brought to light life and immortality.

7
Prophecy always accompanied by miracles,

When a revelation was made of any important truth, the grounds of which the mind of man has not faculties to comprehend, that revelation, though undoubtedly a prophecy, must have been so far from confirming the truth of revealed religion in general, that it could not gain credit itself, but by some extrinsic evidence that it came indeed from God. Hence we find Moses, after it was revealed to him from the burning bush that he should deliver his countrymen from Egyptian bondage, replying, "Behold, they will not believe me, nor hearken to my voice; for they will say, the Lord hath not appeared unto thee." This revelation certainly constituted him a prophet to Israel; and there cannot be a doubt but that he perfectly knew the divine source from which he received it: but he very naturally and reasonably concluded, that the children of Israel would not believe that the Lord had appeared to him, unless he could give them some other proof of this preternatural appearance than his own simple affirmation of its reality. This proof he was immediately enabled to give, by having conferred upon him the power of working miracles in confirmation of his prophecy. Again, when Gideon was called to the deliverance of Israel, the angel of the Lord came and said unto him, "The Lord is with thee, thou mighty man of valour: go in this thy might, and thou shalt save Israel from the hand of the Midianites. Have not I sent thee?" Here was a prophecy delivered by the angel of the Lord to encourage Gideon's undertaking: but he, being probably afraid of some illusion of sense or imagination, demanded a sign that he was really an angel who talked with him. A sign is accordingly given him, a miraculous sign, with which he is satisfied, and undertakes the work appointed him.

8
and of itself can be no proof of a revelation.

From these and many similar transactions recorded in the Old Testament, it appears that prophecy was never intended as evidence of an original revelation. It is indeed, by its very nature, totally unfit for such a purpose; because it is impossible, without some extrinsic proof of its divine origin, to know whether any prophecy be true or false, till the era arrive at which it ought to be fulfilled. When it is fulfilled, it affords complete evidence that he who uttered it spake by the spirit of God, and that the doctrines which he taught of a religious nature, were all either dictated by the same spirit, or at least are true, and calculated to direct mankind in the way of their duty.

9
It was intended to preserve a sense of religion among men.

The prophecies vouchsafed to the patriarchs in the most early periods of the world, were all intended to keep alive in their minds a sense of religion, and to direct their views to the future completion of that first and greatest prophecy which was made to Adam immediately on his fall: but in order to secure credit to those prophecies themselves, they were always accompanied by some miraculous sign that they were indeed given by the God of truth, and not the delusions of fanaticism or hypocrisy. Prophecy, in the proper sense of the word, commenced with the fall; and the first instance of it is implied in the sentence denounced upon the

the original deceiver of mankind; "I will put enmity between thee and the woman, and between thy seed and her seed: It shall bruise thy head, and thou shalt bruise his heel."

10
Probable effects of the first prophecy on our first parents.

This prophecy, though one of the most important that ever was delivered, when considered by itself, is exceedingly obscure. That Adam should have understood it, as some of his degenerate sons have pretended to do, in a literal sense, is absolutely impossible. He knew well that it was the great God of heaven and earth who was speaking, and that such a Being was incapable of trifling with the wretchedness of his fallen creature. The sentence denounced upon himself and his wife was awful and severe. The woman was doomed to sorrow in conception; the man to sorrow and travel all the days of his life. The ground was cursed for his sake; and the end of the judgment was, "Dust thou art, and to dust thou shalt return." Had our first parents been thus left, they must have looked upon themselves as rejected by their Maker, delivered up to trouble and sorrow in the world, and as having no hope in any other. With such impressions on their minds they could have retained no sense of religion; for religion, when unaccompanied by hope, is a state of frenzy and distraction: yet it is certain that they could have no hope from any thing expressly recorded by Moses, except what they might draw from this sentence passed on their deceiver. Let us then endeavour to ascertain what consolation it could afford them.

At that awful juncture, they must have been sensible that their fall was the victory of the serpent, whom by experience they had found to be an enemy to God and to man. It could not therefore but be some comfort to them to hear this enemy first condemned, and to see that, however he had prevailed against them, he had gained no victory over their Maker. By this condemnation they were secured from thinking that there was any malignant being equal to the Creator in power and dominion; an opinion which, through the prevalency of evil, gained ground in after times, and was destructive of all true religion. The belief of God's supreme dominion being thus preserved, it was still necessary to give them such hopes as might induce them to love as well as to fear him; and these they could not but conceive when they heard from the mouth of their Creator and Judge, that the serpent's victory was not complete even over themselves; that they and their posterity should be enabled to contest his empire; and that though they were to suffer much in the struggle, they should yet finally prevail, bruise the serpent's head, and deliver themselves from his power and dominion.

This prophecy therefore was to our first parents a light shining in a dark place. All that they could certainly conclude from it was, that their case was not desperate; that some remedy, some deliverance from the evil they were under, would in time appear; but *when* or *where*, or by *what means* they were to be delivered, they could not possibly understand, unless the matter was further revealed to them, as probably it was at the institution of sacrifice (see SACRIFICE). Obscure, however, as this promise or prophecy was, it served after the fall as a foundation for religion, and trust and confidence towards God in hopes of deliverance in time from the evils of disobedience: and this appears to have been the sole purpose for which it was given, and not, as some well-meaning though weak advocates for Christianity have imagined, as a prediction pointing *directly* to the cross of Christ.

As this prophecy was the first, so is it the only considerable one in which we have any concern from the creation to the days of Noah. It was proportioned to the then wants and necessities of the world, and was the grand charter of God's mercy after the fall. Nature had no certain help for sinners; her rights were lost with her innocence. It was therefore necessary either to destroy the offenders, or to raise them to a capacity of salvation, by giving them such hopes as might enable them to exercise a reasonable religion. So far the light of this prophecy extended. By what *means* God intended to work their salvation, he did not expressly declare: and who has a right to complain that he did not, or to prescribe to him rules in dispensing his mercy to the children of men?

11
The curse removed from the ground.

Upon the hopes of mercy which this prophecy gives in very general terms, mankind rested till the birth of Noah. At that period a new prophecy was delivered by Lamech, who foretels that his son should comfort them concerning the work and toil of their hands, "because of the *earth which the Lord had cursed.*" We are to remember that the curse pronounced upon the earth was part of the sentence passed upon our first parents; and when that part was remitted, if it ever was remitted, mankind would acquire new and more lively hopes that in God's good time they should be freed from the whole. But it has been shown by Bishop Sherlock*, that this declaration of Lamech's was a prediction, that during the life of his son the curse should be taken off from the earth: and the same prelate has proved with great perspicuity, and in the most satisfactory manner, that this happy revolution actually took place after the flood. The limits prescribed to an article of this kind will not permit us even to abridge his arguments. We shall only observe, that the truth of his conclusion is manifest from the very words of scripture; for when God informs Noah of his design to destroy the world, he adds, "But with thee will I establish my covenant:" and as soon as the deluge was over, he declared that he "would not again curse the ground any more for man's sake; but that while the earth should remain, seed-time and harvest, and cold and heat, and summer and winter, and day and night, should not cease." From this last declaration it is apparent that a curse *had* been on the earth, and that seed-time and harvest had often failed; that the curse was now taken off; and that in consequence of this covenant, as it is called, with Noah and his seed and with every living creature, mankind should not henceforth be subjected to toil so severe and so generally fruitless.

* *Use and Intent of Prophecy.*

12
A future life not then explicitly revealed.

It may seem surprising perhaps to some, that after so great a revolution in the world as the deluge made, God should say nothing to the remnant of mankind of the punishments and rewards of another life, but should make a new covenant with them relating merely to fruitful seasons and the blessings of the earth. But in the scriptures we see plainly a gradual working of providence towards the redemption of the world from the curse of the fall; that the temporal blessings were first restored as an earnest and pledge of better things to follow; and that the covenant given to Noah had, strictly speaking, nothing to do with the hopes of futurity, Prophecy. ty, which were reserved to be the matter of another covenant, in another age, and to be revealed by him, whose province it was to "bring life and immortality to light through the gospel." But if Noah and his forefathers expected deliverance from the whole curse of the fall, the actual deliverance from one part of it was a very good pledge of a further deliverance to be expected in time. Man himself was cursed as well as the ground; he was doomed to dust: and fruitful seasons are but a small relief compared to the greatness of his loss. But when fruitful seasons came, and one part of the curse was evidently abated, it gave great assurance that the other should not last for ever, but that by some means, still unknown to them, they should be freed from the whole, and finally bruise the serpent's head, who, at the deluge, had so severely bruised man's heel.

Upon this assurance mankind rested for some generations, and practised, as we have every reason to believe, a rational worship to the one God of the universe. At last, however, idolatry was by some means or other introduced (see POLYTHEISM), and spread so universally through the world, that true religion would in all probability have entirely failed, had not God visibly interposed to preserve such a sense of it as was necessary for

13 Promise to Abraham.

the accomplishment of his great design to restore mankind. This he did by calling Abraham from amidst his idolatrous kindred, and renewing to him the word of prophecy: "Get thee out of thy country (said he), and from thy kindred, and from thy father's house, unto a land that I will shew thee. And I will make of thee a great nation, and I will bless thee, and make thy name great; and thou shalt be a blessing. And I will bless them that bless thee, and curse him that curseth thee; and in thee shall all the families of the earth be blessed." These magnificent promises are several times repeated to the father of the faithful, with additional circumstances of great importance, such as, "that he should be multiplied exceedingly; that he should be a father of many nations; that kings should come out of him;" and above all, that God would establish an *everlasting covenant* with him and his seed, to give him and them all the land of Canaan for an *everlasting possession*, and to be *their God*."

Upon such of these promises, as relate to temporal blessings we need not dwell. They are much of the same nature with those which had been given before to Lamech, Noah, Shem, and Japheth; and all the world knows how amply and literally they have been fulfilled. There was, however, so little probability in nature of their accomplishment at the time when they were made, that we find the patriarch asking, "Whereby he should *know* † that he should inherit such an extent of country?" And as the promises that he should inherit it were found to be a foundation for religion and confidence in God, a miraculous sign was given him that they came indeed from the spirit of truth. This removed from his mind every doubt, and made him give the fullest credit, not only to them, but also to that other promise, "that in his seed should all the nations of the earth be blessed."

† Genesis xv. 8. &c.

What distinct notion he had of this blessing, or in what manner he hoped it should be effected, we cannot pretend to say. "But that he understood it to be a promise of restoring mankind, and delivering them from the remaining curse of the fall, there can be no doubt. He knew that death had entered by sin; he knew that God had promised victory and redemption to the seed of the woman. Upon the hopes of this restoration the religion of his ancestors was founded; and when God, from whom this blessing on all men was expected, did expressly promise a blessing on all men, and in this promise founded his everlasting covenant—what could Abraham else expect but the completion in his seed of that ancient promise and prophecy concerning the victory to be obtained by the woman's seed? The curse of the ground was expiated in the flood, and the earth restored with a blessing, which was the foundation of the temporal covenant with Noah; a large share of which God expressly grants to Abraham and his posterity particularly, together with a promise to bring, by their means, a new and further blessing upon the whole race of men. If we lay these things to heart, we cannot suppose that less could be expected from the new promise or prophecy given to Abraham than a deliverance from that part of the curse still remaining on men: *Dust thou art, and to dust thou shalt return.* In virtue of this covenant Abraham and his posterity had reason to expect that the time would come when man should be called from his dust again. For this expectation they had his assurance who gave the covenant, that he would be their God for ever. Well might our Saviour then tell the sons of Abraham, that even Moses at the bush showed the resurrection of the dead, when he called the Lord the God of Abraham, and the God of Isaac, and the God of Jacob *."

* Sherlock's *Use and Intent of Prophecy*.

14 To Isaac and Jacob.

These promises made to Abraham were renewed to Isaac and Jacob; to the last of whom it was revealed, not only that all the nations of the earth should be blessed in his seed, but that the blessing should spring from his son Judah. It is, however, by no means evident that any one of those patriarchs knew precisely by what *means* (A) the curse of the fall was to be entirely removed, and all men called from their dust again. It was enough that they were convinced of the fact in general terms, since such conviction was a sufficient foundation of a rational religion; and the descendants of Abraham had no other foundation upon which to rest their

(A) This they certainly could not know from the promises expressed in the very general terms in which they are recorded in the book of Genesis. It is, however, not improbable that those promises, as they immediately received them, were conceived in terms more precise and particular; and, at all events, Dr Warburton has proved to the full conviction of every man who is not a determined unbeliever, that Abraham was commanded to sacrifice his son Isaac, not only as a trial of his obedience, but also that God might give him what he earnestly desired, a scenical representation of the means by which mankind were to be redeemed from death. The learned writer thinks, and his reasoning compels us to think with him, that to this transaction our Saviour alludes when he says, "Your father Abraham rejoiced to see my *day*, and he saw it and was glad."

Prophecy. their hopes, and pay a cheerful worship to the God of their fathers, till the giving of the law to Moses. Then

15
The law of Moses and the succeeding prophets.

indeed they were incorporated into a society with municipal laws of their own, and placed under a theocratic government; the temporal promises made to their fathers were amply fulfilled; religion was maintained among them by rewards and punishments equally distributed in this world (see THEOLOGY): and a series of prophets succeeding one another pointed out with greater and greater clearness, as the fulness of time approached, the person who was to redeem mankind from the power of death; by what means he was to work that great redemption, and at what precise period he was to make his appearance in the world. By these supernatural interpositions of divine providence, the principles of pure theism and the practice of true religion were preserved among the children of Israel, when all other nations were sunk in the grossest idolatry, and wallowed in the most abominable vices; when the far-famed Egyptians, Greeks, and Romans, fell down with adoration to stocks and stones and the vilest reptiles; and when they had no well-grounded hope of another life, and were in fact without God in the world.

16
Were all intended to keep alive a sense of religion.

From this short deduction, we think ourselves intitled to conclude, that the *primary* use and intent of prophecy, under the various dispensations of the Old Testament, was not, as is too often supposed, to establish the divine mission of Jesus Christ, but to keep alive in the minds of those to whom it was given, a sense of religion, and a hope of future deliverance from the curse of the fall. It was, in the expressive language of St Peter, "a light that shone in a dark place, unto which men did well to take heed until the day dawned and the day-star arose in their hearts." But though this was certainly the original intent of prophecy (for Christ, had he never been foretold, would have proved himself to be the son of God with power by his astonishing miracles, and his resurrection from the dead), yet it cannot be denied, that a long series of prophecies, given in different and far distant ages, and having all their completion in the life, death, and resurrection, of Jesus, concur very forcibly with the evidence of miracles to prove that he was the seed of the woman ordained to bruise the head of the serpent, and restore man to his forfeited inheritance. To the Jews the force of this evidence must have been equal, if not superior, to that of miracles themselves; and therefore we find the Apostles and first preachers of the gospel, in their addresses to them, constantly appealing to the law and the prophets, whilst they urged upon the Gentiles the evidence of miracles.

17
The prophecies to be considered in connection.

In order to form a right judgment of the argument for the truth of Christianity drawn from the sure word of prophecy, we must not consider the prophecies given in the Old Testament as so many *predictions* only independent of each other; for if we do, we shall totally lose sight of the purpose for which they were originally given, and shall never be able to satisfy ourselves when confronted by the objections of unbelievers. It is easy for men of leisure and tolerable parts to find difficulties in particular predictions, and in the application of them made by writers, who lived many hundred years ago, and who had many ancient books and records of the Jewish church, from which they drew many passages, and perhaps some prophecies; which books and records we have not to enable us to understand, and to justify their applications. But it is not so easy a matter to show, or to persuade the world to believe, that a chain of prophecies reaching through several thousand years, delivered at different times, yet manifestly subservient to one and the same administration of providence from beginning to end, is the effect of art and contrivance and religious fraud. In examining the several prophecies recorded in the Old Testament, we are not to suppose that each of them *expressly* pointed out and *clearly* characterized Jesus Christ. Had they done so, instead of being a support to religion in general, the purpose for which they were originally intended, they would have had a very different effect, by making those to whom they were given repine at being placed under dispensations so very inferior to that of the gospel. We are therefore to inquire only whether all the notices, which, in general and often metaphorical terms, God gave to the fathers of his intended salvation, are perfectly answered by the coming of Christ; and we shall find that nothing has been promised with respect to that subject which has not been performed in the amplest manner. If we examine the prophecies in this manner, we shall find that there is not one of them, which the Apostles have applied to the Messiah, that is not applicable in a rational and important sense to something in the birth, life, preaching, death, resurrection, and ascension of Jesus of Nazareth; that as applied to him they are all consistent with each other; and that though some few of them may be applied without absurdity to persons and events under the Jewish dispensation, Christ is the only person that ever existed in whom they all meet as in a centre. In the limits prescribed us, it is impossible that we should enter upon a particular proof of this position. It has been proved by numberless writers, and, with respect to the most important prophecies, by none with greater success than Bishop Sherlock in his Use and Intent of Prophecy in the several ages of the World; a work which we recommend to our readers as one of the most valuable on the subject in our own or any other language.

18
Objection from the obscurity of prophecy.

But admitting that it would have been improper, for the reason already hinted at, to have given a clear and precise description of Christ, and the Christian dispensation, to men who were ordained to live under dispensations less perfect, how, it may be asked, comes it to pass that many of the prophecies applied by the writers of the gospel to our Saviour and his actions are still dark and obscure, and so far from belonging evidently to him and to him only, that it requires much learning and sagacity to show even now the connection between some prophecies and the events?

19
Answered.

In answer to these questions, the learned prelate just referred to observes, "That the obscurity of prophecy does not arise from hence, that it is a relation or description of something *future*; for it is as easy to speak of things future plainly, and intelligibly, as it is of things past or present. It is not, therefore, of the nature of prophecy to be obscure; for it may easily be made, when he who gives it thinks fit, as plain as history. On the other side, a figurative and dark description of a future event will be figurative and dark still when the event happens; and consequently will have all the obscurity of a figurative and dark description as well after as before the event. The prophet Isaiah describes the peace

peace of Christ's kingdom in the following manner: 'The wolf shall dwell with the lamb, and the leopard shall lie down with the kid, and the calf and the young lion, and the fatling, together, and a little child shall lead them.' Nobody, some modern Jews excepted, ever understood this literally; nor can it now be *literally* applied to the state of the gospel. It was and is capable of different interpretations: it may mean temporal peace, or that internal and spiritual peace—that tranquillity of mind, which sets a man at peace with God, himself, and the world. But whatever the true meaning is, this prophecy does no more obtrude one determinate sense upon the mind since the coming of Christ than it did before. But then we say, the state of the gospel was very properly prefigured in this description, and is as properly prefigured in a hundred more of the like kind; and since they all agree in a fair application to the state of the gospel, we strongly conclude, that this state was the thing foretold under such expressions. So that the argument from prophecy for the truth of Christianity does not rest on this, that the event has necessarily limited and ascertained the particular sense and meaning of every prophecy; but in this, that every prophecy has in a proper sense been completed by the coming of Christ. It is absurd, therefore, to expect clear and evident conviction from every single prophecy applied to Christ; the evidence must arise from a view and comparison of all together." It is doubtless a great mistake to suppose that prophecy was intended solely or chiefly for their sakes in whose time the events predicted are to happen. What great occasion is there to lay in so long beforehand the evidence of prophecy to convince men of things that are to happen in their own times; the truth of which they may, if they please, learn from their own senses? Yet some people are apt to talk as if they thought the truth of the events predicted depended very much on the evidence of prophecy: they speak, for instance, as if they imagined the certainty and reality of our Saviour's resurrection were much concerned in the clearness of the prophecies relating to that great and wonderful event, and seem to think that they are confuting the truth of his resurrection when they are pointing out the absurdity of the prophecies relating to it. But can any thing be more absurd? For what ground or pretence is there to inquire whether the prophecies foretelling that the Messiah should die and rise again do truly belong to Christ, unless we are first satisfied that Christ died and rose again?

The part which unbelievers ought to take in this question, if they would make any use of prophecy, should be, to show from the prophets that Christ was necessarily to rise from the dead; and then to prove that in fact Jesus never did rise. Here would be a plain consequence. But if they like not this method, they ought to let the prophecies alone; for if Christ did not rise, there is no harm done though the prophets have not foretold it. And if they allow the resurrection of Christ, what do they gain by discrediting the prophets? The event will be what it is, let the prophets be what they will.

These considerations show how far the gospel is *necessarily* concerned in prophetical evidence, and how clear the prophecies should be. Christ claims to be the person foretold in the law and the prophets; and as truth must ever be consistent with itself, this claim must be true as well as all others. This is the part then to be tried on the evidence of prophecy: Is Christ that person described and foretold under the Old Testament or not? Whether all the prophecies relating to him be plain or not plain, it matters little; the single question is, Are there enough plain to show us that Christ is the person foretold under the Old Testament? If there be, we are at an end of our inquiry, and want no farther help from prophecy; especially since we have seen the day dawn and enjoyed the marvellous light of the gospel of God.

20 Objections from the clearness of some prophecies,

But so unreasonable are unbelievers, that whilst some of them object to the obscurity of the prophecies, others have rejected them altogether on account of their clearness, pretending that they are histories and not predictions. The prophecies against which this objection has been chiefly urged are those of Daniel, which were first called in question by the famous Porphyry. He affirmed that they were not composed by Daniel, whose name they bear, but by some author who lived in Judea about the time of Antiochus Epiphanes; because all to that time contained true history, but that all the facts beyond that were manifestly false.

21 answered;

This method of opposing the prophecies, as a father of the church rightly observes, is the strongest testimony of their truth: for they are so exactly fulfilled, that to infidels the prophet seemed not to have foretold things future, but to have related things past. To an infidel of this age, if he has the same ability and knowledge of history that Porphyry had, all the subsequent prophecies of Daniel, except those which are still fulfilling, would appear to be history and not prophecy;

22 from what has happened since the objection was first started,

for it entirely overthrows the notion of their being written in the days of *Antiochus Epiphanes*, or of the *Maccabees*, and establishes the credit of Daniel as a prophet beyond contradiction, that there are several of those prophecies which have been fulfilled since that period as well as before; nay, that there are prophecies of Daniel which are fulfilling at this very time in the world.

Our limits will not permit us to enter into the objections which have been made to this prophet by the author of the Literal Scheme of Prophecy considered; nor is there occasion that we should enter into them. They have been all examined and completely answered by Bishop Chandler in his Vindication of his Defence of Christianity, by Mr Samuel Chandler in his Vindication of the Antiquity and Authority of Daniel's Prophecies, and by Bishop Newton in his excellent Dissertations on the Prophecies. To these authors we refer the reader; and shall conclude the present article with a view of some prophecies given in very remote ages, which are in this age receiving their accomplishment.

23 and from facts of the present age.

Of these the first is that of Noah concerning the servitude of the posterity of Canaan. In the greater part of original manuscripts, and in our version of the holy scriptures, this prophecy is thus expressed: "Cursed be Canaan; a servant of servants shall he be unto his brethren:" but in the Arabic version, and in some copies of the Septuagint, it is, "Cursed be *Ham* the father of Canaan; a servant of servants shall he be to his brethren." Whether the curse was really pronounced upon Ham, which we think most probable, or only upon his son Canaan, we shall find the prediction remarkably

ably fulfilled, not barely ages after the book of Genesis was very generally known, but also at this very day. It is needless to inform any man who has but looked into the Old Testament, that when the ancient patriarchs pronounced either a curse or a blessing upon any of their sons, they meant to declare the future fortunes, not of that son individually, but of his descendants as a tribe or a nation. Let us keep this in mind, and proceed to compare with Noah's prophecy *first* the fortunes of the descendants of Canaan, the fourth son of Ham, and then the fortunes of the posterity of Ham by his other sons.

With the fate of the Canaanites every reader is acquainted. They were conquered by Joshua several centuries after the delivery of this prophecy; and such of them as were not exterminated were by him and Solomon reduced to a state of the lowest servitude to the Israelites, the posterity of Shem the brother of Ham. The Greeks and Romans, too, who were the descendants of Japheth, not only subdued Syria and Palestine, but also pursued and conquered such of the Canaanites as were anywhere remaining, as for instance the Tyrians and Carthaginians, of whom the former were ruined by Alexander and the Grecians, and the latter by Scipio and the Romans. Nor did the effects of the curse stop there. The miserable remainder of that devoted people have been ever since slaves to a foreign yoke; first to the Saracens who are descended from Shem, and afterwards to the Turks who are descended from Japheth; and under the Turkish dominion they groan at this day.

If we take the prophecy as it stands in the Arabic version, its accomplishment is still more remarkable. The whole continent of Africa was peopled principally by the posterity of Ham. And for how many ages have the better parts of that country lain under the dominion first of the Romans, then of the Saracens, and now of the Turks? In what wickedness, ignorance, barbarity, slavery, and misery, live most of its inhabitants? and of the poor negroes how many thousands are every year sold and bought like beasts in the market, and conveyed from one quarter of the world to do the work of beasts in another; to the full accomplishment indeed of the prophecy, but to the lasting disgrace of those who are from the love of gain the instruments of fulfilling it. Nothing can be more complete than the execution of the sentence as well upon Ham as upon Canaan; and the hardiest infidel will not dare to say that it was pronounced after the event.

The next prophecy which we shall notice is that of Abraham concerning the multitude of his descendants; which every one knows is still fulfilled in the Jews even in their dispersed state, and therefore cannot have been given after the event of which it speaks.

Of the same kind are the several prophecies concerning Ishmael; of which some have been fulfilled, and others are at present fulfilling in the most astonishing manner. Of this son of Abraham it was foretold, that "he should be a wild man; that his hand should be against every man, and every man's hand against him; that he should dwell in the presence of all his brethren; that he should be multiplied exceedingly, beget twelve princes, and become a great nation." The sacred historian who records these prophecies adds, that "God was with the lad, and he grew, and dwelt in the wilderness, and became an archer."

To show how fully and literally all these prophecies have been accomplished, would require more room than we have to bestow; and to the reader of history the labour would be superfluous. We shall therefore only request the unbeliever to attend to the history of the Arabs, the undoubted descendants of Ishmael; and to say how it comes to pass, that though they have been robbers by land and pirates by sea for time immemorial, though their hands have been against every man, and every man's hand against them, they always have dwelt, and at this day dwell, in the presence of their brethren, a free and independent people. It cannot be pretended that no attempt has ever been made to conquer them; for the greatest conquerors in the world have all in their turns attempted it: but though some of them made great progress, not one was ever crowned with success. It cannot be pretended that the inaccessibleness of their country has been their protection; for their country has been often penetrated, though it never was entirely subdued. When in all human probability they have been on the brink of ruin, they were signally and providentially delivered. Alexander was preparing an expedition against them, when he was cut off in the flower of his age. Pompey was in the career of his conquests when urgent affairs called him elsewhere. Ælius Gallus had penetrated far into their country, when a fatal disease destroyed great numbers of his men, and obliged him to return. Trajan besieged their capital city, but was defeated by thunder and lightning and whirlwinds. Severus besieged the same city twice, and was twice repelled from before it. The Turks, though they were able to wrest from them their foreign conquests, have been so little able to subdue the Arabs themselves, or even to restrain their depredations, that they are obliged to pay them a sort of annual tribute for the safe passage of the pilgrims who go to Mecca to pay their devotions. On these facts we shall not exclaim. He who is not struck upon comparing the simple history of this singular people with the prophecies so long ago delivered of them and their great ancestor, whose love of liberty is compared to that of the wild ass, would rise wholly unmoved from our exclamations. 14

The dispersion of the Jews plainly foretold.

A fourth prophecy of this kind, which cannot be alleged to have been uttered after the event, is the denunciation of Moses against the children of Israel in case of their disobedience; which is so literally fulfilled, that even at this moment it appears rather a history of the present state of the Jews, than a remote prediction of their apostasy and punishment. "And the Lord shall scatter thee among all people from the one end of the earth even unto the other. And among these nations shalt thou find no ease, neither shall the sole of thy foot have rest; but the Lord shall give thee there a trembling heart and falling of eyes, and sorrow of mind. And thy life shall hang in doubt before thee; and thou shalt fear day and night, and shall have none assurance of thy life," (Deut. xxviii. 64, 65, 66.). "And thou shalt become an astonishment, a proverb, and a bye-word, among all nations, whither the Lord shall lead you." (Deut. xxviii. 37.).

Similar to this denunciation, but attended with some circumstances still more wonderful, is the following prediction of the prophet Hosea: "The children of Israel shall abide many days without a king, and without a prince, and without a sacrifice, and without an image,

and

and without an ephod, and without teraphim. Afterwards shall the children of Israel return, and seek the Lord their God, and David their king; and shall fear the Lord and his goodness in the latter days (B)." In this passage we find the state of the Jews for the last 1700 years clearly and distinctly described with all its circumstances. From the time that they rejected their Messiah all things began to work towards the destruction of their politics both civil and religious; and within a few years from his death, their city, temple, and government, were utterly ruined; and they themselves not carried into a gentle captivity, to enjoy their laws, and live under governors of their own, as they did in Babylon, but they were sold like beasts in a market, and became slaves in the strictest sense; and from that day to this have had neither prince nor chief among them. Nor will any one of them ever be able, after all their pretences, to prove his descent from Aaron, or to say with certainty whether he is of the tribe of Judah or of the tribe of Levi, till he shall discover that unknown country where never mankind dwelt, and where the apocryphal Esdras has placed their brethren of the ten tribes. This being the case, it is impossible they can have either an altar, or a sacrifice, or a priesthood, according to the institution of Moses, but are evidently an outcast people living under laws which cannot be fulfilled.

25 nd the ause of it.

The cause of this deplorable condition is likewise assigned with the same perspicuity: They are scattered over the face of the earth, because they do not acknowledge Christ for the Messiah; because they do not submit to their own king, the true David. In the prophetic writings the name of David is frequently given to the Messiah, who was to descend from that prince. Thus Ezekiel, speaking of the kingdom of Christ, says, "I will set up one Shepherd over them, and he shall feed them, even my servant David; he shall feed them, and he shall be their shepherd." And Jeremiah says, "They shall serve the Lord their God, and David their king, whom I will raise up unto them."

That in these places, as well as in the passage under consideration, the Messiah is meant, is undeniable; for David the son of Jesse was dead long before any of the three prophets was born; and by none of them it is said "afterwards David their king shall come again;" but "afterwards the children of Israel *shall* return to David their king," they shall recover from their blind infatuation, and seek him whom they have not yet known. By their not receiving Jesus for their Christ, they have forfeited all claim to the divine favour, and are, of consequence, "without a king, and without a chief, and without a sacrifice, and without an altar, and without a priesthood."

26 eir re- n also ;told.

The time, however, will come, when they shall return and seek "the Lord their God and David their king;" when they shall tremble before him whom their fathers crucified, and honour the son even as they honour the father. That this part of the prophecy will in time be as completely fulfilled as the other has been, may be confidently expected from the wonderful preservation of the Jews for so many ages. Scattered as they are over the whole earth, and hated as they are by all nations, it might naturally be thought, that in process of time they would have coalesced with their conquerors, and have been ultimately absorbed and annihilated by their union, so that no trace of them should now have remained; yet the fact is, that, dispersed as they have ever since been over the whole face of the globe, they have never, in a single instance, in any country, lost their religious or natural distinctions; and they are now generally supposed to be as numerous as they were under the reigns of David and Solomon. This is contrary to all history, and all experience of the course of human affairs in similar cases; it has been boldly and justly styled a standing miracle. Within 1000 or 1200 years back, a great variety of extraordinary and important revolutions have taken place among the nations of Europe. In the southern part of this island the Britons were conquered by the Saxons, the Saxons by the Danes, and the Danes and Saxons by the Normans; but in a few centuries these opposite and hostile nations were consolidated into one indistinguishable mass. Italy, about the same time that Britain was subdued by the Saxons, was conquered by the Goths and Vandals: and it is not easy to conceive a more striking contrast than that which subsisted between the polished inhabitants of that delightful country and their savage invaders; and yet how soon did all distinction cease between them! In France, the Roman colonies gradually assimilated with the ancient Gauls; and in Spain, though the Moors continued for several ages, and till their final expulsion, a distinct people, yet after they were once reduced to a state of subjection, their numbers very sensibly diminished; and such of them as were suffered to remain after their last overthrow have been long since so blended with the Spaniards that they cannot now be distinguished. But with regard to the Jews, the wonder is, that though they do not in any country where they are settled bear any proportion to the natural inhabitants, though they are universally reduced to a state of the lowest subjection, and even exposed to hatred, contempt, and persecution; yet in no instance does there seem to be the least appearance or probability of their numbers being diminished, in no instance do they discover any decay of attachment to their religious principles. Whence then comes it that this people alone, who, having no form of government or a republic anywhere subsisting, are without the means by which other people are kept united and distinct, should still be preserved amongst so many different nations? How comes it, when they have been thus scattered into so many distant corners, like dust which cannot be perceived, that they should still so long survive the dissolution of their own state, as well as that of so many others! To these questions the answer is obvious: They are

(B) Such is our translation of this remarkable prophecy; but the Greek version of the Seventy has it, perhaps more properly, thus: "The children of Israel shall abide many days without a king, and without a chief, and without a sacrifice, and without an altar, and without a priesthood, and without prophecies. Afterwards," &c.

Prophecy, Prophet. are preserved, that, as a nation, "they may return and seek the Lord their God and David their king, and fear the Lord and his goodness in the latter days."

27
Of prophecies respecting the Christian church.

We might here subjoin many prophecies both from the Old and the New Testament, and especially from the writings of St Paul and St John, which so clearly describe the various fortunes of the Christian church, her progress to that state of general corruption under which she was sunk three centuries ago, and her gradual restoration to her primitive purity, that they cannot be supposed to proceed from the cunning craftiness of men, or to have been written after the events of which they speak. To do justice to these, however, would require a volume, and many excellent volumes have been written upon them. The reader who wishes for satisfaction on so interesting a subject will do well to consult the writings of Mr Mede and Sir Isaac Newton, together with Bishop Newton's Dissertations, and the Sermons of Hurd, Halifax, and Bagot, preached at Warburton's lecture. We shall only observe, that one of the ablest reasoners that Great Britain ever produced, after having paid the closest attention to the predictions of the New Testament, hath been bold enough to put the truth of revealed religion itself upon the reality of that prophetic spirit which foretold the desolation of Christ's church and kingdom by antichrist. "If (says he), IN THE DAYS OF ST PAUL AND ST JOHN, there was any footstep of such a sort of power as this in the world; or if there HAD BEEN any such power in the world; or if there WAS THEN any appearance or probability that could make it enter into the heart of man to imagine that there EVER COULD BE any such kind of power in the world, much less in the *temple* or *church of God;* and if there be not NOW such a power actually and conspicuously exercised in the world; and if any picture of this power, DRAWN AFTER THE EVENT, can now describe it more plainly and exactly than it was originally described in the words of the prophecy—then may it, with some degree of plausibility, be suggested, that the prophecies are nothing more than enthusiastic imaginations."

Upon the whole, we conclude with Bishop Sherlock, that the various prophecies recorded in the Holy Scriptures were given, not to enable man to foresee with clearness future events, but to support the several dispensations of religion under which they were respectively promulgated. The principal prophecies recorded in the Old Testament led mankind to hope for a complete deliverance from the curse of the fall; and therefore tended to fill their minds with gratitude, and to enforce a cheerful obedience to that God who in the midst of judgment remembereth mercy. The prophecies, whether in the Old or New Testament, that pourtray the present state of the Jews, and the various fortunes of the Christian church, as they are daily fulfilling in the presence of all men, are the strongest possible proof of the divinity of our holy religion, and supply to us in the latter-days the place of miracles, by which it was at first established.

PROPHET, in general, a person who foretels future events; but is particularly applied to such inspired persons among the Jews as were commissioned by God to declare his will and purposes to that people. Among the canonical books of the Old Testament we have the writings of 16 prophets, four of whom are denominated the *greater prophets*, viz. Isaiah, Jeremiah, Ezekiel, and Daniel; so called from the length and extent of their writings, which exceed those of the others, viz. Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Haggai, Zechariah, and Malachi, who are called the *lesser prophets*, from the shortness of their writings. The Jews do not place Daniel among the prophets, because, they say, he lived the life of a courtier rather than that of a prophet. An account of the several writings of the prophets may be seen each under its particular head. See the article ISAIAH, &c.

Sons of the PROPHETS, in scripture history, an appellation given to young men who were educated in the schools or colleges under a proper master, who was commonly, if not always, an inspired prophet, in the knowledge of religion and in sacred music, and thus were qualified to be public preachers; which seems to have been part of the business of the prophets on the Sabbath days and festivals. It is probable that God generally chose the prophets, whom he inspired, out of these schools. See PROPHECY.

PROPITIATION, in *Theology*, a sacrifice offered to God to assuage his wrath and render him propitious. Among the Jews there were both ordinary and public sacrifices, as holocausts, &c. offered by way of thanksgiving; and extraordinary ones, offered by particular persons guilty of any crime, by way of propitiation. The Romish church believe the mass to be a sacrifice of propitiation for the living and the dead. The reformed churches allow of no propitiation but that one offered by Jesus Christ on the cross. See SACRIFICE.

PROPITIATORY, any thing rendering God propitious; as we say *propitiatory* sacrifices, in contradistinction to sacrifices which were *eucharistical*. Among the Jews the propitiatory was the cover or lid of the ark of the covenant; which was lined both within and withoutside with plates of gold, insomuch that there was no wood to be seen. This propitiatory was a type or figure of Christ, whom St Paul calls the propitiatory ordained from all ages. See *Ark of the Covenant*.

PROPOLIS, the name of a certain substance more tenacious than wax, with which the bees stop up all the holes or cracks in the side of their hives. See BEE, N° 13.

PROPONTIS, or SEA of MARMORA, a part of the Mediterranean, dividing Europe from Asia; it has the Hellespont or canal of the Dardanelles to the south-west, whereby it communicates with the Archipelago, and the ancient Bosphorus of Thrace, or strait of Constantinople, to the north-east, communicating with the Black or Euxine sea. It has two castles: that on the Asia side is on a cape, where formerly stood a temple of Jupiter. The castle of Europe is on an opposite cape, and had anciently a temple of Serapis. It is 120 miles long, and in some places upwards of 40 miles broad.

PROPORTION, the identity or similitude of two ratios. Hence quantities that have the same ratio between them are said to be proportional; *e. gr.* if A be to B as C to D, or 8 be to 4 as 30 to 15; A, B, C, D, and 8, 4, 30, and 15, are said to be in proportion, or are simply called proportionals. Proportion is frequently confounded with ratio; yet have the two in reality very different ideas, which ought by all means to be distinguished. Ratio is properly the relation or habitude

tude of two things, which determines the quantity of one from the quantity of another, without the intervention of any third: thus we say the ratio of 5 and 10 is 2, the ratio of 12 and 24 is 2. Proportion is the sameness or likeness of two such relations; thus the relations between 5 and 10 and 12 and 24 being the same, or equal, the four terms are said to be in proportion. Hence ratio exists between two numbers, but proportion requires at least three. Proportion, in fine, is the habitude or relation of two ratios when compared together; as ratio is of two quantities. See ALGEBRA, ARITHMETIC, and GEOMETRY.

Arithmetical and Geometrical PROPORTION. See PROGRESSION.

Inordinate PROPORTION, is where the order of the terms compared is disturbed or irregular. As, for example, in two ranks of numbers, three in each rank,

viz. in one rank, - - 2, 3, 9,
and in the other, - - 8, 24, 36,

which are proportional, the former to the latter, but in a different order, viz. - 2 : 3 : : 24 : 36,
and - - - 3 : 9 : : 8 : 24,
then; casting out the mean terms in each rank it is concluded that - - 2 : 9 : : 8 : 36,
that is, the first is to the third in the first rank, as the first is to the third in the second rank.

Harmonical or *Musical* PROPORTION, is a kind of numeral proportion formed thus: of three numbers, if the first be to the third as the difference of the first and second to the difference of the second and third; the three numbers are in harmonical proportion.

Thus 2, 3, 6, are harmonical, because 2 : 6 : : 1 : 3. So also four numbers are harmonical, when the first is to the fourth as the difference of the first and second to the difference of the third and fourth.

Thus 24, 16, 12, 9, are harmonical, because 24 : 9 : : 8 : 3. By continuing the proportional terms in the first case, there arises an harmonical progression or series.

1. If three or four numbers in harmonical proportion be multiplied or divided by the same number; the products or quotients will also be in harmonical proportion: thus, if 6, 8, 12, which are harmonical, be divided by 2, the quotients 3, 4, 6, are also harmonical; and reciprocally the products by 2, viz. 6, 8, 12.

2. To find an harmonical mean between two numbers given; divide double the product of the two numbers by their sum, the quotient is the mean required; thus suppose 3 and 6 the extremes, the product of these is 18, which doubled gives 36; this divided by 9 (the sum of 3 and 6) gives the quotient 4. Whence 3, 4, 6, are harmonical.

3. To find a third harmonical proportion to two numbers given.

Call one of them the first term, and the other the second; multiply them together, and divide the product by the number remaining after the second is subtracted from double the first; the quotient is a third harmonical proportional: thus, suppose the given terms 3, 4, their product 12 divided by 2 (the remainder after 4 is taken from 6, the double of the first), the quotient is 6, the harmonical third sought.

4. To find a fourth harmonical proportion to three terms given; multiply the first into the third, and divide the product by the number remaining after the middle or second is subtracted from double the first; the quotient is a third harmonical proportion; thus supposing the numbers 9, 12, 16, a fourth will be found by the rule to be 24.

5. If there be four numbers disposed in order, whereof one extreme and the two middle terms are in arithmetical proportion; and the same middle terms with the other extreme are in harmonical proportion; the four are in geometrical proportion; as here 2 : 3 : : 4 : 6, which are geometrical; whereof 2, 3, 4, are arithmetical, and 3, 4, 6, are harmonical.

6. If betwixt any two numbers you put an arithmetical mean, and also an harmonical one, the four will be in geometrical proportion: thus betwixt 2 and 6 an arithmetical mean is 4, and an harmonical one 3; and the four 2 : 3 : : 4 : 6, are geometrical.

We have this notable difference between the three kinds of proportion, arithmetical, harmonical, and geometrical; that from any given number we can raise a continued arithmetical series increasing *in infinitum*, but not decreasing: the harmonical is decreasable *in infinitum*, but not increasable; the geometrical is both.

PROPORTION, or *Rule of Three*. See ARITHMETIC.

Reciprocal PROPORTION. See RECIPROCAL.

PROPORTION is also used for the relation between unequal things of the same kind, whereby their several parts correspond to each other with an equal augmentation or diminution.

Thus, in reducing a figure into little, or in enlarging it, care is taken to observe an equal diminution or enlargement through all its parts; so that if one line, *e. gr.* be contracted by one-third of its length, all the rest shall be contracted in the same proportion.

PROPORTION, in *Architecture*, denotes the just magnitude of the members of each part of a building, and the relation of the several parts of the whole; *e. gr.* of the dimensions of a column, &c. with regard to the ordonnance of the whole building.

One of the greatest differences among architects, M. Perrault observes, is in the proportion of the heights of entablatures with respect to the thickness of the columns, to which they are always to be accommodated.

In effect, there is scarcely any work, either of the ancients or moderns, wherein this proportion is not different; some entablatures are even near twice as high as others:—yet it is certain this proportion ought of all others to be most regulated; none being of greater importance, as there is none in which a defect is sooner seen, nor any in which it is more shocking.

Compass of PROPORTION, a name by which the French, and after them some English, authors call the SECTOR.

PROPORTIONAL, relating to proportion. Thus we say, proportional compasses, parts, scales, spirals, &c.

PROPORTIONALS, in *Geometry*, are quantities, either linear or numeral, which bear the same ratio or relation to each other.

PROPOSITION, in *Logic*, part of an argument, wherein some quality, either negative or positive, is attributed to a subject.

PROPOSITION, in *Mathematics*, is either some truth advanced and shown to be such by demonstration, or some operation proposed and its solution shown. If the proposition

proposition be deduced from several theoretical definitions compared together, it is called a *theorem*; if from a praxis, or series of operations, it is called a *problem*. See the articles THEOREM and PROBLEM.

PROPOSITION, in *Oratory*. See ORATORY, N° 28. 124.

PROPOSITION, in *Poetry*, the first part of a poem, wherein the author proposes briefly, and in general, what he is to say in the body of his work. It should comprehend only the matter of the poem, that is, the action and persons that act. Horace prescribes modesty and simplicity in the proposition, and would not have the poet promise too much, nor raise in the reader too great ideas of what he is going to relate.

PROPREFECT, among the Romans, the prefect's lieutenant, or an officer whom the prefect of the pretorium commissioned to do part of his duty in his place.

PROPRETOR, a Roman magistrate, who, having discharged the office of pretor at home, was sent into a province to command there with his former pretorial authority. It was also an appellation given to those who, without having been pretors at Rome, were sent extraordinarily into the provinces to administer justice with the authority of pretors.

PROPRIETOR, or PROPRIETARY, is he who possesses any thing as his own in the utmost degree. Such monks were called *proprietary* as had reserved goods and effects to themselves, notwithstanding their formal renunciation of all at the time of their profession. They are frequently mentioned in the *Monast. Anglic.* &c. and were to be very severely dealt with; to be excommunicated, deprived of burial, &c. *Monachi proprietarii excommunicentur ab abbatibus: et, si in morte proprietarius inventus fuerit, ecclesiastica careat sepultura*, &c. Addit. ad Matt. Par.

PRO RATA, in commerce, a term sometimes used by merchants for *in proportion;* as, each person must reap the profit or sustain the loss, *pro rata* to his interest, that is, in proportion to his stock.

PROROGATION, the act of prolonging, adjourning, or putting off, to another time. The difference between a prorogation and an adjournment of parliament is, that by prorogation the session is ended, and such bills as passed in either house, or both houses, and had not the royal assent, must at the next assembly begin again.

PROSCRIPTION, a publication made in the name of the chief or leader of a party, whereby he promises a reward to any one who shall bring him the head of one of his enemies.

Sylla and Marius by turns proscribed each others adherents.—Under the triumvirate great part of the best and bravest of the Romans fell by proscription.

The term took its rise from the practice of writing down a list of the persons names, and posting it in public; from *pro* and *scribo*, "I write."

PROSE, the natural language of mankind, loose and unconfined by poetical measures, rhymes, &c. In which sense it stands opposed to verse.

There is, however, a species of prose which is measured, such as that in which epitaphs and other inscriptions are generally written; and indeed every man who has formed for himself a style writes in uniform periods regularly recurring. It has been much disputed whether a poem can be written in prose. We enter not into that dispute, as we have said enough on the subject elsewhere. See NOVEL.

The word *prose* comes from the Latin *prosa*, which some will have derived from the Hebrew *poras*, which signifies *expendit:* others deduce it from the Latin *prorsa*, of *prorsus*, "going forwards:" by way of opposition to *versa*, or "turning backwards," as is necessary in writing.

PROSECUTION, in the criminal law. The next step towards the punishment of offenders after COMMITMENT, is their prosecution, or the manner of their formal accusation. And this, in the English law, is either upon a previous finding of the fact by an inquest or grand jury; or without such previous finding.

The former way is either by PRESENTMENT or INDICTMENT. See these articles.

The remaining methods of prosecution are without any previous finding by a jury, to fix the authoritative stamp of verisimilitude upon the accusation. One of these, by the common law, was when a thief was taken *with the mainour*, that is, with the thing stolen upon him, *in manu*. For he might, when so detected, *flagrante delicto*, be brought into court, arraigned, and tried, without indictment: as by the Danish law he might be taken and hanged upon the spot without accusation or trial. But this proceeding was taken away by several statutes in the reign of Edward III. though in Scotland a similar process remains to this day. So that the only species of proceeding at the suit of the king, without a previous indictment or presentment by a grand jury, now seems to be that of INFORMATION; which see.

These are all the methods of prosecution at the suit of the king. There yet remains another, which is merely at the suit of the subject, and is called an APPEAL. See that article.

But of all the methods of prosecution, that by indictment is the most general. See INDICTMENT.

PROSECUTOR, in *Law*, he that pursues a cause in another's name.

PROSELYTE, a new convert to some religion or religious sect.

PROSERPINACA, a genus of plants belonging to the triandria class, and in the natural method ranking under the 15th order, *Inundatæ*. See BOTANY *Index*.

PROSERPINE, in fabulous history, the daughter of Jupiter and Ceres, was carried off by Pluto as she was gathering flowers with her companions. Ceres, disconsolate for the loss of her daughter, after having long sought her, heard where she was, and intreated Jupiter to let her return from hell. This request Jupiter granted, on condition she had tasted nothing in Pluto's dominions. Ceres therefore went to fetch her; but when her daughter was preparing to return, Ascalaphus gave information that he had seen Proserpine eat some grains of a pomegranate she had gathered in Pluto's garden; on which she was sentenced to continue in Tartarus in quality of Pluto's spouse, and the queen of those gloomy regions: but to mitigate the grief of Ceres for her disappointment, Jupiter granted that her daughter should only spend six months together in hell with her husband, and the other six on earth with her mother.

Some mythologists imagine that the latter part of the fable

fable alludes to the corn, which must remain all the winter hid in the earth, in order to sprout forth in the spring, and produce the harvest.

PROSEUCHE, in antiquity, properly signifies *prayer;* but it is taken for the places of prayer of the Jews, and was pretty near the same as their synagogues. But the synagogues were originally in the cities, and were covered places: whereas, for the most part, the proseuches were out of the cities, and on the banks of rivers; having no covering except perhaps the shade of some trees or covered galleries. The word is Greek, προσευχη, prayer.

PROSLAMBANOMENE, the name of a musical note in the Greek system.

As the two tetrachords of the Greeks were conjunctive, or, in other words, as the highest note of the first served likewise for the lowest note of the second, it is plain that a complete octave could not be formed. To remedy this deficiency, therefore, one note beneath the lowest tetrachord was added, as an octave to the highest of the last tetrachord. Thus, if we suppose the first to have begun on B, the last must have ended upon A, to which one note subjoined immediately beneath the lowest B in the diatonic order must have formed an octave. This note was called *proslambanomene.* But it appears from authors who have scrutinized antiquity with some diligence, and perhaps with as much success as the data upon which they proceeded could produce, that the names of the notes in the Greek system, which originally signified their natural station in the scale of ascending or descending sounds, were afterwards applied to their positions in the lyre. *Higher* or *lower*, then, according to this application, did not signify their degrees of acuteness or gravity, but their higher or lower situation upon this instrument.

Burney's History of Music, Dissert. i.

PROSODY, that part of grammar which treats of the quantities and accents of syllables, and the manner of making verses.

The English prosody turns chiefly on two things, numbers and rhyme. See POETRY, N° 66—76. and Part III.

PROSOPIS, in *Botany*, a genus of the monogynia order, belonging to the dodecandria class of plants. The calyx is hemispherical and quadridentate; the stigma is simple; the legumen inflated and monospermous. See BOTANY *Index*.

PROSOPOPOEIA, a figure in oratory, whereby we raise qualities of things inanimate into persons. See ORATORY.

PROSTATÆ, in *Anatomy*, a gland, generally supposed to be two separate bodies, though in reality but one, situated just before the neck of the bladder, and surrounding the beginning of the urethra. See ANATOMY *Index*.

PROSTYLE, in *Architecture*, a range of columns in the front of a temple.

PROTAGORAS, a famous Greek philosopher, was born at Abdera. In his youth, his poverty obliged him to submit to the servile office of frequently carrying logs of wood from the neighbouring fields to Abdera. It happened that as he was one day going on briskly towards the city under one of these loads, he was met by Democritus, who was particularly struck with the neatness and regularity of the bundle. Desiring him to stop and rest himself, Democritus examined more closely the structure of the load, and found that it was put together with mathematical exactness; upon which he asked the youth whether he himself had made it up. Protagoras assured him that he had; and immediately taking it to pieces, with great ease replaced every log in the same exact order as before. Democritus expressed much admiration of his ingenuity; and said to him, "Young man, follow me, and your talents shall be employed upon greater and better things." The youth consented, and Democritus took him home, maintained him at his own expence, and taught him philosophy, which qualified him for the office of legislator of the Thurians. He was more subtle than solid in his reasonings; however, he taught at Athens with great reputation, but was at length banished from thence for the impiety of his doctrines. He then travelled, and visited the islands in the Mediterranean, where it is said that he was the first philosopher who taught for money. He died in a voyage to Sicily, in a very advanced age. He commonly reasoned by dilemmas, and left the mind in suspense with respect to all the questions he proposed. His moral principles were adopted by Hobbes. (See MORAL PHILOSOPHY). Plato wrote a dialogue against him. He flourished 400 years B. C.

Enfield's History of Philosophy, vol. i.

PROTASIS, in the ancient drama, the first part of a comic or tragic piece, wherein the several persons are shown, their characters intimated, and the subject of the piece proposed and entered upon.

It might reach as far as our two first acts; and where it ended the epitasis commenced. See the article EPITASIS.

PROTEA, the SILVER-TREE, a genus of plants, belonging to the tetrandria class; and in the natural method ranking under the 47th order, *Stellatæ.* See BOTANY *Index*.

PROTECTOR, a person who undertakes to shelter and defend the weak, helpless and distressed.

Every Catholic nation, and every religious order, has a protector residing at the court of Rome, who is a cardinal, and is called the *cardinal protector.*

Protector is also sometimes used for a regent of a kingdom, made choice of to govern it during the minority of a prince.

Cromwell assumed the title and quality of *lord protector of the commonwealth of England.*

PROTESILAI TURRIS, the sepulchre of Protesilaus, with a temple, at which Alexander sacrificed, (Arian); situated at the south extremity of the Hellespont, near the Chersonesus Thracia. Protesilaus was the first Greek who landed on the coast of Troy, and the first Greek slain by the Trojans, (Homer, Ovid). His wife Laodamia, to assuage her grief, begged the gods for a sight of his shade; and obtaining her request, she expired in his embraces, (Hyginus). Protesilaus was also called *Phylacides*, from Phylace, a town of Thessaly.

PROTEST, in *Law*, is a call of witness, or an open affirmation that a person does, either not at all, or but conditionally, yield his consent to any act, or to the proceeding of any judge in a court in which his jurisdiction is doubtful, or to answer upon his oath farther than he is bound by law.

Any of the lords in parliament have a right to protest their dissent to any bill passed by a majority: which protest is entered in form. This is said to be a very ancient privilege. The commons have no right to protest. See PARLIAMENT.

PROTEST, in *Commerce*, a summons written by a notary-public to a merchant, banker, or the like to accept or discharge a bill of exchange drawn on him, after his having refused either to accept or pay it. See *BILL of Exchange*.

PROTESTANT, a name first given in Germany to those who adhered to the doctrine of Luther; because in 1529 they protested against a decree of the emperor Charles V. and the diet of Spires; declaring that they appealed to a general council. The same name has also been given to those of the sentiments of Calvin; and is now become a common denomination for all those of the reformed churches.

PROTEUS, in *Heathen Mythology*. See EGYPT, N° 6.

PROTHONOTARY, a term which properly signifies *first notary*, and which was anciently the title of the principal notaries of the emperors of Constantinople.

Prothonotary, with us, is used for an officer in the court of king's bench and common pleas; the former of which courts has one, and the latter three. The prothonotary of the king's bench records all civil actions sued in that court, as the clerk of the crown-office does all criminal causes. The prothonotaries of the common pleas enter and enrol all declarations, pleadings, assizes, judgments, and actions: they also make out all judicial writs, except writs of *habeas corpus*, and *distringas jurator*, for which there is a particular office, called the *habeas corpora office*; they likewise enter recognizances acknowledged, and all common recoveries; make exemplifications of records, &c.

In the court of Rome there is a college of 12 prelates, called *apostolical prothonotaries*, empowered to receive the last wills of cardinals, to make all informations and proceedings necessary for the canonization of saints; and all such acts as are of great consequence to the Papacy: for which purpose they have the right of admission into all consistories, whether public or half public. They also attend on the pope whenever he performs any extraordinary ceremony out of Rome.

PROTO, a Greek term, frequently used in composition of priority: thus proto-collum, in the ancient jurisprudence, signifies the first leaf of a book; protomartyr, the first martyr; proto-plast, the first man formed, &c.

PROTOGENES, a celebrated ancient painter, was born at Caunas, a city of Caria, subject to the Rhodians, and flourished 300 years before the birth of our Saviour. He was first obliged to paint ships for his livelihood; but afterwards acquired the highest reputation for history-painting; though Apelles blamed him for finishing his pieces too highly, and not knowing when to have done. The finest of his pictures was that of Jalisus, which is mentioned by several ancient authors, though none of them give any description of it. He worked seven years on this picture; during which time he lived entirely upon lupines and water, being of opinion that this light and simple nourishment left him greater freedom of fancy. Apelles, on seeing this picture, was struck with such admiration, that he was unable to speak, or to find words sufficient to express his idea of its beauty. It was this picture that saved the city of Rhodes when besieged by Demetrius king of Macedon; for being able to attack it only on that side where Protogenes worked, which he intended to burn, he chose rather to abandon his design than to destroy so fine a piece. Pliny says, that Apelles asking him what price he had for his pictures, and Protogenes naming an inconsiderable sum, Apelles concerned at the injustice done to the beauty of his productions, gave him 50 talents, about 10,000l. for one picture only, declaring publicly, that he would sell it for his own. This generosity made the Rhodians sensible of the merit of Protogenes; and they were so eager to purchase the picture Apelles had bought, that they paid him a much greater price for it than he had given.

PROTOTYPE, is the original or model after which a thing was formed; but chiefly used for the patterns of things to be engraved, cast, &c.

PROTRACTOR, an instrument for laying down and measuring angles upon paper with accuracy and dispatch; and by which the use of the line of chords is superseded. This instrument is variously formed, as semicircular, rectangular, or circular; and constructed of different materials, as brass, ivory, &c. It is necessary in laying down those surveys or other plans where angles are concerned.

The rectangular protractor is constructed in form of a right-angled parallelogram, which, when applied to a case of mathematical instruments, is substituted in place of the semicircular protractor and scale of equal parts. Fig. 1. is a representation of it: the manner of using it is exactly similar to that of the semicircular one. Plate cccclviii. fig. 1.

The circular protractor, as its name implies, is a complete circle, and is superior by far to either of the former, both in point of accuracy and dispatch, especially when several angles are to be formed at the same point. The limb of this instrument is divided into 360 degrees, and each degree in some protractors is halved: it has a subdividing scale or vernier, by which an angle may be laid down or measured to a single minute. In the centre of the protractor is a fine mark, which, when an angle is to be protracted or measured, is to be laid upon the angular point, and o, or zero on the limb, upon the given line forming one side of the angle.

Fig. 2. represents a circular protractor whose limb is divided as above described, and the dividing scale on the index, which moves round the limb of the protractor on a conical centre, gives every minute of a degree. That part of the index beyond the limb has a steel point fixed at the end, in a direct line with the centre of the protractor, and whose use is to prick off the proposed angles. Fig. 2.

Fig. 3. is another circular protractor, a little differently constructed from the former. The central point is formed by the intersection of two lines crossing each other at right angles, which are cut on a piece of glass. The limb is divided into degrees and half degrees, having an index with a vernier graduated to count to a single minute, and is furnished with a tooth and pinion, by means of which the index is moved round by turning a small nut. It has two pointers, one at each end of the index, furnished with springs for keeping them suspended while they are bringing to any angle; and Fig. 3.

being

PROTRACTOR. PLATE CCCCXLVIII.

Fig. 1.

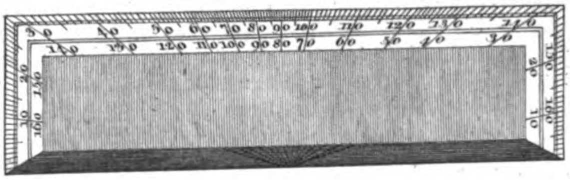


Fig. 2.

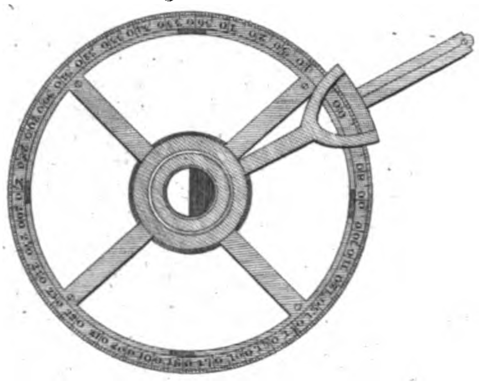


Fig. 3.

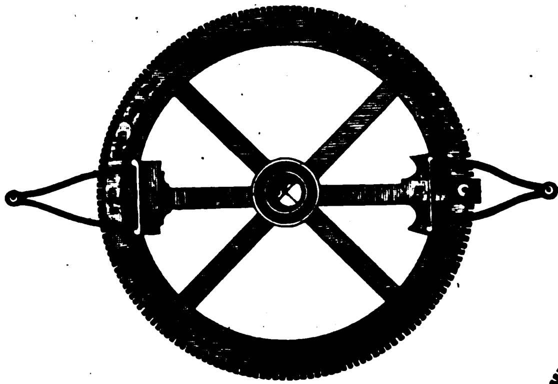
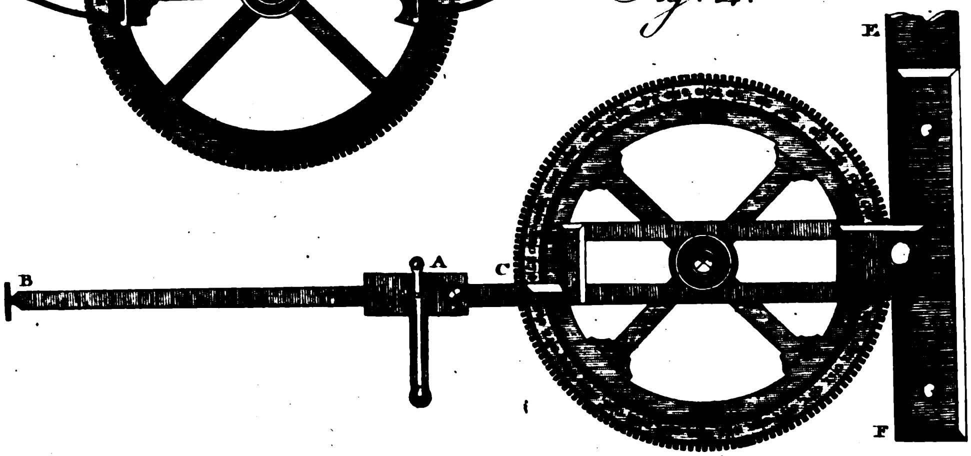


Fig. 4.



REDUCTION.

Fig. 1.

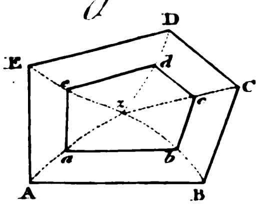


Fig. 2.

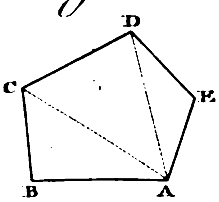


Fig. 3.

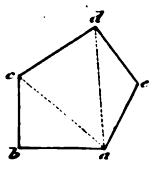
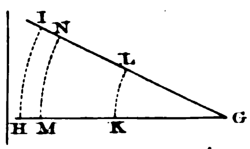


Fig. 4.



W. Archibald Sculp.

Protractor ‖ Proverb. being brought, applying a finger to the top of the pointer, and pressing it down, pricks off the angle. There is this advantage in having two pointers, that all the bearings round a circuit may be laid or pricked off, although the index traverses but one-half of the protractor.

Another circular protractor, different from either of the former, is represented at fig. 4. The centre is also formed by the intersection of two lines at right angles to each other, which are cut on glass, that all parallax may thereby be avoided. The index is moved round by a tooth and pinion. The limb is divided into degress and half degrees, and subdivided to every minute by the vernier. The pointer may be set at any convenient distance from the centre, as the socket which carries it moves upon the bar BC, and is fixed thereto by the nut D, at right angles to the bar BC, and moveable with it. There is another bar EF: On this bar different scales of equal parts are placed; so that by moving a square against the inner edge thereof, angles may be transferred to any distance within the limits, from the centre containing the same number of degrees marked out by the index.

Fig. 4.

It would indeed be superfluous to describe any more of these circular protractors, especially as the little alterations in them depend very much upon the fancy of the artist. Suffice it however to say, that we have seen others still differently constructed, one of which we shall briefly describe. The divisions upon the limb of this instrument are similar to those already described; but the index is a straight bar continued to some considerable distance each way beyond the limb of the instrument, and has a vernier to show minutes as usual; a mark upon one of the edges of the index, always coincides with the centre of the instrument. Instead, therefore, of pricking down the angle as in the former, part of the line containing the angle may be drawn, which, although perhaps not so accurate as a point, is more conspicuous, and the line is easily completed upon removal of the protractor. The common dimensions of the circular part of these instruments is from six to ten inches diameter; and they are made of brass.

PROTUBERANCE, in *Anatomy*, is any eminence, whether natural or preternatural, that projects or advances out beyond the rest.

PROVEDITOR, an officer in several parts of Italy, particularly at Venice, who has the direction of matters relating to policy.

PROVENCE, a province or government of France, bounded by Dauphiné on the north, by Piedmont on the east, by the Mediterranean on the south, and by the river Rhone, which separates it from Languedoc, on the west: it is about 100 miles long, and near as many broad.

PROVEND, or PROVENDER, originally signified a kind of vessel containing the measure of corn daily given to a horse, or other beast of labour, for his subsistence; but is now generally used to signify the food for cattle; whatever it is.

PROVERB, according to Camden, is a concise, witty, and wise speech, grounded upon experience, and for the most part containing some useful instruction.

Book of PROVERBS, a canonical book of the Old Testament, containing a part of the proverbs of Solomon the son of David king of Israel. The first 24 chapters are acknowledged to be the genuine work of that prince; the next five chapters are a collection of several of his proverbs made by order of King Hezekiah; and the two last seem to have been added, though belonging to different and unknown authors, Agur the son of Jakeh, and King Lemuel.

Proverb, Providence.

In this excellent book are contained rules for the conduct of all conditions of life; for kings, courtiers, masters, servants, fathers, mothers, children, &c.

PROVIDENCE, the superintendence and care which God exercises over creation. 1 Definition.

That there exists a divine providence which attends to the affairs of this world, and directs their course, has been a received opinion among the human race in every country and in every period of history. Every altar that is erected, every prayer and every sacrifice that is offered up, affords a proof of this belief. So fully have men been convinced of the sincerity of each other's faith upon this subject, that in one form, that of an appeal to the Divine Ruler of the world, by the solemnity of an oath, they have introduced it both into the most ordinary and the most important business of life. 2 Belief of a providence universal.

This universal conviction of men of all degrees of knowledge, from the most profound philosopher to the rudest barbarian, is probably to be traced to some primæval tradition, never totally effaced from any nation under heaven. The truth itself, however, is susceptible of the most complete proof from principles of science. If the world had a beginning, it may obviously have an end, and can be continued in existence only by the constant energy of that power by which it was at first created. He therefore who acknowledges a creation and denies a providence, involves himself in this palpable contradiction—"that a system, which of itself had not an original and momentary existence, may yet of itself have a perpetual existence; or that a being which cannot of itself exist for a second of time, may yet, of itself, exist for thousands of years!" Or should we be so complaisant, as for a moment to suppose, with certain theists, ancient and modern, that the *matter* of the universe is self-existent and eternal, and that the power of God was exerted, not in creating substances, but in reducing the original matter from a state of chaos into that beautiful order in which we see it arranged; the constant energy of providence must still be admitted as necessary to preserve the forms and to continue the motions which were originally impressed upon the chaotic mass. From late experiments it appears extremely doubtful whether any two atoms of the most solid body be in actual contact; and that they are not *all* in contact is certain. (See METAPHYSICS, N° 176. and OPTICS, N° 45, p. 185.). Yet it requires a very considerable degree of force to carry to a greater distance from one another the parts of a stone or of a bar of iron. By what power then are those parts kept contiguous? It cannot be by their own; because nothing can act where it is not present, and because our best philosophy has long taught us that the atoms of matter are essentially inactive. Again, it requires a very great degree of force to bring two bodies, however small, into *apparent* contact (see OPTICS, *ubi supra*); and therefore it follows that they must be kept asunder by some foreign power. Every attempt to solve these phenomena by the intervention 3 Existence of providence may be proved on scientific principles.

Providence. vention of a subtle fluid is vain; for the question recurs, what keeps the parts of the fluid itself contiguous, and yet separated from each other?

The cohesion therefore of the parts of matter, and that which is called their repulsive power, demonstrate, through the whole system, the immediate energy of something which is not matter, and by which every body small and great is preserved in its proper form. It has been elsewhere shown (see METAPHYSICS, Part II. chap. 5. and MOTION, N° 19, 20.), that the various motions which are regularly carried on through the universe, by which animals and vegetables grow and decay, and by which we have day and night, summer and winter, cannot be accounted for by any laws of mere mechanism, but necessarily imply the constant agency of something which is itself distinct from matter. But the forms of bodies are preserved, and their natural motions carried on, for purposes obviously planned by Wisdom. The power therefore which effects these things must be combined with intelligence: but power and intelligence preserving the order of the universe constitute all that is meant by a general providence; which is therefore as certainly administered as the sun daily rises and sets, or as bodies are kept solid by what is termed cohesion and repulsion.

4
Reasoning of the Bramins of Hindostan.

Abstracted and metaphysical as this reasoning may appear, it is by no means peculiar to the philosophers of Europe. Its force has been felt from time immemorial by the Bramins of Hindostan, who, as Sir William Jones informs us *, "being unable to form a distinct idea of brute matter independent of mind, or to conceive that the work of supreme goodness was left a moment to itself, imagine that the Deity is ever present to his work, not in substance, but in spirit and in energy." On this rational and sublime conception they have indeed built numberless absurd superstitions; but their holding the opinion itself, shows that they believe in the reality of providence upon philosophical principles: and what truth is there on which the mind of man has not ingrafted marks of its own weakness?

* *Asiatic Researches*, vol. i.

Few nations, however, except the ancient Greeks, have had philosophers equally subtile with the Bramins of India; and therefore though all mankind have in general agreed in the belief of a superintending Providence, they have in different ages and countries admitted that truth upon different kinds of evidence, and formed very different notions concerning the mode in which the Divine superintendence is exerted.

5
Idea of providence in rude ages.

While societies are still in a rude and unpolished state, while individuals possess little security and little leisure for the exertion of their rational powers, every important or singular appearance in nature becomes an object of wonder or of terror. In this state of ignorance, men see not the universe as it is, a great collection of connected parts, all contributing to form one grand and beautiful system. Every appearance seems to stand alone; they know that it must have a cause, but what that cause is they are ignorant. The phenomena exhibited by nature are so complicated and so various, that it never occurs to them that it is possible for one Being to govern the whole. Hence arose the different systems of polytheism that have appeared in the world. Nature was divided into different regions, and a particular invisible power was assigned to each department: one conducted the flaming chariot of the sun, another wielded the terrible thunderbolt, and others were employed in diffusing plenty, and introducing the useful arts among men. Thus, although the various systems of polytheism in general acknowledged one Supreme Ruler, the father of gods and men, yet they at the same time peopled not only the regions above, the air and the heavens, but they also filled the ocean and the land, every grove, and every mountain, with active but invisible natures. Having arisen from the same causes, these systems of polytheism, which are so many hypotheses concerning Divine providence, are all extremely similar; and we have a very favourable specimen of them in the elegant mythology of Greece and Rome, which gave to every region of nature a guardian genius, and taught men in the deep recesses of the forest, or in the windings of the majestic flood, to expect the presence of protecting and friendly powers. See POLYTHEISM.

6
The doctrine has had opponents in almost every age.

Notwithstanding this universal reception, in some form or other, of the doctrine of a divine providence, it has in every age met with some opponents. The most ancient of these were Democritus and Leucippus. They denied the existence of a Deity—asserted that all things were mechanically necessary, and that thought and sense were only modifications of matter. This is atheism in the strictest sense, and the only form of it that has ever been consistently supported. Epicurus followed upon the same principles; but he rendered the system altogether absurd, by confessing the freedom of the human will. To avoid the imputation of atheism, he asserted the existence of God; but declared that he resided above the heavens, and interfered not in human affairs. One of his maxims was, that "the blessed and immortal Being neither hath any employment himself, nor troubles himself with others." Maximus Tyrius * justly observes, that this is rather a description of a Sardanapalus than of a Deity. And some of the moralists † of antiquity remarked, that they knew many men among themselves possessed of active and generous minds, whose characters they valued more highly than that of Epicurus's god. Some of the ancients also appear to have entertained the following strange notion: They acknowledged the existence of a Supreme and of many inferior deities; but at the same time, they supposed that there is a certain fate which rules over all, and is superior to the gods themselves. See NECESSITY in Mythology.

* *Max. Tyr. Diss. art.* 19.

† *Cicero de finibus* lib. i. and *De Natura Deorum*, lib. ii.

The providence exerted by the Author of nature over his works is usually divided into two branches: a *general*, referring to the management of the universe at large; and a *particular* providence, chiefly regarding particular men.

7
General providence.

Upon the first of these, in *The Religion of Nature delineated*, the question is stated somewhat in the following manner: The world may be said to be governed, or at least cannot be said to fluctuate fortuitously, if there are laws or rules by which natural causes act; if the several phenomena in it succeed regularly, and in general the constitution of things is preserved; if there are rules observed in the production of herbs, trees, and the like; if the several kinds of animals are furnished with faculties proper to determine their actions in the different stations which they hold in the general economy of the world; and lastly, if rational beings are taken care of in such a manner as will at last agree best with reason. By the providence of God we ought to understand

 understand his governing the world by *such* laws as these now mentioned: so that if there are such, there must be a Divine providence.

8 as it respects inanimate objects With regard to *inanimate objects*, the case agrees precisely with the above supposition. The whole of that universe which we see around us is one magnificent and well regulated machine. The world that we inhabit is a large globe, which, conducted by an invisible power, flies with a rapidity of which we have no conception, through an extent of space which sets at defiance every power of fancy to embody it into any distinct image. A large flaming orb stands immoveable in the heavens; around which this, and other worlds of different magnitudes, perform their perpetual revolutions. Hence arise the expected returns of day and night, and the regular diversity of seasons. Upon these great operations a thousand other circumstances depend. Hence, for example, the vapours ascend from the ocean, meet above in clouds, and after being condensed, descend in showers to cover the earth with fertility and beauty. And these appearances are permanent and regular. During every age since men have been placed upon the earth, this astonishing machine continued steadily to perform its complicated operations. Nothing is left to chance. The smallest bodies are not less regular than the largest, and observe continually the same rules of attraction, repulsion, &c. The apparent variations of nature proceed only from different circumstances and combinations of things, acting all the while under their ancient laws. We ourselves can calculate the effects of the laws of gravitation and of motion. We can render them subservient to our own purposes, with entire certainty of success if we only adhere to the rules established by nature, that is to say, by providence.

9 vegetables, *Vegetables* also live and flourish according to prescribed methods. Each sort is produced from its proper seed; has the same texture of fibres, is at all times nourished by the *same* kind of juices, digested and prepared by the *same* vessels. Trees and shrubs receive annually their peculiar liveries, and bear their proper fruits: so regular are they in this last respect, that every species may be said to have its profession or trade appointed to it, by which it furnishes a certain portion of manufacture, or of food, to supply the wants of animals: being created for the purpose of consumption, all vegetables produce great quantities of seed to supply the necessary waste. Here too, then, there is evidently a *regulation* by which the several orders are preserved, and the ends of them answered according to their first establishment.

10 animals, With regard to *animals*, they too, in structure of their form, are subject to laws similar to those which govern the vegetable world. In the sentient part of their constitution they are no less subject to rule. The lion is always fierce, the fox is crafty, and the hare is timid. Every species retains from age to age its appointed place and character in the great family of nature. The various tribes are made and placed in such a manner as to find proper means of support and defence. Beasts, birds, fishes, and insects, are all possessed of organs and faculties adapted to their respective circumstances, and opportunities of finding their proper food and prey.

11 and man. *Man* is subject to the ordinary laws which other material and animal substances obey; but he is left more at large in the determination of his actions. Yet even here things do not fluctuate at random. Individuals do indeed rise and perish according to fixed rules, and nations themselves have only a temporary endurance. But the species advances with a steady progress to intellectual improvement. This progress is often interrupted; but it appears not to be less sure at the long-run than even the mechanical laws which govern the material part of our constitution. Amidst the convulsion of states and the ruin of empires, the useful arts, when once invented, are never lost. These, in better times, render subsistence easy, and give leisure for reflection and study to a greater number of individuals. Tyre and Sidon have passed away, Athens itself has become the prey of barbarians, and the prosperity of ancient Egypt is departed, perhaps for ever; but the ship, the plough, and the loom, remain, and have been perpetually improving. Thus every new convulsion of society does less mischief than the last; and it is hoped that by the assistance of printing the most polished arts and the most refined speculations have now become immortal.

The world is not then left in a state of confusion: it is reduced into order, and methodised for ages to come; the several species of beings having their offices and provinces assigned them. Plants, animals, men, and nations, are in a state of continual change; but successors are appointed to relieve them, and to carry on the *scheme of Providence*.

12 Difficulty of accounting for particular providence. But the great difficulty is, how to account for that providence which is called *particular*: For rational beings, and free agents, are capable of doing and deserving well or ill; and the safety or danger, that happiness or unhappiness of a man here, must depend upon many things that seem scarcely *capable* of being determined by Providence. Besides *himself* and his own conduct, he depends upon the conduct of *other men*; whose actions, as we naturally suppose, cannot, consistently with their free will, be controuled for the advantage of another individual. The actions of numbers of men proceeding upon their private freedom, with different degrees of ability, as they cross and impede, or directly oppose each other, must produce very different effects upon men of different characters, and thus in a strange manner embarrass and entangle the general plan. And as to the *course of nature*, it may justly be asked, is the force of gravitation to be suspended till a good man pass by an infirm building? (See PRAYER). Add to this, that some circumstances appear absolutely irreconcileable. The wind which carries one into port drives another back to sea: and the rains that are just sufficient upon the hills may drown the inhabitants of the valleys. In short, may we expect *miracles*? or can there be a particular Providence that foresees and prepares for the several cases of individuals, without force frequently committed upon the laws of nature and the freedom of intelligent agents?

13 No good argument against its existence. In whatever way it is brought about, there is little doubt that something of this kind *must* take place. For as the Deity *does* direct, as already mentioned, the great and general progress of things in this world, he must also manage those of less importance. Nations are composed of individuals. The progress of individuals is the progress of the nation, and the greatest events usually depend upon the history and the most trifling actions

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actions of private persons. The difficulty is to conceive how the superintendence and management of all this can be brought about. But as the ways and the thoughts of the Omnipotent Spirit whose influence pervades, and rules, and animates nature, resemble not the limited operations of men, we can only form conjectures concerning the means by which his government is conducted.

14
The Deity may easily foresee the actions of men;

1. In the first place, then, it is not impossible that the Deity should foresee the future actions of intelligent beings. Many of these actions depend upon the mechanism of the material world, which was formed by himself, and must be entirely known to him. Many men among ourselves possess much sagacity in discerning the future actions of others, from attending to their known characters, and the circumstances in which they are placed. If superior natures do exist, and minds more perfect than the human, they must possess this penetration in a more eminent degree in proportion to the excellence of their intellectual powers. But if this discernment be in God proportionable to his nature, as in lower beings it is proportionable to theirs, it then becomes altogether unlimited, and the future actions of free agents are at once unlocked and exposed to his view. Add to this, that the Author of nature is well acquainted with the creatures that he has made; he knows the mechanism of our bodies, the nature and extent of our understandings, and all the circumstances by which we are surrounded. With all these advantages, it is making no great stretch to suppose him capable of discerning the line of conduct which we will pursue; and this even setting aside the infinity of his nature, to which a thousand years are as one day, and supposing him to reason from probabilities in the imperfect manner that we do.

15
and may thence fit them for their situations in life.

2. There is no impossibility at least, that men, whose characters and actions are thus foreknown, may be introduced into the world in such times and places as that their acts and behaviour may not only coincide with the general plan of things, but may also answer many private cases. The celestial bodies are so placed that their jarring attractions make out a splendid system. Why then may there not be in the Divine mind something like a projection of the future history of mankind, as well as of the motions of the heavenly bodies? And why should it not be thought possible for men, as well as for them, by some secret law, or rather by the management of an unseen power, to be brought into their places in such a manner as that, by the free use of their faculties, the conjunctions and oppositions of their interests and inclinations, the natural influence of their different degrees of talents, power, and wealth, they may conspire to make out the great scheme of human affairs? There is no absurdity in this supposition: it is not beyond the power of an almighty and perfect Being; and it is worthy of him. Let us take from the Jewish history, as most generally known, an example of what may be supposed to happen daily. It was the intention of providence to place David the son of Jesse upon the throne of the Hebrews. The country is invaded by a foreign enemy: the hostile armies meet, and lie encamped upon opposite mountains. A man comes forth from the army of the invaders, as was extremely common in those times, and defies the Hebrew host to send forth a champion to meet him in single combat.

16
The possibility of this exemplified.

Terrified by the gigantic bulk and mighty force of Goliah, no man would risk the unequal conflict. David, who was too young to carry arms, had been sent to the camp with provisions for his brothers, and heard the challenge. In defence of his flock he had killed some beasts of prey in the wilderness, and he was an excellent marksman with the sling. He thought it might probably be as easy to kill a man as a wild beast; at all events, he knew that a stone well directed would prove no less fatal to a giant than to a dwarf: he therefore resolved to try his skill; and he tried it with success. Here no man's free will was interrupted, and no miracle was accomplished: Yet by this *train* of circumstances thus *brought* together, a foundation was laid for the future fortunes of the son of Jesse, for the greatness of his country, and for accomplishing the purposes of Providence. According to Seneca, "Hoc dico, fulmina non mitti à Jove, sed sic omnia disposita, ut ea etiam quæ ab illo non fiunt, tamen sine ratione non fiunt; quæ illius est.—Nam etsi Jupiter illa nunc non facit, fecit ut fierent."—*I say, that the lightning comes not directly from the hand of Jove, but things are properly disposed for the indirect execution of his will; for he acts not immediately, but by the intervention of means.*

17
Secret influences on the mind are far from impossible.

3. Lastly, it is *not impossible* that many things may be accomplished by secret influence upon the human mind, either by the Deity himself, or by the intervention of agents possessed of powers superior to those which belong to us. "For instance, if the case should require that a particular man be delivered from some threatening *ruin*, or from some *misfortune*, which would certainly befal him if he should go such a way at such a time, as he intended: upon this occasion some *new* reasons may be presented to his mind why he should not go *at all*, or not *then*, or not *by that road*; or he may forget to go. Or, if he is to be delivered from some dangerous *enemy*, either some new turn given to his thoughts may divert him from going where the *enemy* will be, or the enemy may be after the same manner diverted from coming where *he* shall be, or his resentment may be *qualified*; or some proper method of *defence* may be suggested to the person in danger. After the same manner advantages and successes may be conferred on the deserving; as, on the other side, men, by way of punishment for their crimes, may incur mischiefs and calamities. These things, and such as these (says Mr Wollaston*), *may be*. For since the motions and actions of men, which depend upon their wills, do also depend upon their judgments, as these again do upon the *present appearances* of things in their minds; if a new prospect of things can be any way produced, the lights by which they are seen *altered*, new forces and directions impressed upon the spirits, passions *exalted* or *abated*, the power of judging *enlivened* or *debilitated*, or the attention taken off without any suspension or alteration of the standing laws of nature,—then, without that, *new* volitions, designs, measures, or a cessation of thinking, may also be produced; and thus many things prevented that otherwise would *be*, and many brought about that would *not*. That there may possibly be such inspirations of new thoughts and counsels (continues our author), may perhaps appear farther from this, that we frequently find thoughts arising in our heads, into which we are led by no discourse, nothing we read, no clue of reasoning, but they surprise and come upon us from we know not

* *Religion of Nature delineated*, sect. 5.

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not what quarter. If they proceeded from the mobility of spirits straggling out of order, and fortuitous affections of the brain, or were they of the nature of *dreams*, why are they not as wild, incoherent, and extravagant as they are?" Is it not much more reasonable to imagine that they come by the order and direction of an all-seeing and all-gracious God, who continually watches over us, and disposes every thing in and about us for the good of ourselves or others? not to speak of the agreeableness of this notion to the opinions of the best and wisest men in all ages (A). "If this, then, be the case, as it seems to be, that men's minds are susceptible of such *insinuations* and *impressions*, as frequently, by ways unknown, do affect them, and give them an inclination towards this or that; how many things (asks our author) may be brought to pass by these means without *fixing* and *refixing* the laws of nature, any more than they are unfixed when one man alters the opinion of another by throwing in his way a book proper for that purpose?"

18 And may be effected by beings superior to us, or by the Deity.

All this may be effected either by the immediate interposition of God himself, or by that of beings *invisible*, and in nature superior to us, who act as the ministers of his providence. That there are such beings we can hardly doubt, as it is in the highest degree improbable that such imperfect beings as men are at the top of the scale of created existence. And since we ourselves, by the use of our limited powers, do often alter the course of things within our sphere from what they would be if left to the ordinary laws of motion and gravitation, without being said to alter those laws; why may not superior beings do the same as instruments of divine providence? This idea of the intervention of superior natures is beautifully illustrated by Thomson in the following passage:

These are the haunts of meditation, these
The scenes where ancient bards th' inspiring breath,
Ecstatic, felt; and from this world retir'd,
Convers'd with angels and immortal forms,
On gracious errands bent: to save the fall
Of virtue struggling on the brink of vice;
In waking whispers, and repeated dreams,
To hint pure thought, and warn the favour'd soul
For future trials fated to prepare.

We agree, however, with Mr Wollaston, in thinking the power of these beings not so large as to alter or suspend the general laws of nature (see MIRACLE); for the world is not like a bungling piece of clock-work, which requires to be often set backwards or forwards. We are likewise perfectly satisfied, that they cannot change their condition, to ape us or inferior beings; and consequently we are not apt hastily to credit stories of *portents*, &c. such as cannot be true, unless the nature of things and their manner of existence were occasionally reversed. Yet as men may be so placed as to become, even by the free exercise of their own powers, *instruments* of God's particular providence to other men; so may we well suppose that these higher beings may be so *distributed* through the universe, and subject to such an economy, unknown to us, as may render *them also* instruments of the same providence; and that they may, in proportion to their greater abilities, be capable, *consistently with the laws of nature*, of influencing human affairs in proper places.

19 Objections to the doctrine of Providence

We shall next proceed to state some of the chief objections which in ancient or modern times have been brought against the opinion, that the world is governed by a Divine providence.

20 from the imperfections of nature,

1. The first of these is this, that the system of nature contains many imperfections which it ought not to do if it be the work of a perfectly wise and good Being. To avoid the force of this objection, some modern writers have deserted the ground of supreme and absolute goodness, which the ancient theists always occupied, and have asserted that the divine perfection consists in unlimited power and uncontrouled supremacy of will; that consequently the Deity does not always that which is best, but merely what he himself pleases; and that for no other reason but because he *wills* to do so. But this is no better than atheism itself. For it is of no importance to us whether the universe is governed by blind fate or chance, that is to say, by nothing at all; or whether it is governed by an arbitrary sovereign will that is directed by chance, or at least by no principle of beneficence.

21 answered.

The true answer to this objection is, that no created system can have every perfection, because it must necessarily be destitute of self-existence and independence; and therefore if being destitute of some perfections be better than nothing, it was worthy of infinite power and perfect goodness to create such beings. In our present state, we mortals stand upon too low ground to take a commanding view of the whole frame of things. We can only reason concerning what is unknown from the little that is within our reach. In that little, we can see that wisdom and goodness reign; that nature always aims to produce perfection; that many salutary effects result even from the thunder and the storm: and we doubt not that a view of the whole structure of the universe would afford an additional triumph to the goodness and skill of its great Architect.

We see a regular ascent in the scale of beings from mere lifeless matter up to man; and the probability is, that the scale continues to ascend as far above man in perfection as created beings can possibly be raised.—The sole purpose of God in creating the world must have been to produce happiness: but this would be most effectually done by creating, in the first place, as many of the most perfect class of beings as the system could contain; and afterwards other classes less and less perfect, till the whole universe should be completely full. We do not positively assert such a scheme of creation,

Where

(A) That such was the general belief of the Greeks in the days of Homer, is plain from that poet's constantly introducing his deities into the narrative of his poems, and telling us that Minerva, or some other god, altered the minds of his heroes. "By this," says Plutarch, "the poet does not mean to make God *destroy* the will of man, but only move him to will: nor does he miraculously produce the appetites themselves in men, but only causes such imaginations as are capable of exciting them."

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Where all must fall, or not coherent be;
And all that rises, rise in due degree,

was actually in the divine Architect's intention; but that it is possible, is sufficiently obvious. No man will pretend to say, that this earth could afford a comfortable subsistence to a greater number of the human race, were all the inferior animals annihilated, than it could at present, swarming as every element is with life.—Suppose then, that as many men had been placed at first upon the earth as it could possibly support, and that matters had been so constituted, as that the number should never have been either increased or diminished; we beg leave to ask, whether, since there would have been evidently room for inferior animals, it would have been most worthy of infinite goodness to leave the whole globe to men, or to introduce into it different orders of less perfect beings, which, while they could not incommode this principal inhabitant, would each find pleasure in its own existence? To this question different answers cannot surely be given. Let the reader then extend his view, and consider the universe, which, however vast, cannot be positively infinite, as one system as much united as the several parts of this globe; let him suppose that there were at first created as many of the highest order of beings as it could have contained had creation there stopt; let him remember that happiness in many different degrees is valuable;—and he will not surely think it any imputation on the goodness of God that there are in the universe many beings far from perfection. The most imperfect of these are by themselves better than nothing; and they all contribute to make up a system which, considered as a whole, we have every reason to believe to be as perfect as any thing not self-existent can possibly be.

22 Objection from the introduction of evil.

2. If the world is conducted by a benevolent providence, how came evil to be introduced into it? This question has perplexed mankind in all ages. The ancient Persians resolved it, by asserting the existence of two gods, Oromasdes the author of good, and Arimanius the author of evil. From them the Christian heretics called *Manichees* borrowed their doctrine of two opposite co-eternal principles. Both the Platonists and Stoics ascribed the origin of evil to the perverseness or imperfection of matter, which they thought the Deity could not alter: and Pythagoras imagined a state of pre-existence, in which the souls of men had committed offences, for which they are here suffering the punishment. But these hypotheses are, some of them impious, and all unsatisfactory.

23 answered.

Taking the expression in its most extensive sense, the evils to which the human race are exposed may be reduced to *pain*, *uneasiness*, *disappointment of appetites*, and *death;* of which not one could have been wholly prevented without occasioning greater evils, inconsistent with the perfect goodness of the Creator. As long as we have solid bodies capable of motion, supported by food, subject to the influence of the atmosphere, and divisible, they must necessarily be liable to dissolution or death: But if a man could suffer death, or have his limbs broken, without feeling pain, the human race had been long ago extinct. A fever is a state of the body in which the fluids are in great disorder. Felt we no uneasiness from that disorder, we should have no inducement to pay the proper attention to our state, and should certainly die unawares, without suspecting ourselves to be in danger; whereas, under the present administration of divine providence, the pain and sickness of the disease compel us to have recourse to the remedies proper for restoring us to soundness and to health. Of the uneasinesses to which we are liable, and which are not the effect of immediate pain, the greatest has been sometimes said to arise from the apprehension of death, which constantly stares us in the face, and frequently embitters all our pleasures even in the hour of perfect health.—But this dread of death is implanted in our breasts for the very best of purposes. Had we no horror at the apprehension of death, we should be apt, whenever any misfortune befel us, to quit this world rashly, and rush unprepared into the presence of our Judge: but the horror which attends our reflections on our own dissolution, arising not from any apprehensions of the pain of dying, but from our anxiety concerning our future state of existence, tends strongly to make us act, while we are here, in such a manner as to ensure our happiness hereafter. Add to this, that the fear of death is the greatest support of human laws. We every day see persons breaking through all the regulations of society and good life, notwithstanding they know death to be the certain consequence, and feel all the horrors of it that are natural to man: and therefore were death divested of these horrors, how insignificant would capital punishments be as guardians of the law, and how insecure would individuals be in civil society?

With regard to the unavoidable misfortunes and anxieties of our present state, so far from being truly hurtful in themselves, they are proofs of divine beneficence. When we see men displeased with their situation, when we hear them complain of the difficulties, the miseries, and the cares of life, of the hardships which they have undergone, and the labours which still lie before them: instead of accounting them unfortunate, we ought to regard them as active beings, placed in the only situation that is fit for the improvement of their nature. That discontent, these restless wishes to improve their condition, are so many sure indications that their faculties will not languish. They who are in the least degree accustomed to observe the human character, know well the influence which pleasure and repose have in enfeebling every manly principle, and how capable they are of attaching us even to a sordid and dishonourable existence.

Happy indeed it is for the human race, that the number of those men is small whom providence has placed in situations in which personal activity is unnecessary. By far the greater number are compelled to exert themselves, to mix and to contend with their equals, in the race of fortune and of honour. It is thus that our powers are called forth, and that our nature reaches its highest perfection. It is even perhaps a general truth, that they who have struggled with the greatest variety of hardships, as they always acquire the highest energy of character, so if they have retained their integrity, and have not sunk entirely in the contest, seldom fail to spend their remaining days respectable and happy, superior to passion, and secured from folly by the possession of a wisdom dearly earned.

24 Physical evil the cause of moral good.

But the benefits of physical evils have been set in a still stronger light by a great master of moral wisdom, who was himself subject to many of those evils. That

Providence. man is a moral agent, sent into this world to acquire habits of virtue and piety to fit him for a better state, is a truth to which no consistent theist will for a moment refuse his assent. But almost all the moral good which is left among us, is the apparent effect of physical evil.

Johnson's Idler, No. 89. "Goodness is divided by divines into soberness, righteousness, and godliness. Let it be examined how each of these duties would be practised if there were no physical evil to enforce it.

"Sobriety or temperance is nothing but the forbearance of pleasure; and if pleasure was not followed by pain, who would forbear it? We see every hour those in whom the desire of present indulgence overpowers all sense of past, and all foresight of future misery. In a remission of the gout, the drunkard returns to his wine, and the glutton to his feast; and if neither disease nor poverty were felt or dreaded, every one would sink down in idle sensuality, without any care of others, or of himself. To eat and drink, and lie down to sleep, would be the whole business of mankind.

"Righteousness, or the system of social duty, may be subdivided into justice and charity. Of justice, one of the heathen sages has shown, with great acuteness, that it was impressed upon mankind only by the inconveniences which injustice had produced. 'In the first ages (says he) men acted without any rule but the impulse of desire; they practised injustice upon others, and suffered it from others in their turn; but in time it was discovered, that the pain of suffering wrong was greater than the pleasure of doing it; and mankind, by a general compact, submitted to the restraint of laws, and resigned the pleasure to escape the pain.'

"Of charity, it is superfluous to observe, that it could have no place if there were no want; for of a virtue which could not be practised, the omission could not be culpable. Evil is not only the occasional but the efficient cause of charity; we are incited to the relief of misery by the consciousness that we have the same nature with the sufferer; that we are in danger of the same distresses, and may some time implore the same assistance.

"Godliness or piety is elevation of the mind towards the Supreme Being, and extension of the thoughts to another life. The other life is future, and the Supreme Being is invisible. None would have recourse to an invisible power, but that all other subjects had eluded their hopes. None would fix their attention upon the future, but that they are discontented with the present. If the senses were feasted with perpetual pleasure, they would always keep the mind in subjection. Reason has no authority over us but by its power to warn us against evil.

"In childhood, while our minds are yet unoccupied, religion is impressed upon them; and the first years of almost all who have been well educated are passed in a regular discharge of the duties of piety: But as we advance forward into the crowds of life, innumerable delights solicit our inclinations, and innumerable cares distract our attention. The time of youth is passed in noisy frolics; manhood is led on from hope to hope, and from project to project; the dissoluteness of pleasure, the inebriation of success, the ardour of expectation, and the vehemence of competition, chain down the mind alike to the present scene: nor is it remembered how soon this mist of trifles must be scattered, and the bubbles that float upon the rivulet of life be lost for ever in the gulf of eternity. To this consideration scarce any man is awakened but by some pressing and resistless evil; the death of those from whom he derived his pleasures, or to whom he destined his possessions, some disease which shows him the vanity of all external acquisitions, or the gloom of age which intercepts his prospects of long enjoyment, forces him to fix his hopes upon another state; and when he has contended with the tempests of life till his strength fails him, he flies at last to the shelter of religion.

"That misery does not make all virtuous, experience too certainly informs us; but it is no less certain, that of what virtue there is, misery produces far the greater part. Physical evil may be therefore endured with patience, since it is the cause of moral good; and patience itself is one virtue by which we are prepared for that state in which evil shall be no more."

The calamities and the hardships of our present state, then, are so far from being real evils, of which providence ought to be accused, that in every point of view in which we can consider them, they afford the surest proofs of the wisdom of its administration, and of its goodness to man.

25 Objections from the permission of moral guilt,

The most serious difficulty lies in accounting for the permission of moral evil or guilt, in a system governed by infinite benevolence and wisdom. Those who in a consistent manner hold the doctrine of the absolute necessity of human actions in its full extent, and acknowledge all its consequences, find it easy to elude this difficulty. They very fairly deny the existence of any such thing as moral evil in the abstract; and assert, that what we call a *crime*, is nothing more than an action which we always regard with a painful sensation: that these apparent evils endure only for a time; and that all will at last terminate in the perfection and happiness of every intelligent being.

26 answered.

Upon the system of liberty, the shortest answer seems to be this: that some things are absolutely impossible, not from any weakness in the Deity, but because they infer absurdity or contradiction. Thus it is impossible for twice two to be any thing else than four; and thus it is impossible for Omnipotence itself to confer self-approbation upon an intelligent being who has never deserved it; that is to say, it is impossible for a man of sense to be pleased with himself for having done a certain action, while he himself is conscious that he never did that action. But self-approbation constitutes the highest, the most unmingled, and permanent felicity, of which our nature is capable. It is not in the power of Omnipotence itself, then, to bestow the highest and most permanent felicity of our nature; it must be *earned* and deserved before it can be obtained. In the same manner good desert, virtue or merit, cannot be *conferred;* they must be *acquired.* To enable us to acquire these, we must be exposed to difficulties, and must suffer in a certain degree. If these difficulties had no influence upon our conduct and feelings, if they exposed us to no real danger, no fabric of merit and of self-approbation could be reared upon them. All that the Supreme Being could do for us, was to confer such an original constitution and character as would enable us to do well if we should exert our utmost powers. The universe

universe is not ruled by favour, but by justice. Complete felicity must be purchased. Guilt is an abuse of our freedom, a doing ill where we could have done well, and is entirely the work of man. Heaven could not avoid permitting its existence, and exposing us to danger; for temptation is necessary to virtue, and virtue is the perfection of our nature, our glory, and our happiness.

27
By Simplicius.

The permission of moral evil has been so ably accounted for by Simplicius, a Pagan writer, and therefore not biassed by any partiality to the Jewish or Christian Scriptures, that we cannot deny ourselves the pleasure of laying his reasoning before our readers. He asks *, "Whether God may be called the author of sin, because he permits the soul to use her liberty? and answers the question thus:

* *Simplic. Com. in Epict.* p. 186, 187. ed. *Salmas.*

"He who says that God should not permit the exercise of its freedom to the soul, must affirm one of these two things; either that the soul, though by nature capable of indifferently choosing *good* or *evil*, should yet be constantly prevented from choosing evil; or else that it should have been made of such a nature as to have no *power* of choosing *evil*.

"The former assertion (continues he) is irrational and absurd; for what kind of liberty would that be in which there should be no freedom of choice? and what choice could there be, if the mind were constantly restrained to one side of every alternative? With respect to the second assertion, it is to be observed (says he), that no evil is in itself desirable, or can be chosen *as evil*. But if this power of determining itself either way in any given case must be taken from the soul, it must either be as something not good, or as some great evil. But whoever saith so, does not consider how many things there are which, though accounted good and desirable, are yet never put in competition with this freedom of will: for without it we should be on a level with the brutes; and there is no person who would rather be a brute than a man. If God then shows his goodness in giving to inferior beings such perfections as are far below this, is it incongruous to the divine nature and goodness to give man a self-determining power over his actions, and to permit him the free exercise of that power? Had God, to prevent man's sin, taken away the liberty of his will, he would likewise have destroyed the foundation of all virtue, and the very nature of man; for there could be no virtue were there not a possibility of vice; and man's nature, had it continued rational, would have been divine, because impeccable. Therefore (continues he), though we attribute to God, as its author, this self-determining power, which is so necessary in the order of the universe; we have no reason to attribute to him that evil which comes by the abuse of liberty: For God doth not cause that aversion from good which is in the soul when it sins; he only gave to the soul such a power as might turn itself to evil, out of which he produces much good, which, without such a power, could not have been produced by Omnipotence itself." So consonant to the doctrine of our scriptures is the reasoning of this opponent of the writings of Moses! *Fas est et ab hoste doceri.*

28
Objection from the apparent confusion of human affairs,

The last objection to the belief of a divine providence arises from the apparent confusion of human affairs, that all things happen alike to all, that bad men are prosperous, and that a total want of justice appears to attend the divine administrations. Even the best men have at times been shaken by this consideration.—But there are many reasons for rendering this world a mixed scene: it would become unfit for a state of trial and of education to virtue were it otherwise. 29

answered,

It has been shown already, that physical evil is the parent of moral good; and therefore it would be absurd to expect that the virtuous should be entirely exempted from that evil. For the occasional prosperity of the wicked, many reasons have been assigned even by those who, in their disquisitions, were not guided by that revelation which has brought to light life and immortality. "God (says Plutarch) spares the wicked, that he may set to mankind an example of forbearance, and teach them not to revenge their injuries too hastily on each other. He spares some wicked men from early punishment, in order to make them instruments of his justice in punishing others. And he spares all for a time, that they may have leisure for repentance; for men (says the same excellent moralist) look at nothing further, in the punishments which they inflict, than to satisfy their revenge and malice, and therefore they pursue those who have offended them with the utmost rage and eagerness; whereas God, aiming at the cure of those who are not utterly incurable, gives them μεταβαλλεσθαι χρονον, "time to be converted."

30
by Plutarch

But this objection receives the best solution from the doctrine of the immortality of the human soul.

31
The immortality of the soul the best answer to this objection

——————And see!
'Tis come, the glorious morn! the second birth
Of heav'n and earth! awakening nature hears
The *new creating word*, and starts to life,
In every height'ned form, from pain and death
For ever free. *The great eternal scheme*,
Involving all, and in a *perfect whole*
Uniting, as the prospect wider spreads,
To reason's eye refin'd clears up apace.
Ye vainly wise! Ye blind presumptuous! now,
Confounded in the dust, adore that Pow'r
And Wisdom oft arraign'd; see now the cause,
Why unassuming worth in secret liv'd
And died neglected: why the good man's share
In life was gall and bitterness of soul:
Why the lone widow and her orphans pin'd
In starving solitude; while luxury,
In palaces, lay straining her low thought,
To form unreal wants: why heav'n-born truth,
And moderation fair, wore the red marks
Of superstition's scourge; why licenc'd pain,
That cruel spoiler, that embosom'd foe,
Imbitter'd all our bliss. Ye good distrest!
Ye noble few! who here unbending stand
Beneath life's pressure, yet bear up a while,
And what your bounded view, which only saw
A little part, deem'd evil, is no more:
The storms of wintry time will quickly pass,
And one unbounded spring encircle all."

THOMSON'S *Winter*.

PROVIDENCE-Plantation, a colony of New England, which, with Rhode-island, formerly constituted a charter government. Its chief town is Newport.

PROVIDENCE, one of the least of the Bahama islands in the American ocean, but the best of those planted and fortified by the English. It is seated on the east

side

side of the gulf of Florida. W. Long. 77. 35. N. Lat. 25. 0.

PROVINCE, in Roman antiquity, a country of considerable extent, which, upon being entirely reduced under the Roman dominion, was new-modelled according to the pleasure of the conquerors, and subjected to the command of annual governors sent from Rome; being commonly obliged to pay such taxes and contributions as the senate thought fit to demand.

Of these countries, that part of France next the Alps was one, and still retains the name *Provence.*

Nicod derives the word *à procul vivendo*, "living afar off;" but it is better deduced from *pro* and *vinco*, "I overcome."

PROVINCE, in *Geography*, a division of a kingdom or state, comprising several cities, towns, &c. all under the same government, and usually distinguished by the extent either of the civil or ecclesiastical jurisdiction.

The church distinguishes its provinces by archbishoprics; in which sense, England is divided into two provinces, Canterbury and York.

The United Provinces are seven provinces of the Netherlands, who, revolting from the Spanish dominion, made a perpetual alliance, offensive and defensive, at Utrecht, anno 1579. See *UNITED Provinces*.

PROVINCIAL, something relating to a province. It also denotes, in Romish countries, a person who has the direction of the several convents of a province.

PROVISIONS, in a military sense, implies all manner of eatables, food or provender, used in an army, both for man and beast.

PROVOST of a city or town, is the chief municipal magistrate in several trading cities, particularly Edinburgh, Paris, &c. being much the same with mayor in other places. He presides in city-courts, and together with the bailies, who are his deputies, determines in all differences that arise among citizens.

The provost of Edinburgh is called *lord*, and the same title is claimed by the provost of Glasgow. The former calls yearly conventions of the royal boroughs to Edinburgh by his missives, and is, *ex officio*, president to the convention when met.

PROVOST, or *Prevot-Royal*, a sort of inferior judge formerly established throughout France, to take cognizance of all civil, personal, real, and mixed causes, among the people only.

Grand PROVOST of France, or *of the Household*, had jurisdiction in the king's house, and over the officers therein; looked to the policy thereof, the regulation of provisions, &c.

Grand PROVOST of the Constable, a judge who manages processes against the soldiers in the army who have committed any crime.

He has four lieutenants distributed throughout the army, called *provosts of the army*, and particular provosts in the several regiments.

PROVOST Marshal of an Army, is an officer appointed to seize and secure deserters, and all other criminals. He is to hinder soldiers from pillaging, to indict offenders, and see the sentence passed on them executed. He also regulates the weights and measures, and the price of provisions, &c. in the army. For the discharge of his office, he has a lieutenant, a clerk, and a troop of marshal-men on horseback, as also an executioner.

There is also a provost-marshal in the navy, who has charge over prisoners, &c.

The French also had a provost-general of the marines, whose duty it was to prosecute the marines when guilty of any crime, and to make report thereof to the council of war; besides a marine provost in every vessel, who was a kind of gaoler, and took the prisoners into his care, and kept the vessel clean.

PROVOSTS of the Marshals, were a kind of lieutenants of the marshals of France; of these there were 180 seats in France; their chief jurisdiction regarded highwaymen, footpads, house-breakers, &c.

PROVOST of the Mint, a particular judge instituted for the apprehending and prosecuting of false coiners.

PROVOST, or *Prevot*, in the king's stables; his office is to attend at court, and hold the king's stirrup when he mounts his horse. There are four provosts of this kind, each of whom attends in his turn, monthly.

PROW, denotes the head or fore-part of a ship, particularly in a galley; being that which is opposite to the poop or stern.

PROXIMITY, denotes the relation of nearness, either in respect of place, blood, or alliance.

PRUDENCE, in ethics, may be defined an ability of judging what is best, in the choice both of ends and means. According to the definition of the Roman moralist, *De Officiis*, lib. i. cap. 43. prudence is the knowledge of what is to be desired or avoided. Accordingly, he makes *prudentia* (*De Legibus*, lib. i.) to be a contraction of *providentia*, or foresight. Plato (*De Legibus*, lib. iii.) calls this the leading virtue; and Juvenal, Sat. x. observes,

Nullum numen abest si sit prudentia.

The idea of prudence includes ευβουλια, or due consultation; that is, concerning such things as demand consultation in a right manner, and for a competent time, that the resolution taken up may be neither too precipitate nor too slow; and συνεσις, or a faculty of discerning proper means when they occur: and to the perfection of prudence, these three things are farther required, viz. δεινοτης, or a natural sagacity; αγχινοια, presence of mind, or a ready turn of thought; and εμπειρια, or experience. The extremities of prudence are craft or cunning on the one hand, which is the pursuit of an ill end by direct and proper though not honest means; and folly on the other, which is either a mistake, both as to the end and means, or prosecuting a good end by foreign and improper means. Grove's *Moral Philosophy*, vol. ii. chap. ii.

PRUDENTIUS, or AURELIUS PRUDENTIUS CLEMENS, a famous Christian poet, under the reign of Theodosius the Great, who was born in Spain in the year 348. He first followed the profession of an advocate, was afterwards a judge, then a soldier, and at length had an honourable employment at court. We have a great number of his poems, which, from the choice of his subject, may be termed *Christian poems*; but the style is barbarous, and very different from the purity of the Augustan age. The most esteemed editions of Prudentius's works are that of Amsterdam, in 1667, with Heinsius's Notes, and that of Paris in 1687, *in usum Delphini.*

PRUNELLA, a genus of plants belonging to the didynamia class; and in the natural method ranking under

under the 12th order, *Holoraceæ*. See BOTANY *Index*.

PRUNES, are plums dried in the sunshine, or in an oven.

PRUNING, in *Gardening* and *Agriculture*, is the lopping off the superfluous branches of trees, in order to make them bear better fruit, grow higher, or appear more regular.

Pruning, though an operation of very general use, is nevertheless rightly understood by few; nor is it to be learned by rote, but requires a strict observation of the different manners of growth of the several sorts of fruit-trees; the proper method of doing which cannot be known without carefully observing how each kind is naturally disposed to produce its fruit: for some do this on the same year's wood, as vines; others, for the most part, upon the former year's wood, as peaches, nectarines, &c.; and others upon spurs which are produced upon wood of three, four, &c. to fifteen or twenty years old, as pears, plums, cherries, &c. Therefore, in order to the right management of fruit-trees, provision should always be made to have a sufficient quantity of bearing wood in every part of the trees; and at the same time there should not be a superfluity of useless branches, which would exhaust the strength of the trees, and cause them to decay in a few years.

The reasons for pruning of fruit-trees, are, 1. To preserve them longer in a vigorous bearing-state; 2. To render them more beautiful; and, 3. To cause the fruit to be larger and better tasted.

The general instructions for pruning are as follow. The greatest care ought to be taken of fruit-trees in the spring, when they are in vigorous growth; which is the only proper season for procuring a quantity of good wood in the different parts of the tree, and for displacing all useless branches as soon as they are produced, in order that the vigour of the tree may be entirely distributed to such branches only as are designed to remain. For this reason trees ought not to be neglected in April and May, when their shoots are produced: however, those branches which are intended for bearing the succeeding year should not be shortened during the time of their growth, because this would cause them to produce two lateral shoots from the eyes below the place where they were stopped, which would draw much of the strength from the buds of the first shoot: and if the two lateral shoots are not entirely cut away at the winter-pruning, they will prove injurious to the tree. This is to be chiefly understood of stone-fruit and grapes; but pears and apples, being much harder, suffer not so much, though it is a great disadvantage to those also to be thus managed. It must likewise be remarked, that peaches, nectarines, apricots, cherries, and plums, are always in the greatest vigour when they are least maimed by the knife; for where large branches are taken off, they are subject to gum and decay. It is therefore the most prudent method to rub off all useless buds when they are first produced, and to pinch others, where new shoots are wanted to supply the vacancies of the wall; by which management they may be so ordered as to want but little of the knife in winter-pruning. The management of pears and apples is much the same with these trees in summer; but in winter they must be very differently pruned: for as peaches and nectarines, for the most part, produce their fruit upon the former year's wood, and must therefore have their branches shortened according to their strength, in order to produce new shoots for the succeeding year; so, on the contrary, pears apples, plums, and cherries, producing their fruit upon spurs, which come out of the wood of five, six, and seven years old, should not be shortened, because thereby those buds which were naturally disposed to form these spurs, would produce wood branches; by which means the trees would be filled with wood, but would never produce much fruit. The branches of standard-trees should never be shortened unless where they are very luxuriant, and, by growing irregularly on one side of the trees, attract the greatest part of the sap, by which means the other parts are either unfurnished with branches, or are rendered very weak; in which case the branch should be shortened down as low as is necessary, in order to obtain more branches to fill up the hollow of the tree: but this is only to be understood of pears and apples, which will produce shoots from wood of three, four, or more years old; whereas most sorts of stone-fruit will gum and decay after such amputations: whenever this happens to stone-fruit, it should be remedied by stopping or pinching those shoots in the spring, before they have obtained too much vigour, which will cause them to push out side-branches; but this must be done with caution. You must also cut out all dead or decaying branches, which cause their heads to look ragged, and also attract noxious particles from the air: in doing of this, you should cut them close down to the place where they were produced, otherwise that part of the branch which is left will also decay, and prove equally hurtful to the rest of the tree; for it seldom happens, when a branch begins to decay, that it does not die quite down to the place where it was produced, and if permitted to remain long uncut, often infects some of the other parts of the tree. If the branches cut off are large, it will be very proper, after having smoothed the cut part exactly even with a knife, chissel, or hatchet, to put on a plaster of grafting clay, which will prevent the wet from soaking into the tree at the wounded part. All such branches as run across each other, and occasion a confusion in the head of the tree, should be cut off; and as there are frequently young vigorous shoots on old trees, which rise from the old branches near the trunk, and grow upright into the head, these should be carefully cut out every year, lest, by being permitted to grow, they fill the tree too full of wood.

As to the pruning of forest-trees, if they be large, it is best not to prune them at all; yet, if there be an absolute necessity, avoid taking off large boughs as much as possible. And, 1. If the bough be small, cut it smooth, close and sloping. 2. If the branch be large, and the tree old, cut it off at three or four feet from the stem. 3. If the tree grow crooked, cut it off at the crook, sloping upward, and nurse up one of the most promising shoots for a new stem. 4. If the tree grow top-heavy, its head must be lightened, and that by thinning the boughs that grow out of the main branches. But if you would have them spring, rub off the buds, and shroud up the side-shoots. 5. If the side-bough still break out, and the top be able to sustain itself, give the boughs that put forth in spring a pruning after Midsummer, cutting them close.

It

It has been observed, that trees are subject to gum and decay, in consequence of pruning; to prevent these injurious effects, a remedy has been proposed by Mr Bucknall, which on trial, it is said, has been succesful. By this method the branches to be removed are to be cut close to the place of separation from the trunk, smoothed well with a knife, and the wound is to be smeared over with medicated tar, laid on with a painter's brush. The following is the composition of this medicated tar. One quarter of an ounce of corrosive sublimate reduced to fine powder, by beating it with a wooden hammer, is introduced into a three pint earthen pipkin, with about a glassful of gin or other spirit. The mixture is to be well stirred till the sublimate is dissolved. The pipkin is then gradually filled with vegetable or common tar, and constantly stirred, till the mixture be blended together as intimately as possible; and this quantity will at any time be sufficient for 200 trees. To prevent danger, let the corrosive sublimate be mixed with the tar as quickly as possible after it is purchased; for being of a very poisonous nature to all animals, it should not be suffered to lie about a house, for fear of mischief to some part of the family.

By applying this composition, Mr Bucknall can, without the least danger, use the pruning hook on all sorts of trees, much more freely than by the use of any article hitherto recommended. The following remarks by the author on pruning in general, seem worthy of notice, and we give them in his own words. "I give no attention (says he) to fruit branches, and wood branches; but beg, once for all, that no branch shall ever be shortened unless for the figure of the tree, and then constantly taken off close to the separation, by which means the wound soon heals. The more the range of the branches shoots circularly, a little inclining upwards, the more equally will the sap be distributed, and the better will the tree bear; for, from that circumstance, the sap is more evenly impelled to every part. Do not let the ranges of branches be too near each other; for, remember all the fruit and the leaves should have their full share of the sun; and where it suits, let the middle of the tree be free from wood, so that no branch shall ever cross another, but all the extreme ends point upwards."

PRUNUS, a genus of plants belonging to the icosandria class; and in the natural method ranking under the 36th order, *Pomaceæ*. See BOTANY *Index*.

PRUSA, in *Ancient Geography*, a town situated at Mount Olympus in Mysia, built by Prusias, who waged war with Crœsus, (Strabo); with Cyrus, (Stephanus); both cotemporary princes. Now called *Bursa* or *Prusa*, capital of Bithynia, in Asia Minor. E. Long. 29. 5. N. Lat. 39. 22.

PRUSIAS, the name of several kings of Bithynia.

PRUSIAS, a town of Bithynia, anciently called *Cios*, from a cognominal river, and giving name to the Sinus Cianus of the Propontis; rebuilt by Prusias the son of Zela, after having been destroyed by Philip the son of Demetrius: it stood on the Sinus Cianus, at the foot of Mount Arganthonius. This is the Prusias who harboured Hannibal after the defeat of Antiochus.—Of this place was Asclepiades, surnamed *Prusicus*, the famous physician.

PRUSSIA, a modern, but deservedly celebrated kingdom of Europe, whose monarch, along with Prussia Proper, possesses also the electorate of Brandenburg, and some other territories of considerable extent. The district properly called *Prussia* is of great extent, and divided into the Ducal and Regal Prussia, the latter belonging to the republic of Poland till the late partition of the Polish territories. Both together are of great extent; being bounded on the north by the Baltic, on the south by Poland and the duchy of Mazovia, on the west by Pomerania, and on the east by Lithuania and Samogitia. The name is by some thought to be derived from the *Borussi*, a tribe of the Sarmatians, who, migrating from the foot of the Riphæan mountains, were tempted by the beauty and fertility of the country to settle there. Others think that the name of this country is properly *Porussia; Po* in the language of the natives signifying *near*, and *Porussia* signifying *near Russia*. To the latter etymology we find the king of Prussia himself assenting in the treatise intitled *Memoirs of the House of Brandenburg*. However, it must be owned, that these or any other etymologies of the word are very uncertain, and we find nothing like it mentioned by historians before the tenth century.

See Map of Poland and Prussian States. Plate CCCCXXXIV.

1 Etymology of the name.

2 Extreme barbarity of the ancient inhabitants.

The ancient state of Prussia is almost entirely unknown. However, the people are said to have been very savage and barbarous; living upon raw flesh, and drinking the blood of horses at their feasts, according to Stella, even to intoxication (A). Nay, so extremely savage were this people, that they were even unacquainted with the method of constructing huts, and took up their dwelling in caves and cavities of rocks and trees, where they protected themselves and children from the inclemencies of the weather. Among such a people it is vain to expect that any transactions would be recorded, or indeed that any thing worthy of being recorded would be transacted. We shall therefore begin our history of Prussia with the time when the Teutonic knights first got footing in the country. (See TEUTONIC *Knights*).

3 Teutonic knights first get footing in the country.

On the expulsion of the Christians from the Holy Land by Saladin, a settlement was given to the Teutonic knights in Prussia by Conrade duke of Mazovia, the competitor of Boleslaus V. for the crown of Poland. Their first residence in this country was Culm; to which territory they were confined by the conditions of the donation, excepting what they could conquer from their pagan neighbours, all which the emperor granted to them in perpetuity.

Encouraged by this grant, the knights conquered the greatest

(A) This author does not mention any particular method by which they communicated an inebriating quality to the blood of animals. Possibly, however, the vital fluid may have a property of this kind, though unknown in our days where such barbarous customs are disused. Drunkenness from drinking blood is frequently mentioned in Scripture, but whether literally or metaphorically must be decided by the learned.

Prussia. greatest part of the country which now goes by the name of *Prussia*; and, not content with this, became very troublesome to Poland, insomuch that the monarchs of that kingdom were sometimes obliged to carry on dangerous and bloody wars with them; for an account of which we refer to the article POLAND, N° 61, 67, &c.

The Teutonic order continued in Prussia till the year 1531. Their last grand-master was Albert marquis of Brandenburg, and nephew to Sigismund I. king of Poland. He was preferred to this dignity, in hopes that his affinity to Sigismund might procure a restitution of some of the places which had been taken from the order during the former unsuccessful wars with Poland; but in this the fraternity were disappointed. Albert, however, was so far from endeavouring to obtain any favour from his uncle by fair means, that he refused to do homage to him, and immediately began to make preparations for throwing off his dependence altogether, and recovering the whole of Prussia and Pomerania by force of arms. In this he was so far from succeeding, that, being foiled in every attempt, he was forced to resign the dignity of grand-master; in recompense for which, his uncle bestowed on him that part of Prussia

4 Expelled. now called *Ducal*, in quality of a secular duke. It was now the interest of the house of Brandenburg to assist in the expulsion of the fraternity; and accordingly, being at last driven out of Prussia and Pomerania, they transferred their chapter to Mariendal in Franconia; but in that and other provinces of the empire where they settled, little more than the name of the order, once so famous, now remains.

5 History of Brandenburg. The other most considerable part of his Prussian majesty's dominions is the electorate of Brandenburg. Like other parts of Germany, it was anciently possessed by barbarians, of whom no history can be given. These were subdued by Charlemagne, as is related under the article FRANCE *; but being on every occasion ready to revolt, in 927 Henry the Fowler established margraves, or governors of the frontiers, to keep the barbarians in awe. The first margrave of Brandenburg was Sigefroy, brother-in-law to the above-mentioned emperor; under whose administration the bishoprics of Brandenburg and Havelberg were established by Otho I. From this Sigefroy, to the succession of the house of Hohenzollern, from whom the present elector is descended, there are reckoned eight different families, who have been margraves of Brandenburg; namely, the family of the Saxons, of Walbeck, Staden, Plenck, Anhalt, Bavaria, Luxemberg, and Misnia. The margraves of the four first races had continual wars with the Vandals and other barbarous people; nor could their ravages be stopped till the reign of Albert surnamed *the Bear*, the first prince of the house of Anhalt. He was made margrave by the emperor Conrad III. and afterwards raised to the dignity of elector by Frederic Barbarossa, about the year 1100. Some years afterwards the king of the Vandals dying without issue, left the Middle Marche by his last will to the elector, who was besides possessed of the Old Marche, Upper Saxony, the country of Anhalt, and part of Lusace. In 1332 this line became extinct, and the electorate devolved to the empire. It was then given by the emperor Louis of Bavaria to his son Louis, who was the first of the sixth race. Louis the Roman succeeded his brother; and as he also died without children, he was succeeded by Otho, his third brother, who sold the electorate to the emperor Charles IV. of the house of Luxemburg, for 200,000 florins of gold. Charles IV. gave the Marche to his son Winceslaus, to whom Sigismund succeeded. This elector, being embarrassed in his circumstances, sold the New Marche to the knights of the Teutonic order. Josse succeeded Sigismund; but aspiring to the empire, sold the electorate to William duke of Misnia; who, after he had possessed it for one year, sold it again to the emperor Sigismund. In 1417, Frederic VI. burgrave of Nuremberg, received the investiture of the country of Brandenburg at the diet of Constance from the hands of the emperor Sigismund; who, two years before, had conferred upon him the dignity of elector, and arch-chamberlain of the Holy Roman empire.

* N° 27, &c.

This prince, the first of the family of Hohenzollern, found himself possessed of the Old and Middle Marche, but the dukes of Pomerania had usurped the Marche Ukraine. Against them, therefore, the elector immediately declared war, and soon recovered the province. As the New Marche still continued in the hands of the Teutonic knights, to whom it had been sold, as we have already mentioned, the elector, to make up for this, took possession of Saxony, which at that time happened to be vacant by the death of Albert the last elector of the Anhalt line. But the emperor, not approving of this step, gave the investiture of Saxony to the duke of Misnia; upon which Frederic voluntarily desisted from his acquisitions. This elector made a division of his possessions by will. His eldest son was deprived of his right on account of his having too closely applied himself to search for the philosopher's stone; so he left him only Voigtland. The electorate was given to his second son Frederic; Albert, surnamed *Achilles*, had the duchies of Franconia; and Frederic, surnamed the *Fat*, had the Old Marche; but by his death it returned to the electorate of Brandenburg.

Frederic I. was succeeded by his son, called also *Frederic*, and surnamed *Iron-tooth* on account of his strength. He might with as great reason have been surnamed *the Magnanimous*, since he refused two crowns, viz. that of Bohemia, which was offered him by the pope, and the kingdom of Poland to which he was invited by the people; but Frederic declared he would not accept of it unless Casimir brother to Ladislaus the late king refused it. These instances of magnanimity had such an effect on the neighbouring people, that the states of Lower Lusatia made a voluntary surrender of their country to him. But as Lusatia was a fief of Bohemia, the king of that country immediately made war on the elector, in order to recover it. However, he was so far from being successful, that, by a treaty of peace concluded in 1462, he was obliged to yield the perpetual sovereignty of Corbus, Peits, Sommerfeld, and some other places, to the elector. Frederic then, having redeemed the New Marche from the Teutonic order for the sum of 100,000 florins, and still further enlarged his dominions, resigned the sovereignty in 1469 to his brother Albert, surnamed *Achilles*. 6 Exploits of Albert surnamed Achilles.

Albert was 57 years old when his brother resigned the

Prussia.

the electorate to him. Most of his exploits, for which he had the surname of *Achilles*, had been performed while he was burgrave of Nuremberg. He declared war against Lewis duke of Bavaria, and defeated and took him prisoner. He gained eight battles against the Nurembergers, who had rebelled and contested his rights to the burgraviate. In one of these he fought singly against 16 men, till his people came up to his assistance. He made himself master of the town of Grieffenburg in the same manner that Alexander the Great took the capital of the Oxydracæ, by leaping from the top of the walls into the town, where he defended himself singly against the inhabitants till his men forced the gates and rescued him. The confidence which the emperor Frederic III. placed in him, gained him the direction of almost the whole empire. He commanded the Imperial armies against Lewis the Rich duke of Bavaria; and against Charles the Bold duke of Burgundy, who had laid siege to Nuis, but concluded a peace at the interposition of Albert. He gained the prize at 17 tournaments, and was never dismounted.

7
Prussia and Brandenburg united.

All these exploits, however, had been performed before Albert obtained the electorate. From that time we meet with no very important transactions till the year 1594, when John Sigismund of Brandenburg, having married Anne the only daughter of Albert duke of Prussia, this united that duchy to the electorate, to which it has continued to be united ever since; and obtained pretensions to the countries of Juliers, Berg, Cleves, Marck, Ravensburg, and Ravenstein, to the succession of which Anne was heiress.

8
Unfortunate reign of the elector George William.

Sigismund died in 1619, and was succeeded by his son George William; during whose government the electorate suffered the most miserable calamities. At this time it was that the war commenced between the Protestants and Catholics, which lasted 30 years. The former, although leagued together, were on the point of being utterly destroyed by the Imperialists under the command of Count Tilly and Wallenstein, when Gustavus Adolphus of Sweden turned the scale in their favour, and threatened the Catholic party with utter destruction *. But by his death at the battle of Lutzen, the fortune of war was once more changed. At last, however, peace was concluded with the emperor; and, in 1640, the elector died, leaving his dominions to his son Frederic William, surnamed the *Great*.

* See *Sweden*.

9
Reign of Frederic William the Great.

This young prince, though only 20 years of age at the time of his accession, applied himself with the utmost diligence to repair the losses and devastations occasioned by the dreadful wars which had preceded. He received the investiture of Prussia personally from the king of Poland, on condition of paying 100,000 florins annually, and not making truce or peace with the enemies of that crown. His envoy likewise received the investiture of the electorate from the emperor Ferdinand III. The elector then thought of recovering his provinces from those who had usurped them. He concluded a truce for 20 years with the Swedes, who evacuated the greatest part of his estates. He likewise paid 140,000 crowns to the Swedish garrisons, which still possessed some of his towns; and he concluded a treaty with the Hessians, who delivered up a part of the duchy of Cleves; and obtained of the Hollanders the evacuation of some other cities.

In the mean time, the powers of Europe began to be weary of a war which had continued for such a length of time with such unrelenting fury. The cities of Osnaburg and Munster being chosen as the most proper places for negociation, the conferences were opened in the year 1645; but, by reason of the multiplicity of business, they were not concluded till two years after. France, which had espoused the interests of Sweden, demanded that Pomerania should be ceded to that kingdom as an indemnification for the expences which the war had cost Gustavus Adolphus and his successors. Although the empire and the elector refused to give up Pomerania, it was at last agreed to give up to the Swedes Hither Pomerania, with the isles of Rugen and Wollin, also some cities; in return for which cession, the bishoprics of Halberstadt, Minden, and Camin, were secularized in favour of the elector, of which he was put in possession, together with the lordships of Hochenstein and Richenstein, with the reversion of the archbishopric of Magdeburg. Thus was the treaty of Westphalia concluded in 1648, and which serves as a basis to all the possessions and rights of the German princes. The elector then concluded a new treaty with the Swedes, for the regulation of limits, and for the acquittal of some debts, of which Sweden would only pay a fourth; and next year the electorate, Pomerania, and the duchies of Cleves, were evacuated by the Swedes.

10
Treaty of Westphalia concluded.

11
The elector succeeds against the Swedes.

Notwithstanding all these treaties, however, the Swedes soon after invaded Pomerania, but were entirely defeated by the elector near the town of Fehrbellin. Three thousand were left dead on the spot, among whom were a great number of officers; and a great many were taken prisoners. The elector then pursued his victory, gained many advantages over the Swedes, and deprived them of the cities of Stralsund and Gripswald. On this the Swedes, hoping to oblige the elector to evacuate Pomerania, which he had almost totally subdued, invaded Prussia, from Livonia, with 16,000 men; and advancing into the country, they burned the suburbs of Memel, and took the cities of Tilse and Insterburg. The elector, to oppose the invaders, left Berlin on the 10th of January 1679, at the head of 9000 men. The Swedes retired at his approach, and were greatly harassed by the troops on their march. So successful indeed was the elector on this occasion, that the Swedes lost almost one half of their army killed or taken prisoners. At last, having crossed the bay of Frisch-haff and Courland on the ice, he arrived on the 19th of January, with his infantry, within three miles of Tilse, where the Swedes had their head-quarters. The same day, his general, Trefenfeldt, defeated two regiments of the enemy near Splitter; and the Swedes who were in Tilse abandoned that place, and retired towards Courland. They were pursued by General Gortz, and entirely defeated with such slaughter, that scarce 3000 of them returned to Livonia. Yet, notwithstanding all these victories, the elector, being pressed on the other side by the victorious generals of France, M. Turenne and the prince of Conde, was obliged to make peace with the Swedes. The conditions were,

12
Is obliged to conclude a treaty of peace with them.

Prussia. that the treaty of Westphalia should serve for a basis to the peace; that the elector should have the property of the customs in all the ports of Further Pomerania, with the cities of Camin, Gartz, Grieffenburg, and Wildenbruck: on his part, he consented to give up to the Swedes all that he had conquered from them, and to give no assistance to the king of Denmark, upon condition that France delivered up to him his provinces in Westphalia, and paid him 300,000 ducats, as an indemnification for the damages done by the French to his states. This treaty was styled *the peace of St Germain*.

13 A strange embassy from the cham of Tartary.

With the treaty of St Germain terminated the military exploits of Frederic William, who passed the last years of his administration in peace. His great qualities had rendered him respected by all Europe, and had even been heard of in Tartary. He received an embassy from Murad Geray, cham of the Tartars, courting his friendship. The barbarian ambassador appeared in such tattered clothes as scarce covered his nakedness, so that they were obliged to furnish him with other clothes before he could appear at court. His interpreter had a wooden nose and no ears. In 1684, Frederic received into his dominions great numbers of Protestants who fled out of France from the persecutions of Louis XIV. after he had revoked the edict of Nantz. Twenty thousand of them are said to have settled at this time in the electorate, where they introduced new arts and manufactures, that were of the utmost benefit to the country. By this, however, he disobliged Louis XIV. for which reason he concluded an alliance with the emperor; and having furnished him with 8000 troops against the Turks in Hungary, the emperor yielded to him the circle of Schwibus in Silesia, as an equivalent for all his rights in that province.

14 Frederic III. obtains the title of king of Prussia.

In 1688, the elector Frederic William died, and was succeeded by his son Frederic III. This prince was remarkably fond of show and ceremony, which, during the course of his government, involved him in much expence. The regal dignity seemed to be the greatest object of his ambition. To obtain this, he joined with the emperor in the alliance against France, in which he was engaged by William III. king of Britain. He also yielded up the circle of Schwibus, which had been given to his predecessor; and, in 1700, obtained from the emperor that dignity which he had so earnestly desired. The terms on which it was obtained were, 1. That Frederic should never separate from the empire those provinces of his dominions which depended on it. 2. That he should not, in the emperor's presence, demand any other marks of honour than those which he had hitherto enjoyed. 3. That his Imperial majesty, when he wrote to him, should only give him the title of *Royal Dilection*. 4. That nevertheless the ministers which he had at Vienna should be treated like those of other crowned heads. 5. That the elector should maintain 6000 men in Italy at his own expence, in case the emperor should be obliged to make war on account of the succession of the house of Bourbon to the crown of Spain. 6. That those troops should continue there as long as the war lasted.

Thus was the kingdom of Prussia established through the friendship of the emperor, with whom Frederic I. so called as being the first king of Prussia, continued all his life in strict alliance. Indeed he was a pacific prince; and though contemptible in his person, and incapable of achieving great things, had this merit, that he always preserved his dominions in peace, and thus consulted the true interest of his subjects much more than those monarchs who have dazzled the eyes of the world by their military exploits. He was indeed vain, and fond of show, as we have already observed; but had a good heart, and is said never to have violated his conjugal vow; though it does not appear that he was greatly beloved by his royal consorts (of whom he had three) on that or any other account.

15 Frederic II. of Prussia a martial prince.

Frederic I. died in the beginning of 1713, and was succeeded by Frederic William. He was in almost every thing the reverse of his father. His dispositions were altogether martial; so that he applied himself entirely to the augmentation of his army, and perfecting them in their exercise, by which means they became the most expert soldiers in Europe. His foible was an ambition of having his army composed of men above the ordinary size; but as these could not be procured, he composed a regiment of the tallest men he could find; and as his officers made no scruple of picking up such men wherever they could find them for his majesty's use, the neighbouring states were frequently offended, and a war was often likely to ensue even from this ridiculous cause. However, his Prussian majesty was never engaged in any martial enterprise of consequence: but having put his army on the most respectable footing of any in the world, and filled his coffers, for he was of a very saving disposition, he put it in the power of his son to perform those exploits which have been matter of astonishment to all Europe.

16 Enmity between Prussia and Austria.

It was in this king's reign that Prussia first perceived her natural enemy and rival to be the house of Austria, and not France as had been formerly supposed. Hence frequent bickerings took place between these two powers, for which the persecution of the Protestants by some of the Catholic states of the empire afforded a pretence; and though a war never actually took place, yet it was easy to see that both were mortal enemies to each other. But when Frederic William died in 1740, this enmity broke out in full force. The empress queen was then left in a very disagreeable situation, as has been observed under the article BRITAIN, N° 410, &c. Of this Frederic III. took the advantage to do himself justice, as he said, with regard to Silesia, of which his ancestors had been unjustly deprived. This province he seized at that time: but it cost him dear; for the empress having at last overcome all difficulties, formed against him the most terrible combination that ever was known in Europe.

17 Frederic III. seizes Silesia.

18 Combination against him.

The treaty was hardly concluded with the king of Prussia, by which she reluctantly yielded up the province of Silesia, and with it a clear revenue of 800,000l. a year, before she entered into another with the court of Petersburg, which was concluded May 22. 1746. This treaty, as far as it was made public, was only of a defensive nature; but six secret and separate articles were added to it. By one of these it was provided, that in case his Prussian majesty should attack the empress queen, or the empress of Russia, or even the republic of Poland, it should be considered as a breach of the treaty of Dresden, by which Silesia was given up. It was also stipulated, that, notwithstanding that treaty (which indeed had been dictated by the king of Prussia himself), the

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the right of the empress-queen to Silesia still continued, and for the recovery of that province the contracting powers should mutually furnish an army of 60,000 men. To this treaty, called the treaty of *Petersburg*, the king of Poland was invited to accede; but he, being in a manner in the power of the king of Prussia, did not think proper to sign it: however, he verbally acceded to it in such a manner, that the other parties were fully convinced of his design to cooperate with all their measures; and in consideration of this intention, it was agreed that he should have a share in the partition of the king of Prussia's dominions, in case of a successful event of their enterprises.

In consequence of these machinations, every art was used to render the king of Prussia personally odious to the empress of Russia; the queen of Hungary made vast preparations in Bohemia and Moravia; and the king of Poland, under pretence of a military amusement, drew together 16,000 men, with whom he occupied a strong post at Pirna. The queen of Hungary, still further to strengthen herself, concluded a treaty with the court of France at Versailles, dated May 1. 1756. But in the mean time, the king of Prussia having understood by his emissaries what was going forward, resolved to be beforehand with his enemies, and at least

19 He invades Saxony,

to keep the war out of his own country; and therefore entered Saxony with a considerable army. At first he affected only to demand a free passage for his troops, and an observance of the neutrality professed by the king of Poland; but, having good reasons to doubt this neutrality, he demanded, as a preliminary, that these Saxon troops should immediately quit the strong post they occupied, and disperse themselves. This demand was refused; on which his Prussian majesty blockaded the Saxon camp at Pirna, resolving to reduce it by famine, since its strong situation rendered an attack very dangerous. At that time there were in Bohemia two Saxon armies, one under the command of M. Brown, and the other under M. Picolomini. To keep these in awe, the king had sent M. Schwerin with an army into Bohemia from the country of Glatz, and M. Keith had penetrated into the same kingdom on the side of Misnia. But still the king of Prussia did not entirely confide in these dispositions;

20 and takes 16,000 Saxons prisoners.

and therefore fearing lest M. Brown might afford some assistance to the Saxons, he joined his forces under Keith, and on December 1. attacked and defeated the Austrian general, so that the latter found it impossible to relieve the Saxons, who, after a vain attempt to retire from their post, were all taken prisoners. The king of Poland quitted his dominions in Germany, and the Prussians took up their winter quarters in Saxony. Here they seized on the revenues, levied exorbitant contributions, and obliged the country to furnish them with recruits. The king of Prussia at this time made himself master of the archives of Dresden, by which means he procured the originals of those pieces above mentioned, which, when produced to the world, gave a full proof of the combination that had been formed against him, and consequently justified the measures he had taken for his own defence.

21 He is prosecuted in the Aulic council, and put to the ban of the empire.

No sooner had the king entered Saxony, in the manner already related, than a process was commenced against him in the emperor's Aulic council, and before the diet of the empire, where he was soon condemned for contumacy, and put to the ban of the empire.—The various circles of the empire were ordered to furnish their contingents of men and money to put this sentence in execution; but these came in so slowly, that, had it not been for the assistance of the French under the prince de Soubise, the army would probably have never been in a condition to act. The Austrians, in the mean time, made great preparations, and raised 100,000 men in Bohemia, whom they committed to the care of Prince Charles of Lorrain, assisted by M. Brown. The Czarina sent a body of 60,000 men under M. Apraxin, to invade the Ducal Prussia; whilst a strong fleet was equipped in the Baltic, in order to co-operate with that army. The king of Sweden also acceded to the confederacy, in hopes of recovering the possessions in Pomerania which his ancestors had enjoyed; and the duke of Mecklenburg took the same party, promising to join the Swedish army with 6000 men as soon as it should be necessary. On the king of Prussia's side appeared nobody excepting an army of between 30,000 and 40,000 Hanoverians commanded by the duke of Cumberland; and these were outnumbered and forced to yield to a superior army of French commanded by M. d'Etrees.

22 Prodigious preparations against him.

23 He invades Bohemia, and totally defeats the Austrian army.

In the mean time, his Prussian majesty, finding that he must depend for assistance solely on his own abilities, resolved to make the best use of his time. Accordingly, in the spring 1757, his armies poured into Bohemia from two different quarters, while the king himself prepared to enter it from a third. M. Schwerin entered from Silesia; the prince of Bevern from Lusatia, where he defeated an army of 28,000 Austrians that opposed his passage. As the intentions of the king himself were not known, the Austrians detached a body of 20,000 men from their main army to observe his motions. This was no sooner done than the king cut off all communication between the detachment and the main body: and having joined his two generals with incredible celerity, he engaged the Austrians near Prague, totally defeated them, took their camp, military chest, and cannon; but lost the brave General Schwerin, who was killed at the age of 82, with a colonel's standard in his hand. On the Austrian side, M. Brown was wounded, and died in a short time, though it is supposed more from the chagrin he suffered, than from the dangerous nature of the wound itself.

24 Besieges and bombards Prague.

About 40,000 of the Austrian army took refuge in Prague, while the rest fled different ways. The city was instantly invested by the king, and all succours were cut off. The great number of troops which it contained rendered an attack unadvisable, but seemed to render the reduction of it by famine inevitable; however, the king, to accomplish his purpose the more speedily, prepared to bombard the town. On the 29th of May, after a most dreadful storm of thunder and lightning, four batteries began to play on the city. From these were thrown, every 24 hours, 288 bombs, besides a vast number of red-hot balls, so that it was soon on fire in every quarter. The garrison made a vigorous defence, and one well-conducted sally; but had the misfortune to be repulsed with great loss. The magistrates, burghers, and clergy, seeing their city on the point of being reduced

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reduced to an heap of rubbish, supplicated the commander in the most earnest manner to capitulate; but he was deaf to their intreaties, and drove 12,000 of the most useless mouths out of town, who were quickly driven in again by the Prussians.

25
Count Daun takes the command of the Austrian army.

Thus the affairs of the empress queen seemed verging to destruction, when Leopold count Daun took upon him the command of the remains of M. Brown's army. This general had arrived within a few miles of Prague the day after the great battle. He immediately collected the scattered fugitives with the greatest diligence, and retired with them to a strong post in the neighbourhood, from whence he gave the troops in Prague hopes of a speedy relief. It was now the king of Prussia's business, either to have attempted to make himself master of the city by one desperate effort, or entirely to have abandoned the enterprise, and driven Count Daun from his post before his troops had recovered from the terror of their late defeat; but, by attempting to do both, he rendered himself incapable of doing either. Though the army of Count Daun already amounted to 60,000 men, and though they were strongly entrenched, and defended by a vast train of artillery, his majesty thought proper to send no more than 32,000 men. This body made the arduous attempt on the 18th of June; but though they did all that human courage and conduct could do, and though the king himself at last charged at the head of his cavalry, the Prussians were driven out of the field with great loss. This engagement was named *the battle of Colin.*

26
Defeats the Prussians at Colin.

27
Siege of Prague raised.

The first consequence of the battle of Colin was, that the king of Prussia was obliged to raise the siege of Prague; soon after which, he was obliged to quit Bohemia, and take refuge in Saxony. The Austrians harassed him as much as possible; but, notwithstanding their great superiority, their armies were not in a condition to make any decisive attempt upon him, as the frontiers of Saxony abounded with situations easily defended. In the mean time the Russians, who had hitherto been very dilatory in their motions, began to exert themselves, and entered Ducal Prussia, under M. Apraxin and Fermor, where they committed innumerable cruelties and excesses. A large body of Austrians entered Silesia, and penetrated as far as Breslau. Then they made a turn backwards, and besieged Schweidnitz. Another body entered Lusatia, and made themselves masters of Zittau. An army of 22,000 Swedes entered Prussian Pomerania, took the towns of Anclam and Demmein, and laid the whole country under contribution. The French, too, being freed from all restraint by the capitulation of the duke of Cumberland at Closter Seven *, made their way into Halberstadt and the Old March of Brandenburg, first exacting contributions, and then plundering the towns. The army of the empire, being reinforced by that of the prince de Soubise, after many delays, was on full march to enter Saxony, which left the Austrians at liberty to exert the greatest part of their force in the reduction of Silesia. General Haddick penetrated through Lusatia, passed by the Prussian armies, and suddenly appeared before the gates of Berlin, which city he laid under contribution. He retired on the approach of a body of Prussians; yet he still found means to keep such a post as interrupted the king's communication with Silesia. The destruction of the king of Prussia therefore now seemed inevitable. Every exertion which he had made, though brave and well-conducted, had been unsuccessful. His general Lehwald, who opposed the Russians, had orders to attack them at all events. He obeyed his orders; and with 30,000 men attacked 60,000 of the enemy strongly entrenched at a place called *Norkitten*. The Prussians behaved with the greatest valour; but after having killed five times more of the enemy than they themselves lost, they were obliged to retire, though more formidable after their defeat than the Russians after their victory. The king, in the mean time, exerted himself on every side, and his enemies fled everywhere before him; but whilst he pursued one body, another gained upon him in some other part, and the winter came on fast, while his strength decayed, and that of his adversaries seemed to increase on every quarter.

* See Britain, N° 441.

28
Berlin laid under contribution.

29
Lehwald's Prussian general defeated by the Russians.

The Prussian monarch, however, though distressed, did not abandon himself to despair, or lose that wonderful presence of mind which has so eminently distinguished him in all his military enterprises. He industriously delayed a decisive action till the approach of winter; but at last, after various movements, on November 5. 1757, he met at Rosbach with the united army of his enemies commanded by the prince of Saxe Hilburghausen and the prince de Soubise. The allied army amounted to 50,000 men complete; but most of the troops of the Circles were new raised, and many of them not well affected to the cause. The Prussians did not exceed 25,000 men; but they were superior to any troops in the world, and were inspired, by the presence of their king, with the most enthusiastic valour. The Austrians were defeated with the loss of 3000 killed, eight generals, 250 officers of different ranks, and 6000 private soldiers, taken prisoners, while night alone prevented the total destruction of the army.

30
The king gains a great victory at Rosbach.

By this battle the king was set free on one side; but this only gave him an opportunity of renewing his labours on another. The Austrians had a great force, and now began to make a proportionable progress in Silesia. After a siege of 16 days, they had reduced the strong fortress of Schweidnitz, and obliged the Prussian garrison of 4000 men to surrender prisoners of war. Hearing then of the victory at Rosbach, and that the king of Prussia was in full march to relieve Silesia, they resolved to attack the prince of Bevern in his strong camp under the walls of Breslau. They attacked the prince's army on November 22d; but their attack was sustained with the greatest resolution. The slaughter of the Austrians was prodigious. A great part of the enemy had retired from the field of battle, and the rest were preparing to retire, when all at once the Prussian generals took the same resolution. Their army had suffered much in the engagement, and they became apprehensive of a total defeat in case their intrenchments should be forced in any part; for which reason they quitted their strong post, and retired behind the Oder. Two days after, the prince of Bevern, going to reconnoitre without escort, attended only by a groom, was taken prisoner by an advanced party of Croats, a small body of whom had crossed the Oder.

31
Schweidnitz taken by the Austrians.

32
Battle with the prince of Bevern.

On

Prussia

33 Breslau taken by the Austrians.

On this the town of Breslau immediately surrendered; where, as well as at Schweidnitz, the Austrians found great quantities of provisions, ammunition, and money. All Silesia was on the point of falling into their hands, and the Prussian affairs were going into the utmost distraction, when the king himself by a most rapid march passed through Thuringia, Misnia, and Lusatia, in spite of the utmost efforts of the generals Haddick and Marshal, who were placed there to oppose him; and, entering Silesia on the 2d of December, joined the prince of Bevern's corps, who repassed the Oder to meet him. The garrison of Schweidnitz, who, as we have already observed, had been made prisoners of war, also joined the king's army unexpectedly; and their presence contributed not a little, notwithstanding the smallness of their number, to raise the spirits of the whole army. They had submitted to the capitulation with the greatest reluctance; but as the Austrians were conducting them to prison, they happened to receive intelligence of the victory at Rosbach: on which they immediately rose on the escort that conducted them, and entirely dispersed it; and afterwards marched in such a direction as they thought might most readily lead them to their king, they accidentally fell in with his army.

34 Garrison of Schweidnitz recover their liberty.

35 Count Daun defeated by the king of Prussia at Leuthen.

His Prussian majesty now approached Breslau; on which the Austrians, confiding in their superiority, (for they exceeded 70,000, while the Prussians scarce amounted to 36,000), abandoned their strong camp, the same which the prince of Bevern had formerly occupied, and advanced to give him battle. The king did not intend by any means to disappoint them, but advanced on his part with the greatest celerity. The two armies met on December 5th, near the village of Leuthen. Count Daun made the best dispositions possible. The ground occupied by his army was a plain, with small eminences in some parts. These eminences they surrounded with artillery; and as the ground was also interspersed with thickets, they sought to turn these likewise to their advantage. On their right and left were hills, on which they planted batteries of cannon. The ground in their front was intersected by many causeways; and to make the whole more impracticable, the Austrians had felled a great number of trees, and scattered them in the way. It was almost impossible at the beginning of the engagement for the Prussian cavalry to act, on account of these impediments; but, by a judicious disposition made by the king himself, all difficulties were overcome. His majesty had placed four battalions behind the cavalry of his right wing; foreseeing that General Nadasti, who was placed on the enemy's left with a corps de reserve, designed to attack him in flank. It happened as he had foreseen: that general's cavalry attacked the Prussian right wing with great fury; but he was received with such a severe fire from the four battalions, that he was obliged to retire in disorder. The king's flank then, well covered and supported, was enabled to act with such order and vigour as repulsed the enemy. The Austrian artillery was also silenced by that of the Prussians; however, the Austrians continued to make a gallant resistance during the whole battle. After having been once thrown into disorder, they rallied all their forces about Leuthen, which was defended on every side by entrenchments and redoubts. The Prussians attacked them with the utmost impetuosity, and at last became masters of the post; on which the enemy fled on all sides, and a total rout ensued. In this battle the Austrians lost 6000 killed on the spot, 15,000 taken prisoners, and upwards of 200 pieces of cannon.

36 Breslau retaken.

The consequences of this victory were very great. Breslau was immediately invested, and surrendered on December 29th; the garrison, amounting to 13,000 men, were made prisoners of war. The blockade of Schweidnitz was formed as closely as the season of the year would permit; while detached Prussian parties overran the whole country of Silesia, and reduced every place of less importance. The Russians, who had ravaged and destroyed the country in such a manner that they could not subsist in it, thought proper to retire out of the Prussian dominions altogether. Thus General Lehwald was left at liberty to act against the Swedes; and them he quickly drove out of Prussian Pomerania, the whole of which country he not only recovered, but also some part of Swedish Pomerania. Thus the duchy of Mecklenburg being left quite exposed, the king took ample vengeance on it by exacting the most severe contributions of men and money. To complete this monarch's good fortune also, the French, who had retired after the battle of Rosbach, were now opposed by the Hanoverians under Prince Ferdinand, who kept them so well employed, that, during the rest of the war, the king of Prussia had no more trouble from them. See Britain, N° 442.

37 Swedes driven out of Pomerania.

38 Schweidnitz retaken.

The beginning of the year 1758 was favourable to the arms of his Prussian majesty. On the 3d of April he commenced his operations against Schweidnitz, and pushed the siege so vigorously, that the place surrendered in 13 days. He then disposed his forces in such a manner as might best guard his dominions against his numerous enemies. For this purpose Count Dohna commanded a body of troops on the side of Pomerania; another considerable body was posted between Wohlau and Glogau, in order to cover Silesia from the Russians, in case they should make their inroad that way. An army, in a little time after, was formed in Saxony, commanded by the king's brother Prince Henry. This army consisted of 30 battalions and 45 squadrons, and was designed to make head against the army of the empire; which, by great efforts made during the winter, and the junction of a large body of Austrians, was again in a condition to act. Between all these armies a ready communication was kept up by a proper choice of posts. After the reduction of Schweidnitz, the king having made a show of invading Bohemia, suddenly burst into Moravia, where in a short time he made himself master of the whole country, and on the 27th of May laid siege to Olmutz the capital. Of this M. Daun was no sooner informed, than he took his route to Moravia through Bohemia: and though he was not in a condition to risk a battle, nor indeed would have done so unless he had had a very considerable advantage; yet, by placing himself in a strong situation where he could not be attacked, by harassing the king's troops and cutting off their convoys, he at last obliged him to abandon the enterprise. The king, however, who frequently owed a good part of his success to the impenetrable secrecy with which he covered all his designs, gave not the least hint of his intention to raise the siege of Olmutz.

39 The king besieges Olmutz without success.

On

Prussia. On the contrary, the very day before the siege was raised, the firing continued as brisk as ever; but in the night (July 1.) the whole army took the road to Bohemia in two columns, and gained an entire march upon the Austrians. Thus, notwithstanding the utmost efforts of his enemies, the Pussian army reached Bohemia with very little molestation. Here he seized upon a large magazine at Lieutomissel; defeated some corps of Austrians who had attempted to interrupt his progress; and arrived at Konigsgratz, of which he took possession, after driving from it 7000 Austrians who were intrenched there. This city and several other districts he laid under contribution: but soon after entered Silesia, and marched with the utmost rapidity to encounter the Russians, who had at that time united their forces under generals Brown and Fermor, entered the New Marche of Brandenburg, and laid siege to Custrin.

40 The Russians besiege Custrin.

The king arrived at this city at a very critical period. The Russians had laid siege to it on the 15th of August; and though they were not well skilled in managing artillery, yet, by furious and unremitting discharges at random, they threw in such a number of bombs and red-hot balls, that the town was soon on fire in every quarter. Some of the wretched inhabitants were burned; others buried in the ruins of their houses, or killed by the balls which fell like hail in the streets; while many of the survivors abandoned their habitations, and fled out of the town on that side where it was not invested. The governor did every thing for the defence of the place; but as the walls were built after the old manner, it was impossible that the town could have made a defence for any length of time, especially as the principal magazine of the besieged had been blown up. The avenger of all these injuries, however, was now at hand. The king came in sight of the Russians on the 25th of August, after a march of 56 days, and beheld the country everywhere desolated, and the villages in flames by the depredations of his cruel enemy, who had raised the siege at his approach, and retired towards a neighbouring village named *Zorndorff*. At nine o'clock in the morning, a most terrible fire of cannon and mortars poured destruction on the right wing of the Russian army for two hours without intermission. The slaughter was such as might have been expected; but the Russians kept their ground with astonishing resolution, new regiments still pressing forward to supply the places of those that fell. When the first line had fired away all their charges, they rushed forward on the Prussians with their bayonets; and all at once these brave troops, though encouraged by the presence of their king, gave way and fled before an enemy already half defeated. The Russian generals ought now to have attacked with their cavalry the disordered infantry of their enemies, which would have completed the defeat, and in all probability given the finishing stroke to the king of Prussia's affairs. This opportunity, however, they lost: but the king was not so negligent; for, by a very rapid and masterly motion, he brought all the cavalry of his right wing to the centre, and falling on the Russian foot uncovered by their horse, and even disordered by their own success, they pushed them back with most miserable slaughter, at the same time that the repulsed battalions of infantry, returning from the charge, and exasperated at their late disgrace, rendered the victory no longer doubtful. The Russians were now thrown into the most dreadful confusion. The wind blew the dust and smoke into their faces, so that they could not distinguish friends from foes; they fired on each other, plundered their own baggage which stood between the lines, and intoxicated themselves with brandy: the ranks fell in upon one another; and, being thus crammed together into a narrow space, the fire of the Prussians had a full and dreadful effect, while their enemies kept up only a scattered and ineffectual fire, generally quite over their heads. Yet even in this dismal situation the Russians did not fly; but suffered themselves to be slaughtered till seven at night, when their generals having caused an attack to be made on the Prussian right wing, the attention of the enemy was drawn to that quarter, and they had time to retire a little from the field of battle to recover their order.

41 But are defeated at Zorndorff.

In this engagement, which was called the *battle of Zorndorff*, the Russians lost 21,529 men, while that of the Prussians did not exceed 2000. A vast train of artillery was taken, together with the military chest, and many officers of high rank. The consequence was, that the Russian army retreated as far as Landsperg on the frontiers of Poland, and the king was left at liberty to march with his usual expedition to the relief of Prince Henry in Saxony.

42 Operations of Count Daun,

The prince was at this time sorely pressed by M. Daun. As soon as the king had left Bohemia in the manner already related, M. Daun, considering that it would have been to no purpose to follow him, resolved to turn his arms towards Saxony. Towards that country, therefore, he took his route through Lusatia, by Zittau, Gorlitz, and Bautzen. On the 3d of September he invested the strong fortress of Sonnestein; which unaccountably surrendered, after a single day's resistance, to one of his generals named *Macguire*. He then began to favour the operations of General Laudohn, who had advanced through the Lower Lusatia to the confines of Brandenburg; and, by drawing the attention of the Prussian forces which were left in Silesia to the northward of that duchy, he facilitated the progress of the generals Harsch and De Ville in the southern parts. He then proposed that Prince Henry should be attacked by the army of the empire, while that of the Austrians should pass the Elbe, and falling at the same time on the Prussians, second the attack of the Imperialists, and cut off the retreat of their enemies from Dresden. The sudden appearance of the king of Prussia, however, put an end to his plan; General Laudohn abandoned all his conquests in Lower Lusatia, and retired towards M. Daun, while that general himself retired from the neighbourhood of Dresden as far as Zittau. The army of the empire only kept its ground; possessing itself of the strong post at Pirna, formerly mentioned, but did not undertake any thing. As for the Swedes, who had directed their motions by those of the Russians, they no sooner heard of the victory of Zorndorff, than they retreated with much more expedition than they had advanced.

43 rendered abortive by the king of Prussia;

Thus the king of Prussia's affairs seemed to be pretty well retrieved, when by one fatal piece of negligence he was brought to the verge of ruin. M. Daun had possessed himself of an advantageous camp at Stolphen, by which he preserved a communication with the army of

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of the empire. On the other hand, the king of Prussia, having taken possession of an important post at Bautzen, extended his right wing to the village of Hochkirchen, by which he preserved a communication with his brother Prince Henry, protected Brandenburg, and was better situated than he could be anywhere else for throwing succours into Silesia. The two armies kept a watchful eye on the motions of each other; and as the principal aim of M. Daun was to cut off the king's communication with Silesia, and of the king to cut off M. Daun's communication with Bohemia, a battle seemed inevitable, though great danger seemed to await that party who should begin the attack.

44
Who is surprised and defeated at Hochkirchen.

In this critical posture of affairs, the Austrian general formed a design of attacking the Prussian camp in the night. In what manner he came to surprise such a vigilant enemy has never been accounted for; but that such a surprise was actually accomplished on the 14th of October, is certain. In the dead of the preceding night, the Austrian army began to march in three columns towards the camp of the king of Prussia; and though the night was exceedingly dark, and they had a considerable way to go, they all arrived at the same time, in safety, without being discovered, aud without the least confusion; and at five in the morning began a regular and well-conducted attack. The Prussians were in a moment thrown into confusion; Marshal Keith, one of their best generals, received two musket-balls, and fell dead on the spot. Prince Francis of Brunswick had his head shot off by a cannon-ball as he was mounting his horse; and every thing seemed to announce the total destruction of the army. Still, however, the king preserved his wonderful presence of mind, which indeed he never appears to have lost on any occasion. He ordered some detachments from his left to support his right wing; but the moment that these orders were received, the left itself was furiously attacked. General Ketzow, who commanded in that quarter, repulsed the Austrians with difficulty, and was not able to afford any considerable assistance to the right; which alone was obliged to sustain the weight of the grand attack. The Austrians, in the beginning of the engagement, had driven the Prussians out of the village of Hochkirchen; and as the fate of the day depended on the possession of that post, the hottest dispute was there. The Prussians made three bloody and unsuccessful attacks on the village; on the fourth they carried it; but the Austrians continually pouring in fresh troops, at last drove them out with prodigious slaughter on all sides. The king then ordered a retreat, which was conducted in good order, without being pursued; however, this bloody action cost him 7000 men, together with a great number of cannon. The Austrians computed their own loss at 5000.

His Prussian majesty, having thus happily escaped such imminent danger, took every possible measure to prevent the enemy from gaining any considerable advantage from his defeat. Perceiving that the only advantage they wished to derive from it was to cover the operations of their armies in Silesia, and that he had now nothing to fear on the side of Saxony, he largely reinforced his own army from that of Prince Henry, and hastened into Silesia, in order to raise the siege of Neiss, which had been completely invested on the 4th of October. On the 24th of that month, therefore, he quitted his camp, and making a great compass to avoid obstructions from the enemy, arrived in the plains of Gorlitz. A body of the Austrians had in vain attempted to secure this post before him, and some who arrived after him were defeated with the loss of 800 men. From this place the king pursued his march with the utmost diligence; but was followed by General Laudohn, at the head of 24,000 men, who constantly hung on his rear, and harassed his army. The king, however, knowing the importance of his expedition, continued his march without interruption, and suffered his antagonist to obtain many little advantages without molestation. Daun, however, not content with the opposition given by Laudohn, sent a large body of horse and foot by another route to reinforce the generals Karsch and De Ville, who had formed the siege of Neiss and the blockade of Cosel, while he himself passed the Elbe, and advanced towards Dresden.

All these precautions, however, were of little avail. The generals Karsch and De Ville, notwithstanding their reinforcement, no sooner heard of the king of Prussia's approach, than they raised the siege of both places, and retired, leaving behind them a considerable quantity of military stores. The end of the Prussian monarch's march being thus accomplished, he instantly returned by the same way he came, and hastened to the relief of Saxony, the capital of which (Dresden) was in great danger from Marshal Daun. The place was but indifferently fortified, and garrisoned only by 12,000 men; so that it could not promise to hold out long against a numerous and well-appointed army. It was besides commanded by a large suburb, of which, if once the enemy got possession, all defence of the city must then be vain. For this reason M. Schmettau, the Prussian governor, determined to set these suburbs on fire, which was actually done November 10th, with an incredible loss to the inhabitants, as in the suburbs were carried on most of those valuable manufactures which render the city of Dresden remarkable. This disappointed the designs of M. Daun; but, though the action was agreeable to the laws of war, and had been executed with all the caution and humanity of which such an action was capable, yet the Austrians exclaimed against it as a piece of the most unprovoked and wanton cruelty recorded in history.

45
Suburbs of Dresden burnt.

46
Saxony oppressed by the king of Prussia.

After the king of Prussia had approached Dresden, all the Austrian armies retired into Bohemia, where they took up their winter-quarters, as the king of Prussia did in Saxony. This unhappy country he said he would now consider as his own by right of conquest. But instead of treating the conquered people as his lawful subjects, he oppressed them in all possible ways, by levying the most severe and exorbitant contributions, surrounding the exchange with soldiers, and confining the merchants in narrow lodgings on straw-beds, till they drew upon their correspondents for such sums as he wanted.

In 1759, as early as the 23d of February, the Prussians commenced their military operations. General Wobersow marched with a body of troops into Poland, where he destroyed several very large magazines belonging to the Russians, and returned into Silesia without any loss on the 18th of April. In the mean time, by some movements of the king of Prussia himself, the greatest part of the Austrian troops had been drawn

drawn towards the frontiers of Silesia. Prince Henry immediately took advantage of this opening, and on the 15th of April entered Bohemia with his army divided into two columns. One, commanded by himself, marched towards Peterswade; the other, under General Hulsen, passed by the towns of Pasberg and Commottau. That commanded by Prince Henry himself penetrated as far as Loboschutz and Leitmeritz; the enemy flying everywhere before them, and burning or abandoning the vast magazines which they had amassed in these parts. The body under General Hulsen had a more active employment. A strong pass at Pasberg was defended by a considerable body of Austrians. General Hulsen, having conducted his cavalry by another way in such a manner as to fall directly on their rear, attacked them in front with his infantry, drove them out of their intrenchments, and totally defeated them with the loss of a great number killed, and 2000 taken prisoners, while that of the Prussians did not exceed 70 in killed and wounded. After this exploit they returned into Saxony, with hostages for the contributions which they had largely exacted during the course of their expedition.

47 Bohemia invaded by Prince Henry.

48 A body of Austrians defeated by General Hulsen.

Some other successes obtained by Prince Henry cleared the country of Franconia of his enemies; but now the approach of the Russians seemed once more to bring the affairs of the king of Prussia to a crisis. Notwithstanding the destruction of their magazines, they had continued to advance into Silesia, where they were opposed by Count Dohna; but as the troops he had with him were very far inferior to his enemies, he found it impossible to do more, at least with any appearance of success, than to observe their motions and harass them on their march. But this was so displeasing to the king, that he disgraced his general, and appointed Wedel to succeed him, with orders to attack the Russians at all events. To enable him, however, in some measure to comply with this desperate order, he sent him some reinforcements, which brought his army up to near 30,000. With these, on the 23d of July 1759, General Wedel attacked 70,000 Russians posted in the most advantageous manner at Zulichau, and defended by a numerous artillery. Though the Prussians marched on to certain destruction and disgrace, they sustained the attack for a long time with unparalleled resolution. At last, however, they gave way, and were obliged to retire with the loss of 4700 killed or taken prisoners, and 3000 wounded.

49 Prussians defeated at Zulichau.

50 The Russians take Crossen and Frankfort on the Oder.

The consequences of this victory were, that the Russians penetrated into the king's territories, and took possession of the towns of Crossen and Frankfort on the Oder, which made it absolutely necessary for the king to come in person to oppose them. Accordingly, on the 4th of August, he joined Wedel with a considerable body of forces, having left the greatest part of his army in Saxony under Prince Henry. But as Marshal Daun had sent a body of 12,000 horse and 8000 foot under General Laudohn to the assistance of the Russians, the king still found himself unable to fight them; as, with this and some other reinforcements, their army now amounted to upwards of 90,000. He therefore recalled General Finck, whom he had sent into Saxony with 9000 men; but with all his reinforcements, it was found impossible to augment his army to 50,000 complete. His situation, however, was now so critical that a battle was unavoidable; and therefore, on the 12th of August, with this inferiority of number, the king attacked his enemies strongly intrenched, and defended by a prodigious number of cannon. In this action, his principal effort was against the left wing of the Russian army. He began the attack, according to custom, with a heavy cannonade; which having produced the desired effect, he attacked that wing with several battalions disposed in columns. The Russian intrenchments were forced with great slaughter, and 72 pieces of cannon were taken. But still there was a defile to be passed, and several redoubts which covered the village of Cunnersdorf to be mastered. These were attacked with the same resolution, and taken one after another. The enemy made another stand at the village, and endeavoured to preserve their ground there by pushing forward several battalions of horse and foot: but this also proved unsuccessful; they were driven from post to post quite to the last redoubts. For upwards of six hours the Prussians were successful, and everywhere broke the enemy with prodigious slaughter; drove them from almost all the ground they had occupied before the battle, took more than half their artillery, and scarce any thing seemed wanting to make the victory complete. In these circumstances, the king wrote the following billet to the queen: "Madam, we have beat the Russians from their intrenchments. In two hours expect to hear of a glorious victory." Of this victory, however, he deprived himself, by an excessive eagerness for conquest. The enemy, defeated almost in every quarter, found their left wing, shattered as it was, to be more entire than any other part of their army. Count Soltikoff, the Russian general, therefore, assembled the remains of his right wing, and, gathering as many as he could from his centre, reinforced the left, and made a stand at a redoubt which had been erected on an advantageous eminence in a placed called *the Jews burying-ground*. All the king's generals are said to have been of opinion that he ought to allow the Russians the peaceable possession of this post. Their army had already suffered so much, that it would have been impossible for them to have attempted any enterprise of consequence after the battle; but their artillery was still numerous, the post very strong, and the Prussian troops greatly fatigued. These reasons for a few moments had some weight with the king; but the natural impetuosity of his temper getting the better of his reason, he led on his wearied troops again and again; till at last, when their strength was in a manner totally exhausted, they were attacked and utterly routed by the Austrian and Russian cavalry, the former of which had hitherto remained quite inactive, and were therefore quite fresh, and irresistible by the enfeebled Prussians. The night, and the prudent use of some eminences, prevented the total destruction of the army; however, their loss amounted to 20,000 men killed and wounded. The king, when he found the victory totally lost, sent another billet to the queen, expressed in the following manner: "Remove from Berlin with the royal family; let the archives be carried to Potsdam; the town may make conditions with the enemy."

51 King of Prussia defeated by the Russians at Cunnersdorf.

Immediately after this defeat, the king set himself about repairing his losses with the utmost diligence. In a few days every thing was again put in order in his camp.

Prussia.

camp. He replaced his artillery from Berlin; recalled General Kliest with 5000 men from Pomerania; detached 6000 from his own army to the defence of Saxony; and with the remainder put himself between the Russsians and Great Glogau, covering that city which had been the chief object of their designs; and in short, notwithstanding their victory, obliged them to return to Poland without accomplishing any thing besides the carnage at Cunnersdorff.

The misfortunes of the Prussian monarch, however, were not at an end. Prince Henry, indeed, by a most extraordinary and well-conducted march, entered Saxony, which was now totally overrun by the armies of the enemy. At the same time, strong detachments having been sent into that country under generals Finck and Wunsch, the whole was in a short time recovered except Dresden. Towards this place Marshal Daun retired, and in all probability would soon have been obliged to leave Saxony entirely. But the king's impatience could not be satisfied without cutting off his retreat, and forcing him to a battle; for which purpose he sent General Finck with upwards of 12,000 men according to the Prussian account, but 20,000 according to the Austrians, to seize some passes through which M. Daun could only take his route towards Bohemia.

52
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This commission was executed with great exactness; but the Prussian general, having probably advanced too far into these defiles, and neglected to preserve a communication with the main army, gave his enemy an opportunity of surrounding him, and at last forcing him and his whole army to surrender prisoners of war. This disaster was soon after followed by another. General Durceke was posted at the right of the Elbe, opposite to Messen; but on the approach of a large body of Austrians, they prepared to retreat over the river into a place where they hoped to be more secure. But having been obliged by an hard frost to withdraw their bridge of boats, a thaw supervened, when they attempted to lay a bridge of pontoons, so that they were again obliged to have recourse to their boats. In this situation, their rear-guard was attacked with great fury by the Austrians, and all the soldiers who composed it killed or taken. The loss of the Prussians on this occasion was computed at 3000 men.

The year 1760 showed the Prussian monarch in a more dangerous situation than he had ever yet experienced.

53
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Indeed his affairs now seemed to be altogether desperate. His losses were not to be measured by the number of the killed or prisoners, but by armies destroyed or taken. Forty generals had died or been killed in his service since the beginning of October 1756, exclusive of those who were wounded or taken prisoners. This of itself would have been an irreparable loss, had not the very wars which destroyed these furnished others equally capable of filling their places. But another deficiency, which could not be remedied, still remained.—The king had, by his indefatigable industry and exertions, supplied all the deficiencies of men in his armies, but they were not the same men as before. The hardy veterans, with whom he had originally taken the field, were now no more, and their places were supplied by others who had neither the same experience nor discipline; so that now he was obliged to supply this deficiency by his own genius and heroism.

But whatever abilities the Prussian monarch might possess, and though he undoubtedly exerted them to the utmost, it seemed only to be contending against fate, and his enemies gained still greater and greater advantages. General Laudohn, with whom none but the king himself seems to have been able to cope, by a series of artful movements, drew into a disadvantageous situation M. Fouquet, one of the Prussian generals, with a strong body of forces. Perceiving it impossible for them to escape, Laudohn then made a violent attack on their entrenchments in the dead of the night of June 23d. The Prussians made a gallant defence, but at last were all killed or taken prisoners except about 300. Of the Prussians were killed 4000, and 7000 taken prisoners; 58 pieces of cannon, and a great number of colours, were also lost. The victory, however, was dear bought; for the Austrians lost above 12,000 men in killed and wounded; whom, however, they could better spare than the Prussians, on account of their numbers.—This action was called the *battle of Landshut*.

54
Prussians
defeated at
Landshut.

Baron Laudohn failed not to improve this victory to the utmost. He instantly turned back from Landshut, and fell upon the city of Glatz; which he took in a very short time, with the garrison who defended it, consisting of 2000 men. In this place were found 101 pieces of brass cannon, with immense quantities of provisions and military stores. From thence he marched against Breslau, and immediately invested it. But, in the mean time, the king of Prussia, whose motions had been all this time counteracted by M. Daun in Saxony, marched with his usual rapidity towards Silesia. By this means he drew M. Daun out of Saxony; and indeed the Austrian general used such expedition, that he gained two full days on the king. This was no sooner known to his Prussian majesty, than he returned with the same expedition that he had advanced, and sat down before Dresden. Of this M. Daun soon received intelligence, and returned also. In the mean time, however, the buildings of the city were terribly shattered by the king's cannon and bombs which continually played on it. His endeavours, however, proved ineffectual to reduce it before the arrival of M. Daun. The siege had been begun on the 13th of July, and on the 19th M. Daun appeared within a league of Dresden. The Prussians then redoubled their efforts. They had that day received reinforcements of heavy cannon and mortars, with which they battered the place incessantly. The cathedral church, New Square, several principal streets and some palaces, and the noble manufactory of porcelain, were entirely destroyed. The siege was continued till the 22d; but, on the night of the 21st, M. Daun had thrown 16 battalions into the city; which rendered it impossible for the king to continue longer before it with any prospect of success. He therefore raised the siege, and retired without molestation, though there were three considerable armies of the enemy in the neighbourhood. Breslau was fiercely bombarded by Laudohn, but the approach of Prince Henry obliged him to desist from his enterprise on the 5th of August.

55
Glatz taken by the Austrians.

56
Dresden besieged, but without success, by the king of Prussia.

But, in the mean time, the fortune of the king seemed likely to be terminated by one fatal stroke. Finding it impossible for him to carry on a defensive war, he marched towards Silesia with such astonishing rapidity,

Prussia.

57 Three Austrian generals join their forces against him.

pidity, that before the middle of August he had advanced 200 miles, leaving Marshal Daun with his army far behind him. This expedition he undertook in order to engage General Laudohn before he could have time to effect a junction with Daun and Lacy, another Austrian general; which triple union seemed to threaten him with unavoidable destruction at once. This, however, he found it impossible to prevent: and the three armies, when joined, formed a most tremendous line of encampments, extending no less than 30 English miles; at the same time that every one of their posts was strong, and the communication between them easy. The king was strongly encamped at Lignitz; and for several days employed all his military skill in attempting to induce one of the bodies to detach itself from the rest, or to attack them at some disadvantage; but without effect. At last, the Austrian generals, having maturely weighed all circumstances, resolved to attack the king's camp itself, strong as it was; and Marshal Daun, remembering the advantage he had gained at Hochkirchen by an attack in the night-time, resolved to follow the same plan now. The plan therefore was laid in the following manner. The whole army, as soon as it should begin to grow dark, was to march from their several posts to such situations as were marked out for each corps: they were to strike their tents, but yet to keep up the fires in their camps, and to have the drums beat the tattoo as usual, by which means they had a probability of surprising the enemy; or if not, they judged it absolutely impossible for him to escape them, though he should be ever so much on his guard. In what manner the king of Prussia became acquainted with this plan, is not known. His friends attributed it to his own penetration and knowledge of the stratagems of war; the Austrians, to intelligence given him by deserters. But, in whatever way he became acquainted with this design, it is certain that he took the most effectual methods of preventing it. As the Austrian plan was to surround his camp, and this could not be done without the division of their army which he had so long desired, he resolved to intercept one of the parties; and if that should be disabled from acting, he could then more easily deal with the other two. Therefore, in the very evening calculated for the decisive attack on his camp, he quitted it with the utmost privacy, and took an advantageous post on the road through which General Laudohn was to pass. The nature of this post was such, that at the same time that it stopped the progress of Laudohn in front, Daun would lie under great difficulties if he should attempt his rear; at the same time that, for his further security, the king strengthened the rear with several batteries. As soon as his army was drawn up, he divided it; leaving his right on the ground where it had been formed, to observe Marshal Daun, and to maintain that post; whilst with his left he turned in order to fall on the corps under General Laudohn. In the mean time, that commander, ignorant of the fate which was awaiting him, advanced with the utmost expedition towards the place which had been assigned him, in order to share in the glory of destroying the Prussian monarch; when, at three in the morning, on the 15th of August, a thick fog which covered the ground, suddenly clearing up, discovered, like the opening of a great scene, the dreadful front of the Prussian army regularly embattled, and advantageously posted. Laudohn, though surprised, made the best dispositions that circumstances would admit of, and an obstinate engagement ensued; in which, however, he was at last obliged to yield to the superior skill of his adversary, with the loss of 10,000 killed, wounded, and prisoners, 82 pieces of cannon, and 23 pair of colours.

Prussia.

58 He defeats General Laudohn and intimidates the Russians.

The victory, though complete, gave but a partial relief to the king of Prussia. The most essential service it did was the preventing of the Russians from joining those enemies which he already had. Count Czernichew had been advancing with 24,000 men, and had even passed the Oder; but was so intimidated by this news, that he instantly repassed that river on the same bridges which he had lately built, even though M. Daun sent him a strong body of troops in order to encourage him to advance. Soon after this battle, the king joined his brother Prince Henry at New Marche, and marched against Daun, who had begun to form the blockade of Schweidnitz; fell upon a corps under General Beck, made two battalions of Croats prisoners, and dispersed the rest, which obliged the enemy to abandon the enterprise they had just undertaken. About the same time, General Hulsen gained a considerable advantage over the Imperial army in Saxony, with very trifling loss on his part, by which he effectually prevented them fnom cutting off his communication with the city of Torgau.

By these successes the affairs of his Prussian majesty seemed to revive: but there was no end of his enemies. The late manœuvres had drawn him so far into Silesia, that his communication with Brandenburg was almost wholly cut off. The Russian army, which after it had repassed the Oder began to move out of Silesia, sent forward a powerful detachment under Count Czernchew towards the marche of Brandenburg. A body of 15,000 Austrians, under the generals Lacy and Brentano, and the whole united body of Austrians and Imperialists which acted in Saxony, began their march in concert with the Russians, and proposed to unite at the gates of Berlin. These armies amounted to 40,000 men. To oppose this formidable power, General Hulsen called to his assistance General Werner, who had been sent with a body of troops into Pomerania; but, after being joined by him, their united forces were found not to exceed 15,000 or 16,000 men. To attempt a defence of the capital with this force would have been little short of madness: and therefore these commanders were obliged to leave Berlin to its fate;

59 Berlin taken by the Austrians and Russians.

which indeed, considering the barbarity of the Russians and the animosity of the Austrians, seemed to be a dreadful one. However, by the powerful mediation of several foreign ministers, the town obtained terms which were not altogether intolerable; but the magazines, arsenals, and founderies were destroyed, and an immense quantity of military stores seized, with a number of cannon and other arms. The city was first obliged to pay 800,000 guilders, after which a contribution of 1,900,000 crowns was laid on: yet, notwithstanding this, many violences were committed, and the king's palace was plundered and the furniture abused in a scandalous army.

The combined armies staid in Berlin only four days; dreading the severe vengeance of the king of Prussia, who

Prussia.

60 Extreme embarrassment of the king.

who they heard was advancing towards that place with great expedition. But so great were the embarrassments which now attended that monarch, that it seemed almost beyond human power to retrieve his affairs. The Imperialists, on their return from Berlin, having no army to oppose them, made themselves masters of Leipsic, Torgau, Meissen, and Wirtemberg; (in which last city they found the grand magazine of the Prussians immensely stored with provisions, ammunition, &c. M. Stainville also, with a detachment from Broglio the French general's army, laid the city and duchy of Halberstadt under contribution. In Eastern Pomerania, the Russians had besieged Colberg by sea and land. In the Western Pomerania, the Swedes advanced with great celerity, hoping to share in the plunder of Berlin. In Silesia, the king no sooner began his march to the northward, than Laudohn advanced, and laid siege to the important fortress of Cosel; and, to complete this distress and embarrassment, the king himself was attended at every step by Count Daun with a superior army well prepared to take every advantage.

In this desperate situation the king, being joined by his generals Hulsen and Prince Eugene of Wirtemberg with the corps under their command, advanced up the Elbe, while M. Daun fell back to cover Leipsic and Torgau, but the latter finding that the Prussians directed their march towards the Elbe, encamped within reach of Torgau; one part of his army extending to the Elbe, by which he was covered on that side, whilst on the other he was covered by hills and woods, so that it was impossible to choose a more advantageous situation. The Prussian army did not amount to 50,000 men, whilst that of the Austrians exceeded 86,000: yet such were the unfortunate circumstances of the king, that he was obliged to fight under all these disadvantages; and therefore he caused his army to be informed, that he was now to lead them to a most desperate attempt, that his affairs required it, and that he was determined to conquer or die. His soldiers unanimously declared that they would die with him.

61 He defeats Count Daun at Torgau.

The 3d of November 1760 was the day on which this important affair was decided. The king divided his forces into three columns. General Hulsen was to take post with one in a wood that lay on the left of the Austrian army, and had orders not to move until he found the rest of the Prussians engaged. General Ziethen was to charge on the right; and the great attack in front was to be conducted by the king in person. His forces were disposed in such a manner, that either his right or left must take the enemy in rear and close them in, so as to disable them from undertaking any thing against the part where he intended to effect his principal attack. On the other hand, M. Daun perceiving the king to be serious in his design of fighting, to prevent confusion, sent all his baggage over the Elbe, across which he threw three bridges in case a retreat should be necessary. At the same time he caused Torgau to be evacuated; and then, extending his first line to a village called *Zinne* on the left, he stretched it to another called *Croswitz* on the right; supporting the right of his second line upon the Elbe. In this disposition he was found, when, about two o'clock in the afternoon, the king began his attack. He was received by the fire of 200 pieces of cannon, which, were disposed along the Austrian front. The Prussians were thrice led on to the attack; but were every time repulsed and broken with terrible slaughter. The king at length commanded a fresh body of cavalry to advance, which at first compelled the Austrians to retire; but new reinforcements continually coming in, this cavalry was in its turn obliged to fall back, and the Prussians maintained themselves with extreme difficulty, until General Ziethen, with the right wing, attacked the enemy in the rear, repulsed them, and possessed himself of some eminences which commanded the whole Austrian army. Encouraged by this success, the Prussian infantry once more advanced, mastered several of the enemy's intrenchments, and made way for a new attack of their cavalry, which broke in with irresistible fury on the Austrians, and threw several bodies of them into irreparable disorder. It was now about 9 o'clock, and of consequence both armies were involved in thick darkness; yet the fire continued without intermission, and the battalions with a blind rage discharged at one another without distinguishing friend from foe. M. Daun received a dangerous wound in the thigh, and was carried from the field, which probably hastened the defeat of his troops. The command then devolved on Count O'Donnel; who, finding the greatest part of his troops in disorder, the night advanced, and the enemy possessed of some eminences which commanded his camp, and from which it was in vain to think of driving them, ordered a retreat, which was conducted with wonderful order and exactness; none were lost in passing the bridges, and by far the greater part of their artillery was preserved. The loss of the Prussians was estimated at 10,000 killed and wounded, and 3000 taken prisoners. That of the Austrians in killed and wounded is not known; but 8000 were taken prisoners, with 216 officers, among whom were four generals.

62 All Saxony except Dresden recovered.

The consequence of the victory of Torgau was, that the king recovered all Saxony except Dresden; and in the mean time General Werner having marched into Pomerania, the Russians raised the siege of Colberg, and retired into Poland, without having effected any thing further than wasting the open country. Werner then flew to the assistance of Western Pomerania, where he defeated a body of Swedes, and at last drove them totally out of the country. General Laudohn too abruptly raised the blockade of Cosel; and afterwards, abandoning Landshut, he retired into the Austrian Silesia, leaving the Prussian part entirely in quiet. M. Daun placed one part of his army in Dresden, and the other in some strong posts which lie to the south and west of it, by which he commanded the Elbe, and preserved his communication with Bohemia. The army of the empire retired into Franconia, and placed its headquarters at Bamberg.

Though these successes had, to appearance, retrieved the king's affairs in some measure, yet his strength seemed now to be wholly exhausted; and in the campaign of 1761, he made no such vigorous efforts as he had formerly done. The Russians, dividing themselves into two bodies, invaded Silesia and Pomerania. In the former country they laid siege to Breslau, and in the latter to Colberg. Tottleben also, who had commanded the Russian armies, was now removed on a suspicion that he had corresponded with the king of Prussia, and General Romanzow put in his place; by which it was

 expected

expected that the Russian operations would be more brisk this year than formerly.

The king continued strongly encamped near Schweidnitz; where he was so closely watched by generals Daun and Laudohn, that he could attempt nothing. However, he defeated the designs of the Russians against Breslau, by sending General Platen to destroy their magazines; which he accomplished with great success, at the same time cutting off a body of 4000 of their troops. But this only brought the more sure destruction upon Colberg; to which place that body of Russians immediately marched, cruelly wasting the country as they went along. The king of Prussia could do nothing but send detachments of small parties, which, though they could not oppose their enemies in the field, yet he hoped, by cutting off the convoys of the enemy, might distress them to such a degree as to oblige them to abandon the siege, or at least protract it till the severity of the winter should render it impossible for them to carry on their operations. Thus he weakened his own army so much, that it was found requisite to draw 4000 men out of Schweidnitz in order to reinforce it; and no sooner was this done, than General Laudohn suddenly attacked and took that fortress by a coup de main. Colberg made a brave defence; but the troops sent to its relief being totally unable to cope with the Russian army, consisting of 50,000 men, it was obliged to surrender on the 3d of December; and thus the fate of the Prussian monarch seemed to be decided, and almost every part of his dominions lay open to the invaders.

63
Schweidnitz and Colberg retaken.

64
Empress of Russia dies.

In the midst of these gloomy appearances the empress of Russia, the king's most inveterate and inflexible enemy, died on the 2d of January 1762. Her successor, Peter III. instead of being the king's enemy, was his most sanguine friend. As early as the 23d of February, in a memorial delivered to the ministers of the allied courts, he declared, that, "in order to the establishment of peace, he was ready to sacrifice all the conquests made in this war by the arms of Russia, in hopes that the allied courts will on their parts equally prefer the restoration of peace and tranquillity, to the advantages which they might expect from the continuance of the war, but which they cannot obtain but by a continuance of the effusion of human blood."—This address was not so well relished by the allies: however, they were very willing to make peace, provided it was for their own interest; but they recommended to his attention fidelity to treaties, which constitutes a no less valuable part of the royal character, than humanity and disinterestedness. This answer made no impression on the czar; a suspension of hostilities took place on the 16th of March, which was followed by a treaty of alliance on the 5th May. In this treaty the czar stipulated nothing in favour of his former confederates; on the contrary, he agreed to join his troops to those of the king of Prussia, in order to act against them. Sweden, which had for a long time acted under the direction of Russian counsels, now followed the example of her mistress, and concluded a peace with Prussia on the 22d of May.

65
Peace between Russia, Sweden, and Prussia.

66
Successes of the king of Prussia.

It is not to be supposed that the king of Prussia would remain long inactive after such an unexpected turn in his favour. His arms were now everywhere attended with success. Prince Henry drove the Imperialists from some important posts in Saxony, by which he secured all that part which the Prussians possessed; and though the Austrians frequently attempted to recover these posts, they were constantly repulsed with great slaughter. The king was not joined by his new allies till the latter end of June; after which he drove M. Daun before him to the extremity of Silesia, leaving the town of Schweidnitz entirely uncovered, and which the king immediately prepared to invest. In the mean time, different detachments of Prussians, some on the side of Saxony, and others on that of Silesia, penetrated deep into Bohemia, laid many parts of the country under contribution, and spread an universal alarm. A considerable body of Russian irregulars also made an irruption into Bohemia, where they practised on the Austrians the same cruelties which they had long been accustomed to practise on the Prussians.

67
A new revolution in Russia.

But while the king was thus making the best use of his time, he was all at once threatened with a fatal reverse of fortune by a new revolution in Russia. The emperor was deposed, and his deposition was soon after followed by his death. The empress, who succeeded him, suspected that her husband had been misled by the counsels of his Prussian majesty, against whom, therefore, she entertained a mortal enmity. She could not, however, in the very beginning of her reign, undertake again a war of so much importance as that which had been just concluded. She therefore declared her intention of observing the peace concluded by the late emperor; but, at the same time, of recalling her armies from Silesia, Prussia, and Pomerania; which indeed the unsettled state of the kingdom now made in some degree necessary. At the same time a discovery was made with regard to the king of Prussia himself, which turned the scale greatly in his favour. The Russian senate, flaming with resentment against this monarch, and against their late unfortunate sovereign; and the empress, full of suspicion, that the conduct of the latter might have been influenced by the counsels of the former, searched eagerly amongst the papers of the late emperor for an elucidation or proofs of this point. They found indeed many letters from the Prussian monarch, but in a strain absolutely different from what they had expected. The king had, as far as prudence would permit, kept a reserve and distance with regard to the too rash advances of this unhappy ally; and, in particular, counselled him to undertake nothing against the empress his consort. The hearing of these letters read is said to have had such an effect upon the empress, that she burst into tears, and expressed her gratitude towards the Prussian monarch in the warmest terms. Still, however, the Russian army was ordered to separate from the Prussians; but all the important places which the former had taken during the whole war were faithfully restored.

The king, finding that the Russians were no more to take an active part in his favour, resolved to profit by their appearance in his camp; and, therefore, the very day after the order for their return had arrived, he attacked the Austrian army, and drove their right wing from some eminences and villages where they were advantageously posted; by which means he entirely cut off their communication with Schweidnitz, so that nothing could be attempted for its relief. Prince Henry kept them in continual alarms for Bohemia; and a

great

Prussia.

68 General Laudohn utterly defeated.

great part of their attention, and no small part of their forces, were engaged on that side. Marshal Daun, now finding himself rendered almost incapable of undertaking any thing, detached General Laudohn, with a force very much superior, to attack the prince of Bevern, and drive him from the advantageous post he occupied. But the prince defended himself with such resolution, that all the efforts of Laudohn could not succeed before the king had time to come to his assistance. The Austrians, being then put between two fires, were routed and pursued with terrible slaughter; after which, the king met with no more disturbance in his preparations for the siege, and the trenches were opened on the 18th of July. Marshal Daun made no attempts to relieve the place; but the garrison being very strong, it held out for near two months from the opening of the trenches. It is said that the attack was conducted, and the defence made, by two engineers who had written on the subject of the attack and defence of fortified places; and they were now practically engaged to prove the superiority of their systems. At last, however, the garrison, to the number of 8000 men, surrendered prisoners of war; and the whole body, except nine, were soon after drowned at the mouth of the Oder, on their passage to their intended confinement in Konigsberg.

69 The total defeat of the Austrians at Freyberg produces a peace.

The king of Prussia, now become master of Schweidnitz, turned his attention towards Saxony, where he considerably reinforced his brother's army, and made preparations for laying siege to Dresden. In this country the Austrians had lately met with some success, and driven Prince Henry as far back as Freyberg; but on the 29th of October, they were attacked by the Prussian army thus reinforced, and totally routed. Great numbers were slain, and near 6000 taken prisoners. This victory proved decisive: and the empress-queen, finding herself deserted by all her allies, was glad to conclude a treaty, the substance of which was, that a mutual restitution and oblivion should take place, and both parties sit down at the end of the war in the same situation in which they began it. This treaty is called the *peace of Hubertsburg*.

The war was no sooner concluded than the king of Prussia turned his attention to domestic policy, and the recovery of his dominions from those innumerable calamities which had befallen them during the war. He immediately distributed lands to his disbanded soldiers, and gave them the horses of his artillery to assist them in their cultivation. By his wise and prudent management, the horrors of war were soon forgotten; and the country was quickly in as flourishing a state as ever. Notwithstanding this pacific disposition, however, the king never slackened his endeavours for the defence of his country, by keeping a respectable army on foot; which might be able to act on the least emergency.

70 A new war commences, but produces no memorable event.

In the year 1778, a new difference with the house of Austria took place, concerning the duchy of Bavaria. But though the most enormous warlike preparations were made on both sides, and immense armies brought into the field, nothing of consequence was effected. What little advantage there was, seems to have been on the Prussian side, since they made themselves masters of several towns, and kept the war in the enemy's country. However, the emperor acted with so much caution, and showed so much skill in a defensive war, that all the manœuvres of his Prussian majesty could gain no material advantage; as, on the other hand, his adversary was too wise to venture an engagement. A peace therefore was very soon concluded, and since that time the history of Prussia, during the remainder of the great Frederic's reign, affords no remarkable event which we have not mentioned in the life of that hero, and the article POLAND. He left his crown to his nephew, whose character was not then much developed; and it was easily seen that a new kingdom, which had risen suddenly to such unexampled power and greatness as to excite the jealousy or apprehension of all its neighbours, would require great abilities to preserve it from dismemberment.

71 The great Frederic succeeded by his nephew.

72 State of the nation, and behaviour of the new king.

The late king had indeed bequeathed the most effectual securities to his successor for the preservation of his dominions, that human wisdom could provide or devise; by leaving him a full treasury, the finest army in the world, and a people enthusiastically attached to his memory and government. The new monarch, with these advantages, was not wanting to himself. The late king's predilection for the French language and French literature were not grateful to his subjects. The present sovereign began his reign with declaring in council, "Germans we are, and Germans I mean we shall continue;" giving directions, at the same time, that their native language should resume its natural rank and station, from which for near half a century it had been degraded by the French. This was a very popular measure, and it was followed by another still more so. Observing that he had marked with great concern the progress of impiety and profaneness on the one hand, and of enthusiasm on the other, he declared, that he would not have his subjects corrupted either by fanatics or atheists, and strictly prohibited all publications tending to excite a contempt or indifference for religion.

73 He assists the stadtholder against the states of Holland.

Such, on his immediate accession to the throne, was the pacific conduct of the monarch, which endeared him to his subjects, and commanded the approbation of all good men. An opportunity soon occurred, in which he was thought to have displayed such talents in negociation and in military arrangements, as proclaimed him in every respect a worthy successor of his uncle. The states of Holland, who had long been jealous of the power of the stadtholder, and inclined to a republican government without any permanent chief, had gained such an ascendency in the states general, that in 1786 and 1787 they in effect divested the Prince of Orange of all his prerogatives, (see UNITED *Provinces*). They proceeded even to the seizure and imprisonment of the princess, sister to the king of Prussia; and depending upon support from France, treated with insolence every power connected with them in Europe. The court of Berlin did not witness these proceedings without indignation; and the king formed his plan for restoring the power of the stadtholder with such secrecy and prudence, that perhaps nothing could surpass it but the bravery and military skill of the duke of Brunswick, by whom it was carried into execution. In the short space of one month, that accomplished general led 18,000 Prussians to Amsterdam, and restored the just prerogatives of the prince of Orange.

The affairs of Prussia during the early period of the French revolution, and the active but unsuccessful part which that monarch took against it, are interwoven with the

Prussia. the historical details of that period under the articles FRANCE and BRITAIN, to which we refer our readers. For a number of years he acted the prudent part of standing clear of hostilities as much as possible; and when he did at last interfere, we find little in his conduct which is intitled to the praise either of consistency or honour. Indeed it may perhaps be admitted, that on many occasions he acted rather from necessity than choice; and finding that a contest with France was both absurd and ruinous, he chose to sacrifice a less evil to a greater good. Whether by consent or compulsion is not certainly known, the king of Prussia ceded to France the duchies of Cleves and Berg, March 1806, which were to be governed by Prince Murat, the brother-in-law of Bonaparte, under the title of Joachim, duke of Cleves and Berg.

The king of Prussia likewise took possession of the Hanoverian states 30th October 1806, at the time when Great Britain had no reason to apprehend any such mysterious conduct from that quarter. He entered into a secret treaty with France for the purpose of shutting the northern ports; a measure which gave such offence to this country, that the British minister thought proper to take his leave of Berlin. At one period he came to a final determination to make no separate treaty with the French government, and proposed a treaty of peace and alliance between his court and that of Britain. To give this as much effect as possible, the Prussian princes of the blood began to raise volunteer regiments in Poland and Silesia, the loyalty of the peasantry in these countries far exceeding the most sanguine expectations.

So low, however, were the king of Prussia's finances at the time of Lord Hutchinson's arrival at Memel, March 1807, that his lordship found it necessary to advance 80,000l. for the support of his family and domestic household. This being intimated to the British ministers, his majesty recommended it to parliament to enable him to implement the agreement. Yet not long after this period he actually entered into a treaty of peace with the emperor of France, by virtue of which his territories were so dreadfully mutilated, as to leave him little more of a sovereign than the name. He was required to renounce the whole of his dominions situated between the Rhine and the Elbe; the circle of Cotbus in Lower Lusatia; nearly all the provinces which formerly constituted part of the kingdom of Poland; the city of Dantzic; and he was laid under the necessity of shutting all the ports and harbours of his whole dominions against the trade and navigation of Great Britain. Not above 18 months prior to this treaty, the king of Prussia might have been said to hold the fate of Europe in his hands; but by means of it he was reduced to the very lowest rank among the powers of Europe. Had he taken a decided part against France before the battle of Austerlitz, he might have been able to secure the independence of Europe; but, having suffered this auspicious moment to pass unimproved, the consequences were exactly such as might have been predicted, without any pretensions to uncommon sagacity.

The king of Prussia being thus degraded by means of his own imprudence and want of sound policy, endeavoured to ease the burdens of his remaining subjects by reducing his civil and military establishments. The army was reduced to 24,000 men, and General Knoblesdorf was sent to Paris to procure a diminution of the contributions exacted from him, or to crave that payments might be accepted of by instalments; and, in the mean time, the troops belonging to France were not to be withdrawn from the impoverished kingdom of Prussia. Every decree issued in Holland against the commerce of Great Britain, this humbled monarch was obliged to adopt, and to order the publication of them in every part of his mutilated dominions. Prussia.

In this state of degradation the Prussian monarchy continued till the extraordinary events of 1812. When Bonaparte made his irruption into Russia, Prussia was compelled to furnish a body of troops for the service, who formed part of the army under Macdonald. After the disastrous retreat of the French, the king made his escape from Potsdam, and retired to Silesia. He immediately called on his subjects to rise in arms for the defence of their country, without at first disclosing against whom he was to act. Great numbers of all ages joyfully obeyed the call. On the 22d February 1813, he entered into a treaty of alliance with Russia. The battle of Lutzen, however, on the 2d, and of Bautzen on the 20th May, threw discouragement on the rising hopes of the allies. But in August they were strengthened by the junction of Austria. The battle of Dresden was lost on the 26th of August; but from this time their affairs began to improve, and the victory of Leipsic, on the 16th October, turned the scale entirely in their favour. Prussia was now delivered entirely from French oppression; and her armies took a part in all the events that followed, to the peace of Paris in May 1814. When the war broke out again on Bonaparte's return, the Prussian armies performed essential services. The advance of Blucher in the afternoon gave a decisive turn to the battle of Waterloo.

By these successes Prussia not only recovered her former losses, but gained large additions of territory and population. She recovered the province of Posen in Poland, all her territories between the Elbe and the Rhine; and obtained besides, about one half of the king of Saxony's territories, and extensive districts on the south side of the Rhine. She acquired also Swedish Pomerania; and ceded East Friesland with some other districts to Hanover, and Anspach and Bayreuth to Bavaria. After these acquisitions and cessions, Prussia contained in 1819, 106,000 square English miles, and 10,065,000 inhabitants.

74 Air, soil, and population of Prussia.

The air of Prussia is wholesome, and the soil fruitful in grain; affording, besides, plenty of pitcoal and other fuel. The rivers and lakes are well stored with fish; and amber is found on its coast towards the Baltic. The principal rivers are the Vistula, Bregel, Memel, the Passarge, and the Elbe; all of which frequently do damage by their inundations.

Since the year 1719 it is computed that about 34,000 colonists have removed to Prussia from France, Switzerland, and Germany; of which number one half were Saltzburghers. These emigrants have built 400 small villages, 11 towns, 50 new churches, and founded 1000 village-schools. The manners of the people differ but little from those of the Germans. The established religions are those of Luther and Calvin, but chiefly the former; though almost all other sects are tolerated.

75 Commerce and manufactures.

The late king of Prussia, by the assistance of an excellent police, brought the commerce and manufactures of of this country to a very flourishing state, which during his life were daily improving. The manufactures of Prussia consist in glass, iron-work, paper, gunpowder, copper and brass-mills, manufactures of cloth, camblet, linen, silk, gold and silver lace, stockings, and other articles. The inhabitants export variety of naval stores, amber, lint-seed and hemp-seed, oat-meal, fish, mead, tallow, and caviar; and it is said that 500 ships are loaded with those commodities every year, chiefly from Koningsberg.

76 Constitution.

His Prussian majesty is absolute through all his dominions; but the late king was too wise to oppress his subjects, though he availed himself to the full of his power. The government of this kingdom is by a regency of four chancellors of state, viz. 1. The great-master; 2. The great-burgrave; 3. The great-chancellor; and, 4. The great-marshal. There are also some other councils, and 37 bailiwicks. The states consist, 1. Of counsellors of state; 2. Of deputies from the nobility; and, 3. From the commons. Besides these institutions, the late king erected a board for commerce and navigation.

77 Revenues.

His Prussian majesty, by means of the happy situation of his country, its inland navigation, and the excellent regulations of his predecessor, derives an amazing revenue from this country, which, about a century and a half ago, was the seat of boors and barbarism. It is said, that amber alone brings him in 26,000 dollars annually. His other revenues arise from his demesnes, his duties of customs and tolls, and the subsidies yearly granted by the several states. In 1815 the whole revenues of Prussia were estimated at seven millions sterling. See EUROPE, SUPPLEMENT.

78 Military strength.

The military regulations introduced by the late king had a wonderfully quick operation in forming his troops and recruiting his armies. Every regiment has a particular district assigned it, where the young men proper for bearing arms are registered; and when occasion offers, they join their regiment, and being incorporated with veterans they soon become well disciplined troops. The Prussian army, in the time of peace, consists of 250,000 of the best disciplined troops in the world; and during the last war, that force was augmented to 300,000 men.

79 Royal arms, &c.

The royal arms of Prussia are argent, an eagle displayed sable, crowned, or, for Prussia: azure, the Imperial sceptre, or, for Courland: argent, an eagle displayed, gules, with semicircular wreaths, for the marquisate of Brandenburg: to these are added the respective arms of the several provinces subject to the Prussian crown.

There are two orders of knighthood; the first, that of the Black Eagle, instituted by Frederic I. on the day of his coronation at Koningsberg, with this motto, *Suum cuique*. The sovereign is always grand-master; and the number of knights, exclusive of the royal family, is limited to 30. Next to this is the order of Merit, instituted by his late majesty; the motto is, *Pour le merite*.

PRUSSIAN BLUE. See PRUSSIATE OF IRON, CHEMISTRY *Index*.

PRUSSIC ACID. See CHEMISTRY *Index*.

PRYNNE, WILLIAM, an English lawyer, much distinguished in the civil commotions under Charles I. was born at Swainswick in Somersetshire in 1600. His *Histriomastix*, written against stage-plays in 1632, containing some reflections that offended the court, he was sentenced by the star-chamber to pay a fine of 5000l. to stand in the pillory, to lose his ears, and to perpetual imprisonment. During his confinement, he wrote several more books; particularly, in 1637, one entitled *News from Ipswich*, which reflecting severely on the bishops, he was again sentenced by the star-chamber to another fine of 5000l. to lose the remainder of his ears in the pillory, to be branded on both cheeks with S. L. for seditious libeller, and to be perpetually imprisoned in Caernarvon castle. Nothing but cutting off his hands could have prevented Prynne from writing: he wrote still; and in 1640, being set at liberty by the house of commons, he entered London in a kind of triumph, was elected into parliament for Newport in Cornwall, and opposed the bishops with great vigour, being the chief manager of Archbishop Laud's trial. In the long parliament he was zealous in the Presbyterian cause; but when the Independents gained the ascendency, he opposed them warmly, and promoted an agreement with the king. When the army garbled the house and refused him entrance, he became a bitter enemy to them and their leader Cromwell, and attacked them with his pen so severely, that he was again imprisoned: but he pleaded the liberty of the subject so successfully, that he was enlarged, to write more controversial books. Being restored to his seat after Cromwell's death, with the other secluded members, he assisted in promoting the restoration, and was appointed keeper of the Tower records; a place excellently well calculated for him, and where he was very useful by the collections he published from them. He presented 40 volumes of his works, in folio and 4to, to Lincoln's-inn library, of which society he was a member; and, dying in 1669, was buried under the chapel.

PRYTANES, in Grecian antiquity, were the presidents of the senate, whose authority consisted chiefly in assembling the senate; which, for the most part, was done once every day.

The senate consisted of 500, 50 senators being elected out of each tribe: after which, lots were cast to determine in what order the senators of each tribe should preside; which they did by turns, and during their presidentship were called *prytanes*. However, all the 50 prytanes of the tribes did not govern at once, but one at a time, viz. for seven days; and after 35 days, another tribe came into play, and presided for other five weeks; and so of the rest.

PSALM, a divine song or hymn; but chiefly appropriated to the 150 Psalms of David, a canonical book of the Old Testament.

Most of the psalms have a particular title, signifying either the name of the author, the person who was to set it to music or sing it, the instrument that was to be used, or the subject and occasion of it. Some have imagined that David was the sole author of the Book of Psalms; but the titles of many of them prove the contrary, as psalm xix. which appears to have been written by Moses. Many of the psalms are inscribed with the names *Korah*, *Jeduthun*, &c. from the persons who were to sing them.

PSALMANAZAR, GEORGE, the fictitious name of a pretended Formosan, a person of learning and ingenuity. He was born in France, and educated in a

free

free-school, and and afterwards in a college of Jesuits, in an archiepiscopal city, the name of which, as likewise those of his birth-place and of his parents, are unknown. Upon leaving the college, he was recommended as a tutor to a young gentleman; but soon fell into a mean rambling life which involved him in disappointments and misfortunes. His first pretence was that of being a sufferer for religion. He procured a certificate that he was of Irish extraction, that he left that country for the sake of the Catholic faith, and was going on a pilgrimage to Rome. Being unable to purchase a pilgrim's garb, and observing one in a chapel, dedicated to a miraculous saint, which had been set up as a monument of gratitude by some wandering pilgrims, he contrived to take both the staff and cloak away; and, being thus accoutred, begged his way in fluent Latin, accosting only clergymen or persons of figure; whom he found so generous and credulous, that, before he had gone 20 miles, he might easily have saved money, and put himself in a much better dress: but as soon as he had got what he thought was sufficient, he begged no more; but viewed every thing worth seeing, and then retired to some inn, where he spent his money as freely as he had obtained it. Having heard the Jesuits speak much of China and Japan, he started the wild scheme, when he was in Germany, of passing for a native of the island of Formosa; and what he wanted in knowledge, he supplied by a pregnant invention. He formed a new character and language on grammatical principles, which, like other oriental languages, he wrote from right to left with great readiness; and planned a new religion, and a division of the year into 20 months, with other novelties, to credit his pretensions. He was now a Japanese convert to Christianity, travelling for instruction, with an appearance more wretched than even that of common beggars. He then entered as a soldier in the Dutch service: but, still desirous of passing for a Japanese, he altered his plan to that of being an unconverted heathen; and at Sluys, Brigadier Lauder, a Scots colonel, introduced him to the chaplain, who, with the view of recommending himself to the bishop of London, resolved to carry him over to England. At Rotterdam, some persons having put shrewd questions to him, that carried the air of doubt, he took one more whimsical step, which was to live upon raw flesh, roots, and herbs; which strange food he thought would remove all scruples. The bishop of London patronized him with credulous humanity; and Psalmanazar found a large circle of friends, who extolled him as a prodigy. Yet were there some who entertained a just opinion of him, particularly the Drs Halley, Mead, and Woodward; but their endeavours to expose him as a cheat only made others think the better of him, especially as those gentlemen were supposed to be unfriendly to revelation. But in this instance at least, easiness of belief was no great evidence of penetration. He was employed to translate the church-catechism into the Formosan language, which was examined, approved, and laid up as a valuable MS.; and the author, after writing his well-known *History of Formosa*, was rewarded and sent to Oxford to study what he liked, while his patrons and opponents were learnedly disputing at London on the merits of his work. The learned members of the university were no better agreed in their opinions than those at London; but at length the sceptics triumphed. Some absurdities were discovered in his history, of such a nature as to discredit the whole narration, and saved him the trouble of an open declaration of his imposture; which however he owned at length to his private friends. For the remainder of his life, his learning and ingenuity enabled him to procure a comfortable support by his pen: he was concerned in several works of credit, particularly *The Universal History*. He lived irreproachably for many years, and died in 1763.

PSALMIST, in the church of Rome, one of the lesser ecclesiastical orders; the same with what among us is called *clerk*, *precentor*, or *singer*.

PSALMODY, the art or act of singing psalms. See PSALM.

Psalmody was always esteemed a considerable part of devotion, and usually performed in the standing posture: and as to the manner of pronunciation, the plain song was sometimes used, being a gentle inflexion of the voice, not much different from reading, like the chant in cathedrals; at other times more artificial compositions were used, like our anthems.

As to the persons concerned in singing, sometimes a single person sung alone; sometimes the whole assembly joined together, which was the most ancient and general practice. At other times the psalms were sung alternately, the congregation dividing themselves into two parts, and singing verse about, in their turns. There was also a fourth way of singing pretty common in the fourth century, which was, when a single person began the verse, and the people joined with him in the close: this was often used for variety, in the same service with alternate psalmody.

The use of musical intruments in the singing of psalms, seem to be as ancient as psalmody itself; the first psalm we read of being sung to the timbrel, viz. that of Moses and Miriam, after the deliverance of the Israelites from Egypt; and afterwards, musical instruments were in constant use in the temple of Jerusalem. See ORGAN.

PSALTER, the same with the book of psalms. See the article PSALM.

Among the religious in the Popish countries, the term *psalter* is also given to a large chaplet or rosary, consisting of 150 beads, according to the number of psalms in the psalter.

PSALTERY, a musical instrument, much in use among the ancient Hebrews, who called it *nebel*.

We know little or nothing of the precise form of the ancient psaltery. That now in use is a flat instrument, in form of a trapezium or triangle truncated at top: it is strung with 13 wire-chords, set to unison or octave, and mounted on two bridges, on the two sides: it is struck with a plectrum, or little iron rod, and sometimes with a crooked stick. Its chest or body resembles that of a spinet.

PSAMMETICUS, or PSAMMITICHUS, a renowned conqueror, who subduing 11 other petty kings of Egypt, became the founder of the kingdom of Egypt, about 670 B. C. He is memorable likewise for taking the city of Azot, after a siege of 29 years; and for discovering the sources of the river Nile. See EGYGT, N° 10.

PSATYRIANS, a sect of Arians, who, in the council of Antioch, held in the year 360, maintained that

Psatyrians | Pseudo.

that the Son was not like the Father as to will; that he was taken from nothing, or made of nothing; and that in God, generation was not to be distinguished from creation.

Enfield's History of Philosophy.

PSELLUS, MICHAEL, a learned Christian of the 11th century, was, by birth, a Constantinopolitan of consular rank, and flourished under the emperor Constantine Monomachus. His genius and industry raised him far above the level of his cotemporaries; and the female historian Anna Comnena speaks of him as one who had been more indebted for his attainments to his own excellent talent than to the instructions of his preceptors; adding, that having made himself master of all the wisdom of the Greeks and the Chaldeans, he was justly esteemed the most learned man of the age. Thus furnished, he became the chief instructor of the Constantinopolitan youth. He was at the same time the companion and the preceptor of the emperor, who was so captivated by the studies and amusements in which Psellus engaged him, that, according to Zonaras, he neglected the concerns of the empire. The Byzantine historians complain, that the emperor, deluded by the head of the philosophers (the title with which Psellus was honoured), lost the world. Meeting, towards the close of this life, with some disappointment, Psellus retired into a monastery, and soon afterwards died; the time of his death is uncertain. His works, which have been much celebrated, are, Commentaries upon Aristotle's Logic and Physics; a Compendium of Questions and Answers; and an Explanation of the Chaldean Oracles. The two latter works prove him to have been conversant, not only with Grecian, but with Oriental, philosophy.

PSEUDO, from ψευδος, a Greek term used in the composition of many words to denote *false* or *spurious*: as the pseudo-acacia, or bastard acacia; pseudo-fumaria, or bastard-fumitory; pseudo-ruta, or bastard-rue, &c.

We also say, a pseudo-apostle or false apostle; a pseudo-prophet, or false prophet, &c.

PSEUDO-China. See SMILAX.

PSEUDO-Galena, or *Black-Jack*. See ZINC, ORES of, MINERALOGY *Index*.

PSEUDO-Tinea, in *Natural History*, the name of a very remarkable species of insect described by M Reaumur, approaching to the nature of the *tinea*, or *clothes moth*, while in the worm-state, but not making themselves coats of the substance of leaves, cloth, &c. though they form a sort of cases for their defence against a very terrible enemy.

These creatures are of the caterpillar kind, and have, in the manner of many of these insects, 16 legs. They feed on wax, and for food enter the bee-hives; where they boldly engage the bees, and are not to be prevented by them from feeding, though at the expence of their habitations and the cells of their reservoirs of honey: so that it is no uncommon thing for a swarm of bees to be forced to change their place of habitation, and make new combs elsewhere; leaving the old ones to this contemptible victor, whom they know not how to drive out or dispossess.

Virgil and Aristotle, and all the authors who have written on bees, have complained of this destructive animal. It never eats the honey, but feeds only on the wax; attacking principally those waxy cells where the female bee deposits her eggs for the future progeny.

Pseudo, Pseudonymous.

The bees, who are a match for most other creatures by means of their stings, would easily destroy these weak creatures, were it not for the impervious armour they are covered with. They form themselves a coat of armour of a double matter. The first, which immediately covers the body, is of a kind of silk of their own spinning; and the outer covering over this is of the bees-wax: this is laid considerably thick; and the creature, just thrusting out its head to feed, goes on devouring the cells undisturbed, while a whole army of the inhabitants are in vain buzzing about him, and attempting to pierce him with their stings. He never forsakes his covering, but lengthens and enlarges it as he goes; and gnawing down the sides of the cells in his march, without staying to eat them one by one, the havock and destruction he occasions are scarcely to be conceived. When the time of the change of this creature approaches, it contracts its body within its double covering, and there changes into the nympth state; whence, after a proper time, it comes forth in form of a moth, with granulated horns and a crooked proboscis.

The bees have cunning enough to know their destructive enemy in this new form; and as this is a weak and defenceless state, they attack and destroy all the moths of this species they meet with. They seldom are so fortunate, however, as to kill the whole race as soon as produced; and if only one escapes, it is able to lay a foundation of revenge for the death of its brethren. All the flies of the moth kind lay a vast number of eggs, and this is behind hand with none of them in that particular: the young ones produced from the eggs of one surviving female of this species are sufficient to destroy many honey-combs; nay, many hives of them. The moth produced by this caterpillar flies but little; yet it is very nimble in avoiding danger, by running, which it does with great swiftness.

There is a species of these pseudo-tineæ, or wax-eating caterpillars, which infest the subterraneous hives of wasps and other creatures which make wax: the manner of living, feeding, and defending themselves from their enemies, is the same in all the species. These last, if they are at any time distressed for food, will eat their own dung; the wax having passed almost unaltered through their bodies, and being still wax, and capable of affording them more nourishment on a second digestion. These species, though they naturally live on this soft food, yet if by any accident they meet with harder only, they know how to live upon it; and can eat a way into the covers and leaves of books, and make themselves cases and coverings of the fragments of these substances. The accurate author† of these observations describes also a kind of *pseudo-tinea* which feeds on wool, and another that eats leather; both making themselves houses also of the materials they feed on.

† *Reaumur's History of Insects.*

There is also another kind very destructive to corn: these make themselves a covering by fastening together a great number of the grains, and there living and eating in secret. All these creatures, whatever be their food or habitation, finally become *phalenæ*, or moths; and may be distinguished, even in this state, from the other species, by having granulated horns of a remarkable structure, and all of them a proboscis, or trunk, more or less incurvated.

PSEUDONYMOUS, among critics, an author who publishes a book under a false or feigned name; as *cryptonymous*

tonymous is given to him who publishes one under a disguised name, and *anonymous* to him who publishes without any name at all.

PSIDIUM, the GUAVA; a genus of plants belonging to the icosandria class, and in the natural method ranking under the 19th order, *Hesperideæ*. See BOTANY *Index*.

A decoction of the roots of guava is employed with success in dysenteries: a bath of the decoction of the leaves is said to cure the itch and other cutaneous eruptions. Guayava, or guava, is distinguished from the colour of the pulp into two species, the white and the red; and, from the figure of the fruit, into the round and the pear-fashioned or perfumed guava. The latter has a thicker rind and a more delicate taste than the other. The fruit is about the bigness of a large tennis ball; the rind or skin generally of a russet stained with red. The pulp within the thick rind is of an agreeable flavour, and interspersed with a number of small white seeds. The rind, when stewed, is eaten with milk, and preferred to any other stewed fruit. From the same part is made marmalade; and from the whole fruit is prepared the finest jelly in the world. The fruit is very astringent, and nearly of the same quality with the pomegranate. The seeds are so hard as to resist the effects of the stomachs of animals; so that, when voided with the excrements, they take root, germinate, and produce thriving trees. Whole meadows in the West Indies are covered with guavas, which have been propagated in this manner.

PSITTACUS, or PARROT, a genus of birds, belonging to the order of *Picæ*. See ORNITHOLOGY *Index*.

PSOAS, in *Anatomy*. See there, *Table of the Muscles*.

PSOPHIA, a genus of birds belonging to the order of *Gallinæ*. See ORNITHOLOGY *Index*.

PSORALEA, a genus of plants belonging to the diadelphia class, and in the natural method ranking under the 32d order, *Papilionaceæ*. See BOTANY *Index*.

PSYCHOTRIA, a genus of plants belonging to the pentandria class, and in the natural method ranking under the 47th order, *Stellatæ*. See BOTANY *Index*.

PSYLLI, (Strabo, Ptolemy): a people in the south of Cyrenaica, so called from King Psyllus, (Agathargides, quoted by Pliny): almost all overwhelmed by sand driven by a south wind (Herodotus). They had something in their bodies fatal to serpents, and their very smell proved a charm against them, according to Pliny, Lucan, &c.

Though we may justly look upon it as fabulous, that these people had any thing in their bodies different from others; it is, however, certain that there are in Egypt at this day some persons who have a method of handling the most poisonous serpents without any hurt. Of these Mr Hasselquist gives the following account:

"They take the most poisonous vipers with their bare hands, play with them, put them in their bosoms, and use a great many more tricks with them, as I have often seen. I have frequently seen them handle those that were three or four feet long, and of the most horrid sort. I inquired and examined whether they had cut out the vipers poisonous teeth; but I have with my own eyes seen they do not. We may therefore conclude, that there are to this day Psylli in Egypt; but what art they use is not easily known. Some people are very superstitious, and the generality believe this to be done by some supernatural art which they obtain from invisible beings. I do not know whether their power is to be ascribed to good or evil; but I am persuaded that those who undertake it use many superstitions.

"The art of fascinating serpents is a secret amongst the Egyptians. It is worthy the endeavours of all naturalists, and the attention of every traveller, to learn something decisive as to this affair. How ancient this art is among the Africans, may be concluded from the ancient Marii and Psylli, who were from Africa, and daily showed proofs of it at Rome. It is very remarkable that this should be kept a secret for more than 2000 years, being known only to a few, when we have seen how many other secrets have within that time been revealed. The circumstances relating to the fascination of serpents in Egypt, related to me, were principally, 1. That the art is only known to certain families, who propagate it to their offspring. 2. The person who knows how to fascinate serpents, never meddles with other poisonous animals, such as scorpions, lizards, &c. There are different persons who know how to fascinate these animals; and they again never meddle with serpents. 3. Those that fascinate serpents, eat them both raw and boiled, and even make broth of them, which they eat very commonly amongst them; but in particular, they eat such a dish when they go out to catch them. I have been told, that serpents fried or boiled are frequently eaten by the Arabians both in Egypt and Arabia, though they know not how to fascinate them, but catch them either alive or dead. 4. After they have eaten their soup, they procure a blessing from their scheik (priest or lawyer), who uses some superstitious ceremonies, and amongst others, spits on them several times with certain gestures. This manner of getting a blessing from the priest is pure superstition, and certainly cannot in the least help to fascinate serpents; but they believe, or will at least persuade others, that the power of fascinating serpents depends upon this circumstance."

Notwithstanding this testimony of Hasselquist, the story of the incantation of serpents, though frequently alluded to in Scripture, has been generally treated as a fable. It is, however, affirmed as a certain truth, both by Mr Bruce and M. Savary. "There is no doubt (says the former of these travellers) of its reality. The Scriptures are full of it. All that have been in Egypt have seen as many different instances as they chose. Some have doubted that it was a trick; and that the animals thus handled had been first trained, and then deprived of their power of hurting; and fond of the discovery, they have rested themselves upon it, without experiment, in the face of all antiquity. But I will not hesitate to aver, that I have seen at Cairo (and this may be seen daily without any trouble or expence), a man who came from the catacombs, where the pits of the mummy-birds are kept, who has taken a cerastes with his naked hand from a number of others lying at the bottom of a tub, has put it upon his bare head, covered it with the common red cap he wears, then taken it out, put it in his breast, and tied it about his neck like a necklace; after which it has been applied to a hen, and bit it, which died in a few minutes; and,

and, to complete the experiment, the man has taken it by the neck, and beginning at his tail, has ate it as one would do a carrot or stock of celery, without any seeming repugnance.

"We know from history, that where any country has been remarkably infested with serpents, there the people have been screened by this secret.

"To leave ancient history, I can myself vouch, that all the black people in the kingdom of Sennaar, whether Funge or Nuba, are perfectly armed against the bite of either scorpion or viper. They take the cerastes in their hands at all times, put them in their bosoms, and throw them to one another as children do apples or balls, without having irritated them by this usage so much as to bite. The Arabs have not this secret naturally, but from their infancy they acquire an exemption from the mortal consequences attending the bite of these animals, by chewing a certain root, and washing themselves (it is not anointing) with an infusion of certain plants in water,"

From this account we should be apt to think, that these vipers really *would not* bite any who were thus armed against their poison; especially as he adds, that he "constantly observed, that the viper, however lively before, upon being seized by any of these barbarians, seemed as if taken with sickness and feebleness, frequently shut his eyes, and never turned his mouth towards the arm of the person who held him." Yet in another place, speaking of the activity of the cerastes, he says, "I saw one of them at Cairo, in the house of Julian and Rosa, crawl up the side of a box in which there were many, and there lie still, as if hiding himself, till one of the people who brought them to us came near him; and though in a very disadvantageous posture, sticking as it were perpendicularly to the side of the box, he leaped near the distance of three feet, and fastened between the man's fore-finger and thumb, so as to bring the blood. The fellow showed no signs of either pain or fear, and even kept him with us full four hours, without his applying any sort of remedy, or seeming inclined to do so."

It is difficult to see how these two accounts can be reconciled. If those who catch vipers are in danger of being bit by them *after* they are catched, certainly they must be so before, and then the whole relation becomes contradictory. Our author tells us, that these feats were performed *for a season*, by those who were artificially armed against the viper's poison, as well as those who had the exemption naturally; but though put in possession of the drugs, he never had the courage to make the experiment. That he should have made such a dreadful experiment on *himself*, no person in his senses would expect; but it is indeed very surprising, that he did not attempt by means of these medicines to arm some of the brute creatures, of the lives of which he was sufficiently prodigal, against the effects of that deadly poison by which so many of them perished. As surprising it is, that he did not try what effect the root or its decoction would have upon the serpents themselves; or that, though he says he had a small quantity of this extraordinary root by him, he gave neither drawing nor description of it.

Though it is impossible to reconcile the particulars of this account to one another, the general fact of the incantation is confirmed by the testimony of M. Savary. This writer tells us, that he saw at the feast of Sidi Ibrahim, a troop of people, seemingly possessed, with naked arms and a fierce look, holding in their hands enormous serpents, which twined round their body, and endeavoured to escape. These Psylli, grasping them strongly by the neck, avoided the bite; and notwithstanding their hissing, tore them with their teeth, and ate them alive, while the blood streamed from their mouth.

PTARMIGAN. See TETRAO, ORNITHOLOGY *Index*.

PTELEA, SHRUB-TREFOIL; a genus of plants belonging to the tetrandria class; and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

PTERIS, a genus of plants belonging to the order of filices, and to the cryptogamia class. See BOTANY *Index*. The fructifications are in lines under the margin. There are 19 species; the most remarkable is the aquilina, or common female fern. The root of this is viscid, nauseous, and bitterish; and like all the rest of the fern tribe, has a salt, mucilaginous taste. It creeps under the ground in some rich soils to the depth of five or six feet, and is very difficult to be destroyed. Frequent mowing in pasture grounds, plentiful dunging in arable lands, but, above all, pouring urine upon it, are the most approved methods of killing it. It has, however, many good qualities to counterbalance the few bad ones. Fern cut while green, and left to rot upon the ground, is a good improver of land; for its ashes, if burnt, will yield the double quantity of salt that most other vegetables will. Fern is also an excellent manure for potatoes; for if buried beneath their roots, it never fails to produce a good crop.—Its astringency is so great, that it is used in many places abroad in dressing and preparing kid and chamois leather. In several places in the north, the inhabitants mow it green, and, burning it to ashes, make those ashes up into balls, with a little water, which they dry in the sun, and make use of them to wash their linen with instead of soap. In many of the Western Isles the people gain a very considerable profit from the sale of the ashes to soap and glass makers. In Glenelg in Inverness-shire, and other places, the people thatch their houses with the stalks of this fern, and fasten them down with ropes made either of birk-bark or heath. Sometimes they use the whole plant for the same purpose, but that does not make so durable a covering. Swine are fond of the roots, especially if boiled in their wash. In some parts of Normandy we read that the poor have been reduced to the miserable necessity of mixing them with their bread. And in Siberia, and some other northern countries, the inhabitants brew them in their ale, mixing one-third of the roots to two-thirds of malt. The ancients used the root of this fern, and the whole plant, in decoctions and diet-drinks, in chronic disorders of all kinds, arising from obstructions of the viscera and the spleen. Some of the moderns have given it a high character in the same intentions, but it is rarely used in the present practice. The country people, however, still continue to retain some of its ancient uses; for they give the powder of it to destroy worms, and look upon a bed of the green plant as a sovereign cure for the rickets in children.

PTEROCARPUS, a genus of plants belonging to the

the diadelphia class; and in the natural method ranking under the 32d order, *Papilionaceæ*. See BOTANY *Index*. There are four species, viz. 1. *Draco*; 2. *Ecastaphyllum*; 3. *Lunatus*; and, 4. *Santalinus*. This last is by some referred to the genus *Santalum*. It is called *red saunders*; and the wood is brought from the East Indies, in large billets, of a compact texture, a dull red almost blackish colour on the outside, and a deep brighter red within. This wood has no manifest smell, and little or no taste. It has been commended as a mild astringent, and a corroborant of the nervous system; but these are qualities that belong only to the yellow sort.

The principal use of red saunders is as a colouring drug; with which intention it is employed in some formulæ, particularly in the *tinctura lavendulæ composita*. It communicates a deep red to rectified spirit, but gives no tinge to aqueous liquors; a small quantity of the resin, extracted by means of spirit, tinges a large one of fresh spirit of an elegant blood-red. There is scarcely any oil, that of lavender excepted, to which it communicates its colour. Geoffrey and others take notice, that the Brazil woods are sometimes substituted for red saunders; and the college of Brussels are in doubt whether all that is sold among them for saunders be not really a wood of that kind. According to the account which they have given, their saunders is certainly the Brazil wood; the distinguishing character of which is, that it imparts its colour to water.

PTEROCOCEUS, a species of plant belonging to the genus Calligonum. See CALLIGONUM, BOTANY *Index*.

PTERONIA, a genus of plants belonging to the monodelphia class; and in the natural method ranking under the 37th order, *Columniferæ*. See BOTANY *Index*.

PTINUS, a genus of insects belonging to the order of coleoptera. See ENTOMOLOGY *Index*.

PTISAN, is properly barley decorticated, or deprived of its hulls, by beating in a mortar, as was the ancient practice; though the cooling potion obtained by boiling such barley in water, and afterwards sweetening the liquor with liquorice-root, is what at present goes by the name of *ptisan*; and to render it laxative, some add a little sena or other ingredient of the same intention.

PTOLEMAIC *System of Astronomy*, is that invented by Claudius Ptolemæus. See PTOLEMY, *Claudius*.

PTOLEMAIS, in *Ancient Geography*; the port of Arsinoë, situated on the west branch of the Nile, which concurs to form the island called *Nomos Heracleotes*, to the south of the vertex of the Delta.

PTOLEMAIS, (Strabo); the largest and most considerable town of the Thebais, or Higher Egypt, and in nothing short of Memphis; governed in the manner of a Greek republic; situated on the west side of the Nile, almost opposite to Coptos. This town, which was built by Ptolemy Philadelphus, is now known by the name of *Ptolometa*. The walls and gates are still entire, and there are a vast number of Greek inscriptions, but only a few columns of the portico remain. There is likewise an Ionic temple done in the most ancient manner of executing that order, of which Mr Bruce took a drawing, which is preserved in the king's collection. Another, of Cyrenaica, anciently called *Barce*. A third of the Troglodytica, surnamed *Epitheras*, from the chace of wild beasts, as elephants; lying in the same parallel with Meroe (Strabo); on the Arabian gulf (Pliny); 4820 stadia to the south of Berenice. A fourth, of Galilee, anciently called *Aca*, or *Acon*; made a Roman colony under the emperor Claudius (Pliny). A fifth of Pamphylia; situated near the river Melas, on the borders of Cilicia Aspera.

PTOLEMY SOTER, or *Lagus*, king of Egypt, a renowned warrior, and an excellent prince: he established an academy at Alexandria, and was himself a man of letters. Died 284 B. C. aged 92.

PTOLEMY *Philadelphus*, his second son, succeeded him to the exclusion of Ptolemy Ceraunus. He was renowned as a conqueror, but more revered for his great virtues and political abilities. He established and augmented the famous Alexandrian library, which had been begun by his father. He greatly increased the commerce of Egypt, and granted considerable privileges to the Jews, from whom he obtained a copy of the Old Testament, which he caused to be translated into Greek, and deposited in his library. This is supposed to have been the version called the *Septuagint*. He died 246 years B. C. aged 64.

PTOLEMY *Ceraunus*, the elder brother, fled to Seleucus king of Macedon, who received him hospitably; in return for which he assassinated him, and usurped his crown. He then invited Arsinoë, who was his widow and his own sister, to share the government with him; but as soon as he got her in his power, he murdered her and her children. He was at length defeated, killed, and torn limb from limb by the Gauls, 279 B. C.

PTOLEMY, *Claudius*, a celebrated mathematician and astrologer, was born at Pelusium, and surnamed by the Greeks *Most Divine* and *Most Wise*. He flourished at Alexandria in the second century, under the reigns of Adrian and Marcus Aurelius, about the 138th year of the Christian era. There are still extant his Geography, and several learned works on astronomy. The principal of which are, 1. The Almagest; 2. *De Judiciis Astrologicis*; 3. *Planisphærium*. His system of the world was for many years adopted by the philosophers and astronomers; but the learned have rejected it for the system of Copernicus. See ASTRONOMY, N° 16.

PTYALISM, in *Medicine*, a salivation, or frequent and copious discharge of saliva. The word is Greek, formed from πτυω, "to spit."

PUBERTY, denotes the age at which the person is capable of procreating or begetting children. See MAN.

PUBERTY, in *Law*, is fixed at the age of 12 in females, and 14 in males; after which they are reckoned to be fit for marriage. But as to crimes and punishments, the age of puberty is fixed at 14 in both sexes.

PUBES, in *Anatomy*, denotes the middle part of the hypogastric region in men or women, lying between the two inguina or groins.

Section of the Pubes. See MIDWIFERY and SIGAULTIAN *Operation*.

PUBES, in *Botany*, the hair or down on the leaves of some plants. See HAIR.

PUBLICAN, among the Romans, one who farmed the taxes and public revenues.

PUBLICATION, the art of making a thing known to the world; the same with promulgation.

PUBLIUS SYRUS, a Syrian mimic poet, who flourished about 44 years before Christ. He was originally a slave sold to a Roman patrician, called *Domitius*, who brought him up with great attention, and gave him his freedom when of age. He gained the esteem of the most powerful men at Rome, and reckoned Julius Cæsar among his patrons. He soon eclipsed the poet Laberius, whose burlesque compositions were in general esteem. There remains of Publius a collection of moral sentences, written in iambics, and placed in alphabetical order.

OAK PUCERON, a name given by naturalists to a very remarkable species of animal of the puceron kind. They bury themselves in the clefts of the oak and some other trees, and getting into the crevices, where the bark is a little separated from the wood, they there live at ease, and feed to their fill, without being exposed to their common enemies. They are larger than the other pucerons, the winged ones being nearly as large as a common house fly; and those without wings are also larger than any other species of the same genus. The winged ones are black, and the others of a coffee colour. Their trunk is twice the length of their bodies, and, when walking, it is carried straight along the belly, trailing behind it with the point up. When the creature has a mind to suck a part of the tree that is just before it, it draws up and shortens the trunk, till it brings it to a proper length and direction; but when it sucks in the common way, it crawls upon the inner surface of the bark, and the turned up end of the trunk, which resembles a tail, fixes itself against the wood that is behind it, or contiguous to its back, and sucks there. The extremity of this trunk holds so fast by the wood, that when it is pulled away, it frequently brings a small piece of the wood away with it.

The ants are as fond of these as of the other species of pucerons, and that for the same reason, not feeding upon them, but on their dung, which is a liquid matter of a sweet taste, and is the natural juice of the tree, very little altered. These creatures are the surest guides where to find this species of puceron; for if we at any time see a number of these crawling up an oak to a certain part, and there creeping into the clefts of the bark, we may be assured that in that place there are quantities of these oak pucerons. The ants are so extremely fond of the juices of the tree, when prepared for them by passing through the body of this animal, that when the puceron has a drop not yet evacuated, but hanging only in part out at the passage, an ant will often seize on it there.

PUCERONS, *Vine-fretters*, or *Plant-lice*. See APHIS.

PUDENDA, the parts of generation in both sexes. See ANATOMY, N° 107 and 108.

PUERILITY, in discourse, is defined by Longinus to be a thought which, by being too far fetched, becomes flat and insipid. Puerility, he adds, is the common fault of those who affect to say nothing but what is brilliant and extraordinary.

PUFFENDORF, SAMUEL DE, was born in 1631 at Fleh, a little village in Misnia, a province in Upper Saxony; and was son of Elias Puffendorf, minister of that place. After having made great progress in the sciences at Leipsic, he turned his thoughts to the study of the public law, which in Germany consists of the knowledge of the rights of the empire over the princes and states of which it is composed, and those of the princes and states with respect to each other. But though he used his utmost efforts to distinguish himself, he despised those pompous titles which are so much sought for at universities, and never would take the degree of doctor. He accepted the place of governor to the son of M. Coyet, a Swedish nobleman, who was then ambassador from Sweden to the court of Denmark. For this purpose he went to Copenhagen, but continued not long at ease there; for the war being renewed some time after between Denmark and Sweden, he was seized with the whole family of the ambassador. During his confinement, which lasted eight months, as he had no books, and was allowed to see no person, he amused himself by meditating on what he read in Grotius's treatise *De Jure Belli et Pacis*, and the political writings of Mr Hobbes. Out of these he drew up a short system, to which he added some thoughts of his own, and published it at the Hague in 1660, under the title of *Elementa Jurisprudentiæ Universalis*. This recommended him to the elector Palatine, who invited him to the university of Heidelberg, where he founded in his favour a professorship of the law of nature and nations, which was the first of that kind established in Germany. Puffendorf remained at Heidelberg till 1673, when Charles XI. of Sweden gave him an invitation to be professor of the law of nature and nations at Lunden; which place the elector Palatine reluctantly allowed him to accept. He went thither the same year; and after that time his reputation greatly increased. Some years after, the king of Sweden sent for him to Stockholm, and made him his historiographer, and one of his counsellors. In 1688, the elector of Brandenburg obtained the consent of his Swedish majesty, that he should come to Berlin, in order to write the history of the elector William the Great; and in 1694 made him a baron. But he died that same year of an inflammation in his feet, occasioned by cutting his nails; having attained his grand climacteric. Of his works, which are numerous, the following are the principal: 1. A Treatise on the law of Nature and Nations, written in German; of which there is an English translation with Barbeyrac's Notes. 2. An Introduction to the History of the Principal States which at present subsist in Europe; written in German; which has been also translated into English. 3. The History of Sweden, from Gustavus Adolphus's expedition into Germany to the abdication of Queen Christina. 4. The History of Charles Gustavus, two volumes folio, &c.

PUFFIN. See ALCA, ORNITHOLOGY *Index*.

PUGET, PETER PAUL, one of the greatest painters and sculptors France ever produced, though but little noticed by their own writers, was born at Marseilles in 1623. In his youth he was the disciple of Roman, an able sculptor; and then went to Italy, where he studied painting and architecture. In painting he so well imitated the manner of Peter de Cortona, that this painter desired to see him, and entered into a friendship with him. In 1657, a dangerous disorder obliged him to renounce the pencil, and devote himself to sculpture; and his reputation causing him to be invited to Paris, he enjoyed a pension of 1200 crowns, as sculptor and director of the works relating to vessels and galleys.

gallcys. He died at Marseilles in 1695, and has left a number of admirable statues behind him both in France and Italy.

PUGIL, in *Materia Medica*, such a quantity of flowers, seeds, or the like, as may be taken up between the thumb and two fore-fingers. It is reckoned the eighth part of the manipulus or handful.

PULEGIUM, or *Penny-Royal*. See MENTHA, BOTANY *Index*.

PULEX, the FLEA, in *Zoology*, a genus of insects belonging to the order of aptera. See ENTOMOLOGY *Index*.

By keeping fleas in a glass tube corked up at both ends, but so as to admit fresh air, their actions and manners may be observed. They are thus seen to lay their eggs, not all at once, but ten or twelve in a day, for several days successively; which eggs will be afterwards found to hatch successively in the same order. The flea may easily be dissected in a drop of water; and by this means the stomach and bowels, with their peristaltic motion, may be discovered very plainly, as also their testes and penis, with the veins and arteries, though minute beyond all conception. Mr Leuwenhoek affirms also, that he has seen innumerable animalcules, shaped like serpents, in the semen masculinum of a flea. This blood-thirsty insect, which fattens at the expence of the human species, prefers the more delicate skin of women; but prays neither upon epileptic persons, nor upon the dead or dying. It loves to nestle in the fur of dogs, cats, and rats. The nests of river-swallows are sometimes plentifully stored with them.

Barbut's Genera of Insects, p. 330, &c.

Fleas are apterous; walk but little, but leap to a height equal to 200 times that of their own body. This amazing motion is performed by means of the elasticity of their feet, the articulations of which are so many springs. Thus it eludes, with surprising agility, the pursuit of the person on whom it riots. Among the memorabilia of fleas, one, they say, has been seen to draw a small silver piece of ordnance to which it was fastened, the firing of the gun nowise daunting its intrepidity. The owner carried it about in a little box lined with velvet, every now and then placing it on her arm to let it feed; but winter put an end to the being of this martial flea. Another flea that became slave to an Englishman, had, for its daily and easy task, to drag its golden chain and padlock, of the weight of one grain. A third flea served as a thill-horse to an English artist, who had made an ivory coach and six, that carried a coachman and his dog between his legs, a postillion, two footmen, and four inside riders. At Surat fleas, bugs, and other voracious vermin, are in so great veneration, that they have an hospital endowed, where every night a poor fellow, for hire, suffers himself to be preyed upon. He is fastened naked on a bed, when the feast begins at his expence. In Turkey there is a similar foundation for decayed dogs; an institution less ridiculous than the other. Mercurial ointment brimstone, a fumigation with the leaves of pennyroyal, or fresh-gathered leaves of that plant sewed up in a bag, and laid in the bed, are remedies pointed out as destructive of fleas.

Pulex Arboreus, in *Natural History*, the name given by Mr Reaumur to a very large genus of small animals. They are a kind of half-winged creatures: they have granulated antennæ; and some of them, in their most perfect state, have complete wings. These are distinguished from the others by the name of *musca-pulex*, or the *winged pulex*. See COCCUS, ENTOMOLOGY *Index*.

Pulex Aquaticus auctorum (monoculus pulex of Linnæus) is a species of the genus MONOCULUS; which see, under ENTOMOLOGY *Index*.

Pulex-Eaters, a name given by naturalists to a sort of worms frequently found on the leaves of trees, where they devour the animals called *pulices arborei*.

Of these there are several species, which owe their origin to the eggs of different creatures; for there are none of them in their ultimate state in this their time of feeding. According to the different animals whose eggs they are hatched from, these are of different form and structure. Some are hexapodes, or endued with six feet; these belong to the beetle-tribe, and finally change into beetles like the parent animal from whose eggs they sprung. Others have no legs, and are produced from the eggs of flies of various kinds. And, finally, others are genuine caterpillars, though small; but these are the most rare of all.

The two general kinds are the hexapodes, or beetle-worms; and the apodes, or fly-worms. The fly which gives origin to the last of these is a four-winged one; and takes care always to deposit her eggs in a place where there are plenty of the pulices, usually on the stalk or young branches of a tree in the midst of large families of them. The worm, as soon as hatched, finds itself in the midst of abundance of food, preying at pleasure on these animals, which are wholly defenceless. The stalks of the elder and woodbine are frequently found covered over with these pulices; and among them there may usually be found one or more of these destroyers feeding at will, sucking in the juices from their bodies, and then throwing away the dry skins. Besides the worms of this four-winged fly, there is one of a two-winged wasp-fly, very destructive of these animals.

PULLEY, in *Mechanics*, one of the five mechanical powers. See MECHANICS.

PULMO, the LUNGS, in *Anatomy*. See ANATOMY *Index*.

PULMONARIA, LUNGWORT, a genus of plants belonging to the pentandria class, and in the natural method ranking under the 41st order, *Asperifoliæ*. See BOTANY *Index*.

PULO, the name of several Asiatic islands, in the Indian ocean, the principal of which only, it is said, is inhabited. It is denominated

Pulo-Condore, an island about 13 miles long and three broad, which was visited by Lord Macartney on his way to China. It has convenient anchoring places during either monsoon. Here his lordship's squadron came to anchor on the 17th of May. The bay is formed by four small islands approaching so near to each other, as to exhibit the appearance of meeting together in different points. They all seem to be the rude fragments of primitive mountains, which have been detached from the great continent in the lapse of ages. Condore lies in 8° 40′ North Lat. and 105° 55′ E. Long.

The English at one period had a settlement here, but being driven from it by some Malay soldiers in their pay, probably for some unjustifiable treatment, no Europeans, it is said, have resided in it ever since. When a party went on shore from Lord Macartney's squadron,

they

they were welcomed by the natives with much urbanity of manners, and conducted to the house of their chief. Their dress consisted chiefly of blue cotton garments hanging loosely about them; and their flat faces and noses seemed to denote that they were descended from the Chinese. A missionary being of the party, could not understand their language as they spoke it; but as soon as committed to writing it was perfectly intelligible to him. This led to the conclusion, that the inhabitants of Pulo-Condore were originally Cochin Chinese, who fled from their own country in consequence of their attachment to one of its sovereigns who had been dethroned by a number of his own subjects.

Here the squadron was to purchase provisions, and the people promised to have the proposed quantity in readiness, if possible, at the appointed time. Next morning, a party of pleasure went from the Hindostan to a small island near Pulo-Condore; but being apprehensive of an approaching storm, they made towards the ship with all convenient speed. The weather again becoming favourable, they set off for the island again, and were astonished, on their arrival, to find it wholly abandoned. In the principal cabin a letter was found, written in the Chinese language, expressing their terror at the arrival of such great ships and powerful persons; not being able to satisfy their demands as to cattle and other provisions, the poor inhabitants of Pulo-Condore having scarcely any to supply, they therefore fled to preserve their lives; declared themselves to be few in number, and very poor, but honest; and concluded with requesting the *great people* to have pity on them, as they had left their all behind, and earnestly implored them not to burn their cabins.

The generous English left them an intimation that they called merely for refreshment on fair and equitable terms, without harbouring against them any evil designs. They claimed a connection to a civilized nation, actuated by principles of humanity, by which they were prohibited from plundering or doing injury to others, who might have the misfortune to be fewer or weaker than themselves. No doubt the poor terrified inhabitants would be agreeably surprised to find, on their return, not only that all their tents were in perfect safety, but that nothing was either disturbed or removed, and a small present left to their chief in the principal dwelling.

Pulo-Lingen, another island of the cluster mentioned above, is of some extent, though inferior in size to Pulo-Condore. It is chiefly remarkable for a mountain in its centre, terminating in a fork like Parnassus, but denominated by mariners the *asses ears*. The people of Lord Macartney's squadron were constantly discovering new islands, many of which were clothed with verdure; some had lofty trees growing upon them; others were nothing but naked rocks, the resort of innumerable birds, and whitened with their dung.

PULO PENANG. See *Prince of Wales's Island*.

PULP, in *Pharmacy*, the fleshy and succulent parts of fruits extracted by infusion or boiling, and passed through a sieve.

PULPIT, an elevated place in a church, whence sermons are delivered. The French give the same name to a reading desk.

PULPITUM, in the Grecian and Roman theatres, was a place where the players performed their parts. It was lower than the scena, and higher than the orchestra. It nearly answered to what we call the stage, as distinguished from the pit and galleries. *Pulpitum* was also a moveable desk or pulpit, from which disputants pronounced their dissertations, and authors recited their works.

PULSE, in the animal economy, denotes the beating or throbbing of the heart and arteries.

No doctrine has been involved in more difficulties than that of pulses; since, in giving a physiological account of them, physicians have espoused quite opposite sentiments; whilst some doubt whether the pulse is owing to the systole or diastole; as also, whether the motion of the heart and arteries is one and the same, for a moment of time.

With regard to motion, the pulses are reckoned only four; great and little, quick and slow. When quickness and greatness are joined together, it becomes violent; and when it is little and slow it is called a *weak pulse*. They are also said to be *frequent* and *rare*, *equal* and *unequal;* but these are not the essential affections of motion. Frequency and quickness are often confounded with each other. A pulse is said to be *hard* or *soft*, with regard to the artery, according as it is tense, renitent, and hard, or flaccid, soft, and lax: for the disposition of the arteries contributes greatly to the change of the pulse; wherefore it sometimes happens, that the pulse in both arms is not alike, which is very common in a hemiplexy. Add to these a convulsive pulse, which does not proceed from the blood, but from the state of the artery; and is known by a tremulous subsultory motion, and the artery seems to be drawn upwards: this, in acute fevers, is the sign of death; and is said to be the pulse in dying persons, which is likewise generally unequal and intermitting. A *great* pulse shows a more copious afflux of the blood to the heart, and from thence into the arteries: a *little* pulse the contrary.

The pulses of persons differ according to the largeness of the heart and vessels, the quantity and temperies of the blood, the elastic force of the canals; as also with regard to the sex, age, season, air, motion, food, sleep, watchings, and passions of the mind. The pulse is larger and more quick in men than in women; in the bilious and sanguineo-bilious, than in the phlegmatic and melancholic. Those who are lean, with tense fibres, and large vessels, have a greater and a stronger pulse, than those that are obese, with lax fibres and small vessels; whence they are more healthy, robust, and apt for labour. In children, the pulse is quick and soft; in adults greater and more violent. In the old, it is commonly great, hard, and slow. Labour, motion, and exercise of the body, increase the circulation of the blood, the excretions, and particularly respiration; rest renders the circulation slow and weak; intense speaking increases the circulation, and consequently renders the pulse large and quick. In watching, the pulse is more evident; in sleep, more slow and languid. After drinking hot things, such as coffee and tea, or hot bath-waters, as well as after meals, the pulse vibrates more quick. But nothing produces a greater change in the pulse than affections of the mind: in terror, it is unequal, small, and contracted: in joy, frequent and great; in anger, quick and hard; in sadness, slow, small, deep, and weak; and in intense study, languid and weak. With regard to the air, when, after the predominancy

predominancy of a west or south wind, it becomes north or east, the pulse is stronger and larger; as also when the quicksilver rises in the barometer. But when the atmosphere is dense, humid, rainy, with a long south wind; as also where the life is sedentary, the sleep long, and the season autumnal, the pulse is languid and small, and the perspiration decreased. In May it is great, and sometimes violent; in the middle of summer, quick but weak; in the autumn, slow, soft, and weak; in the winter, hard and great. A drastic purge and an emetic render the pulse hard, quick, and weak, with loss of strength; chalybeates, and the bark, render it great and robust, and the complexion lively; volatiles amplify and increase the pulse; acids and nitrous remedies refrigerate the body, and appease the pulse; opiates and the like render it small and weak, and decrease the elasticity of the solids; and poisons render it small, contracted, and hard. When the quantity of the blood is too great, bleeding raises the pulse.

Pulse, is also used for the stroke with which any medium is affected by the motion of light, sound, &c. through it.

Sir Isaac Newton demonstrates, that the velocities of the pulses in an elastic fluid medium (whose elasticity is proportionable to its density) are in a ratio compounded of half the ratio of the elastic force directly, and half the ratio of the density inversely; so that in a medium whose elasticity is equal to its density, all pulses will be equally swift.

Pulse, in *Botany*, a term applied to all those grains or seeds which are gathered with the hand; in contradistinction to corn, &c. which are reaped, or mowed: or, It is the seed of the leguminous kind of plants, as beans, vetches, &c.; but is by some used for artichokes, asparagus, &c.

PULTENEY, William, the famous opposer of Sir Robert Walpole in parliament, and afterward earl of Bath, was descended from one of the most ancient families in the kingdom, and was born in 1682. Being well qualified in fortune, he early procured a seat in the house of commons, and distinguished himself as a warm partisan against Queen Anne's ministry; whose errors he had sagacity to detect, and spirited eloquence to expose. When King George I. came to the throne, Mr Pulteney was made secretary at war, and soon after cofferer to the king's household; but the good understanding between this gentleman and Sir Robert Walpole, who then acted as prime minister, was interrupted in 1725, on a suspicion that Walpole was desirous of extending the limits of prerogative, and of promoting the interests of Hanover, to the prejudice of those of Britain. His opposition to Sir Robert was indeed carried to such indiscriminate lengths, that some have been of opinion he often acted against measures beneficial to the public, merely from personal motives. It would be impracticable here to trace his parliamentary conduct: so it must suffice to observe in general, that he became so obnoxious to the crown, that in 1731 the king called for the council-book, and with his own hand struck out his name from the list of privy-counsellors; a proceeding that only served to inflame his resentment and increase his popularity. Thus he still continued to attack the minister with a severity of eloquence and sarcasm that worsted every antagonist; so that Sir Robert was heard to declare, he dreaded that man's tongue more than another man's sword. At length, when Walpole found the place of prime minister no longer tenable, and resigned in 1741, among other promotions Mr Pulteney resumed his place in the privy-council, and was created earl of Bath; a title purchased at the expence of that popularity which afterward he naturally enough affected to contemn. In 1760, toward the close of the war, he published *A Letter to two Great Men*, recommending proper articles to be insisted on in a treaty of peace; which, though the writer was then unknown, was greatly applauded, and went through several impressions. He died in 1764; and as his only son died before him, the title became extinct.

PULVERIZATION, the art of pulverizing, or reducing a dry body into a fine powder; which is performed in friable bodies by pounding or beating them in a mortar, &c; but to pulverize malleable ones, other methods must be taken. To pulverize lead, or tin, the method is this: Rub a round wooden box all over the inside with chalk; pour a little of the melted metal nimbly into the box; when shutting the lid, and shaking the box briskly, the metal will be reduced to powder.

PUMEX, the Pumice-stone. See Mineralogy *Index*.

Pumice-stone is used in some mechanical arts; as for rubbing and smoothing the surface of metals, wood, pasteboard, and stone; for which it is well fitted by reason of its harsh and brittle texture; thus scouring and carrying off the little inequalities from the surfaces just mentioned.

PUMICE-stone. See Mineralogy *Index*.

PUMP, an hydraulic machine for raising water by means of the pressure of the atmosphere.

1 Of the invention of pumps.

It would be an entertaining and not an uninstructive piece of information to learn the progressive steps by which the ingenuity of man has invented the various methods of raising water. A pump must be considered as the last step of this progress. Common as it is, and overlooked even by the curious, it is a very abstruse and refined invention. Nothing like it has been found in any of the rude nations whom the restless spirit of the Europeans has discovered, either in the new continent of America, or the islands of the Pacific ocean. Nay, it was unknown in the cultivated empire of China at the time of our arrival there by sea; and it is still a rarity everywhere in Asia, in places unfrequented by the Europeans. It does not appear to have been known to the Greeks and Romans in early times; and perhaps it came from Alexandria, where physical and mathematical science was much cultivated by the Greek school under the protection of the Ptolemies. The performances of Ctesibius and Hero are spoken of by Pliny and Vitruvius as curious novelties (A). It is perhaps not difficult to trace the steps by which those mechanicians were led to

(A) In the early Greek writings, it does not appear that the words ἄντλος, ἀντλεῖν, ἀντλία, &c, were used to express any thing like what we call a pump. In all these passages the words either express generally the drawing of water, to the invention. The Egyptian wheel was a common machine all over Asia, and is still in use in the remotest corners, and was brought by the Saracens into Spain, where it is still very common under its ancient name NORIA. The Danish missionaries found in a remote village in the kingdom of Siam the immediate off-spring of the noria (*Lettres Edifiantes et Curieuses*). It was a wheel turned by an ass, and carrying round, not a string of earthen pots, but a string of wisps of hay, which it drew through a wooden trunk. This rude chain-pump was in frequent use for watering the rice fields. It is highly probably that it is of great antiquity, although we do not recollect its being mentioned by any of the Greek or Roman writers. The Arabs and Indians were nothing less than innovators; and we may suppose with great safety, that what arts we now find among them they possessed in very remote periods. Now the step from this to the pump is but short, though it is nice and refined; and the forcing pump of Ctesibius is the easiest and most natural.

Plate CCCCXLIX. fig. 1.

2 Ctesibius's pump.

Let AB (fig. 1.) be the surface of the water in the well, and D the height where it is to be delivered. Let DC be a long wooden trunk, reaching as deep under water as possible. Let the rope EF be fitted with its knot of hay F. When it is drawn up through the trunk, it will bring up along with it all the water lying between C and A, which will begin to run out by the spout D as soon as the knot gets to G, as far below D as C is below A. All this is very obvious: and it required but little reflection to be assured, that if F was let down again, or pushed down, by a rod instead of a rope, it would again perform the same office. Here is a very simple pump. And if it was ever put in practice, it behoved to show the supporting power of the atmosphere, because the water would not only be lifted by the knot, but would even follow it. The imperfection of this pump behoved to appear at first sight, and to suggest its remedy. By pushing down the knot F, which we shall henceforth call the *piston*, all the force expended in lifting up the water between A and G is thrown away, because it is again let down. A valve G, at the bottom would pervent this. But then there must be a passage made for the water by a lateral tube KBD (fig. 2.) And if this be also furnished with a valve H, to prevent its losing the water, we have the pump of Ctesibius, as sketched in fig. 2. The valve is the great refinement: but perhaps even this had made its appearance before in the noria. For, in the more perfect kinds of these machines, the pots have a stop or valve in their bottom, which hangs open while the pot descends with its mouth downwards, and then allows it to fill readily in the cistern: whereas, without the valve, it would occasion a double load to the wheel. If we suppose that the valve had made its appearance so early, it is not improbable that the common pump sketched in fig. 3. was as old as that of Ctesibius. In this place we shall first give a short description of the chief varieties of these engines, considering them in their simplest form, and we shall explain in very general terms their mode of operation. We shall then give a concise and popular theory of their operation, furnishing principles to direct us in their construction; and we shall conclude with the description of a few peculiarities which may contribute to their improvement or perfection.

Fig. 2.

Fig. 3.

There are but two sorts of pumps which essentially differ; and all the varieties that we see are only modifications of these. One of these original pumps has a solid piston; the other has a piston with a perforation and a valve. We usually call the first a FORCING PUMP, and the second a LIFTING OR SUCKING PUMP.

3 Forcing pump described. Fig. 2.

Fig. 2. is a sketch of the forcing pump in its most simple form and situation. It consists of a hollow cylinder AC c a, called the WORKING BARREL, open at both ends, and having a valve G at the bottom, opening upwards. This cylinder is filled by a solid piston EF, covered externally with leather or tow, by which means it fits the box of the cylinder exactly, and allows no water to escape by its sides. There is a pipe KHD, which communicates laterally with this cylinder, and has a valve at some convenient place H, as near as possible to its junction with the cylinder. This valve also opens upwards. This pipe, usually called the RISING PIPE, or MAIN, terminates at the place D, where the water must be delivered.

4 Its mode of operation.

Now suppose this apparatus set into the water, so that the upper end of the cylinder may be under or even with the surface of the water AB; the water will open the valve G, and after filling the barrel and lateral pipe, will also open the valve H, and at last stand at an equal height within and without. Now let the piston be put in at the top of the working barrel, and thrust down to K. It will push the water before it. This will shut the valve G, and the water will make its way through the valve H, and fill a part B b of the rising pipe, equal to the internal capacity of the working barrel. When this downward motion of the piston ceases, the valve H will fall down by its own weight and shut this passage. Now let the piston be drawn up again: The valve H hinders the water in the rising pipe from returning into the working barrel. But now the valve G is opened by the pressure of the external water, and the water enters and fills the cylinder as the piston rises. When the piston has got to the top, let it be thrust down again: The valve G will again be shut, and the water will be forced through the passage at H, and rise along the main, pushing before it the water already there, and will now have its surface at L. Repeating this operation, the water must at last arrive at D, however

water, or, more particularly, the drawing it with a bucket or something similar. Ἄντλος, which is the primitive, is a drain, sink, or receptacle for collecting scattered water, either for use, or to get rid of it; hence it came to signify the sink or well of a ship; and ἀντλεῖν was synonymous with our verb "to bale the boat." (*Odyss.* O. 476 M. 411. *Eurip. Hecuba*, 1025). Ἀντλίον is the *vessel* or *bucket* with which water is drawn. Ἀντλία is the service (generally a punishment) of drawing water. Ἀντλεῖν, "to draw water with a bucket:" hence the force of Aristotle's expression (*Oecon.* I.) τὸ γὰρ ὕδωρ ἀντλεῖν τοῦτ' ἐστι. See even the late authority of the New Testament, John ii. 8.; iv. 7. 11. Here ἄντλημα is evidently something which the woman brought along with her; probably a bucket and rope.

ever remote, and the next stroke would raise it to e; so that during the next rise of the piston the water in e D will be running off by the spout.

The effect is the same whatever be the position of the working barrel, provided only that it be under water. It may lie horizontally or sloping, or it may be with its mouth and piston rod undermost. It is still the same forcing pump, and operates in the same manner and by the same means, viz. the pressure of the surrounding water.

The external force which must be applied to produce this effect is opposed by the pressure exerted by the water on the opposite face of the piston. It is evident, from the common laws of hydrostatics, that this opposing pressure is equal to the weight of a pillar of water, having the face of the piston for its base, and the perpendicular height d A of the place of delivery above the surface of the water AB in the cistern for its height. The form and dimensions of the rising pipe are indifferent in this respect, because heavy fluids press only in the proportion of their perpendicular height. Observe that it is not d F, but d A, which measures this pressure, which the moving force must balance and surmount. The whole pressure on the under surface F f of the piston is indeed equal to the weight of the pillar d F $f\delta$; but part of this is balanced by the water AFf a. If indeed the water does not get into the upper part of the working barrel, this compensation does not obtain. While we draw up the piston, this pressure is removed, because all communication is cut off by the valve H, which now bears the whole pressure of the water in the main. Nay, the ascent of the piston is even assisted by the pressure of the surrounding water. It is only during the descent of the piston therefore that the external force is necessary.

Observe that the measure now given of the external force is only what is necessary for *balancing* the pressure of the water in the rising pipe. But in order that the pump may perform work, it must *surmount* this pressure, and cause the water to issue at D with such a velocity that the required quantity of water may be delivered in a given time. This requires force, even although there were no opposing pressure; which would be the case if the main were horizontal. The water fills it, but it is at rest. In order that a gallon, for instance, may be delivered in a second, the whole water in the horizontal main must be put in motion with a certain velocity. This requires force. We must therefore always distinguish between the state of equilibrium and the state of actual working. It is the equilibrium only that we consider at present; and no more is necessary for understanding the operation of the different species of pumps. The other force is of much more intricate investigation, and will be considered by itself.

5 Lifting pump.

The simplest form and situation of the lifting pump is represented by the sketch fig. 3. The pump is immersed in the cistern till both the valve G and piston F are under the surface AB of the surrounding water. By this means the water enters the pump, opening both valves, and finally stands on a level within and without.

6 Its mode of operating.

Now draw up the piston to the surface A. It must lift up the water which is above it (because the valve in the piston remains shut by its own weight); so that its surface will now be at a, A a being made equal to AF. In the mean time, the pressure of the surrounding water forces it into the working barrel, through the valve G; and the barrel is now filled with water. Now, let the piston be pushed down again; the valve G immediately shuts by its own weight, and in opposition to the endeavours which the water in the barrel makes to escape this way. This attempt to compress the water in the barrel causes it to open the valve F in the piston; or rather, this valve yields to our endeavour to push the piston down through the water in the working barrel. By this means we get the piston to the bottom of the barrel; and it has now above it the whole pillar of water reaching to the height a. Drawing up the piston to the surface A a second time, must lift this double column along with it, and its surface now will be at b. The piston may again be thrust down through the water in the barrel, and again drawn up to the surface; which will raise the water to c. Another repetition will raise it to d; and it will now show itself at the intended place of delivery. Another repetition will raise it to e; and while the piston is now descending to make another stroke, the water in e d will be running off through the spout D; and thus a stream will be produced, in some degree continual, but very unequal. This is inconvenient in many cases: thus, in a pump for domestic uses, such a hobbling stream would make it very troublesome to fill a bucket. It is therefore usual to terminate the main by a cistern LMNO, and to make the spout small. By this means the water brought up by the successive strokes of the piston rises to such a height in this cistern, as to produce an efflux by the spout nearly equable. The smaller we make the spout D the more equable will be the stream; for when the piston brings up more water than can be discharged during its descent, some of it remains in the cistern. This, added to the supply of next stroke, makes the water rise higher in the cistern than it did by the preceding stroke. This will cause the efflux to be quicker during the descent of the piston, but perhaps not yet sufficiently quick to discharge the whole supply. It therefore rises higher next stroke; and at last it rises so high, that the increased velocity of efflux makes the discharge precisely balance the supply. Now, the quantity supplied in each stroke is the same, and occupies the same room in the cistern at top; and the surface will sink the same number of inches during the descent of the piston, whether that surface has been high or low at the beginning. But because the velocities of the efflux are as the square roots of the heights of the water above the spout, it is evident that a sink of two or three inches will make a smaller change in the velocity of efflux when this height and velocity are great. This seems but a trifling observation; but it serves to illustrate a thing to be considered afterwards, which is important and abstruse, but perfectly similar to this.

It is evident, that the force necessary for this operation must be equal to the weight of the pillar of water d A a D, if the pipe be perpendicular. If the pump be standing aslope, the pressure which is to be balanced is still equal to the weight of a pillar of water of this perpendicular height, and having the surface of the piston for its base.

Such is the simplest, and, we may add, by far the best, form of the forcing and lifting pumps; but it is not the most usual. Circumstances of convenience, economy, and more frequently of fancy and habit, have caused the pump-makers to deviate greatly from this form. It is not usual to have the working barrel in the

the water; this, especially in deep wells, makes it of difficult access for repairs, and requires long piston rods. This would not do in a forcing pump, because they would bend.

7 Effect of giving the piston a longer stroke

We have supposed, in our account of the lifting pump, that the rise of the piston always terminated at the surface of the water in the cistern. This we did in order that the barrel might always be filled by the pressure of the surrounding water. But let us suppose that the rise of the piston does not end here, and that it is gradually drawn up to the very top: it is plain that the pressure of the atmosphere is by this means taken off from the water in the pipe (see PNEUMATICS), while it remains pressing on the water of the cistern. It will therefore cause the water to follow the piston as it rises through the pipe, and it will raise it in this way 33 feet at a medium. If, therefore, the spout D is not more than 33 feet above the surface of the water in the cistern, the pipe will be full of water when the piston is at D. Let it be pushed down to the bottom; the water will remain in the pipe, because the valve G will shut: and thus we may give the piston a stroke of any length not exceeding 33 feet. If we raise it higher than this, the water will not follow; but it will remain in the pipe, to be lifted by the piston, after it has been pushed down through it to the bottom.

8 inconvenient and unnecessary.

But it is not necessary, and would be very inconvenient, to give the piston so long a stroke. The great use of a pump is to render effectual the reciprocation of a short stroke which we can command, while such a long stroke is generally out of our power. Suppose that the piston is pushed down only to *b*; it will then have a column *bf* incumbent on it, and it will lift this column when again drawn up. And this operation may be repeated like the former, when the piston was always under water; for the pressure of the atmosphere will always cause the water to follow the piston to the height of 33 feet.

Nor is it necessary that the fixed valve G be placed at the lower orifice of the pipe, nor even under water. For, while things are in the state now described, the piston drawn up to *f*, and the whole pipe full of water; if we suppose another valve placed at *b* above the surface of the cistern, this valve can do no harm. Now let the piston descend, both valves G and *b* will shut. G may now be removed, and the water will remain supported in the space *b* G by the air; and now the alternate motions of the piston will produce the same effect as before.

9 Effect of the weight of the water and pressure of the atmosphere.

We found in the former case that the piston was carrying a load equal to the weight of a pillar of water of the height AD, because the surrounding water could only support it at its own level. Let us see what change is produced by the assistance of the pressure of the atmosphere. Let the under surface of the piston be at *b*; when the piston was at *f*, 33 feet above the surface of the cistern, the water was raised to that height by the pressure of the atmosphere. Suppose a partition made at *b* by a thin plate, and all the water above it taken away. Now piece a hole in this plate. The pressure of the atmosphere was able to carry the whole column *fa*. Part of this column is now removed, and the remainder is not a balance for the air's pressure. This will therefore cause the water to spout up through this hole and rise to *f*. Therefore the under surface of this plate is pressed up by the contiguous water with a force equal to the weight of that pillar of water which it formerly supported; that is, with a force equal to the weight of the pillar *fb*. Now the under surface of the piston, when at *b*, is in the same situation. It is pressed upwards by the water below it, with a force equal to the weight of the column *fb*: But it is pressed downwards by the whole pressure of the atmosphere, which presses on all bodies; that is, with the weight of the pillar *fa*. On the whole, therefore, it is pressed downwards by a force equal to the difference of the weights of the pillars *fa* and *fb*; that is, by a force equal to the weight of the pillar *ba*.

It may be conceived better perhaps in this way. When the piston was under the surface of the water in the cistern, it was equally pressed on both sides, both by the water and atmosphere. The atmosphere exerted its pressure on it by the intervention of the water; which being, to all sense, a perfect fluid, propagates every external pressure undiminished. When the piston is drawn up above the surface of the pit-water, the atmosphere continues to press on its upper surface with its whole weight, through the intervention of the water which lies above it; and its pressure must therefore be added to that of the incumbent water. It also continues to press on the under surface of the piston by the intervention of the water; that is, it presses this water to the piston. But, in doing this, it carries the weight of this water which it is pressing on the piston. The pressure on the piston therefore is only the excess of the whole pressure of the atmosphere above the weight of the column of water which it is supporting. Therefore the difference of atmospheric pressure on the upper and under surfaces of the piston is precisely equal to the weight of the column of water supported in the pipe by the air. It is not, however, the individual weight of this column that loads the piston; it is the part of the pressure of the atmosphere on its upper surface, which is not balanced by its pressure on the under surface.

In attempting, therefore, to draw up the piston, we have to surmount this unbalanced part of the pressure of the atmosphere, and also the weight of the water which lies above the piston, and must be lifted by it: and thus the whole opposing pressure is the same as before, namely, the weight of the whole vertical pillar reaching from the surface of the water in the cistern to the place of delivery. Part of this weight is immediately carried by the pressure of the atmosphere; but, in lieu of it, there is an equal part of this pressure of the atmosphere abstracted from the under surface of the piston, while its upper surface sustains its whole pressure.

10 Other circumstances to be attended to.

So far, then, these two states of the pump agree.—But they differ exceedingly in their mode of operation; and there are some circumstances not very obvious which must be attended to, in order that the pump may deliver any water at the spout D. This requires, therefore, a serious examination.

Let the fixed value G (fig. 4.) be supposed at the surface of the cistern water. Let M*m* be the lowest, and N*n* the highest, positions of the piston, and let HA=*h* be the height of a column of water equiponderant with the atmosphere. Fig. 4.

When the pump is filled, not with water, but with air, and the piston is in its lowest position, and all in equilibrio, the internal air has the same density and elasticity

elasticity with the external. The space MA $a\,m$, therefore, contains air of the common density and elasticity. These may be measured by h, or the weight of a column of water whose height is h. Now, let the piston be drawn up to N n. The air which occupied the space MA $a\,m$ now occupies the space NAan, and its density is now $\frac{\mathrm{MA}\,a\,m}{\mathrm{NA}\,a\,n}$. Its elasticity is now diminished, being proportionable to its density (see PNEUMATICS), and no longer balances the pressure of the atmosphere. The valve G will therefore be forced up by the water, which will rise to some height SA. Now let the piston again descend to M m. It cannot do this with its valve shut; for when it comes down so far as to reduce the air again to its common density, it is not yet at M, because the space below it has been diminished by the water which got into the pipe, and is retained there by the valve G. The piston valve, therefore, opens by the air which we thus attempt to compress, and the superfluous air escapes. When the piston has got to M, the air is again of the common density, and occupies the space MS$\,s\,m$. Now draw the piston up to N. The air will expand into the space NS$\,s\,n$, and its density will be reduced to $\frac{\mathrm{MS}\,s\,m}{\mathrm{NS}\,s\,n}$, and its elasticity will no longer balance the pressure of the atmosphere, and more water will enter, and it will rise higher. This will go on continually. But it may happen that the water will never rise so high as to reach the piston, even though not 33 feet above the water in the cistern: For the successive diminutions of density and elasticity are a series of quantities that decrease geometrically, and therefore will have a limit. Let us see what determines this limit.

At whatever height the water stands in the lower part of the pipe, the weight of the column of water SA $a\,s$, together with the remaining elasticity of the air above it, exactly balances the pressure of the atmosphere (see PNEUMATICS, N° 108.). Now the elasticity of the air in the space NS$\,s\,n$ is equal to $h \times \frac{\mathrm{MS}\,s\,m}{\mathrm{NS}\,s\,n}$. Therefore, in the case where the limit obtains, and the water rises no farther, we must have $h = \mathrm{AS} + h\frac{\mathrm{MS}\,s\,m}{\mathrm{NS}\,s\,n}$, or, because the column is of the same diameter throughout, $h = \mathrm{AS} + h\frac{\mathrm{MS}}{\mathrm{NS}}$, and $\frac{\mathrm{MS}}{\mathrm{NS}}\,h = h - \mathrm{AS}, = \mathrm{HS}$, and NS : MS = HA : HS, and NS—MS : NS = HA—HS : HA, or NM : NS = AS : AH, and NM × AH = NS × AS. Therefore, if AN, the distance of the piston in its highest position from the water in the cistern, and NM the length of its stroke, be given, there is a certain determined height AS to which the water can be raised by the pressure of the air: For AH is a constant quantity; and therefore when MN is given, the rectangle AS × SN is given. If this height AS be less than that of the piston in its lowest position, the pump will raise no water, although AN may be less than AH. Yet the same pump will raise water very effectually, if it be first of all filled with water; and we have seen professional engineers much puzzled by this capricious failure of their pumps. A little knowledge of the principles would have prevented their disappointment.

To insure the delivery of water by the pump, the stroke must be such that the rectangle MN × AH may be greater than any rectangle that can be made of the parts of AN, that is, greater than the square of half AN. Or, if the length of the stroke be already fixed by other circumstances, which is a common case, we must make AN so short that the square of its half, measured in feet, shall be less than 33 times the stroke of the piston.

11
Mode of ensuring the delivery of water.

Suppose that the fixed valve, instead of being at the surface of the water in the cistern, is at S, or anywhere between S and A, the performance of the pump will be the same as before: But if it be placed anywhere above S, it will be very different. Let it be at T. It is plain that when the piston is pushed down from N to M, the valve at T prevents any air from getting down; and therefore, when the piston is drawn up again, the air contained in the space MT$\,t\,m$ will expand into the space NT$\,t\,n$, and its density will be $\frac{\mathrm{MT}}{\mathrm{NT}}$. This is less than $\frac{\mathrm{MS}}{\mathrm{NS}}$, which expresses the density of the air which was left in the space TS$\,s\,t$ by the former operations.—The air, therefore, in TS$\,s\,t$ will also expand, will open the valve, and now the water will rise above S. The proportion of SN to NT may be evidently such that the water will even get above the valve T. This diminishes the space NT$\,t\,n$; and therefore, when the piston has been pushed down to M, and again drawn up to N, the air will be still more rarefied, and the water will rise still higher. The foregoing reasoning, however, is sufficient to show that there may still be a height which the water will not pass, and that this height depends on the proportion between the stroke of the piston and its distance from the water in the cistern. We need not give the determination, because it will come in afterwards in combination with other circumstances. It is enough that the reader sees the physical causes of this limitation: And, lastly, we see plainly that the utmost security will be given for the performance of the pump, when the fixed valve is so placed that the piston, when in its lowest position, shall come into contact with it. In this case, the rarefaction of the air will be the completest possible; and, if there were no space left between the piston and valve, and all were perfectly air-tight, the rarefaction would be complete, and the valve might be any thing less than 33 feet from the surface of the water in the cistern.

12
Valves not easily kept air-tight.

But this perfect contact and tightness is unattainable; and though the pump may be full of water, its continual downward pressure causes it to filtrate slowly through every crevice, and the air enters through every pore, and even disengages itself from the water, with which a considerable portion had been chemically combined. The pump by this means loses water, and it requires several strokes of brisk working to fill it again: and if the leathers have become dry, so much admission may be given to the air, that the pump will not fill itself with water by *any working*. It is then necessary to pour water into it, which shuts up these passages, and soon sets all to rights again. For these reasons it is always prudent to place the fixed valve as low as other circumstances will permit, and to make the piston rod of such a length, that when it is at the bottom of its stroke it shall be almost in contact with the valve. When we we are not limited by other circumstances, it is evident that the best possible form is to have both the piston and the fixed valve under the surface of the water of the cistern. In this situation they are always wet and air-tight. The chief objection is, that by this disposition they are not easily come at when needing repair. This is a material objection in deep mines. In such situations, therefore, we must make the best compensation of different circumstances that we can. It is usual to place the fixed valve at a moderate distance from the surface of the water, and to have a hole in the side of the pipe, by which it may be got out. This is carefully shut up by a plate firmly screwed on, with leather or cement between the parts. This is called the *clack door*. It would, in every case, be very proper to have a fixed valve in the lower end of the pipe. This would combine all advantages. Being always tight, the pipe would retain the water, and it would leave to the valve above it its full effect of increasing the rarefaction. A similar hole is made in the working barrel, a little above the highest position of the piston. When this needs repair, it can be got at through this hole, without the immense trouble of drawing up the whole rods.

Thus we have conducted the reader step by step, from the simplest form of the pump to that which long experience has at last selected as the most generally convenient. This we shall now describe in some detail.

13 **Description of the sucking-pump. Fig. 5.**

The SUCKING PUMP consists of two pipes DCCD, BAAB (fig. 5.); of which the former is called the *Barrel*, or the *Working Barrel*, and the other is called the *Suction-pipe*, and is commonly of a smaller diameter.—These are joined by means of flanches F, F, pierced with holes to receive screwed bolts. A ring of leather, or of lead, covered with a proper cement, is put between them; which, being strongly compressed by the screw-bolts, renders the joint perfectly air-tight.—The lower end A of the suction-pipe is commonly spread out a little to facilitate the entry of the water, and frequently has a grating across at AA to keep out filth or gravel. This is immerged in the standing water YZ. The working barrel is cylindrical, as evenly and smoothly bored as possible, that the piston may fill it exactly through its whole length, and move along it with as little friction as may be consistent with air-tightness.

The piston is a sort of truncated cone OPKL, generally made of wood not made to slip, such as elm or beech. The small end of it is cut off at the sides, so as to form a sort of arch OQP, by which it is fastened to the iron rod or spear. It is exhibited in different positions in figures 6, 7. which will give a more distinct notion of it than any description. The two ends of the conical part may be hooped with brass. This cone has its larger end surrounded with a ring or band of strong leather fastened with nails, or by a copper hoop, which is driven on at the smaller end. This band should reach to some distance beyond the base of the cone; the farther the better: and the whole must be of uniform thickness all round, so as to suffer equal compression between the cone and the working barrel.

Fig. 6. and 7.

14 **Necessity of air-tightness not properly attended to.**

The seam or joint of the two ends of this band must be made very close, but not sewed or stitched together. This would occasion bumps or inequalities, which would spoil its tightness; and no harm can result from the want of it, because the two edges will be squeezed close together by the compression in the barrel. It is by no means necessary that this compression be great. This is a very detrimental error of the pump-makers. It occasions enormous friction, and destroys the very purpose which they have in view, viz. rendering the piston air-tight; for it causes the leather to wear through very soon at the edge of the cone, and it also wears the working barrel. This very soon becomes wide in that part which is continually passed over by the piston, while the mouth remains of its original diameter, and it becomes impossible to thrust in a piston which shall completely fill the worn part.

15 **An easy mode of rendering pumps tight.**

Now, a very moderate pressure is sufficient for rendering the pump perfectly tight, and a piece of glove leather would be sufficient for this purpose, if loose or detached from the solid cone; for suppose such a loose and flexible, but impervious, band of leather put round the piston, and put into the barrel; and let it even be supposed that the cone does not compress it in the smallest degree to its internal surface.—Pour a little water carefully into the inside of this sort of cup or dish; it will cause it to swell out a little, and apply itself close to the barrel all round, and even adjust itself to all its inequalities. Let us suppose it to touch the barrel in a ring of an inch broad all round. We can easily compute the force with which it is pressed. It is half the weight of a ring of water an inch deep and an inch broad. This is a trifle, and the friction occasioned by it not worth regarding; yet this trifling pressure is sufficient to make the passage perfectly impervious, even by the most enormous pressure of a high column of incumbent water: for let this pressure be ever so great, the pressure by which the leather adheres to the barrel always exceeds it, because the incumbent fluid has no *preponderating* power by which it can force its way between them, and it must insinuate itself precisely so far, that its pressure on the inside of the leather shall still exceed, and only exceed, the pressure by which it endeavours to insinuate itself; and thus the piston becomes perfectly tight with the smallest possible friction. This reasoning is perhaps too refined for the uninstructed artist, and probably will not persuade him.

16 **Proved to be practicable from the human frame.**

To such we would recommend an examination of the pistons and valves contrived and executed by that artist, whose skill far surpasses our highest conceptions, the all-wise Creator of this world. The valves which shut up the passages of the veins, and this in places where an extravasation would be followed by instant death, are cups of thin membrane which adhere to the sides of the channel about half way round, and are detached in the rest of their circumference. When the blood comes in the opposite direction, it pushes the membrane aside, and has a passage perfectly free. But a stagnation of motion allows the tone of the muscular (perhaps) membrane, to restore it to its natural shape, and the least *motion* in the opposite direction causes it instantly to clap close to the sides of the vein, and then no pressure whatever can force a passage.

17 **Best form of a piston recommended.**

We shall recur to this again, when describing the various contrivances of valves, &c. What we have said is enough for supporting our directions for constructing a tight piston. But we recommended thick and strong leather, while our present reasoning seems to render thin leather preferable. If the leather be thin, and the solid piston in any part does not press it gently to the barrel, there will be in this part an unbalanced pressure of the incumbent column of water, which would instantly burst even a strong leather bag; but when the solid piston, covered with leather, exactly fills the barrel, and is even pressed a little to it, there is no such risk; and now that part of the leather band which reaches beyond the solid piston performs its office in the completest manner. We do not hesitate, therefore, to recommend this form of a piston, which is the most common and simple of all, as preferable, when well executed, to any of those more artificial, and frequently very ingenious, constructions, which we have met with in the works of the first engineers. To proceed, then, with our description of the sucking-pump.

18

Further description of the sucking-pump.

At the joining of the working barrel with the suction-pipe there is a hole H, covered with a valve opening upwards. This hole H is either made in a plate which makes a part of the suction-pipe, being cast along with it, or it is made in a separate plate. This last is the most convenient, being easily removed and replaced. Different views are given of this valve in figs. 8, 9, 10. The diameter EF (fig. 10.) of this plate is the same with that of the flanches, and it has holes corresponding to them, through which their bolts pass which keep all together. A ring of thick leather NKL is applied to this plate, having a part cut out between N and L, to make room for another piece of strong leather NR (fig. 9.) which composes the valve. The circular part of this valve is broader than the hole in the middle of fig. 10. but not quite so broad as to fill up the inside of the ring of leather OQP of this fig. which is the same with GKI of fig. 10. The middle of this leather valve is strengthened by two brass (not iron) plates, the uppermost of which is seen at R of fig. 9.: the one on its underside is a little smaller than the hole in the valve-plate, that it may go freely in; and the upper plate R is larger than this hole, that it may compress the leather to its brim all round. It is evident, that when this plate with its leathers is put between the joint flanches, and all is screwed together, the tail of leather N of fig. 9. will be compressed between the plates, and form a hinge, on which the valve can turn, rising and falling. There is a similar valve fastened to the upper side, or broadest base of the piston. This description serves for both valves, and in general for most valves which are to be found in any parts of a pump.

Fig. 8.

Fig. 9.

Fig. 10.

19

Its mode of operation.

The reader will now understand, without any repetition, the process of the whole operation of a sucking-pump. The piston rarefies the air in the working barrel, and that in the suction-pipe expands through the valve into the barrel; and, being no longer a balance for the atmospheric pressure, the water rises into the suction-pipe; another stroke of the piston produces a similar effect, and the water rises farther, but by a smaller step than by the preceding stroke: by repeating the strokes of the piston, the water gets into the barrel; and when the piston is now pushed down through it, it gets above the piston, and must now be lifted up to any height. The suction-pipe is commonly of smaller size than the working barrel, for the sake of economy. It is not necessary that it be so wide; but it may be, and often is, made too small. It should be of such a size, that the pressure of the atmosphere may be able to fill the barrel with water as fast as the piston rises. If a void is left below the piston, it is evident that the piston must be carrying the whole weight of the atmosphere, besides the water which is lying above it. Nay, if the pipe be only so wide, that the barrels shall fill precisely as fast as the piston rises, it must sustain all this pressure. The suction-pipe should be wider than this, that all the pressure of the atmosphere which exceeds the weight of the pillar in the suction-pipe may be employed in pressing it on the under surface of the piston, and thus diminish the load. It cannot be made too wide; and too strict an economy in this respect may very sensibly diminish the performance of the pump, and more than defeat its own purpose. This is most likely when the suction-pipe is long, because there the length of the pillar of water nearly balances the air's pressure, and leaves very little accelerating force; so that water will rise but slowly even in the widest pipe. All these things will be made the subjects of computation afterwards.

It is plain that there will be limitations to the rise of the water in the suction-pipe, similar to what we found when the whole pump was an uniform cylinder. Let a be the height of the fixed valve above the water in the cistern: let B and b be the spaces in cubic measure between this valve and the piston in its highest and lowest positions, and therefore express the bulks of the air which may occupy these spaces: let y be the distance between the fixed valve and the water in the suction-pipe, when it has attained its greatest height by the rarefaction of the air above it: let h be the height of a column of water in equilibrio, with the whole pressure of the atmosphere, and therefore having its weight in equilibrio with the elasticity of common air; and let x be the height of the column whose weight balances the elasticity of the air in the suction-pipe, when rarefied as much as it can be by the action of the piston, the water standing at the height $a-y$.

Then, because this elasticity, together with the column $a-y$ in the suction-pipe, must balance the whole pressure of the atmosphere, (see PNEUMATICS, N° 108.), we must have $h=x+a-y$, and $y=a+x-h$.

When the piston was in its lowest position, the bulk of the air between it and the fixed valve was b. Suppose the valve kept shut, and the piston raised to its highest position, the bulk will be B, and its density $\frac{b}{B}$, and its elasticity, or the height of the column whose weight will balance it, will be $h\frac{b}{B}$. If the air in the suction-pipe be denser than this, and consequently more elastic, it will lift the valve, and some will come in; therefore, when the pump has rarefied the air as much as it can, so that none does, in fact, come in, the elasticity of the air in the suction-pipe *must* be the same. Therefore $x=h\frac{b}{B}$.

We had $y=a+x-h$. Therefore $y=a+h\frac{b}{B}-h, =a+\frac{b-B}{B}h, =a-\frac{B-b}{B}h$.

Therefore when $\frac{B-b}{B}h$ is less than a, the water will stop before it reaches the fixed valve. But when a is less than $\frac{B-b}{B}h$, the water will get above the fixed valve, y becoming negative.

But

Pump.

But it does not follow that the water will reach the piston, that is, will rise so high that the piston will pass through it in its descent. Things now come into the condition of a pump of uniform dimensions from top to bottom; and this point will be determined by what was said when treating of such a pump.

20 The same pump is used in an inverted position; Fig. 11.

There is another form of the sucking-pump which is much used in great water works, and is of equal efficacy with the one now described. It is indeed the same pump in an inverted position. It is represented in fig. 11. where ABCD is the working barrel, immersed, with its mouth downwards, in the water of the cistern. It is joined by means of flanches to the rising pipe or MAIN.

This usually consists of two parts. The first, BEFC, is bent to one side, that it may give room for the iron frame TXYV, which carries the rod NO of the piston M, attached to the traverses RS, TOV of this frame. The other part, EGHF, is usually of a less diameter, and is continued to the place of delivery. The piston frame XTVY hangs by the rod Z, at the arm of a lever or working beam, not brought into the figure. The piston is perforated like the former, and is surrounded like it with a band of leather in form of a taper-dish. It has a valve K on its broad or upper base, opening when pressed from below. The upper end of the working barrel is pierced with a hole, covered with a valve I, also opening upwards.

Now suppose this apparatus immersed into the cistern till the water is above it, as marked by the line 2, 3, and the piston drawn up till it touch the end of the barrel. When the piston is allowed to descend by its own weight, the water rises up through its valve K, and fills the barrel. If the piston be now drawn up by the moving power of the machinery with which it is connected, the valve K shuts, and the piston pushes the water before it through the valve I into the main pipe EFGH. When the the piston is again let down, the valve I shuts by its own weight and the pressure of the water incumbent on it, and the barrel is again filled by the water of the cistern. Drawing up the piston pushes this water into the main pipe, &c. and then the water is at length delivered at the place required.

21 and is called a *lifting pump*.

This pump is usually called the *lifting pump*; perhaps the simplest of all in its principle and operation.—It needs no farther explanation: and we proceed to describe

22 Forcing-pump described. Fig. 12.

The FORCING PUMP, represented in fig. 12. It consists of a working barrel ABCD, a suction-pipe CDEF, and a main or rising pipe. This last is usually in three joints. The first GHKI may be considered as making part of the working barrel, and is commonly cast in one piece with it. The second IKLM is joined to it by flanches, and forms the elbow which this pipe must generally have. The third LNOM is properly the beginning of the main, and is continued to the place of delivery. At the joint IK there is a hanging valve or clack S; and there is a valve R on the top of the suction-pipe.

The piston PQTV is solid, and is fastened to a stout iron rod which goes through it, and is fixed by a key drawn through its end. The body of the piston is a sort of double cone, widening from the middle to each end, and is covered with two bands of very strong leather, fitted to it in the manner already described.

The operation of this pump is abundantly simple. When the piston is thrust into the pump, it pushes the air before it through the valve S, for the valve R remains shut by its own weight. When it has reached near the bottom, and is drawn up again, the air which filled the small space between the piston and the valve S now expands into the barrel; for as soon as the air begins to expand, it ceases to balance the pressure of the atmosphere, which therefore shuts the valve S. By the expansion of the air in the barrel the equilibrium at the valve R is destroyed, and the air in the suction-pipe lifts the valve, and expands into the barrel; consequently it ceases to be a balance for the pressure of the atmosphere, and the water is forced into the suction-pipe. Pushing the piston down again forces the air in the barrel through the valve S, the valve R in the mean time shutting. When the piston is again drawn up, S shuts, R opens, the air in the suction-pipe dilates anew, and the water rises higher in it. Repeating these operations, the water gets at last into the working barrel, and is forced into the main by pushing down the piston, and is pushed along to the place of delivery. 23 Its mode of operation.

The operation of this pump is therefore two-fold, sucking and forcing. In the first operation, the same force must be employed as in the sucking-pump, namely, a force equal to the weight of a column of water having the section of the piston for its base, and the height of the piston above the water in the cistern for its height. It is for the sake of this part of the operation that the upper cone is added to the piston. The air and water would pass by the sides of the lower cone while the piston is drawn up; but the leather of the upper cone applies to the surface of the barrel, and prevents this. The space contained between the barrel and the valve S is a great obstruction to this part of the operation, because this air cannot be rarefied to a very great degree. For this reason, the suction-pipe of a forcing-pump must not be made long. It is not indeed necessary; for by placing the pump a few feet lower, the water will rise into it without difficulty, and the labour of suction is as much diminished as that of impulsion is increased. However, an intelligent artist will always endeavour to make this space between the valve S and the lowest place of the piston as small as possible. 24 Is two-fold.

The power employed in forcing must evidently surmount the pressure of the whole water in the rising pipe, and (independent of what is necessary for giving the water the required velocity, so that the proper quantity per hour may be delivered), the piston has to withstand a force equal to the weight of a column of water having the section of the piston for its base, and the perpendicular altitude of the place of delivery above the lower surface of the piston for its height. It is quite indifferent in this respect what is the diameter of the rising pipe; because the pressure on the piston depends on the altitude of the water only, independent of its quantity. We shall even see that a small rising pipe will require a greater force to convey the water along it to any given height or distance.

When we would employ a pump to raise water in a crooked pipe, or in any pipe of moderate dimensions, this form of pump, or something equivalent, must be used. In bringing up great quantities of water from mines, the common sucking-pump is generally employed, ed, as really the best of them all; but it is the most expensive, because it requires the pipe to be perpendicular, straight, and of great dimensions, that it may contain the piston rods. But this is impracticable when the pipe is crooked.

If the forcing pump, constructed in the manner now described, be employed, we cannot use forcers with long rods. These would bend when pushed down by their further extremity. In this case, it is usual to employ only a short and stiff rod, and to hang it by a chain, and load it with a weight superior to the weight of water to be raised by it. The machinery therefore is employed, not in forcing the water along the rising-pipe, but in raising the weight which is to produce this effect by its subsequent descent.

In this case, it would be much better to employ the lifting-pump of fig. 11. For as the load on the forcers must be greater than the resistances which it must surmount, the force exerted by the machine must in like manner be greater than this load. This double excess would be avoided by using the lifting-pump.

25 Measure of the quantity of water delivered by any pump.

It will readily occur to the reader that the quantity of water delivered by any pump will be in the joint proportion of the surface or base of the piston and its velocity: for this measures the capacity of the part of the working barrel which the piston passes over. The velocity of the water in the conduit pipe, and in its passage through every valve, will be greater or less than the velocity of the piston, in the same proportion that the area of the piston or working barrel is greater or less than the area of the conduit or valve. For whatever quantity of water passes through any section of the working barrel in a second, the same quantity must go through any one of these passages. This enables us to modify the velocity of the water as we please: we can increase it to any degree at the place of delivery by diminishing the aperture through which it passes, provided we apply sufficient force to the piston.

26 The operation of pumps not equable;

It is evident that the operation of a pump is by starts, and that the water in the main remains at rest, pressing on the valve during the time that the piston is withdrawn from the bottom of the working barrel. It is in most cases desirable to have this motion equable, and in some cases it is absolutely necessary. Thus, in the engine for extinguishing fires, the spout of water going by jerks could never be directed with a certain aim, and half of the water would be lost by the way; because a body at rest cannot in an instant be put in rapid motion, and the first portion of every jerk of water would have but a small velocity.

27 and the mode of making them so.

A very ingenious contrivance has been fallen upon for obviating this inconvenience, and procuring a stream nearly equable. We have not been able to discover the author. At any convenient part of the rising-pipe beyond the valve S there is annexed a capacious vessel VZ (fig. 13. N° 1. and 2.) close a-top, and of great strength.

Fig. 13.

When the water is forced along this pipe, part of it gets into this vessel, keeping the air confined above it, and it fills it to such a height V, that the elasticity of the confined air balances a column reaching to T, we shall suppose, in the rising-pipe. The next stroke of the piston sends forward more water, which would fill the rising-pipe to some height above T. But the pressure of this additional column causes some more of it to go into the air vessel, and compress its air so much more that its elasticity now balances a longer column. Every succeeding stroke of the piston produces a like effect. The water rises higher in the main pipe, but some more of it goes into the air vessel. At last the water *appears* at the place of delivery; and the air in the air vessel is now so much compressed that its elasticity balances the pressure of the whole column. The next stroke of the piston sends forward some more water. If the diameter of the orifice of the main be sufficient to let the water flow out with a velocity equal to that of the piston, it will so flow out, rising no higher, and producing no sensible addition to the compression in the air vessel. But if the orifice of the main be contracted to half its dimensions, the water sent forward by the piston cannot flow out in the time of the stroke without a greater velocity, and therefore a greater force. Part of it, therefore, goes into the air vessel, and increases the compression. When the piston has ended its stroke, and no more water comes forward, the compression of the air in the air vessel being greater than what was sufficient to balance the pressure of the water in the main pipe, now forces out some of the water which is lying below it. This cannot return towards the pump, because the valve S is now shut. It therefore goes forward along the main, and produces an efflux during the time of the piston's rising in order to make another stroke. In order that this efflux may be very equable, the air vessel must be very large. If it be small, the quantity of water that is discharged by it during the return of the piston makes so great a portion of its capacity, that the elasticity of the confined air is too much diminished by this enlargement of its bulk, and the rate of efflux must diminish accordingly. The capacity of the air vessel should be so great that the change of bulk of the compressed air during the inaction of the piston may be inconsiderable. It must therefore be very strong.

It is pretty indifferent in what way this air vessel is connected with the rising-pipe. It may join it laterally, as in fig. 13. N° 1. and the main pipe go on without interruption; or it may be made to *surround* an interruption of the main pipe, as in fig. 13. N° 2. It may also be in any part of the main pipe. If the sole effect intended by it is to produce an equable jet, as in ornamental water-works, it may be near the end of the main. This will require much less strength, because there remains but a short column of water to compress the air in it. But it is, on the whole, more advantageous to place it as near the pump as possible, that it may produce an equable motion in the whole main pipe. This is of considerable advantage: when a column of water several hundred feet long is at rest in the main pipe, and the piston at one end of it put at once into motion, even with a moderate velocity, the strain on the pipe would be very great. Indeed if it were possible to put the piston instantaneously into motion with a finite velocity, the strain on the pipe, tending to burst it, would be next to infinite. But this seems impossible in nature; all changes of motion *which we observe* are gradual, because all impelling bodies have some elasticity or softness by which they yield to compression. And, in the way in which pistons are commonly moved, viz. by cranks or something analogous to them, the motion is *very sensibly* gradual. But still the air vessel tends to make the motion along the main pipe less desultory, and therefore diminishes those strains which would really take place

28 The desultory motion of the pistons.

5

place in the main-pipe. It acts like the springs of a travelling-carriage, whose jolts are incomparably less than those of a cart; and by this means really enables a given force to propel a greater quantity of water in the same time.

29 Corrected.

We may here by the way observe, that the attempts of mechanicians to correct this unequal motion of the piston-rod are misplaced, and if it could be done, would greatly hurt a pump. One of the best methods of producing this effect is to make the piston-rod consist of two parallel bars, having teeth in the sides which front each other. Let a toothed wheel be placed between them, having only the half of its circumference furnished with teeth. It is evident, without any farther description, that if this wheel be turned uniformly round its axis, the piston-rod will be moved uniformly up and down without intermission. This has often been put in practice; but the machine always went by jolts, and seldom lasted a few days. Unskilled mechanicians attributed this to defect in the execution: but the fault is essential, and lies in the principle.

30 But on a wrong principle.

The machine could not perform one stroke, if the first mover did not slacken a little, or the different parts of the machine did not yield by bending or by compression; and no strength of materials could withstand the violence of the strains at every reciprocation of the motion. This is chiefly experienced in great works which are put in motion by a water-wheel, or some other equal power exerted on the mass of matter of which the machine consists. The water-wheel being of great weight, moves with considerable steadiness or uniformity; and when an additional resistance is opposed to it by the beginning of a new stroke of the piston, its great quantity of motion is but little affected by this addition, and it proceeds very little retarded; and the machine must either yield a little by bending and compression, or go to pieces, which is the common event. Cranks are free from this inconvenience, because they accelerate the piston gradually, and bring it gradually to rest, while the water-wheel moves round with almost perfect uniformity. The only inconvenience (and it may be considerable) attending this slow motion of the piston at the beginning of its stroke is, that the valves do not shut with rapidity, so that some water gets back through them. But when they are properly formed and loaded, this is but trifling.

31 These equable pumps deliver very little more water than the others.

We must not imagine, that because the stream produced by the assistance of an air-barrel is almost perfectly equable, and because as much water runs out during the returning of the piston as during its active stroke, it therefore doubles the quantity of water. No more water can run out than what is sent forward by the piston during its effective stroke. The continued stream is produced only by preventing the whole of this water from being discharged during this time, and by providing a propelling force to act during the piston's return. Nor does it enable the moving force of the piston to produce a double effect: for the compression which is produced in the air-vessel, more than what is necessary for merely balancing the quiescent column of water, reacts on the piston, resisting its compression just as much as the column of water would do which produces a velocity equal to that of the efflux. Thus if the water is made to spout with the velocity of eight feet per second, this would require an additional column of one foot high, and this would just balance the compression in the air-vessel, which maintains this velocity during the non-action of the piston. It is, however, a matter of fact, that a pump furnished with an air-vessel delivers a little more water than it would do without it. But the difference depends on the combination of many very dissimilar circumstances, which it is extremely difficult to bring into calculation. Some of these will be mentioned afterwards.

To describe, or even to enumerate, the immense variety of combinations of these three simple pumps would fill a volume. We shall select a few, which are more deserving of notice.

I. The common sucking-pump may, by a small addition, be converted into a lifting pump, fitted for propelling the water to any distance, and with any velocity. 32 The sucking-pump converted into a lifting pump.

Fig. 14. is a sucking-pump, whose working-barrel ACDB has a lateral pipe AEGHF connected with it close to the top. This terminates in a *main* or rising pipe IK, furnished or not with a valve L. The top of the barrel is shut up by a strong plate MN, having a hollow neck terminating in a small flanch. The piston rod QR passes through this neck, and is nicely turned and polished. A number of rings of leather are put over the rod, and strongly compressed round it by another flanch and several screwed bolts, as is represented at OP. By this contrivance the rod is closely grasped by the leathers, but may be easily drawn up and down, while all passage of air or water is effectually prevented. Fig. 14.

The piston S is perforated, and furnished with a valve opening upwards. There is also a valve T on the top of the suction-pipe YX; and it will be of advantage, though not absolutely necessary, to put a valve L at the bottom of the rising pipe. Now suppose the piston at the bottom of the working-barrel. When it is drawn up, it tends to compress the air above it, because the valve in the piston remains shut by its own weight. The air therefore is driven through the valve L into the rising pipe, and escapes. In the mean time, the air which occupied the small space between the piston and the valve T expands into the upper part of the working-barrel; and its elasticity is so much diminished thereby, that the atmosphere presses the water of the cistern into the suction-pipe, where it will rise till an equilibrium is again produced. The next downward stroke of the piston allows the air, which had come from the suction-pipe into the barrel during the ascent of the piston, to get through its valve. Upon drawing up this piston, the air is also drawn off through the rising pipe. Repeating this process brings the water at last into the working-barrel, and it is then driven along the rising-pipe by the piston.

This is one of the best forms of a pump. The rarefaction may be very perfect, because the piston can be brought so near to the bottom of the working-barrel: and, for forcing water in opposition to great pressures, it appears preferable to the common forcing-pump; because in that the piston rods are compressed and exposed to bending, which greatly hurts the pump by wearing the piston and barrel on one side. This soon renders it less tight, and much water squirts out by the sides of the piston. But in this pump the piston rod is always drawn or pulled, which keeps it straight; 33 Advantages of this conversion.

and rods exert a much greater force in opposition to a pull than in opposition to compression. The collar of leather round the piston-rods is found by experience to need very little repairs, and is very impervious to water. The whole is very accessible for repairs; and in this respect much preferable to the common pump in deep mines, where every fault of the piston obliges us to draw up some hundred feet of piston-rods. By this addition, too, any common pump for the service of a house is converted into an engine for extinguishing fire, or may be made to convey the water to every part of the house; and this without hurting or obstructing its common uses. All that is necessary is to have a large cock on the upper part of the working barrel opposite to the lateral pipe in this figure. This cock serves for a spout when the pump is used for common purposes: and the merely shutting this cock converts the whole into an engine for extinguishing fire or for supplying distant places with water. It is scarcely necessary to add, that for these services it will be proper to connect an air-vessel with some convenient part of the rising pipe, in order that the current of the water may be continual.

34 Equable streams produced in great works by combinations.

We have frequently spoken of the advantages of a continued current in the main pipe. In all great works a considerable degree of uniformity is produced by the manner of disposing the actions of the different pumps; for it is very rarely that a machine works but one pump. In order to maintain some uniformity in the resistance, that it may not all be opposed at once to the moving power, with intervals of total inaction, which would produce a very hobbling motion, it is usual to distribute the work into portions, which succeed alternately; and thus both diminish the strain, and give greater uniformity of action, and frequently enable a natural power which we can command, to perform a piece of work, which would be impossible if the whole resistance were opposed at once. In all pump machines, therefore, we are obviously directed to construct them so that they may give motion to at least two pumps, which work alternately. By this means a much greater uniformity of current is produced in the main pipe. It will be rendered still more uniform if four are employed, succeeding each other at the interval of one quarter of the time of a complete stroke.

35 A single pump for this purpose described.

But ingenious men have attempted the same thing with a single pump, and many different constructions for this purpose have been proposed and executed. The thing is not of much importance, or of great research. We shall content ourselves therefore with the description of one that appears to us the most perfect, both in respect of simplicity and effect.

Fig. 15.

II. It consists of a working-barrel AB (fig. 15.) close at both ends. The piston C is solid, and the rod OP passes through a collar of leathers in the plate, which closes the upper end of the working-barrel. This barrel communicates laterally with two pipes H, K; the communications *m* and *n* being as near to the top and bottom of the barrel as possible. Adjoining to the passage *m* are two valves F and G opening upwards. Similar valves accompany the passage *n*. The two pipes H and K unite in a larger rising pipe L. They are all represented as in the same plane; but the upper ends must be bent backwards, to give room for the motion of the piston-rod OP.

Suppose the piston close to the entry of the lateral pipe *n*, and that it is drawn up: it compresses the air above it, and drives it through the valve G, where it escapes along the rising pipe; at the same time it rarefies the air in the space below it. Therefore the weight of the atmosphere shuts the valve E, and causes the water of the cistern to rise through the valve D, and fill the lower part of the pump. When the piston is pushed down again, this water is first driven through the valve E, because D immediately shuts; and then most of the air which was in this part of the pump at the beginning goes up through it, some of the water coming back in its stead. In the mean time, the air which remained in the upper part of the pump after the ascent of the piston is rarefied by its descent; because the valve G shuts as soon as the piston begins to descend, the valve F opens, the air in this suction pipe F *f* expands into the barrel, and the water rises into the pipes by the pressure of the atmosphere. The next rise of the piston must bring more water into the lower part of the barrel, and must drive a little more air through the valve G, namely, part of that which had come out of the suction-pipe F *f*; and the next descent of the piston must drive more water into the rising pipe H, and along with it most if not all of the air which remained below the piston, and must rarefy still more the air remaining above the piston; and more water will come in through the pipe F *f*, and get into the barrel. It is evident, that a few repetitions will at last fill the barrel on both sides of the piston with water. When this is accomplished, there is no difficulty in perceiving how, at every rise of the piston, the water of the cistern will come in by the valve D, and the water in the upper part of the barrel will be driven through the valve G; and, in every descent of the piston, the water of the cistern will come into the barrel by the valve F, and the water below the piston will be driven through the valve E: and thus there will be a continual influx into the barrel through the valves D and F, and a continual discharge along the rising pipe L through the valves E and G.

This machine is, to be sure, equivalent to two forcing pumps, although it has but one barrel and one piston; but it has no sort of superiority. It is not even more economical in most cases; because we apprehend that the additional workmanship will fully compensate for the barrel and piston that is saved. There is indeed a saving in the rest of the machinery, because one lever produces both motions. We cannot therefore say that it is inferior to two pumps; and we acknowledge that there is some ingenuity in the contrivance. 36 It is equivalent to two forcing-pumps.

We recommend to our readers the perusal of Belidor's *Architecture Hydraulique*, where is to be found a great variety of combinations and forms of the simple pumps; but we must caution them with respect to his theories, which in this article are extremely defective. Also in Leupold's *Theatrum Machinarum Hydraulicarum*, there is a prodigious variety of all kinds of pumps, many of them very singular and ingenious, and many which have particular advantages, which may suit local circumstances, and give them a preference. But it would be improper to swell a work of this kind with so many peculiarities; and a person who makes himself master of the principles delivered here in sufficient detail, can be at no loss to suit a pump to his particular 37 Authors recommended.

iews,

Pump. views, or to judge of the merit of such as may be proposed to him.

We must now take notice of some very considerable and important varieties in the form and contrivance of the essential parts of a pump.

38 The forcing pump differently constructed. Plate CCCCL. fig. 16.

III. The forcing pump is sometimes of a very different form from that already described. Instead of a piston, which applies itself to the inside of the barrel, and slides up and down in it, there is a long cylinder POQ (fig. 16.) nicely turned and polished on the outside, and of a diameter somewhat less than the inside of the barrel. This cylinder (called a PLUNGER) slides through a collar of leathers on the top of the working-barrel, and is constructed as follows. The top of the barrel terminates in a flanch *ab*, pierced with four holes for receiving screw-bolts. There are two rings of metal, *c d*, *e f*, of the same diameter, and having holes corresponding to those in the flanch. Four rings of soft leather, of the same size, and similarly pierced with holes, are well soaked in a mixture of oil, tallow, and a little rosin. Two of these leather rings are laid on the pump flanch, and one of the metal rings above them. The plunger is then thrust down through them, by which it turns their inner edges downwards. The other two rings are then slipped on at the top of the plunger, and the second metal ring is put over them, and then the whole are slid down to the metal ring. By this the inner edges of the last leather rings are turned upwards. The three metal rings are now forced together by the screwed bolts; and thus the leathern rings are strongly compressed between them, and made to grasp the plunger so closely that no pressure can force the water through between. The upper metal ring just allows the plunger to pass through it, but without any play: so that the turned-up edges of the leathern rings do not come up between the plunger and the upper metal ring, but are lodged in a little conical taper, which is given to the inner edge of the upper plate, its hole being wider below than above. It is on this trifling circumstance that the great tightness of the collar depends. To prevent the leathers from shrinking by drought, there is usually a little cistern formed round the head of the pump, and kept full of water. The plunger is either forced down by a rod from a working beam, or by a set of metal weights laid on it, as is represented in the figure.

39 Its mode of operation.

It is hardly necessary to be particular in explaining the operation of this pump. When the plunger is at the bottom of the barrel, touching the fixed valve M with its lower extremity, it almost completely fills it. That it may do it completely, there is sometimes a small pipe RSZ branching out from the top of the barrel, and fitted with a cock at S. Water is admitted till the barrel is completely filled, and the cock is then shut. Now when the plunger is drawn up, the valve N in the rising pipe must remain shut by the pressure of the atmosphere, and a void must be made in the barrel. Therefore the valve M on the top of the suction-pipe must be opened by the elasticity of the air in this pipe, and the air must expand into the barrel; and being no longer a balance for the atmosphere, the water in the cistern must be forced into the suction-pipe, and rise in it to a certain height. When the plunger descends, it must drive the water through the valve N (for the valve M will immediately shut), and along with it most of the air which had come into the barrel. And as this air occupied the upper part of the barrel, part of it will remain when the plunger has reached the bottom; but a stroke or two will expel it all, and then every succeeding stroke of the descending piston will drive the water along the rising pipe, and every ascent of the plunger will be followed by the water from the cistern.

The advantage proposed by this form of piston is that it may be more accurately made and polished than the inside of a working barrel, and it is of much easier repair. Yet we do not find that it is much used, although an invention of the 17th century (we think by Sir Samuel Morland), and much praised by the writers on these subjects.

40 Sucking-pump similarly varied.

It is easy to see that the sucking-pump may be varied in the same way. Suppose this plunger to be open both at top and bottom, but the bottom filled with a valve opening upward. When this is pushed to the bottom of the barrel, the air which it tends to compress lifts the valve (the lateral pipe FIK being taken away and the passage shut up), and escapes through the plunger. When it is drawn up, it makes the same rarefaction as the solid plunger, because the valve at O shuts, and the water will come up from the cistern as in the former case. If the plunger be now thrust down again, the valve M shuts, the valve O is forced open, and the plunger is filled with water. This will be lifted by it during its next ascent; and when it is pushed down again, the water which filled it must now be pushed out, and will flow over its sides into the cistern at the head of the barrel. Instead of making the valve at the bottom of the piston, it may be made at the top; but this disposition is much inferior, because it cannot rarefy the air in the barrel one half. This is evident; for the capacity of the barrel and plunger together cannot be twice the capacity of the barrel.

41 Another form of the sucking-pump, Fig. 17.

IV. It may be made after a still different form, as represented in fig. 17. Here the suction-pipe CO comes up through a cistern KMNL deeper or longer than the intended stroke of the piston, and has a valve C at top. The piston, or what acts in lieu of it, is a tube AHGB, open at both ends, and of a diameter somewhat larger than that of the suction-pipe. The interval between them is filled up at HG by a ring or belt of soft leather, which is fastened to the *outer* tube, and moves up and down with it, sliding along the smoothly polished surface of the suction-pipe with very little friction. There is a valve I on the top of this piston, opening upwards. Water is poured into the outer cistern.

42 and its mode of operation.

The outer cylinder or piston being drawn up from the bottom, there is a great rarefaction of the air which was between them, and the atmosphere presses the water up through the suction-pipe to a certain height; for the valve I keeps shut by the pressure of the atmosphere and its own weight. Pushing down the piston causes the air, which had expanded from the suction-pipe into the piston, to escape through the valve I; drawing it up a second time, allows the atmosphere to press more water into the suction-pipe, to fill it, and also part of the piston. When this is pushed down again, the water which had come through the valve C is now forced out through the valve I into the cistern KMNL, and now the whole is full of water. When, therefore, the piston is drawn up, the water follows, and fills it, if not

not 33 feet above the water in the cistern; and when it is pushed down again, the water which filled the piston is all thrown out into the cistern; and after this it delivers its full contents of water every stroke. The water in the cistern KMNL effectually prevents the entry of any air between the two pipes; so that a very moderate compression of the belt of soft leather at the mouth of the piston cylinder is sufficient to make all perfectly tight.

43
The piston cylinder differently formed.

It might be made differently. The ring of leather might be fastened round the top of the inner cylinder at DE, and slid on the inside of the piston cylinder; but the first form is most easily executed. Muschenbroeck has given a figure of this pump in his large system of natural philosophy, and speaks very highly of its performance. But we do not see any advantage which it possesses over the common sucking-pump. He indeed says that it is without friction, and makes no mention of the ring of leather between the two cylinders. Such a pump will raise water extremely well to a small height, and it seems to have been a model only which he had examined: But if the suction-pipe is long, it will by no means do without the leather; for on drawing up the piston, the water of the upper cistern will rise between the pipes, and fill the piston, and none will come up through the suction-pipe.

44
Pumps without friction not of important use.

We may take this opportunity of observing, that the many ingenious contrivances of pumps without friction are of little importance in great works; because the friction which is completely sufficient to prevent all escape of water in a well-constructed pump is but a very trifling part of the whole force. In the great pumps which are used in mines, and are worked by a steam-engine, it is very usual to make the pistons and valves without any leather whatever. The working barrel is bored truly cylindrical, and the piston is made of metal of a size that will just pass along it without sticking. When this is drawn up with the velocity competent to a properly loaded machine, the quantity of water which escapes round the piston is insignificant. The piston is made without leathers, not to aviod friction, which is also insignificant in such works; but to avoid the necessity of frequently drawing it up for repairs through such a length of pipes.

45
Example of a simple pump without friction.
Fig. 18.

V. If a pump absolutely without friction be wanted, the following seems preferable for simplicity and performance to any we have seen, when made use of in proper situations. Let NO (fig. 18.) be the surface of the water in the pit, and K the place of delivery. The pit must be as deep in water as from K to NO. ABCD is a wooden trunk, round or square, open at both ends, and having a valve P at the bottom. The top of this trunk must be on a level with K, and has a small cistern EADF. It also communicates laterally with a rising pipe GHK, furnished with a valve at H opening upwards. LM is a beam of timber so fitted to the trunk as to fill it without sticking, and is of at least equal length. It hangs by a chain from a working beam, and is loaded on the top with weights exceeding that of the column of water which it displaces. Now suppose this beam allowed to descend from the position in which it is drawn in the figure; the water must rise all around it, in the crevice which is between it and the trunk, and also in the rising pipe; because the valve P shuts, and H opens; so that when the plunger has got to the bottom, the water will stand at the level of K. When the plunger is again drawn up to the top by the action of the moving power, the water sinks again in the trunk, but not in the rising pipe, because it is stopped by the valve H. Then allowing the plunger to descend again, the water must again rise in the trunk to the level of K, and it must now flow out at K; and the quantity discharged will be equal to the part of the beam below the surface of the pit-water, deducting the quantity which fills the small space between the beam and the trunk. This quantity may be reduced almost to nothing; but if the inside of the trunk and the outside of the beam be made tapering, the beam may be let down till they exactly fit; and as this may be done in square work, a good workman can make it exceedingly accurate. But in this case, the lower half of the beam and trunk must not taper: and this part of the trunk must be of sufficient width round the beam to allow free passage into the rising pipe. Or, which is better, the rising pipe must branch off from the bottom of the trunk. A discharge may be made from the cistern EADF, so that as little water as possible may descend along the trunk when the piston is raised.

46
Its excellencies are considerable,

One great excellence of this pump is, that it is perfectly free from all the deficiencies which in common pumps result from want of being air-tight. Another is, that the quantity of water raised is precisely equal to the power expended; for any want of accuracy in the work, while it occasions a diminution of the quantity of water discharged, makes an equal diminution in the weight which is necessary for pushing down the plunger. We have seen a machine consisting of two such pumps suspended from the arms of a long beam, the upper side of which was formed into a walk with a rail on each side. A man stood on one end till it got to the bottom, and then walked soberly up to the other end, the inclination being about twenty-five degrees at first, but gradually diminished as he went along, and changed the load of the beam. By this means he made the other end go to the bottom, and so on alternately, with the easiest of all exertions, and what we are most fitted for by our structure. With this machine, a very feeble old man, weighing 110 pounds, raised 7 cubic feet of water $11\frac{1}{2}$ feet high in a minute, and continued working 8 or 10 hours every day. A stout young man, weighing nearly 135 pounds, raised $8\frac{1}{3}$ to the same height, and when he carried 30 pounds, conveniently slung about him, he raised $9\frac{1}{4}$ feet to this height, working 10 hours a-day without fatiguing himself. This exceeds Desagulier's maximum of a hogshead of water 10 feet high in a minute, in the proportion of 9 to 7 nearly. It is limited to very moderate heights; but in such situations it is very effectual. It was the contrivance of an untaught labouring man, possessed of uncommon mechanical genius. We shall have occasion to mention, with respect, some other contrivances of the same person, in the article *Water-Works*.

47
but it is limited.

48
Haskin's pump described.

VI. The most ingenious contrivance of a pump without friction is that of Mr Haskins, described by Desaguliers, and called by him the QUICKSILVER PUMP. Its construction and mode of operations are pretty complicated; but the following preliminary observations will, we hope, render it abundantly plain.

Let

Pump.

Fig. 19.

Let $i\,l\,m\,k$ (fig. 19.) be a cylindrical iron pipe, about six feet long, open at top. Let $e\,g\,h\,f$ be another cylinder, connected with it at the bottom, and of smaller diameter. It may either be solid, or, if hollow, it must be close at top. Let $a\,c\,d\,b$ be a third iron cylinder, of an intermediate diameter, so that it may move up and down between the other two without touching either, but with as little interval as possible. Let this middle cylinder communicate, by means of the pipe AB, with the upright pipe FE, having valves C and D (both opening upwards) adjoining to the pipe of communication. Suppose the outer cylinder suspended by chains from the end of a working beam, and let mercury be poured into the interval between the three cylinders till it fills the space to $o\,p$, about $\frac{1}{4}$ of their height. Also suppose that the lower end of the pipe FE is immersed into a cistern of water, and that the valve D is less than 33 feet above the surface of this water.

49
Its mode of operation.

Now suppose a perforation made somewhere in the pipe AB, and a communication made with an air-pump. When the air-pump is worked, the air contained in CE, in AB, and in the space between the inner and middle cylinders, is rarefied, and is abstracted by the air-pump; for the valve D immediately shuts. The pressure of the atmosphere will cause the water to rise in the pipe CE, and will cause the mercury to rise between the inner and middle cylinders, and sink between the outer and middle cylinders. Let us suppose mercury 12 times heavier than water: Then for every foot that the water rises in EC, the level between the outside and inside mercury will vary an inch; and if we suppose DE to be 30 feet, then if we can rarefy the air so as to raise the water to D, the outside mercury will be depressed to q, r, and the inside mercury will have risen to s, t, $s\,q$ and $t\,r$, being about 30 inches. In this state of things, the water will run over by the pipe BA, and every thing will remain nearly in this position. The columns of water and mercury balance each other, and balance the pressure of the atmosphere.

While things are in this state of equilibrium, if we allow the cylinders to descend a little, the water will rise in the pipe FE, which we may now consider as a suction-pipe; for by this motion the capacity of the whole is enlarged, and therefore the pressure of the atmosphere will still keep it full, and the situation of the mercury will again be such that all shall be in equilibrio. It will be a little lower in the inside space and higher in the outside.

Taking this view of things, we see clearly how the water is supported by the atmosphere at a very considerable height. The apparatus is analogous to a syphon which has one leg filled with water and the other with mercury. But it was not necessary to employ an air-pump to fill it. Suppose it again empty, and all the valves shut by their own weight. Let the cylinders descend a little. The capacity of the spaces below the valve D is enlarged, and therefore the included air is rarefied, and some of the air in the pipe CE must diffuse itself into the space quitted by the inner cylinder. Therefore the atmosphere will press some water up the pipe FE, and some mercury into the inner space between the cylinders. When the cylinders are raised again, the air which came from the pipe CE would return into it again, but is prevented by the valve C.— Raising the cylinders to their former height would compress this air; it therefore lifts the valve D, and escapes. Another depression of the cylinders will have a similar effect. The water will rise higher in FC, and the mercury in the inner space; and then, after repeated strokes, the water will pass the valve C, and fill the whole apparatus, as the air-pump had caused it to do before.— The position of the cylinders, when things are in this situation, is represented in fig. 20. the outer and inner cylinders in their lowest position having descended about 30 inches. The mercury in the outer space stands at q, r, a little above the middle of the cylinders, and the mercury in the inner space is near the top $t\,s$ of the inner cylinder. Now let the cylinders be drawn up. The water above the mercury cannot get back again through the valve C, which shuts by its own weight. We therefore attempt to compress it; but the mercury yields, and descends in the inner space, and rises in the outer, till both are quickly on a level, about the height $v\,v$. If we continue to raise the cylinders, the compression forces out more mercury, and it now stands lower in the inner than in the outer space. But that there may be something to balance this inequality of the mercurial columns, the water goes through the valve D, and the equilibrium is restored when the height of the water in the pipe ED above the surface of the internal mercury is 12 times the difference of the mercurial columns (on the former supposition of specific gravity). If the quantity of water is such as to rise two feet in the pipe ED, the mercury in the outer space will be two inches higher than that in the inner space. Another depression of the cylinders will again enlarge the space within the apparatus, the mercury will take the position of fig. 19. and more water will come in. Raising the cylinders will send this water four feet up the pipe ED, and the mercury will be four inches higher in the inner than in the outer space. Repeating this operation, the water will be raised still higher in DE; and this will go on till the mercury in the outer space reaches the top of the cylinder; and this is the limit of the performance. The dimensions with which we set out will enable the machine to raise the water about 30 feet in the pipe ED; which, added to the 30 feet of CF, makes the whole height above the pit-water 60 feet. By making the cylinders longer, we increase the height of FD. This machine must be worked with great attention, and but slowly; for at the beginning of the forcing stroke the mercury very rapidly sinks in the inner space and rises in the outer, and will dash out and be lost. To prevent this as much as possible, the outer cylinder terminates in a sort of cup or dish, and the inner cylinder should be tapered a-top.

Fig. 20.

50
Ingenuity of the contrivance great,

The machine is exceedingly ingenious and refined; and there is no doubt but that its performance will exceed that of any other pump which raises the water to the same height, because friction is completely avoided, and there can be no want of tightness of the piston.— But this is all its advantage; and from what has been observed, it is but trifling. The expence would be enormous; for with whatever care the cylinders are made, the interval between the inner and outer cylinders must contain a very great quantity of mercury. The middle cylinder must be made of iron plate, and must be without a seam, for the mercury would dissolve every solder. For such

51
but the advantage trifling.

Pump. such reasons, it has never come into general use. But it would have been unpardonable to have omitted the description of an invention which is so original and ingenious; and there are some occasions where it may be of great use, as in nice experiments for illustrating the theory of hydraulics, it would give the finest pistons for measuring the pressures of water in pipes, &c. It is on precisely the same principle that the cylinder bellows, described in the article PNEUMATICS, are constructed.

52 Description of another pump without friction. We beg leave to conclude this part of the subject with the description of a pump without friction, which may be constructed in a variety of ways by any common carpenter, without the assistance of the pump-maker or plumber, and will be very effective for raising a great quantity of water to small heights, as in draining marshes, marl-pits, quarries, &c. or even for the service of a house.

Fig. 21. VII. ABCD (fig. 21.) is a square trunk of carpenter's work, open at both ends, and having a little cistern and spout at top. Near the bottom there is a partition made of board, perforated with a hole E, and covered with a clack. *ffff* represents a long cylindrical bag or pudding, made of leather or of double canvas, with a fold of thin leather such as sheep skin between the canvas bags. This is firmly nailed to the board E with soft leather between. The upper end of this bag is fixed on a round board, having a hole and valve F. This board may be turned in the lathe with a groove round its edge, and the bag fastened to it by a cord bound tight round it. The fork of the piston-rod EG is firmly fixed into this board; the bag is kept distended by a number of wooden hoops or rings of strong wire *ff*, *ff*, *ff*, &c. put into it at a few inches distance from each other. It will be proper to connect these hoops before putting them in, by three or four cords from top to bottom, which will keep them at their proper distances. Thus will the bag have the form of a barber's bellows powder-puff. The distance between the hoops should be about twice the breadth of the rim of the wooden ring to which the upper valve and piston-rod are fixed.

53 Its mode of operation, &c. Now let this trunk be immersed in the water. It is evident that if the bag be stretched from the compressed form which its own weight will give it by drawing up the piston-rod, its capacity will be enlarged, the valve F will be shut by its own weight, the air in the bag will be rarefied, and the atmosphere will press the water into the bag. When the rod is thrust down again, this water will come out by the valve F, and fill part of the trunk. A repetition of the operation will have a similar effect; the trunk will be filled, and the water will at last be discharged by the spout.

Here is a pump without friction, and perfectly tight. For the leather between the folds of canvas renders the bag impervious both to air and water. And the canvas has very considerable strength. We know from experience that a bag of six inches diameter, made of sail-cloth N° 3. with a sheep skin between, will bear a column of 15 feet of water, and stand six hours work per day for a month without failure, and that the pump is considerably superior in effect to a common pump of the same dimensions. We must only observe, that the length of the bag must be three times the intended length of the stroke; so that when the piston-rod is in its highest position, the angles or ridges of the bag may be pretty acute. If the bag be more stretched than this, the force which must be exerted by the labourer becomes much greater than the weight of the column of water which he is raising. If the pump be laid aslope, which is very usual in these occasional and hasty drawings, it is necessary to make a guide for the piston-rod within the trunk, that the bag may play up and down without rubbing on the sides, which would quickly wear it out.

The experienced reader will see that this pump is very like that of Gosset and De la Deuille, described by Belidor, vol. ii. p. 120. and most writers on hydraulics. It would be still more like it, if the bag were on the under side of the partition E, and a valve placed farther down the trunk. But we think that our form is greatly preferable in point of strength. When in the other situation, the column of water lifted by the piston tends to *burst* the bag, and this with a great force, as the intelligent reader well knows. But in the form recommended here, the bag is *compressed*, and the strain on each part may be made much less than that which tends to burst a bag of six inches diameter. The nearer the rings are placed to each other, the smaller will the strain be.

The same bag-piston may be employed for a forcing pump, by placing it below the partition, and inverting the valve; and it will then be equally strong, because the resistance in this case too will act by compression.

We now come naturally to the consideration of the different forms which may be given to the pistons and valves of a pump. A good deal of what we have been describing already is reducible to this head; but, having a more general appearance, changing as it were the whole form and structure of the pump, it was not improper to keep these things together.

The great desideratum in a piston is, that it be as tight as possible, and have as little friction as is consistent with this indispensable quality. We have already said, that the common form, when carefully executed, has these properties in an eminent degree. And accordingly this form has kept its ground amidst all the improvement which ingenious artists have made. Mr Belidor, an author of the first reputation, has given the description of a piston which he highly extols, and is undoubtedly a very good one, constructed from principle, and extremely well composed. 54 Pistons should have little friction.

It consists of a hollow cylinder of metal *g h* (fig. 22.) pierced with a number of holes, and having at top a flanch AB, whose diameter is nearly equal to that of the working-barrel of the pump. This flanch has a groove round it. There is another flanch IK below, by which this hollow cylinder is fastened with bolts to the lower end of the piston, represented in fig. 23. This consists of a plate CD, with a grooved edge similar to AB, and an intermediate plate which forms the seat of the valve. The composition of this part is better understood by inspecting the figure than by any description. The piston-rod HL is fixed to the upper plate by bolts through its different branches at G, G. This metal body is then covered with a cylindrical bag of leather fastened on it by cords bound round it, filling up the grooves in the upper and lower plates. The operation of the piston is as follows. 55 An improved one by Belidor. Fig. 22. Fig. 23.

A little water is poured into the pump, which gets past

Pump.

past the sides of the piston, and lodges below in the fixed valve. The piston being pushed down dips into this water, and it gets into it by the valve. But as the piston in descending compresses the air below it, this compressed air also gets into the inside of the piston, swells out the bag which surrounds it, and compresses it to the sides of the working-barrel. When the piston is drawn up again, it must remain tight, because the valve will shut and keep in the air in its most compressed state; therefore the piston must perform well during the suction. It must act equally well when pushed down again, and acting as a forcer; for however great the resistance may be, it will affect the air within the piston to the same degree, and keep the leather close applied to the barrel. There can be no doubt therefore of the piston's performing both its offices completely; but we imagine that the adhesion to the barrel will be greater than is necessary: it will extend over the whole surface of the piston, and be equally great in every part of its surface; and we suspect that the friction will therefore be very great. We have very high authority for supposing that the adhesion of a piston of the common form, carefully made, will be such as will make it perfectly tight; and it is evident that the adhesion of Belidor's piston will be much greater, and it will be productive of worse consequences. If the leather bag be worn through in any one place, the air escapes, and the piston ceases to be compressed altogether; whereas in the common piston there will very little harm result from the leather being worn through in one place, especially if it project a good way beyond the base of the cone. We still think the common piston preferable. Belidor's piston would do much better inverted as the piston of a sucking pump; and in this situation it would be equal, but not superior to the common.

56 Its defects.

57 Another by the same author.

Belidor describes another forcing piston, which he had executed with success, and prefers to the common wooden forcer. It consists of a metal cylinder or cone, having a broad flanch uniting to it at one end, and a similar flanch which is screwed on the other end. Between these two plates are a number of rings of leather strongly compressed by the two flanches, and then turned in a lathe like a block of wood, till the whole fits tight, when dry, into the barrel. It will swell, says he, and soften with the water, and withstand the greatest pressures. We cannot help thinking this but an indifferent piston. When it wears, there is nothing to squeeze it to the barrel. It may indeed be taken out and another ring or two of leather put in, or the flanches may be more strongly screwed together; but all this may be done with any kind of piston; and this has therefore no peculiar merit.

58 Objections to it.

59 Another recommended as preferable. Fig 24.

The following will, we presume, appear vastly preferable. ABCD (fig. 24,) is the solid wooden or metal block of the piston; EF is a metal plate, which is turned hollow or dish-like below, so as to receive within it the solid block. The piston rod goes through the whole, and has a shoulder above the plate EF, and a nut H below. Four screw-bolts, such as *i k*, *l m*, also go through the whole, have their heads *k*, *m* sunk into the block, and nuts above at *i*, *l*. The packing or stuffing, as it is termed by the workmen, is represented at NO. This is made as solid as possible, and generally consists of soft hempen twine well soaked in a mixture of oil, tallow, and rosin. The plate EF is gently screwed down, and the whole is then put into the barrel, fitting it as tight as may be thought proper. When it wears loose, it may be tightened at any time by screwing down the nuts *i l*, which cause the edges of the dish to squeeze out the packing, and compress it against the barrel to any degree.

Pump.

60 Difficulties in constructing pistons.

The greatest difficulty in the construction of a piston is to give a sufficient passage through it for the water, and yet allow a firm support for the valve, and fixture for the piston rod. We shall see presently that it occasions a considerable expence of the moving power to force a piston with a narrow perforation through the water lodged in the working barrel. When we are raising water to a small height, such as 10 or 20 feet, the power so expended amounts to a fourth part of the whole, if the water-way in the piston is less than one-half of the section of the barrel, and the velocity of the piston two feet per second, which is very moderate. There can be no doubt, therefore, that metal pistons are preferable, because their greater strength allows much wider apertures.

61 considerably removed in one described by Belidor.

The following piston, described and recommended by Belidor, seems as perfect in these respects as the nature of things will allow. We shall therefore describe it in the author's own words as a model, which may be adopted with confidence in the greatest works.

Plate CCCCLI. Fig. 25. Fig. 26. Fig. 27. Fig. 28.

"The body of the piston is a truncated metal cone (fig. 25.), having a small fillet at the greater end. Fig. 26. shows the profile, and fig. 27. the plan of its upper base; where appears a cross bar DD, pierced with an oblong mortise E for receiving the tail of the piston-rod. A band of thick and uniform leather AA (fig. 26. and 28.) is put round this cone, and secured by a brass hoop BB firmly driven on its smaller end, where it is previously made thinner to give room for the hoop.

Fig. 9.

"This piston is covered with a leather valve fortified with metal plates GG (fig. 29.). These plates are wider than the hole of the piston, so as to rest on its rim. There are similar plates below the leather of a smaller size, that they may go into the hollow of the piston; and the leather is firmly held between the metal plates by screws H, H, which go through all. This is represented by the dotted circle IK. Thus the pressure of the incumbent column of water is supported by the plates GG, whose circular edges rest on the brim of the water-way, and their straight edges rest on the cross bar DD of fig. 26. and 27. This valve is laid on the top of the conical box in such a manner that its middle FF rests on the cross bar. To bind all together, the end of the piston-rod is formed like a cross, and the arms MN (fig. 30.) are made to rest on the diameter FF of the valve, the tail EP going through the hole E in the middle of the leather, and through the mortise E of the cross bar of the box; and also through another bar QR (fig. 28. and 29.) which is notched into the lower brim of the box. A key V is then driven into the hole T in the piston-rod; and this wedges all fast. The bar QR is made strong; and its extremities project a little, so as to support the brass hoop BB which binds the leather band to the piston-box. The adjoining scale gives the dimensions of all the parts, as they were executed for a steam-engine near Condé, where the piston gave complete satisfaction."

Fig. 30.

This piston has every advantage of strength, tightness, and

and large water-way. The form of the valve (which has given it the name of the *butterfly-valve*) is extremely favourable to the passage of the water; and as it has but half the motion of a complete circular valve, less water goes back while it is shutting.

62 Advantages of this piston.

The following piston is also ingenious, and has a good deal of merit. OPPO (fig. 31.) is the box of the piston, having a perforation Q, covered above with a flat valve K, which rests in a metal plate that forms the top of the box. ABCBA is a stirrup of iron to which the box is fixed by screws *a, a, a, a*, whose heads are sunk in the wood. This stirrup is perforated at C, to receive the end of the piston-rod, and a nut H is screwed on below to keep it fast. DEFED is another stirrup, whose lower part at DD forms a hoop like the sole of a stirrup, which embraces a small part of the top of the wooden box. The lower end of the piston-rod is screwed; and before it is put into the holes of the two stirrups (through which holes it slides freely) a broad nut G is screwed on it. It is then put into the holes, and the nut H firmly screwed up. The packing RR is then wound about the piston as tight as possible, till it completely fills the working barrel of the pump. When long use has rendered it in any degree loose, it may be tightened again by screwing down the nut G. This causes the ring DD to compress the packing between it and the projecting shoulder of the box at PP; and thus cause it to swell out, and apply itself closely to the barrel.

63 Another ingenious and useful piston described.

We shall add only another form of a perforated piston; which being on a principle different from all the preceding, will suggest many others; each of which will have its peculiar advantages. OO in fig. 32. represents the box of this piston, fitted to the working barrel in any of the preceding ways as may be thought best. AB is a cross bar of four arms, which is fixed to the top of the box. CF is the piston-rod going through a hole in the middle of AB, and reaching a little way beyond the bottom of the box. It has a shoulder D, which prevents its going too far through. On the lower end there is a thick metal plate, turned conical on its upper side, so as to fit a conical seat PP in the bottom of the piston-box.

64 Another on a different principle. Fig. 32.

When the piston-rod is pushed down, the friction on the barrel prevents the box from immediately yielding. The rod therefore slips through the hole of the cross bar AB. The plate E, therefore, detaches itself from the box. When the shoulder D presses on the bar AB, the box must yield, and be pushed down the barrels, and the water gets up through the perforation. When the piston-rod is drawn up again, the box does not move till the plate E lodge in the seat PP, and thus shuts the water-way; and then the piston lifts the water which is above it, and acts as the piston of a sucking pump.

65 Its advantages.

This is a very simple and effective construction, and makes a very tight valve. It has been much recommended by engineers of the first reputation, and is frequently used; and from its simplicity, and the great solidity of which it is capable, it seems very fit for great works. But it is evident that the water-way is limited to less than one-half of the area of the working-barrel. For if the perforation of the piston be one-half of the area, the diameter of the plate or ball EF must be greater; and therefore less than half the area will be left for the passage of the water by its sides.

66 Observations on valves.

We come now to consider the forms which may be given to the valves of a hydraulic engine.

The requisites of a valve are, that it shall be tight, of sufficient strength to resist the great pressures to which it is exposed, that it afford a sufficient passage for the water, and that it do not allow much to go back while it is shutting.

67 Clack valves.

We have not much to add to what has been said already on this subject. The valves which accompany the pump of fig. 5. are called *clack valves*, and are of all the most obvious and common; and the construction described on that occasion is as perfect as any. We only add, that as the leather is at last destroyed at the hinge by such incessant motion, and it is troublesome, especially in deep mines, and under water, to undo the joint of the pump in order to put in a new valve, it is frequently annexed to a box like that of a piston, made a little conical on the outside, so as to fit a conical seat made for it in the pipe, as represented in fig. 33. and it has an iron handle like that of a basket, by which it can be laid hold of by means of a long grappling-hook let down from above. Thus it is drawn up; and being very gentle tapered on the sides, it sticks very fast in its place. Fig. 33.

68 Defect in them.

The only defect of this valve is, that by opening very wide when pushed up by the stream of water, it allows a good deal to go back during its shutting again. In some great machines which are worked by a slow turning crank, the return of the piston is so very slow, that a sensible loss is incurred by this; but it is nothing like what Dr Desaguliers says, one-half of a cylinder whose height is equal to the diameter of the valve.— For in such machines, the last part of the upward stroke is equally slow, and the velocity of the water through the valve exceedingly small, so that the valve is at this time almost shut.

69 Utility of the butterfly-valve.

The butterfly-valve represented in figures 29, &c. is free from most of these inconveniences, and seems the most perfect of the clack valves. Some engineers make their great valves of a pyramidal form, consisting of four clacks, whose hinges are in the circumference of the water-way, and which meet with their points in the middle, and are supported by four ribs which rise up from the sides and unite in the middle. This is an excellent form, affording the most spacious water-way, and shutting very readily. It seems to be the best possible for a piston. The rod of the piston is branched out on four sides, and the branches go through the piston-box, and are fastened below with screws. These branches form the support for the four clacks. We have a seen a valve of this form in a pump of six feet diameter, which discharged 20 hogsheads of water every stroke, and made 12 strokes in a minute, raising the water above 22 feet.

70 Button valves. Fig. 34.

There is another form of valve, called the *button* or *tail-valve*. It consists of a plate of metal AB (fig. 34.) turned conical, so as exactly to fit the conical cavity *a b* of its box. A tail CD projects from the under side, which passes through a cross bar EF in the bottom of the box, and has a little knob at the end, to hinder the valve from rising too high.

This valve, when nicely made, is unexceptionable. It

It has great strength, and is therefore proper for all severe strains, and it may be made perfectly tight by grinding. Accordingly it is used in all cases where this is of indispensable consequence. It is most durable, and the only kind that will do for passages where steam or hot water is to go through. Its only imperfection is a small water-way; which, from what has been said, cannot exceed, or indeed equal, one half of the area of the pipe.

72 Though somewhat imperfect in the water-way.

If we endeavour to enlarge the water-way, by giving the cone very little taper, the valve frequently sticks so fast in the seat that no force can detach them.—And this sometimes happens during the working of the machine; and the jolts and blows given to the machine in taking it to pieces, in order to discover what has been the reason that it has discharged no water, frequently detach the valve, and we find it quite loose, and cannot tell what has deranged the pump. When this is guarded against, and the diminution of the water-way is not of very great consequence, this is the best form of a valve.

73 A very simple valve described. Fig. 35.

Analogous to this is the simplest of all valves, represented in fig. 35. It is nothing more than a sphere of metal A, to which is fitted a seat with a small portion BC of a spherical cavity. Nothing can be more effectual than this valve; it always falls into its proper place, and in every position fits it exactly. Its only imperfection is the great diminution of the water-way. If the diameter of the sphere does not considerably exceed that of the hole, the touching parts have very little taper, and it is very apt to stick fast. It opposes much less resistance to the passage of the water than the flat under-surface of the button-valve. *N. B.* It would be an improvement of that valve to give it a taper-shape below like a boy's top. The spherical valve must not be made too light, otherwise it will be hurried up by the water, and much may go back while it is returning to its place.

74 A valve by Belidor uniting every requisite.

Belidor describes with great minuteness (vol. ii. p. 221, &c.) a valve which unites every requisite. But it is of such nice and delicate construction, and its defects are so great when this exactness is not attained, or is impaired by use, that we think it hazardous to introduce it into a machine in a situation where an intelligent and accurate artist is not at hand. For this reason we have omitted the description, which cannot be given in few words, nor without many figures; and desire our curious readers to consult that author, or peruse Dr Desaguliers's translation of this passage. Its principle is precisely the same with the following rude contrivance, with which we shall conclude the descriptive part of this article.

75 Another valve on the same principle. Fig. 36.

Suppose ABCD (fig. 36.) to be a square wooden trunk. EF is a piece of oak board, exactly fitted to the trunk in an oblique position, and supported by an iron pin which goes through it at I, one-third of its length from its lower extremity at E. The two ends of this board are bevelled, so as to apply exactly to the sides of the trunk. It is evident, that if a stream of water come in the direction BA, its pressure on the part IF of this board will be greater than that upon EI. It will therefore force it up and rush through, making it stand almost parallel to the sides of the trunk. To prevent its rising so far, a pin must be put in its way. When this current of water changes its direction, the pressure on the upper side of the board being again greatest on the portion IF, it is forced back again to its former situation; and its two extremities rising on the opposite sides of the trunk, the passage is completely stopped. This board therefore performs the office of a valve; and this valve is the most perfect that can be, because it offers the freest passage to the water, and it allows very little to get back while it is shutting; for the part IE brings up half as much water as IF allows to go down. It may be made extremely tight, by fixing two thin fillets H and G to the sides of the trunk, and covering those parts of the board with leather which applies to them; and in this state it perfectly resembles Belidor's fine valve.

76 Description of an occasional pump easily constructed. Fig. 36.

And this construction of the valve suggests, by the way, a form of an occasional pump, which may be quickly set up by any common carpenter, and will be very effectual in small heights. Let *a b c d e* (fig. 36.) be a square box made to slide along this wooden trunk without shake, having two of its sides projecting upwards, terminating like the gable-ends of a house. A piece of wood *e* is mortised into these two sides, and to this the piston-rod is fixed. This box being furnished with a valve similar to the one below, will perform the office of a piston. If this pump be immersed so deep in the water that the piston shall also be under water, we scruple not to say that its performance will be equal to any. The piston may be made abundantly tight by covering its outside neatly with soft leather. And as no pipe can be bored with greater accuracy than a very ordinary workman can make a square trunk, we presume that this pump will not be very deficient even for a considerable suction.

77 The motion of water in pumps,

We now proceed to the last part of the subject, to consider the motion of water in pumps, in reference to the force which must be employed. What we have hitherto said with respect to the force which must be applied to a piston, related only to the sustaining the water at a certain height: but in actual service we must not only do this, but we must discharge it at the place of delivery in a certain quantity; and this must require a force superadded to what is necessary for its mere support at this height.

78 an intricate subject.

This is an extremely intricate and difficult subject, and very imperfectly understood even by professed engineers. The principles on which this knowledge must be founded are of a much more abstruse nature than the ordinary laws of hydrostatics; and all the genius of Newton was employed in laying the foundation of this part of physical science. It has been much cultivated in the course of this century by the first mathematicians of Europe. Daniel and John Bernoulli have written very elaborate treatises on the subject, under the very apposite name of HYDRODYNAMICS; in which, although they have added little or nothing to the fundamental propositions established in some sort by Newton, and acquiesced in by them, yet they have greatly contributed to our progress in it by the *methods* which they have pursued in making application of those fundamental propositions to the most important cases. It must be acknowledged, however, that both these propositions, and the extensions given them by these authors, are supported by a train of argument that is by no means unexceptionable; and that they proceed on assumptions or postulates which are but nearly true in any

79 The theory denominated *Hydrodynamics*,

any case, and in many are inadmissible: and it remains to this hour a wonder or puzzle how these propositions and their results correspond with the phenomena which we observe.

But fortunately this correspondence does obtain to a certain extent. And it seems to be this correspondence chiefly which has given these authors, with Newton at their head, the confidence which they place in their respective principles and methods: for there are considerable differences among them in those respects; and each seems convinced that the others are in a mistake. Messieurs d'Alembert and De la Grange have greatly corrected the theories of their predecessors, and have proceeded on postulates which come much nearer to the real state of the case. But their investigations involve us in such an inextricable maze of analytical investigation, that even when we are again conducted to the light of day by the clue which they have given us, we can make no use of what we there discovered.

80 though imperfect is very useful.

But this theory, imperfect as it is, is of great service. It generalizes our observations and experiments, and enables us to compose a *practical doctrine* from a heap of facts which otherwise must have remained solitary and unconnected, and as cumbersome in their application as the characters of the Chinese writing.

81 Fundamental proposition.

The fundamental proposition of this practical hydrodynamics is, that water or any fluid contained in an open vessel of indefinite magnitude, and impelled by its weight only, will flow through a small orifice with the velocity which a heavy body would acquire by falling from the horizontal surface of the fluid. Thus, if the orifice is 16 feet under the surface of the water, it will issue with the velocity of 32 feet in a second.

Its velocity corresponding to any other depth h of the orifice under the surface, will be had by this easy proportion: "As the square root of 16 is to the square root of h; so is 32 feet to the velocity required: or, alternately, $\sqrt{16} : 32 = \sqrt{h} : v$, and $v = \frac{32\sqrt{h}}{\sqrt{16}}, = \frac{32}{4}\sqrt{h}, = 8\sqrt{h}$: that is, multiply the square root of the height in feet by eight, and the product is the required velocity.

On the other hand, it frequently occurs, that we want to discover the depth under the surface which will produce a known velocity v. Therefore, $\sqrt{h} = \frac{v}{8}$, and $h = \frac{v^2}{64}$: that is, divide the square of the velocity by 64, and the quotient is the depth wanted in feet.

82 Its utility.

This proposition is sufficient for all our purposes. For since water is nearly a perfect fluid, and propagates all impressions undiminished, we can, in place of any pressure of a piston or other cause, substitute a perpendicular column of water whose weight is equal to this pressure, and will therefore produce the same efflux — Thus, if the surface of a piston is half a square foot, and it be pressed down with the weight of 500 pounds, and we would wish to know with what velocity it would cause the water to flow through a small hole, we know that a column of water of this weight, and of half a foot base, would be 16 feet high. And this proposition teaches us, that a vessel of this depth will have a velocity of efflux equal to 32 feet in a second.

If therefore our pressing power be of such a kind that it can continue to press forward the piston with the force of 500 pounds, the water will flow with this velocity, whatever be the size of the hole. All that remains is, to determine what change of *actual pressure* on the piston results from the motion of the piston itself, and to change the velocity of efflux in the subduplicate ratio of the change of actual pressure.

83 Remark previous to its application.

But before we can apply this knowledge to the circumstances which take place in the motion of water in pumps, we must take notice of an important modification of the fundamental proposition, which is but very obscurely pointed out by any good theory, but is established on the most regular and unexceptionable observation.

If the efflux is made through a hole in a thin plate, and the velocity is computed as above, we shall discover the quantity of water which issues in a second by observing, that it is a prism or cylinder of the length indicated by the velocity, and having its transverse section equal to that of the orifice. Thus, in the example already given, supposing the hole to be a square inch, the solid contents of this prism, or the quantity of water issuing in a second, is $1 \times 32 \times 12$ cubic inches, or 384 cubic inches. This we can easily measure by receiving it in a vessel of known dimensions. Taking this method, we uniformly find a deficiency of nearly 38 parts in 100; that is, if we should obtain 100 gallons in any number of seconds, we shall in fact get only 62. This is a most regular fact, whether the velocities are great or small, and whatever be the size and form of the orifice. The deficiency increases indeed in a very minute degree with the velocities. If, for instance, the depth of the orifice be one foot, the discharge is $\frac{6211}{10000}$; if it be 15 feet, the discharge is $\frac{6172}{10000}$.

This deficiency is not owing to a diminution of velocity; for the velocity may be easily and accurately measured by the distance to which the jet will go, if directed horizontally. This is found to correspond very nearly with the proposition, making a very small allowance for friction at the border of the hole, and for the resistance of the air. Sir Isaac Newton ascribed the deficiency with great justice to this, that the lateral columns of water, surrounding the column which is incumbent on the orifice, press towards the orifice, and contribute to the expence equally with that column. These lateral filaments, therefore, issue obliquely, crossing the motion of the central stream, and produce a contraction of the jet; and the whole stream does not acquire a parallel motion and its ultimate velocity till it has got to some distance from the orifice. Careful observation showed him that this was really the case. But even his genius could not enable him to ascertain the motion of the lateral filaments by theory, and he was obliged to measure every thing as he saw it. He found the diameter of the jet at the place of the greatest contraction to be precisely such as accounted for the deficiency. His explication has been unanimously acquiesced in; and experiments have been multiplied to ascertain all those circumstances which our theory cannot determine *à priori*. The most complete set of experiments are those of Michelotti, made at Turin at the expence of the prince of Piedmont.

Piedmont. Here jets were made of 1, 2, 3, and 4 inches diameter; and the water received into cisterns most accurately formed of brick, and lined with stucco. It is the result of these experiments which we have taken for a measure of the deficiency.

We may therefore consider the water as flowing through a hole of this contracted dimension, or substitute this for the real orifice in all calculations. For it is evident that if a mouth-piece (so to call it) were made, whose internal shape precisely tallied with the form which the jet assumes, and if this mouth-piece be applied to the orifice, the water will flow out without any obstruction. The vessel may therefore be considered as really having this mouth-piece.

Nay, from this we derive a very important observation, "that if, instead of allowing the water to flow through a hole of an inch area made in a thin plate, we make it flow through a hole in a thick plank, so formed that the external orifice shall have an inch area, but be widened internally, agreeably to the shape which nature forms, both the velocity and quantity will be that which the fundamental proposition determines. Michelotti measured with great care the form of the great jets of three and four inches diameter, and found that the bounding curve was an elongated trochoid. He then made a mouth-piece of this form for his jet of one inch, and another for his jet of two inches; and he found the discharges to be $\frac{979}{1000}$ and $\frac{987}{1000}$; and he, with justice, ascribed the trifling deficiency which still remained, partly to friction and partly to his not having exactly suited his mouth-piece to the natural form. We imagine that this last circumstance was the sole cause: For, in the first place, the water in his experiments, before getting at his jet-holes, had to pass along a tube of eight inches diameter. Now a jet of four inches bears too great a proportion to this pipe; and its narrowness undoubtedly hindered the lateral columns from contributing to the efflux in their due proportion, and therefore rendered the jet less convergent. And, in the next place, there can be no doubt (and the observations of Daniel Bernoulli confirm it) but that this convergency begins within the vessel, and perhaps at a very considerable distance from the orifice. And we imagine, that if accurate observations could be made on the motion of the remote lateral particles within the vessel, and an internal mouth-piece were shaped according to the curve which is described by the remotest particle that we can observe, the efflux of water would almost perfectly tally with the theory. But indeed the coincidence is already sufficiently near for giving us very valuable information. We learn that the quantity of water which flows through a hole, in consequence of its own weight, or by the action of any force, may be increased one half by properly shaping the passage to this hole; for we see that it may be increased from 62 to near 99.

But there is another modification of the efflux, which we confess our total incapacity to explain. If the water issues through a hole made in a plate whose thickness is about twice the diameter of the hole, or, to express it better, if it issues through a pipe whose length is about twice its diameter, the quantity discharged is nearly $\frac{82}{100}$ of what results from the proposition. If the pipe be longer than this, the quantity is diminished by friction, which increases as the length of the pipe increases. If the pipe be shorter, the water will not fill it, but detaches itself at the very entry of the pipe, and flows with a contracted jet. When the pipe is of this length, and the extremity is stopped with the finger, so that it begins to flow with a full mouth, no subsequent contraction is observed; but merely striking on the pipe with a key or the knuckle is generally sufficient to detach the water in an instant from the sides of the pipe, and reduce the efflux to $\frac{62}{100}$.

This effect is most unaccountable. It certainly arises from the mutual adhesion or attraction between the water and the sides of the pipe; but how this, acting at right angles to the motion, should produce an increase from 62 to 82, nearly $\frac{1}{3}$, we cannot explain. It shows, however, the prodigious force of this attraction, which in the space of two or three inches is able to communicate a great velocity to a very great body of water. Indeed the experiments on capillary tubes show that the mutual attraction of the parts of water is some thousands of times greater than their weight.

We have only further to add, that every increase of pipe beyond two diameters is accompanied with a diminution of the discharge; but in what ratio this is diminished it is very difficult to determine. We shall only observe at present that the diminution is very great. A pipe of 2 inches diameter and 30 feet long has its discharge only $\frac{54}{100}$ of what it would be if only 4 inches long. If its length be 60 feet, its discharge will be no more than $\frac{39}{100}$. A pipe of 1 inch diameter would have a discharge of $\frac{44}{100}$, and $\frac{31}{100}$, in the same situation. Hence we may conclude that the discharge of a 4 inch pipe of 30 feet long will not exceed $\frac{2}{3}$ of what it would be if only 8 inches long. This will suffice for our present purposes; and the determination of the velocities and discharges in long conduits from pump machines must be referred to the article *Water-Works*. At present we shall confine our attention to the pump itself, and to what will contribute to its improvement.

Before we can proceed to apply this fundamental proposition to our purpose, we must anticipate in a loose way a proposition of continual use in the construction of *water-works*.

Let water be supposed stagnant in a vessel EFGH (fig. 37.), and let it be allowed to flow out by a cylindrical pipe HIKL, divided by any number of partitions B, C, D, &c. Whatever be the areas B, C, D, of these orifices, the velocity in the intermediate parts of the pipe will be the same; for as much passes through any one orifice in a second as passes through any other in the same time, or through any section of the intervening pipe. Let this velocity in the pipe be V, and let the area of the pipe be A. The velocity in the orifices B, C, D, must be $\frac{VA}{B}$, $\frac{VA}{C}$, $\frac{VA}{D}$, &c. Let g be the velocity acquired in a second by a heavy body. Then, by the general proposition, the height of water in the vessel which will produce the velocity $\frac{VA}{B}$ in the first orifice alone, is $\frac{V^2 A^2}{2g B^2}$. After this passage the velocity is again reduced to V in the middle of the space between the first and second orifices. In the second orifice this velocity is changed to $\frac{VA}{C}$. This Fig. 37.

 alone

Pump.

alone would have required a height of water $\frac{V^2 A^2}{2g\,C^2}$. But the water is already moving with the velocity V, which would have resulted from a height of water in the vessel (which we shall, in the language of the art, call the HEAD OF WATER) equal to $\frac{V^2}{2g}$. Therefore there is only required a head of water $\frac{V^2 A^2}{2g\,C^2} - \frac{V^2}{2g}$, or $\frac{V^2}{2g} \times \overline{\frac{A^2}{C^2} - 1}$. Therefore the whole height necessary for producing the efflux through both orifices, so as still to preserve the velocity V in the intervening pipe, is $\frac{V^2}{2g} \times \overline{\frac{A^2}{B^2} + \frac{A^2}{C^2} - 1}$. In like manner the third orifice D would alone require a head of water $\frac{V^2}{2g} \times \overline{\frac{A^2}{D^2} - 1}$; and all the three would require a head $\frac{V^2}{2g} \times \overline{\frac{A^2}{B^2} + \frac{A^2}{C^2} + \frac{A^2}{D^2} - 2}$. By this induction may easily be seen what head is necessary for producing the efflux through any number of orifices.

Let the expence or quantity of water discharged in an unit of time (suppose a second) be expressed by the symbol Q. This is measured by the product of the velocity by the area of the orifice, and is therefore $= VA$, or $\frac{VA}{B} \times B$, or $\frac{VA}{C} \times C$, &c. and $V^2 = \frac{Q^2}{A^2}$. Therefore we may compute the head of water (which we shall express by H) in reference to the quantity of water discharged, because this is generally the interesting circumstance. In this view we have $H = \frac{Q^2}{2gA} \times \overline{\frac{A^2}{B^2} + \frac{A^2}{C^2} + \frac{A^2}{D^2} - 2}$: which shows that the head of water necessary for producing the discharge increases in the proportion of the square of the quantity of water which is discharged.

84 To determine the motion of water, &c.

These things being premised, it is an easy matter to determine the motion of water in a pump, and the quantity discharged, resulting from the action of any force on the piston, or the force which must be applied to the piston in order to produce any required motion or quantity discharged. We have only to suppose that the force employed is the pressure of a column of water of the diameter of the working barrel; and this is over and above the force which is necessary for merely supporting the water at the height of the place of delivery. The motion of the water will be the same in both cases.

85 In the sucking-pump,

Let us, first of all, consider a sucking-pump. The motion here depends on the pressure of the air, and will be the same as if the pump were lying horizontally, and communicated with a reservoir, in which is a head of water sufficient to overcome all the obstructions to the motion, and produce a velocity of efflux such as we desire. And here it must be noted that there is a limit. No velocity of the piston can make the water rise in the suction-pipe with a greater velocity than what would be produced by the pressure of a column of water 33 feet high; that is, about 46 feet per second.

Pump.

Let the velocity of the piston be V, and the area of the working barrel be A. Then, if the water fills the barrel as fast as the piston is drawn up, the discharge during the rise of the piston, or the number of cubic feet of water per second, must be $= V \times A$. This is always supposed, and we have already ascertained the circumstances which ensure this to happen. If, therefore, the water arrived with perfect freedom to the piston, the force necessary for giving it this velocity, or for discharging the quantity $V \times A$ in a second, would be equal to the weight of the pillar of water whose height is $\frac{V^2}{2g}$, and base A.

It does not appear at first sight that the force necessary for producing this discharge has any thing to do with the obstructions to the ascent of the water into the pump, because this is produced by the pressure of the atmosphere, and it is the action of this pressure which is measured by the head of water necessary for producing the internal motion in the pump. But we must always recollect that the piston, before bringing up any water, and supporting it at a certain height, was pressed on both sides by the atmosphere. While the air supports the column below the piston, all the pressure expended in this support is abstracted from its pressure on the under part of the piston, while its upper part still supports the whole pressure. The atmosphere continues to press on the under surface of the piston, through the intermedium of the water in the suction-pipe, with the difference of these two forces. Now, while the piston is drawn up with the velocity V, more of the atmospheric pressure must be expended in causing the water to follow the piston; and it is only with the remainder of its whole pressure that it continues to press on the under surface of the piston. Therefore, in order that the piston may be raised with the velocity V, a force must be applied to it, over and above the force necessary for merely supporting the column of water, equal to that part of the atmospheric pressure thus employed; that is, equal to the weight of the head of water necessary for forcing the water up through the suction-pipe, and producing the velocity V in the working barrel.

Therefore let B be the area of the mouth of the suction-pipe, and C the area of the fixed valve, and let the suction-pipe be of equal diameter with the working barrel. The head necessary for producing the velocity V on the working barrel is $\frac{V^2}{2g}\left(\frac{A^2}{B^2} + \frac{A^2}{C^2} - 1\right)$. If d express the density of water; that is, if d be the number of pounds in a cubic foot of water, then $d\,A\frac{V^2}{2g}$ will express the weight of a column whose base is A, and height $\frac{B^2}{2g}$, all being reckoned in feet. Therefore the force which must be applied, when estimated in pounds, will be $p, = \frac{d\,AV^2}{2g}\left(\frac{A^2}{B^2} + \frac{A^2}{C^2} - 1\right)$.

The first general observation to be made on what has been said is, that the power which must be employed to produce the necessary motion, in opposition to all the obstacles, is in the proportion of the square of the velocity.

city which we would produce, or the square of the quantity of water we would discharge.

We have hitherto proceeded on the supposition, that there is no contraction of the jet in passing through these two orifices. This we know would be very far from the truth. We must therefore accommodate things to these circumstances, by diminishing B and C in the ratio of the contraction, and calling the diminished areas b and c; then we have $p = \frac{AdV^2}{2g}\left(\frac{A^2}{b^2} + \frac{A^2}{c^2} - 1\right)$.

What this diminution may be, depends on the form of the parts. If the fixed valve, and the entry into the pump, are simply holes in thin plates, then $b = \frac{62}{100}$ B and $c = \frac{62}{100}$ C. The entry is commonly widened or trumpet-shaped, which diminishes greatly the contraction: but there are other obstacles in the way, arising from the strainer usually put round it to keep out filth. The valve may have its contraction greatly diminished also by its box being made bell-shaped internally; nay, even giving it a cylindrical box, in the manner of fig. 33. is better than no box at all, as in fig. 5.; for such a cylindrical box will have the unaccountable effect of the short tube, and make $b = \frac{82}{100}$ B, instead of $\frac{62}{100}$ B. Thus we see that circumstances seemingly very trifling may produce great effects in the performance of a pump. We should have observed that the valve itself presents an obstacle which diminishes the motion, and requires an increase of power; and it would seem that in this respect the clack or butterfly valve is preferable to the button valve.

Example. Suppose the velocity of the piston to be 2 feet or 24 inches per second, and that the two contracted areas are each $\frac{1}{5}$ of the area of the pump, which is not much less than what obtains in ordinary pumps. We have $\frac{V^2}{2g}\left(\frac{A^2}{b^2} + \frac{A^2}{c^2} - 1\right) = \frac{576}{768}(25 + 25 - 1)$ $= 36{,}75$ inches, and the force which we must add to what will merely support the column is the weight of a pillar of water incumbent on the piston, and something more than three feet high. This would be a sensible portion of the whole force in raising water to small heights.

We have supposed the suction-pipe to be of the same diameter with the working barrel; but it is usual to make it of smaller diameter, generally equal to the water way of the fixed valve. This makes a considerable change in the force necessary to be applied to the piston. Let a be the area of the suction-pipe, the area of the entry being still B; and the equivalent entry without contraction being still b, we have the velocity at the entrance $= \frac{AV}{b}$, and the producing head of water $= \frac{A^2V^2}{2g\,b^2}$. After this the velocity is changed to $\frac{AV}{a}$ in the suction-pipe, with which the water arrives at the valve, where it is again changed to $\frac{AV}{c}$, and requires for this change a head of water equal to $\frac{A^2V^2}{2g\,c^2}$. But the velocity retained in the suction pipe is equivalent to the effect of a head of water $\frac{A^2V^2}{2g\,a^2}$. Therefore the head necessary for producing such a current through the fixed valve, that the water may follow the piston with the velocity V, is $\frac{A^2V^2}{2g\,b^2} + \frac{A^2V^2}{2g\,c^2} - \frac{A^2V^2}{2g\,a^2}$, or $= \frac{V^2}{2g}\left(\frac{A^2}{b^2} + \frac{A^2}{c^2} - \frac{A^2}{a^2}\right)$. This is evidently less than before, because a is less than A, and therefore $\frac{A^2}{a^2}$ is greater than unity, which was the last term of the former formula. There is some advantage, therefore, derived from making the diameter of the suction-pipe less than that of the working barrel: but this is only because the passage of the fixed valve is smaller, and the inspection of the formula plainly points out that the area of the suction-pipe should be equal to that of the fixed valve. When it is larger, the water must be accelerated in its passage through the valve; which is an useless expence of force, because this velocity is to be immediately reduced to V in the working barrel. If the foregoing example be computed with a equal to $\frac{1}{4}$ of A, we shall find the head H equal to 29 inches instead of 37.

But this advantage of a smaller suction-pipe is in all cases very moderate; and the pump is always inferior to one of uniform dimensions throughout, having the orifice at the fixed valve of the same area. And if these orifices are considerably diminished in any proportion, the head necessary for overcoming the obstacles, so that the required velocity V may still be produced in the working barrel, is greatly increased. If we suppose the area a $\frac{1}{9}$ of A, which is frequently done in house pumps, where the diameter of the suction-pipe does seldom exceed $\frac{1}{3}$ of that of the working-barrel; and suppose every thing made in proportion to this, which is also usual, because the unskilled pump-makers study a symmetry which satisfies the eye; we shall find that the pump taken as an example will require a head of water = 13 feet and upwards. Besides, it must be observed that the friction of the suction-pipe itself has not been taken into the account. This alone is greater, in most cases, than all the obstructions we have been speaking of; for if this pipe is three inches diameter, and that of the working-barrel is six, which is reckoned a liberal allowance for a suction-pipe, and if the fixed valve is 25 feet above the surface of the water-pit; the friction of this pipe will amount to one-third of the whole propelling force.

Thus we have enabled the reader to ascertain the force necessary for producing any required discharge of water from a pump of known dimensions: and the converse of this determination gives us the discharge which will be produced by any given force. For making $\frac{A^2}{b^2} + \frac{A^2}{c^2} - \frac{A^2}{a^2}$ (which is a known quantity, resulting from the dimensions of the pump) = M, we have $H = \frac{V^2}{2g}M$, and $V^2 = \frac{2gH}{M}$, and $V = \sqrt{\frac{2gH}{M}}$. Now H is that part of the natural power which we have at command which exceeds what is necessary for merely supporting the column of water. Thus, if we have a pump whose piston has an area of $\frac{1}{4}$ of a square foot, its diameter being $6\frac{3}{4}$ inches; and we have to raise the water 32 feet, and can apply a power of 525 pounds to the piston; we wish to know at what rate the piston will be moved, and the quantity of water discharged?

Merely

Pump.

Merely to support the column of water of this height and diameter, requires 500 pounds. Therefore the remaining power, which is to produce the motion, is 25 pounds. This is the weight of a column 1 foot 4 inches high, and H $=1,333$ feet. Let us suppose the diameter of the suction-pipe $\frac{1}{2}$ of that of the working-barrel, so that $\frac{A}{B}=4$. We may suppose it executed in the best manner, having its lower extremity trumpet-shaped, formed by the revolution of the proper trocheid. The contraction at the entry may therefore be considered as nothing, and $\frac{A}{b}=4$, and $\frac{A^2}{b^2}=16$. We may also suppose the orifice of the fixed valve equal to the area of the suction-pipe, so that $\frac{A^2}{C^2}$ is also $=16$, and there is no contraction here; and therefore $\frac{A^2}{c^2}$ is also 16. And lastly, $\frac{A^2}{a^2}$ is also 16. Therefore $\frac{A^2}{b^2}+\frac{A^2}{c^2}-\frac{A^2}{a^2}$ or M, $=16+16-16,=16$. We have also $2g=64$. Now $N=\sqrt{\frac{2g\,H}{M}}$. $=\sqrt{\frac{64\times 1,333}{16}}$, $=2,309$ feet, and the piston will move with the velocity of 2 feet 4 inches nearly. Its velocity will be less than this, on account both of the friction of the piston and the friction of the water in the suction-pipe. These two circumstances will probably reduce it to one foot eight inches; and it can hardly be less than this.

We have taken no notice of the friction of the water in the working-barrel, or in the space above the piston; because it is in all cases quite insignificant. The longest pipes employed in our deep mines do not require more than a few inches of head to overcome it.

But there is another circumstance which must not be omitted. This is the resistance given to the piston in its descent. The pistons of an engine for drawing water from deep mines must descend again by their own weight in order to repeat their stroke. This must require a preponderance on that end of the working-beam to which they are attached, and this must be overcome by the moving power during the effective stroke. It makes, therefore, part of the whole work to be done, and must be added to the weight of the column of water which must be raised.

This is very easily ascertained. Let the velocity of the piston in its descent be V, the area of the pump-barrel A, and the area of the piston-valve a. It is evident, that while the piston descends with the velocity V, the water which is displaced by the piston in a second is $(A-a)\,V$. This must pass through the hole of the piston, in order to occupy the space above, which is left by the piston. If there were no contraction, the water would go through with the velocity $\frac{A-a}{a}V$; but as there will always be some contraction, let the diminished area of the hole (to be discovered by experiment) be b, the velocity therefore will be $V\frac{A-a}{b}$. This requires for its production a head of water $\frac{V^2}{2g}\left(\frac{A-a}{b}\right)^2$.

Pump.

This is the height of a column of water whose base is not A but $A-a$. Calling the density of water d, we have for the weight of this column, and the force p in $d\times\overline{A-a}+\left(\frac{A-a}{b}\right)\times\frac{V^2}{2g},=\frac{dV^2(A-a)^3}{2g\,b^2}$. This, we see again, is proportional to the square of the velocity of the piston in its descent, and has no relation to the height to which the water is raised.

If the piston has a button valve, its surface is at least equal to a; and therefore the pressure is exerted on the water by the whole surface of the piston. In this case we shall have $p=\frac{d\,V^2\,A^3}{2g\,b^2}$ considerably greater than before. We cannot ascertain this value with great precision, because it is extremely difficult, if possible, to determine the resistance in so complicated a case. But the formula is exact, if b can be given exactly; and we know within very moderate limits what it may amount to. In a pump of the very best construction, with a button valve, b cannot exceed one-half of A; and therefore $\frac{A^2}{b^2}$ cannot be less than 8. In this case, $\frac{V^2\,A^3}{2g\,b^2}$ will be $\frac{V^2}{8}$. In a good steam-engine pump V is about three feet per second, and $\frac{V^2}{8}$ is about $1\frac{1}{8}$ feet, which is but a small matter.

85 and in the forcing-pump.

We have hitherto been considering the sucking-pump alone: but the forcing pump is of more importance, and apparently more difficult of investigation.—Here we have to overcome the obstructions in long pipes, with many bends, contractions, and other obstructions. But the consideration of what relates merely to the pump is abundantly simple. In most cases we have only to force the water into an air-vessel, in opposition to the elasticity of the air compressed in it, and to send it thither with a certain velocity, regulated by the quantity of water discharged in a given time. The elasticity of the air in the air-vessel propels it along the *Main*. We are not now speaking of the force necessary for counterbalancing this pressure of the air in the air-vessel, *which is equivalent to all the subsequent obstructions*, but only of the force necessary for propelling the water out of the pump with the proper velocity.

We have in a manner determined this already. The piston is solid, and the water which it forces has to pass through a valve in the lateral pipe, and then to move in the direction of the main. The change of direction requires an addition of force to what is necessary for merely impelling the water through the valve. Its quantity is not easily determined by any theory, and it varies according to the abruptness of the turn. It appears from experiment, that when a pipe is bent to a right angle, without any curvature or rounding, the velocity is diminished about $\frac{1}{18}$. This would augment the head of water about $\frac{1}{9}$. This may be added to the contraction of the valve hole. Let c be its natural area, and whatever is the contraction competent to its form, increase it $\frac{1}{18}$, and call the contracted area c. Then this will a require a head of water $=\frac{V^2\,A^2}{2g\,c^2}$.

This

Pump. This must be added to the head $\frac{V^2}{2g}$, necessary for merely giving the velocity V to the water. Therefore the whole is $\frac{V^2}{2g}\left(\frac{A^2}{c^2}+1\right)$; and the power p necessary for this purpose is $\frac{d\,AV^2}{2g}\left(\frac{A^2}{c^2}+1\right)$.

It cannot escape the observation of the reader, that in all these formulæ, expressing the height of the column of water which would produce the velocity V in the working barrel of the pump, the quantity which multiplies the constant factor $\frac{d\,AV^2}{2g}$ depends on the contracted passages which are in different parts of the pump, and increases in the duplicate proportion of the sum of those contractions. It is therefore of the utmost consequence to avoid all such, and to make the main which leads from the forcing-pump equal to the working barrel. If it be only of half the diameter, it has but one-fourth of the area, the velocity in the main is four times greater than that of the piston, and the force necessary for discharging the same quantity of water is 16 times greater.

It is not, however, possible to avoid these contractions altogether, without making the main pipe wider than the barrel. For if only so wide, with an entry of the same size, the valve makes a considerable obstruction. Unskilful engineers endeavour to obviate this by making an enlargement in that part of the main which contains the valve. This is seen in fig. 14. at the valve L. If this be not done with great judgment, it will increase the obstructions. For if this enlargement is full of water, the water must move in the direction of its axis with a diminished velocity; and when it comes into the main, it must again be accelerated. In short, any abrupt enlargement which is to be afterwards contracted, does as much harm as a contraction, unless it be so short that the water in the axis keeps its velocity till it reaches the contraction. Nothing would do more service to an artist, who is not well founded in the theory of hydrodynamics, than to make a few simple and cheap experiments with a vessel like that of fig. 37. Let the horizontal pipe be about three inches diameter, and made in joints which can be added to each other. Let the joints be about six inches long, and the holes from one-fourth to a whole inch in diameter. Fill the vessel with water, and observe the time of its sinking three or four inches. Each joint should have a small hole in its upper side to let out the air; and when the water runs out by it, let it be stopped by a peg. He will see that the larger the pipe is in proportion to the orifices made in the partitions, the efflux is *more diminished*. We believe that no person would suspect this who has not considered the subject minutely.

87 Use of experiments.

All angular enlargements, all boxes, into which the pipes from different working barrels, unite their water before it goes into a main, must therefore be avoided by an artist who would execute a good machine; and the different contractions which are unavoidable at the seats of valves and the perforations of pistons, &c. should be diminished by giving the parts a trumpet-shape.

In the air-vessels represented in fig. 13. this is of very great consequence. The throat O, through which the water is forced by the expansion of the confined air, should always be formed in this manner. For it is this which produces the motion during the returning part of the stroke in the pump constructed like fig. 13. N° 1. and during the whole stroke in N° 2. Neglecting this seemingly trifling circumstance will diminish the performance at least one-fifth. The construction of N° 1. is the best, for it is hardly possible to make the passage of the other so free from the effects of contraction. The motion of the water during the returning stroke is very much contorted.

88 Acceleration of the motion of water in pumps.

There is one circumstance that we have not taken any notice of, viz. the gradual acceleration of the motion of water in pumps. When a force is applied to the piston, it does not in an instant communicate all the velocity which it acquires. It acts as gravity acts on heavy bodies; and if the resistances remained the same, it would produce, like gravity, an uniformly accelerated motion. But we have seen that the resistances (which are always measured by the force which just overcomes them) increase as the square of the velocity increases. They therefore quickly balance the action of the moving power, and the motion becomes uniform, in a time so short that we commit no error of any consequence by supposing it uniform from the beginning. It would have prodigiously embarrassed our investigations to have introduced this circumstance; and it is a matter of mere speculative curiosity: for most of our moving powers are unequal in their exertions, and these exertions are regulated by other laws. The pressure on a piston moved by a crank is as variable as its velocity, and in most cases is nearly in the inverse proportion of its velocity, as any mechanician will readily discover. The only case in which we could consider this matter with any degree of comprehensibility is that of a steam-engine, or of a piston which forces by means of a weight lying on it. In both, the velocity becomes uniform in a very small fraction of a second.

89 Deficiency of elementary books on this subject.

We have been very minute on this subject. For although it is the only view of a pump which is of any importance, it is hardly ever understood even by professed engineers. And this is not peculiar to hydraulics, but is seen in all the branches of practical mechanics. The elementary knowledge to be met with in such books as are generally perused by them, goes no farther than to state the forces which are in equilibrio by the intervention of a machine, or the proportion of the parts of a machine which will set two known forces in equilibrio. But when this equilibrium is destroyed by the superiority of one of the forces, the machine must move; and the only interesting question is, *what will be the motion?* Till this is answered with some precision, we have learned nothing of any importance. Few engineers are able to answer this question even in the simplest cases; and they cannot, from any confident science, say what will be the performance of an untried machine. They guess at it with a success proportioned to the multiplicity of their experience and their own sagacity. Yet this part of mechanics is as susceptible of accurate computation as the cases of equilibrium.—We therefore thought it our duty to point out the manner of proceeding so circumstantially, that every step should be plain and easy, and that conviction should always accompany our progress. This we think it has been in our power to do, by the very simple method of substituting a column

lumn of water acting by its weight in lieu of any natural power which we may chance to employ.

To such as wish to prosecute the study of this important part of hydraulics in its most abstruse parts, we recommend the perusal of the dissertations of Mr Pitot and Mr Bossut, in the memoirs of the Academy of Paris; also the dissertations of the Chevalier de la Borda, 1766 and 1767; also the *Hydraulique* of the Chevalier De Buat. We shall have occasion to consider the motion of the water in the mains of forcing or lifting pumps which send the water to a distance, in the article *WATER-Works;* where the reader will see how small is the performance of all hydraulic machines, in comparison of what the usual theories, founded on equilibrium only, would make him expect.

PUN, or PUNN, an expression where a word has at once different meanings. The practice of punning is the miserable refuge of those who wish to pass for wits, without having a grain of wit in their composition. James the I. of England delighted in punning; and the taste of the sovereign was studied by the courtiers, and even by the clergy. Hence the sermons of that age abound with this species of false wit. It continued to be more or less fashionable till the reign of Queen Anne, when Addison, Swift, Pope, and Arbuthnot, with the other real wits of that classical age, united their efforts to banish punning from polite composition. It is still admitted sparingly in conversation; and no one will deny that a happy pun, when it comes unsought, contributes to excite mirth in a company. A professed *punster*, however, who is always pouring forth his senseless quibbles, as Sancho Pança poured forth his proverbs, is such an intolerable nuisance in society, that we do not wonder at Pope or Swift having written a pamphlet with the title of *God's Revenge against Punning*.

PUNCH, an instrument of iron or steel, used in several arts, for the piercing or stamping holes in plates of metals, &c. being so contrived as not only to perforate, but to cut out and take away the piece. The punch is a principal instrument of the metal-button makers, shoemakers, &c.

PUNCH is also a name for a sort of compound drink, much used here, and in many parts abroad, particularly in Jamaica, and several other parts of the West Indies.

Its basis is spring-water; which being rendered cooler, brisker, and more acid, with lemon or lime juice, and sweetened again to the palate with fine sugar, makes what they call *sherbet;* to which a proper quantity of spirituous liquor, as brandy, rum, or arrack, being added, the liquor becomes punch.

PUNCHEON, PUNCHIN, or *Punchion*, a little block or piece of steel, on one end whereof is some figure, letter, or mark, engraven either in creux or relievo, impressions whereof are taken on metal, or some other matter, by striking it with a hammer on the end not engraved. There are various kinds of these puncheons used in the mechanical arts; such, for instance, are those of the goldsmiths, cutlers, pewterers, &c.

The puncheon, in coining, is a piece of iron steeled, whereon the engraver has cut in relievo the several figures, arms, effigy, inscription, &c. that there are to be in the matrices, wherewith the species are to be marked. Minters distinguish three kinds of puncheons, according to the three kinds of matrices to be made; that of the effigy, that of the cross or arms, and that of the legend or inscription. The first includes the whole portrait in relievo; the second are small, such only containing a piece of the cross or arms; for instance, a fleur-de-lis, an harp, a coronet, &c. by the assemblage of all which the entire matrice is formed. The puncheons of the legend only contain each one letter, and serve equally for the legend on the effigy side and the cross side, See the article COINAGE.

For the puncheons used in stamping the matrices wherein the types of printing characters are cast, see *LETTER-Foundery.*

PUNCHEON is also used for several iron tools, of various sizes and figures, used by the engravers en creux on metals. Seal-engravers particularly use a great number for the several pieces of arms, &c. to be engraven, and many stamp the whole seal from a single puncheon.

PUNCHEON is also a common name for all those iron instruments used by stone-cutters, sculptors, blacksmiths, &c. for the cutting, inciding, or piercing their several matters.

Those of sculptors and statuaries serve for the repairing of statues when taken out of the moulds. The locksmiths use the greatest variety of puncheons; some for piercing hot, others for piercing cold; some flat, some square, some round, others oval, each to pierce holes of its respective figure in the several parts of locks.

PUNCHEON, in *Carpentry*, is a piece of timber placed upright between two posts, whose bearing is too great; serving, together with them, to sustain some large weights.

This term is also used for a piece of timber raised upright, under the ridge of a building, wherein the legs of a couple, &c. are jointed.

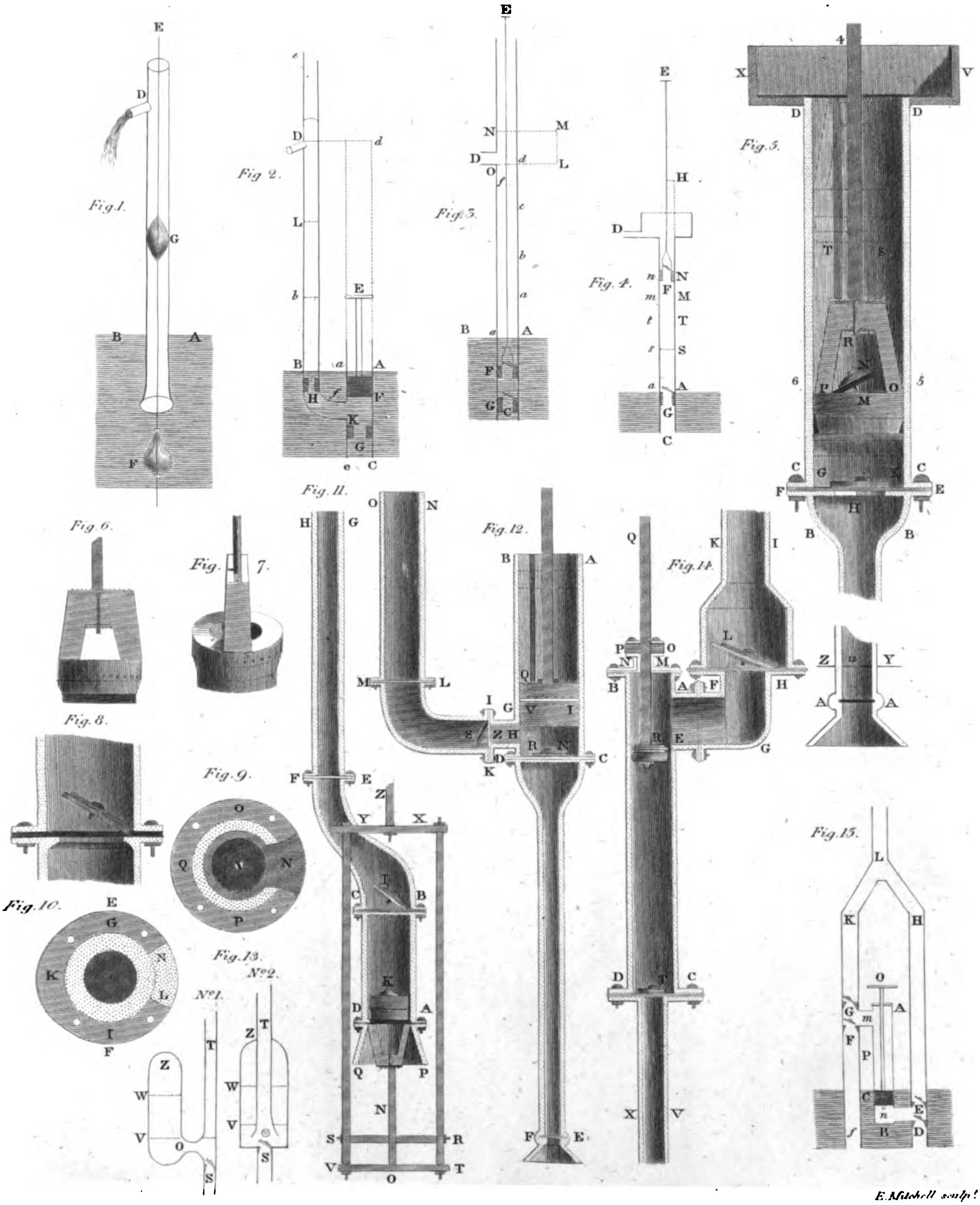
PUNCHEON, is also the name of a measure for liquids. Rum is brought from the colonies in puncheons, which are large casks containing about 130 gallons.

PUNCTUATION, in *Grammar*, the art of pointing, or of dividing a discourse into periods, by points expressing the pauses to be made therein.

The points used are four, viz. the period, colon, semicolon, and comma. See the particular use of each under its proper article, COMMA, COLON, PERIOD, and SEMICOLON.

In general, we shall only here observe, that the comma is to distinguish nouns from nouns, verbs from verbs, and such other parts of a period as are not necessarily joined together. The semi-colon serves to suspend and sustain the period when too long: the colon, to add some new supernumerary reason, or consequence, to what is already said: and the period to close up the sense and construction, and release the voice.

It has been asserted, that punctuation is a modern art, and that the ancients were entirely unacquainted with the use of our commas, colons, &c. and wrote not only without any distinction of numbers and periods, but also without distinction of words: which custom, Lipsius observes, continued till the hundred and fourth Olympiad;



E. Mitchell sculp!

Fig. 16.

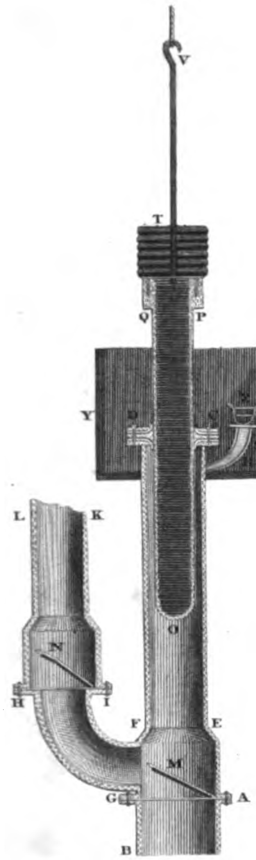


Fig. 17.

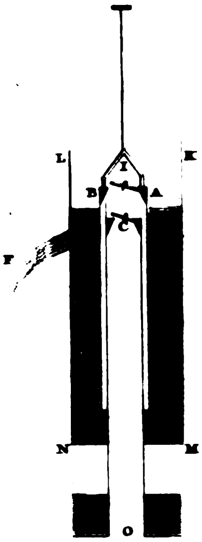


Fig. 18.

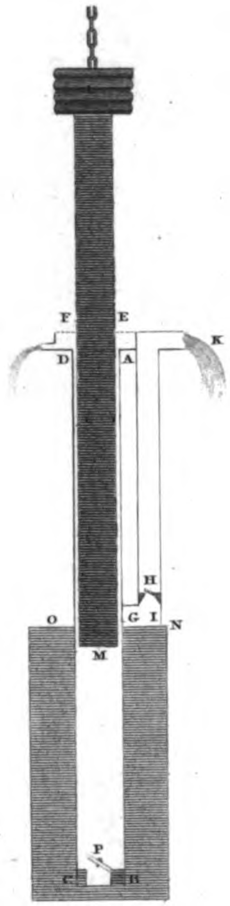


Fig. 19.

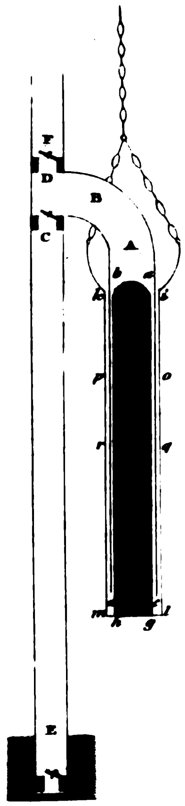


Fig. 23.

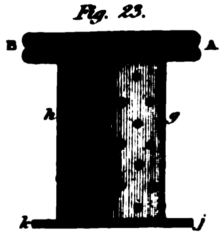


Fig. 20.

Fig. 21.

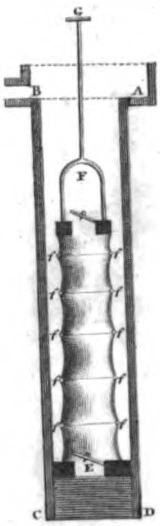


Fig. 22.

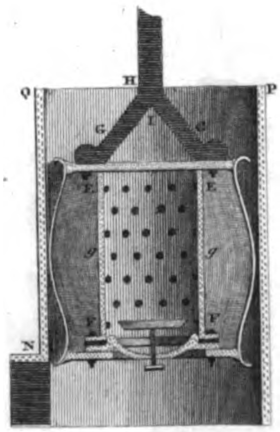
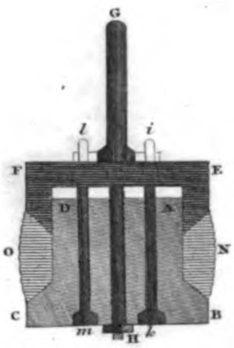


Fig. 24.



Selkirk Sculp.t

Fig. 25.

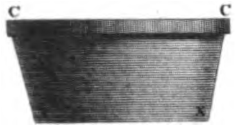


Fig. 26.

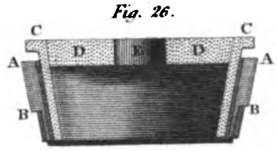


Fig. 27.

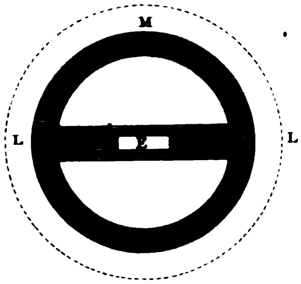
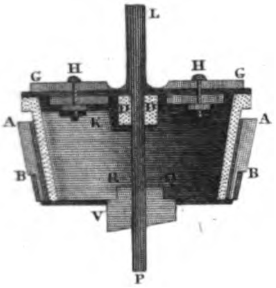


Fig. 28.



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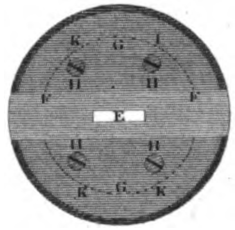


Fig. 30.

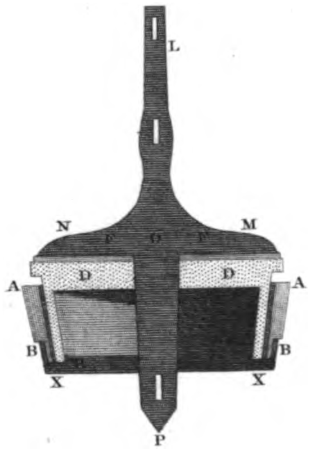


Fig. 31.

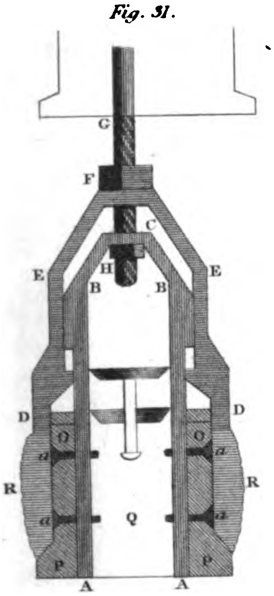


Fig. 32.

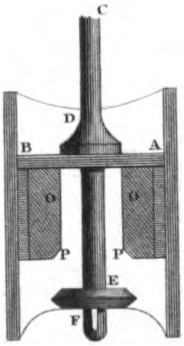


Fig. 33.

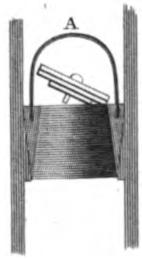


Fig. 34.

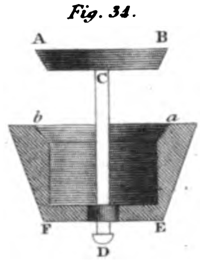


Fig. 35.

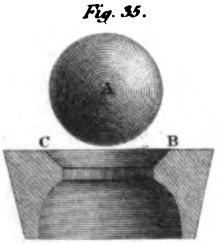


Fig. 36.

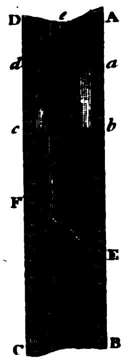
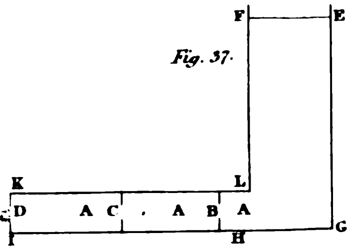


Fig. 37.



Fielding sculp.

Punctuation.

lympiad; during which time the sense alone divided the discourse.

What within our own knowledge at this day puts this beyond dispute, is the Alexandrian manuscript, which is at present in the king's library, at the British Musæum. Whoever examines this, will find that the whole is written *continuo ductu*, without distinction of words or sentences. How the ancients read their works written in this manner, it is not easy to conceive.

After the practice of joining words together ceased, notes of distinction were placed at the end of every word. In all the editions of the *Fasti Capitolini* these points occur. The same are to be seen on the *Columna Rostrata*. For want of these, we find much confusion in the *Chronicon Marmoreum*, and the covenant between the Smyrnæans and Magnesians, which are both now at Oxford. In Salmasius's edition of *Dedicatio statuæ rigillæ Herodis*, the like confusion occurs, where we find ΔΕΥΡΊΤΕ and Δευς ιτι.

Of these marks of distinction, the Walcote inscription found near Bath may serve as a specimen;

IVLIUSv VITALISv FABRI
CESISv LEGv XXVv Vv V
STIPENDIORUMv &c.

After every word here, except at the end of a line, we see this mark v. There is an inscription in Montfaucon, which has a capital letter laid in an horizontal position, by way of interstitial mark, which makes one apt to think that this way of pointing was sometimes according to the fancy of the graver.

P. FERRARIVS HERMES
CAECINIAE ⊢ DIGNAE
CONIVGI ⊣ KARISSIMAE
NVMERIAE ⊢ &c.

He we observe after the words a T laid horizontally, but not after each word, which proves this to be of a much later age than the former.

As the improvement of stops appears not to have taken place while manuscripts and monumental inscriptions were the only known methods to convey knowledge, it is conjectured that it was introduced with the art of printing. The 14th century, to which we are supposed to be indebted for this invention, did not, however, bestow those appendages we call *stops:* whoever will be at the pains of examining the first printed books, will discover no stops of any kind; but arbitrary marks here and there, according to the humour of the printer. In the 16th century, we observe their first appearance. We find, from the books of this age, that they were not all produced at the same time; those we meet with there in use, being only the comma, the parenthesis, the interrogation, and the full point. To prove this, we need but look into Bale's Acts of English Worthies, black letter, printed 1550. Indeed, in the dedication of this book, which is to Edward VI. we discover a colon: but, as this is the only one of the kind throughout the work, it is plain this stop was not established at this time, and so warily put in by the printer; or if it was, that it was not in common use. Thirty years after this time, in that sensible and judicious performance of Sir Thomas Elyot, entitled *The Governour*, imprinted 1580, we see the colon as frequently introduced as any other stop; but the semicolon and the admiration were still wanting, neither of these being visible in this book. In Hackluyt's Voyages, printed 1599, we see the semicolon: and, as if the editors did not fully apprehend the propriety of its general admission, it is but sparingly introduced. It has been said, indeed, that the semicolon was brought into use at a much earlier period; but it appears that it was only for the purpose of an abbreviation, as in (*namq;*) (*neq;*) for *namque*, *neque*, and not in the sense in which it is now employed, *Month. Mag.* v. 411.

The semicolon, indeed, as well as all the ordinary points, is used in a work entitled "Imagines Deorum," printed at Leyden, in the year 1581, in Roman characters. We likewise meet with them in the translation of a justly celebrated book, written in French by that wise and good man, Philip Mornay, lord of Plessis; in the "Schoolmaster" of Roger Ascham, printed in 1570, with the exception of the semicolon; and in the "Trewnesse of the Christian Religion," by Sir Philip Sidney, published in 1587, in which we find the asterisk, brackets, the interrogation, the comma and the semicolon, all as we now use them; and the colon and period are square dots.

In an alchemical manuscript of the date of 1572, the semicolon is said to be met with, as well as the other three points which are in common use. The colon and period are abundant in a work entitled "Dionisius de Situ Orbis," printed at Venice in 1498, but none of the other stops or points. The single point (.) appears to be the most ancient. Since the year 1485 the colon was introduced; the comma is first seen about the year 1521; and the more refined semicolon was brought into use about the year 1570.

The invention of the semicolon is most probably due to the English; for from the Leyden edition of Pliny, 1553, it is evident that the Dutch printers were not then in the practice of using it; and if in 1570, they were, Roger Ascham would probably have employed it; for the Dutch were the principal classical printers in his time; but we find that some English books were marked with it at that period.

The admiration was the last stop that was invented, and seems to have been added to the rest in a period not so far distant from our own time.

Thus we see that these notes of distinction came into use as learning was gradually advanced and improved; one invention indeed, but enlarged by several additions.

But notwithstanding what has been said relative to the use of stops as being a modern invention, we shall find reason to be satisfied that the ancients were not unacquainted with the method of making pauses in speaking and writing, if we attend to the following elaborate investigation of Mr Warburton, which we shall lay before our readers in the words of the author.

"Some species of pauses and divisions of sentences in speaking and writing must have been coeval with the knowledge of communicating ideas by sound or by symbols.

"Suidas* says, that the *period* and the *colon* were discovered and explained by Thrasymachus, about 380 years before the Christian æra. Cicero† says, that Thrasymachus was the first who studied oratorical numbers, which entirely consisted in the artificial structure of periods and colons. It appears from a passage in Aristotle‡, that punctuation was known in his time. The learned

* *De Thrasymacho.*

† *Cicero Orat.* § 33.

‡ *Rhet.* lib. iii. c. 5.

Punctuation.

learned Dr Edward Bernard * refers the knowledge of pointing to the time of that philosopher, and says, that it consisted in the different position of one single point. At the bottom of a letter; thus, (A.) it was equivalent to a comma; in the middle (A·) it was equal to a colon; at the top (A˙) it denoted a period, or the conclusion of a sentence.

* *Bern. Orbis erud. Literat.* tom. 30. edit. 1689.

"This mode was easily practised in Greek manuscripts, while they were written in capitals. But when the small letters were adopted, that is, about the ninth century, this distinction could not be observed; a change was therefore made in the scheme of punctuation. *Unciales literas hodierno usu dicimus eas in vetustis codicibus, quæ priscam formam servant, ac solutæ sunt, nec mutuò colligantur. Hujus modi literæ unciales observantur in libris omnibus ad nonum usque sæculum.* Montf. Palæog. Recens. p. xii.

"According to Cicero, the ancient Romans as well as the Greeks made use of points. He mentions them under the appellation of *librariorum notæ;* and in several parts of his works he speaks of '*interpunctæ clausulæ in orationibus*', of '*clausulæ atque interpunctæ verborum*', of *interpunctiones verborum, &c.* †.

"Seneca, who died A. D. 65, expressly says, that Latin writers in his time, had been used to punctuation. '*Nos* ‡, *cum scribimus interpungere consuevimus.*' Muretus and Lipsius imagined that these words alluded to the insertion of a point after each word; but they certainly were mistaken, for they must necessarily refer to marks of punctuation in the division of sentences, because in the passage in which these words occur, Seneca is speaking of one Q. Haterius, who made no pauses in his orations.

† *Cic. de Orat.* lib. iii § 26. *Ibid.* 7. *Orat. pro Muraena,* § 25.
‡ *Sen. Epist.* 40.

"According to Suetonius in his Illust. Gram. Valerius Probus procured copies of many old books, and employed himself in correcting, pointing and illustrating them; devoting his time to this and no other part of grammar. *Multa exemplaria contracta emendare, ac distinguere et adnotare curavit; soli huic, nec ulli præterea, grammatices parti deditus.*

"It appears from hence that in the time of Probus, or about the year 68, Latin manuscripts had not been usually pointed; and that grammarians made it their business to supply this deficiency.

"Quintilian, who wrote his celebrated treatise on Oratory about the year 88, speaks of commas, colons, and periods; but it must be observed that by these terms he means clauses, members, and complete sentences, and not the marks of punctuation §.

"Ælius Donatus || published a treatise on Grammar in the fourth century, in which he explains the *distinctio*, the *media distinctio*, and the *subdistinctio:* that is, the use of a single point in the various positions already mentioned.

§ *Quinct.* lib. ix. c. iv.
|| A. D. 340.

"Jerom *, who had been the pupil of Donatus, in his Latin version of the scriptures, made use of certain distinctions or divisions, which he calls *cola* and *commata.* It has however been thought probable, that these divisions were not made by the addition of any points or stops; but were formed by writing, in one line, as many words as constituted a clause, equivalent to what we distinguish by a comma or a colon. These divisions were called στιχοι or ῥηματα; and had the appearance of short irregular verses in poetry. There are some Greek manuscripts still extant which are written in this manner †.

* *Hieron. Præf. in Esaiam.* Vide etiam *Præf. in Josuam,* &c. tom. iii. p. 26.
† Vide *Montf Palæog. Græca,* lib. iii. c. 4.

"The best treatise upon punctuation I have seen, and from which these authorities are partly taken, was published some years since and dedicated to Sir Clifton Wintringham, Bart. the name of the author I know not *."

Punctum Punishment.

* *Month. Rev.* vol. li. p. 136.

PUNCTUM SALIENS, in *Anatomy*, the first rudiments of the heart in the formation of the fœtus, where a throbbing motion is perceived. This is said to be easily observed with a microscope in a brood-egg, wherein after conception, we see a little speck or cloud, in the middle whereof is a spot that appears to beat or leap a considerable time before the fœtus is formed for hatching. See the articles FOETUS and ANATOMY.

PUNCTUM stans, a phrase by which the schoolmen vainly attempt to bring within the reach of human comprehension the positive eternity of God. Those subtile reasoners seem to have discovered that nothing, which is made up of parts, whether continuous or discrete, can be absolutely infinite, and that therefore eternity cannot consist of a boundless series of successive moments. Yet, as if such a series had always existed, and were commensurate in duration with the supreme Being, they compared his eternity to one of the moments which compose the flux of time arrested in its course: and to this eternal moment they gave the name of *punctum stans*, because it was supposed to stand still, whilst the rest followed each other in succession, all vanishing as soon as they appeared. We need not waste time or room in exposing the absurdity of this conceit, as we have elsewhere endeavoured, in the best manner we can, to ascertain the meaning of the words *eternity* and *infinity*, and to show that they cannot be predicated of time or space, of points or moments, whether flowing or standing still. See METAPHYSICS, Part II. chap. 7. 8. and Part III. chap. 6.

PUNCTURE, in *Surgery*, any wound made by a sharp-pointed instrument.

PUNDITS, or PENDITS, learned Bramins devoted to the study of the Sanscrit language, and to the ancient science, laws, and religion of Hindostan. See PHILOSOPHY, N° 4—12.

PUNICA, the POMEGRANATE TREE, a genus of plants belonging to the icosandria class, and in the natural method ranking under the 36th order, *Pomaceæ.* See BOTANY *Index.*

PUNISHMENT, in *Law*, the penalty which a person incurs on the commission of a crime. See the article *CRIME and Punishment.*

The ingenuity of men has been much exerted to torment each other; but the following are the punishments that have been usually adopted in the different countries of the world. The capital punishments have been beheading, crucifixion, burning, roasting, drowning, scalping, hanging by the neck, the arm, or the leg, starving, sawing, exposing to wild beasts, rending asunder by horses drawing opposite ways, burying alive, shooting, blowing from the mouth of a cannon, compulsory deprivation of sleep, rolling in a barrel stuck with nails pointed inwards, poisoning, pressing slowly to death by a weight laid on the breast, casting headlong from a rock, tearing out the bowels, pulling to pieces with redhot pincers, the rack, the wheel, impaling, flaying alive, &c. &c.

The punishments short of death have been fine, pillory, imprisonment, compulsory labour at the mines, galleys, Punishment ‖ Purflew.

leys, highways, or correction-house; whipping, bastinading, mutilation by cutting away the ears, the nose, the tongue, the breasts of women, the foot, the hand; squeezing the marrow from the bones with screws or wedges, castration, putting out the eyes, banishment, running the gauntlet, drumming, shaving off the hair, burning on the hand or forehead, &c.

PUNNING. See Pun.

PUPIL, in the civil law, a boy or girl not yet arrived at the age of puberty; i. e. the boy under 14 years, the girl under 12.

Pupil, is also used in universities, &c. for a youth under the education or discipline of any person.

Pupil, in *Anatomy*, a little aperture in the middle of the uvea and iris of the eye, through which the rays of light pass to the crystalline humour, in order to be painted on the retina, and cause vision. See Anatomy *Index*.

PURCELL, Henry, a justly celebrated master of music, began early to distinguish himself. As his genius was original, it wanted but little forming, and he rose to the height of his profession with more ease than others pass through their rudiments. He was made organist to Westminster abbey in the latter end of the reign of Charles II. In that of William, he set several songs for Dryden's *Amphytrion* and his *King Arthur*, which were received with just applause. His notes in his operas were admirably adapted to his words, and so echoed to the sense, that the sounds alone seemed capable of exciting those passions which they never failed to do in conjunction. His music was very different from the Italian. It was entirely English, and perfectly masculine. His principal works have been published under the title of *Orpheus Britannicus*. He died in 1695, in the 37th year of his age, and was interred in Westminster abbey, where a monument is erected to his memory.

PURCHAS, Samuel, an English divine, famous for compiling a valuable collection of voyages, was born in 1577, at Thacksted in Essex. After studying at Cambridge, he obtained the vicarage of Eastwood in his native county; but leaving that cure to his brother, he settled in London, in order to carry on the great work in which he was engaged. He published the first volume in folio, 1613, and the four last, 12 years after, under the title of *Purchas his Pilgrimage, or Relations of the world, and the Religions observed in all ages and places.* Meanwhile he was collated to the rectory of St Martin's, Ludgate, in London, and made chaplain to Dr Abbot, archbishop of Canterbury. His *Pilgrimage*, and the learned Hackluyt's *Voyages*, led the way to all the other collections of that kind, and have been justly valued and esteemed. But unhappily, by his publishing, he involved himself in debt: he did not, however, die in prison, as some have asserted; but at his own house, about the year 1628.

PURCHASE, in *Law*, the buying or acquiring of lands, &c. with money, by deed or agreement, and not by descent or right of inheritance.

Purchase, in the sea-language, is the same as *draw in:* thus, when they say, the capstan purchases a-pace, they only mean it draws in the cable a-pace.

PURE, something free from any admixture of foreign or heterogeneous matters.

PURFLEW, a term in heraldry, expressing ermins, peans, or any of the furs, when they compose a bordure round a coat of arms: thus they say, He beareth gules, a bordure, purflew, vairy; meaning, that the bordure is vairy.

Purflew ‖ Purgatory.

PURGATION, the art of purging, scouring, or purifying a thing, by separating, or carrying off any impurities found therein. Thus,

In pharmacy, purgation is the cleansing of a medicine by retrenching its superfluities. In chemistry, it is used for the several preparations of metals and minerals intended to clear them of their impurities, more usually called *purification* and *refining*.

In medicine, purgation is an excretory motion arising from a quick and orderly contraction of the fleshy fibres of the stomach and intestines, whereby the chyle, corrupted humours, and excrements lodged therein, are protruded further and further, and at length quite excluded the body by stool. See Materia Medica.

Purgation, in *Law*, signifies the clearing a person's self of a crime of which he is suspected and accused before a judge. This purgation is either canonical or vulgar. Canonical purgation is prescribed by the canon-law, and the form thereof in the spiritual court is usually thus: The person suspected takes his oath that he is innocent of the crime charged against him; and at the same time brings some of his neighbours to make oath that they believe he swears truly. Vulgar purgation was anciently by fire or water, or else by combat, and was practised here till abolished by our canons. See Battel, *in law;* Ordeal, &c.

PURGATIVE or *Purging Medicines*, medicaments, which evacuate the impurities of the body by stool, called also *cathartics*.

PURGATORY, a place in which the just, who depart out of this life, are supposed to expiate certain offences which do not merit eternal damnation. Broughton has endeavoured to prove, that this notion has been held by Pagans, Jews, and Mahometans, as well as by Christians; and that in the days of the Maccabees the Jews believed that sin might be expiated by sacrifice after the death of the sinner, cannot be questioned.

Papist misrepresented and represented.

Much abuse has been poured upon the church of Rome for her doctrine of purgatory, and many false representations have been made of the doctrine itself. The following view of it is taken from a work which is considered as a standard by the British Catholics. 1. Every sin, how slight soever, though no more than an idle word, as it is an offence to God, deserves punishment from him, and will be punished by him hereafter, if not cancelled by repentance here. 2. Such small sins do not deserve eternal punishment. 3. Few depart this life so pure as to be totally exempt from spots of this nature, and from every kind of debt due to God's justice. 4. Therefore few will escape without suffering something from his justice for such debts as they have carried with them out of this world; according to that rule of divine justice, by which he treats every soul hereafter according to its works, and according to the state in which he finds it in death. From these propositions, which the Papist considers as so many self-evident truths, he infers that there must be some third place of punishment; for, since the infinite goodness of God can admit nothing into heaven which is not clean and pure from all sin both great and small; and his infinite justice can permit none to receive the reward of bliss, who as yet are not out of debt, but have something in justice to suffer; there must of necessity be some place or state, where souls, departing this life, pardoned as to the eternal guilt or pain, yet obnoxious to some temporal penalty, or with the guilt of some venial faults, are purged and purified before their admittance into heaven. And this is what he is taught concerning purgatory. Which, though he knows not where it is, of what nature the pains are, or how long each soul is detained there; yet he believes, that those that are in this place, being the living members of Jesus Christ, are relieved by the prayers of their fellow members here on earth, as also by alms and masses offered up to God for their souls. And as for such as have no relations or friends to pray for them, or give alms, or procure masses for their relief; they are not neglected by the church, which makes a general commemoration of all the faithful departed in every mass, and in every one of the canonical hours of the divine office.

Such is the Popish doctrine of purgatory, which is built chiefly upon 2 Macc. xii. 43, 44, 45; St Matth. xii. 31, 32; and 1 Cor. iii. 15. By Protestants the books of Maccabees are not acknowledged to be inspired scripture; but if they were, the texts referred to would rather prove that there is no such place as purgatory, since Judas did not expect the souls departed to reap any benefit from his sin-offering till the resurrection. Our Saviour, in St Luke, speaks of remission in *this world*, and in the world to *come;* but surely neither of these is purgatory. The world to come is the state after the resurrection, and the remission spoken of is the sentence of absolution to be pronounced on the penitent from the seat of general judgment. In the obscure verse referred to in the epistle to the Corinthians, the apostle is, by the best interpreters, thought to speak of the difficulty with which Christians should be saved from the destruction of Jerusalem. Of the state of souls departed he cannot well be supposed to speak, as upon disembodied spirits fire could make no impression. We cannot help, therefore, thinking with the church of England, that "the Romish doctrine of purgatory is a fond thing, vainly invented, and grounded on no warranty of scripture;" but we must confess at the same time, that it appears to us to be a very harmless error, neither hostile to virtue nor dangerous to society. See RESURRECTION.

PURIFICATION, in matters of religion, a ceremony which consists in cleansing any thing from a supposed pollution or defilement.

The Pagans, before they sacrificed, usually bathed or washed themselves in water; and they were particularly careful to wash their hands, because with these they were to touch the victims consecrated to the gods. It was also customary to wash the vessel with which they made their libations. The Mahometans also use purifications previous to the duty of prayer; which are also of two kinds, either bathing, or only washing the face, hands and feet. The first is required only in extraordinary cases, as after having lain with a woman, touched a dead body, &c. But lest so necessary a preparation for their devotions should be omitted, either where water cannot be had, or when it may be of prejudice to a person's health, they are allowed in such cases to make use of fine sand, or dust, instead of it; and then they perform this duty by clapping their open hands on the sand, and passing them over the parts, in the same manner as if they were dipped in water.

There were also many legal purifications among the Hebrews. When a woman was brought to bed of a male child, she was esteemed impure for 40 days; and when of a female, for 60: at the end of which time she carried a lamb to the door of the temple to be offered for a burnt-offering, and a young pigeon or turtle for a sin offering; and by this ceremony she was cleansed or purified.

PURIM, or *The Feast of Lots*, a solemn festival of the Jews, instituted in memory of the deliverance they received, by means of Mordecai and Esther, from Haman's wicked attempt to destroy them.

PURITAN, a name formerly given in derision to the dissenters from the church of England, on account of the profession to follow the pure word of God, in opposition to all traditions and human constitutions. It was likewise given in the primitive church to the Novatian schismatics, because they would never admit to communion any one who from dread of death had apostatized from the faith.

PURITY, the freedom of any thing from foreign admixture.

Purity of Style. See ORATORY, p. 411, &c.

PURLIEU, signifies all that ground near any forest, which being made forest by King Henry II. Richard I. and King John, was afterwards by perambulations and grants of Henry III. severed again from the same, and made purlieu; that is to say, pure and free from the laws of the forest.—The word is derived from the French *pur*, "pure," and *lieu*, "place."

PURLINS, in building, those pieces of timber that lie across the rafters on the inside, to keep them from sinking in the middle of their length.

By the act of parliament for rebuilding London, it is provided, that all purlins from 15 feet 6 inches to 18 feet 6 inches long, be in their square 9 inches and 8 inches; and all in length from 18 feet 6 inches to 21 feet 6 inches, be in their square 12 inches and 9 inches.

PURPLE, a colour composed of a mixture of red and blue. See *Colour-Making*, N° 29, and DYEING *Index*.

PURPURA, in *Natural History*. See MUREX, CONCHOLOGY *Index*. The Tyrian method of dyeing purple was with a liquid extracted from this fish. It has been affirmed, however, that no such method was ever practised. "At Tyre (says Mr Bruce) I engaged two fishermen, at the expence of their nets, to drag in those places where they said shell-fish might be caught, in hopes to have brought out one of the famous purple-fish. I did not succeed; but in this I was, I believe, as lucky as the old fishers had ever been. The purple-fish at Tyre seems to have been only a concealment of their knowledge of cochineal; as, had they depended upon the fish for their dye, if the whole city of Tyre applied to nothing else but fishing, they would not have coloured 20 yards of cloth in a year."

PURPURE, in *Heraldry*. The colour so called, which signifies *purple*, is in engraving represented by diagonal lines, from the left to the right. See HERALDRY.

It may serve to denote an administrator of justice, a lawgiver, or a governor equal to a sovereign: and according to G. Leigh, if it is compounded with

Or,	it signifies	Riches.
Arg.		Quietness.
Gul.		Politics.
Az.		Fidelity.
Ver.		Cruelty.
Sab.		Sadness.

PURRE, or PERKIN. See AGRICULTURE *Index*.

PURSER, an officer aboard a man of war, who receives her victuals from the victualler, sees that it be well stowed, and keeps an account of what he every day delivers to the steward. He also keeps a list of the ship's company, and sets down exactly the day of each man's admission, in order to regulate the quantity of provisions to be delivered out; and that the paymaster or treasurer of the navy may issue out the debursements, and pay off the men, according to his book.

PURSLAIN. See PORTULACA, BOTANY *Index*.

PURVIEW, a term used by some lawyers for the body of an act of parliament, or that part which begins with "Be it enacted, &c." as contradistinguished from the preamble.

PURULENT, in *Medicine*, something mixed with, or partaking of, pus or matter.

PUS, in *Medicine*, a white or yellowish matter designed by nature for the healing and cementing of wounds and sores.

The origin and formation of pus is as much unknown as that of any other animal fluid. In an inaugural dissertation published at Edinburgh by Dr Hendy, the author supposes pus to be a secreted fluid. It has been thought by many, that pus is either a sediment from serum when beginning to putrefy, or that it is the same fluid inspissated by the heat of the body. But both these opinions are refuted by some experiments of our author, which show, that pus is much less inclined to putrefaction than serum, and the putrefaction of both is hastened by an addition of some of the red part of the blood. Some other experiments were made in order to try whether pus could be artificially produced. A thin piece of lamb's flesh, applied to an ulcer discharging laudable pus, and covered over with lead, did not assume the appearance of pus, but became fetid, and was much lessened. Serum, in its inflammatory and in its ordinary state, and lymph in different states, were applied to the same ulcer, which still discharged good pus; but none of these were converted into pus; on the contrary, they became very putrid.

In opposition to these arguments of our author, however, it may be alleged, that if pus was a secreted fluid, the vessels by which it was secreted would certainly be visible; but no such thing has ever been observed: on the contrary, it is certain that pus cannot be formed unless the air is excluded from the wound. These disputes, however, are of no great consequence: but in some cases it becomes a matter of real importance to distinguish pus from mucus; as thus we may be enabled to know whether a cough is consumptive, or merely catarrhous. See MUCUS. Mr Hume, in a dissertation on the properties of pus, in which he avails himself of the experiments of Mr Hunter, as delivered in his *Physiological Lectures*, says, "that the characteristic of pus is its being composed of globules; and he thinks that the presence of globules seems to depend upon the pus being in a perfect state. It differs from the blood in the colour of the globules; in their not being soluble in water, which those of the blood are; and from the fluid in which they swim being coagulable by a solution of sal ammoniac, which serum is not." Respecting the formation of pus, our author adopts the idea suggested by Mr Hunter, that the vessels of the part assume the nature of a gland, and secrete a fluid which becomes pus. Mr Horne ascertains, by experiment, that pus, at its formation, is not globular, but a transparent fluid, of a consistence, in some sort, resembling jelly; and that the globules are formed while lying upon the surface of the sore; requiring, in some instances, while the influence of the external air is excluded, fifteen minutes for that purpose.

PUSTULE, a pimple, or small eruption on the skin full of pus; such as the eruptions of the smallpox.

PUTAMINEÆ, (from *putamen*, "a shell,") the name of the 25th order of Linnæus's fragments of a natural method; consisting of a few genera of plants allied in habit, whose fleshy seed-vessel or fruit is frequently covered with a hard woody shell. See BOTANY.

PUTEOLI, (Livy, Strabo): a town of Campania; so called either from its wells, there being many hot and cold springs thereabouts; or from its stench, *putor*, caused by sulphureous exhalations, (Varro, Strabo). It is now called *Puzzuoli*, and is pleasantly and advantageously situated for trade. In a very remote age, the Cumeans made it their arsenal and dockyard; and to this naval establishment gave the sublime appellation of *Dicearchia* or *Just Power*.

Swinburne's Travels in the Two Sicilies.

The Romans were well aware of the utility of this port, and took great pains to improve its natural advantages. Nothing remains of their works but a line of piers, built to break the force of a rolling sea: they are vulgarly called the *bridge of Caligula*, because that madman is said to have marched in triumph from Puzzuoli to Baiæ on a bridge; but his was a bridge of boats.

The ruins of its ancient edifices are widely spread along the adjacent hills and shores. An amphitheatre still exists entire in most of its parts, and the temple of Serapis offers many curious subjects of observation; half of its buildings are still buried under the earth thrown upon it by volcanical commotions, or accumulated by the crumblings of the hill; the inclosure is square, environed with buildings for priests and baths for votaries; in the centre remains a circular platform, with four flights of steps up to it, vases for fire, a centrical altar, rings for victims, and other appendages of sacrifice, entire and not displaced; but the columns that held its roof have been removed to the new palace of Caserta (see CASERTA). Behind this round place of worship stand three pillars without capitals, part of the pronaos of a large temple, they are of cipoline marble, and at the middle of their height are full of holes eaten in them by the file-fish *.

The present city contains near 10,000 inhabitants, and occupies a small peninsula; the cathedral was a pagan temple, dedicated to the divinities that presided over commerce and navigation. E. Long. 14. 40. N. Lat. 41. 15.

* *Pholas Dactylus, Linn.*

In

In the neighbourhood of Puteoli are many relicks of ancient grandeur, of which none deserve more attention than the Campanian way paved with lava, and lined on each side with venerable towers, the repositories of the dead, which are richly adorned with stucco in the inside. This road was made in a most solid expensive manner by order of Domitian, and is frequently the subject of encomium in the poems of Statius.

PUTI CARAJA, in *Botany*, is a genus of Indian plants, of which the characters, as given by Sir William Jones in the Asiatic Researches, vol. ii. p. 351. are these. The calyx is five-cleft, the corolla has five equal petals, the pericarpium a thorny legumen and two seeds, the leaves oval and pinnated, and the stem armed. "The seeds (says the learned president) are very bitter, and perhaps tonic; since one of them, bruised and given in two dozes, will, as the Hindoos assert, cure an intermittent fever."

PUTORIUS. See MUSTELA, MAMMALIA *Index*.

PUTREFACTION, is the natural process by which organized bodies are dissolved, and reduced to what may be called *original elements*.

Putrefaction differs from chemical solution; because in the latter, the dissolved bodies are kept in their state of solution by being combined with a certain agent from which they cannot easily be separated; but in putrefaction, the agent which dissolves the body appears not to combine with it in any manner of way, but merely to separate the parts from each other. It differs also from the resolution of bodies by distillation with violent fire; because, in distillation, new and permanent compounds are formed, but by putrefaction every thing seems to be resolved into substances much more simple and indestructible than those which are the result of any chemical process.

The bodies most liable to putrefaction are those of animals and vegetables, especially when full of juices. Stones, though by the action of the weather they will moulder into dust, yet seem not to be subject to any thing like a real putrefaction, as they are not resolved into any other substance than sand, or small dust, which still preserves its lapideous nature. In like manner, vegetables of any kind, when deprived of their juices by drying, may be preserved for many ages without being subjected to any thing like a putrefactive process. The same holds good with respect to animals; the parts of which, by simple drying, may be preserved in a sound state for a much longer time than they could be without the previous exhalation of their juices.

Putrefaction is generally allowed to be a kind of fermentation, or rather to be the last stage of that process; which beginning with the vinous fermentation, goes on through the acetous, to the stage of putridity, where it stops. It is argued, however, and seemingly not without a great deal of reason, that if putrefaction be a fermentation, it must necessarily be a kind distinct from either the vinous or acetous; since we frequently observe that it takes place where neither the vinous nor the acetous stages have gone before; of consequence, it must be, in some cases at least, entirely independent of and unconnected with them. In several other respects it differs so much from these processes, that it seems in some degree doubtful whether it can with propriety be called a *fermentation* or not. Both the vinous and acetous fermentations are attended with a considerable degree of heat; but in the putrefaction of animal matters especially, the heat is for the most part so small, that we cannot be certain whether there is any degree of it or not produced by the process. In cases, indeed, where the quantity of corrupting animal matter is very great, some heat may be perceived: and accordingly Dr Monro tells us, that he was sensible of heat on thrusting his hand into the flesh of a dead and corrupting whale. But the most remarkable difference between the putrefactive fermentation and that of the vinous and acetous kinds is, that the end of both these processes is to produce a new and permanent compound; but that of the putrefactive process is not to produce any new form, but to destroy, and resolve one which already exists into the original principles from which all things seem to proceed. Thus the vinous fermentation produces ardent spirits; the acetous, vinegar: but putrefaction produces nothing but earth, and some effluvia, which, though most disagreeable, and even poisonous to the human body, yet, being imbibed by the earth and vegetable creation, give life to a new race of beings. It is commonly supposed, indeed, that volatile alkali is a production of the putrefactive process: but this seems liable to dispute. The vapour of pure volatile alkali is not hurtful to the human frame, but that of putrefying substances is exceedingly so; and, excepting in the case of urine, the generation of volatile alkali in putrid substances is very equivocal. This substance, which produces more alkali than any other, is much less offensive by its putrid fetor than others; and all animal substances produce a volatile alkali on being exposed to the action of fire, of quicklime, or of alkaline salts. In these cases the volatile alkali is not supposed to be produced by the quicklime or fixed salt, but only to be extricated from a kind of ammoniacal salt pre-existing in the animal matters; the probability is the same in the other case, viz. that volatile alkali is not produced, but only extricated, from these substances by putrefaction.

The only thing in which the putrefactive fermentation agrees with the other kinds is, that in all the three there is an extrication of fixed air. In the putrefactive process, it has been thought that this escape of the fixed air deprives the body of its cohesion: and Dr Macbride has written a treatise, in which he endeavours to prove that fixed air is the very power of cohesion itself, and that all bodies when deprived of their fixed air entirely lose their cohesion. According to this hypothesis, the cause of putrefaction is the escape of fixed air; but it is impossible to give a reason why fixed air, after having so long remained in a body, and preserved its cohesion, should of a sudden begin to fly off without being acted upon by something else. To a similar objection the hypothesis of those is liable, who suppose putrefaction to be occasioned by the escape of phlogiston; for phlogiston is now known to be a chimera: and though it were a reality, it would not fly off without something to carry it off, any more than fixed air. Animalcules have been thought to be the cause of putrefaction: but if animal substances are covered so as to exclude the access of flies or other insects, no such animalcules are to be discovered though putrefaction has taken place; and indeed it requires little proof to convince us, that animals are produced in corrupted bodies only because such substances prove a proper nidus for the eggs of the parent insects.

To

Putrefaction.

To understand the true cause of putrefaction, we must take notice of the circumstances in which the process goes on most rapidly. These are, heat, a little moisture, and confined air. Extreme cold prevents putrefaction, as well as perfect dryness; and a free circulation of air carries off the putrid effluvia; a stagnation of which seems to be necessary for carrying on the process. It seems also to hold pretty generally, that putrefying bodies swell and become specifically lighter; for which reason the carcases of dead animals, after having sunk in water, rise to the top and float. This last phenomenon, as has been observed under the article BLOOD, N° 29. shows that these bodies have received a certain quantity of an elastic principle from the air, which thus swells them up to such a size. It may be said indeed, that this increase of size in putrefying bodies is owing only to the extrication of air within themselves: but this amounts to the same thing; for the air which exists internally in the body of any animal, is entirely divested of elasticity while it remains there, and only shows its elastic properties upon being extricated. The elastic principle which combines with the air fixed in the animal substance, therefore, must come from the external atmosphere; and consequently the agent in putrefaction must be the elastic principle of the atmosphere itself, probably the same with elementary fire.

But, granting this to be true, it is difficult to show why putrefaction should not take place in a living body as well as in a dead one; seeing the one is as much exposed to the action of the air as the other. This difficulty, however, is not peculiar to the present hypothesis; but will equally occur whatever we may suppose the cause of putrefaction to be. The difficulty seems to be a little cleared up by Dr Priestley, who shows, that, by means of respiration, the body is freed from many noxious effluvia which would undoubtedly destroy it; and by the retention of which, he thinks, a living body would putrefy as soon as a dead one. The way in which respiration prevents the putrefaction of the body, is evidently the same with that in which the wind prevents fish or flesh hung up in it from becoming putrid. The constant inspiration of the air is like a stream of that element continually blown upon the body, and that not only upon its surface, but into it; by which means putrefaction is prevented in those parts that are most liable to become putrid. On the other hand, the elastic principle received from the air by the blood *, by invigorating the powers of life, quickening the circulation, and increasing perspiration, enables the body to expel noxious particles from other parts of the body which cannot conveniently be expelled by the lungs.

* See Blood, N° 29.

This leads us to consider the reason why a free exposure to the air prevents the coming on of putrefaction, or why the confining of the putrid effluvia should be so necessary to this process. Here it will be proper to recollect, that putrefaction is a simple resolution of the body into earth, air, &c. of which it seems originally to have been composed. This resolution is evidently performed by an expansive power seemingly situated in every particle of the body. In consequence of this principle, the body first swells, then bursts, flies off in vapour, and its particles fall asunder from each other. The action of the putrefactive process, then, is analogous to that of fire, since these are the very properties of fire, and the very effects which follow the action of fire upon any combustible body. It is therefore exceedingly probable, that the agent in the air, which we have all along considered as the cause of putrefaction, is no other than fire itself; that is, the ethereal fluid expanding itself every where, as from a centre to a circumference. The force of the fluid, indeed, is much less in putrefaction than in actual ignition; and therefore the effects also take place in a much smaller degree, and require a much longer time: nevertheless, the same circumstances that are necessary for keeping up the action of fire, are also necessary for keeping up the putrefactive process. One of these is a free access of air, yet without too violent a blast; for as fire cannot burn without air, neither can it endure too much of it: thus a candle goes out if put under a receiver, and the air exhausted; and it will do the same if we blow violently upon it. In like manner, putrefaction requires a certain quantity of air, much less indeed than fire: and as it requires less to support it, so it can also endure much less air than fire; for a stream of air which would not put out a fire, will effectually prevent putrefaction. The cause of this in both is the same. Fire cannot burn because the vapour is carried off too fast; and thus the latent heat, which ought to support the flame, is entirely dissipated. In like manner putrefaction is as certainly attended with an emission of azotic gas as fire is with an emission of flame. These gases contain a great quantity of latent heat, or of the expansive principle already mentioned; and if these are carried off with greater rapidity than the heat of the atmosphere can produce them, the consequence must be, that an opposite principle to that which produces putrefaction, namely, a principle of cold, or condensation, instead of expansion, must take place, and the body cannot putrefy. That this must be the case, is evident from the property which all evaporations have of producing cold; and it is well known that a brisk current of air promotes evaporation to a great degree. Hence also the reason is evident why bodies are preserved uncorrupted by cold; for thus the action of the expansive principle is totally overcome and suspended, so that none of its effects can be perceived.

Thus we may say, that one reason why an animal body does not putrefy while alive, is its ventilation, as we may call it, by respiration; and another is, the continual accession of new particles, less disposed to putrefy than itself, by the food and drink which is constantly taken in. But if either of these ways of preventing the commencement of this process are omitted, then putrefaction will take place as well in a living as in a dead body. Of the truth of this last fact we have innumerable instances. When air is infected with the putrid effluvia of marshes, and thus the natural effluvia are not carried off from the human body, but, on the contrary, some enter into it which are not natural to it, the most putrid diseases are produced. The same thing happens from the putrid effluvia of dead bodies. Of this we have a remarkable instance in the fever which took place in Germany in the war of 1755: one reason of which is said to have been an infection of the air by the vast numbers of people killed in battle, to which was added a calm in the atmosphere for a long time; the putrid effluvia being by this prevented from flying off †. When Mr Holwell with 145 others were imprisoned in the black-hole at Calcutta, after passing a

† See *Medicine*, N° 167.

a night in that dismal habitation, he found himself in a high putrid fever. When sailors in long voyages are obliged to feed upon putrid aliments; when, through stormy weather, they are much exposed to wet; in the one case the putrescent effluvia being kept from flying off, and in the other a greater quantity being thrown into the body than what it naturally contains, the scurvy, malignant fevers, &c. make their appearance (A). Neither can these diseases be removed without removing every one of the causes just now mentioned: for as putrid diseases will be the consequence of confined air, nastiness, &c. though the provisions be ever so good; so on the other hand, if the provisions be bad, the best air, and most exact cleanliness, nay, the best medicines in the world, will be of no service; as hath been often observed in the scurvy.

From this account of the nature, cause, and method of preventing putrefaction by means of a current of air, we may easily see the reason why it does not take place in some other cases also. Bodies will not putrefy *in vacuo*, because there the atmosphere has not access to impart its elastic principle; and though in the vacuum itself the principle we speak of does undoubtedly exist, yet its action there is by far too weak to decompose the structure of an animal body. In extreme cold, the reason why putrefaction does not take place, has been already shown. If the heat is extremely great, the process of ignition or burning takes place instead of putrefaction. If the body is very dry, putrefaction cannot take place, because the texture is too firm to be decomposed by the weak action of the elastic principle. Putrefaction may also be prevented by the addition of certain substances; but they are all of them such as either harden the texture of the body, and thus render it proof against the action of the elastic fluid, or, by dissolving its texture entirely, bring it into a state similar to what it would be brought by the utmost power of putrefaction, so that the process cannot then take place. Thus various kinds of salts and acids harden the texture of animal substances, and thus are successfully used as antiseptics. The same thing may be said of ardent spirits; while oils and gums of various kinds prove antiseptic by a total exclusion of air, which is necessary in some degree for carrying on the process of putrefaction. Many vegetables, by the astringent qualities they possess, harden the texture of animal substances, and thus prove powerfully antiseptic; while, on the other hand, fixed alkaline salts, quicklime, and caustic volatile alkali, though they prevent putrefaction, yet they do it by dissolving the substances in such a manner that putrefaction could do no more though it had exerted its utmost force. There is only one other antiseptic substance whose effects deserve to be considered, and that is sugar. This, though neither acid nor alkaline, is yet one of the most effectual means of preventing putrefaction: and this seems to be owing to its great tendency to run into the vinous fermentation, which is totally inconsistent with that of putrefaction; and this tendency is so great, that it can scarce be counteracted, by the tendency of animal substances to putrefy in any circumstances whatever.

Some kinds of air are remarkably antiseptic, though this subject has not been so fully inquired into as could be wished. The most powerful of them in this respect is the nitrous air; next to it, is fixed air; but the powers of the other airs are not so well known. It is probable that the antiseptic properties of fixed and nitrous air, are owing to their quality of extinguishing fire, or at least that the principle is the same; but till the nature of these two kinds of air are better known, little can be said with certainty on the subject.

Sir John Pringle has made experiments to determine the powers of certain substances to promote or to prevent putrefaction. From these experiments he has formed the following Table, showing the relative antiseptic powers of the saline substances mentioned. Having found that two drams of beef put in a phial with two ounces of water, and placed in a heat equal to 90° of Fahrenheit's

(A) This aeriform fluid, which is exhaled from animal bodies in a state of putrefaction, acts at certain times more powerfully than at others, and is indeed in one stage of the process infinitely more noxious than any other elastic fluid yet discovered. In the Gentleman's Magazine for August 1788, Dr St John informs us, that he knew a gentleman who, by slightly touching the intestines of a human body beginning to liberate this corrosive gas, was affected with a violent inflammation, which in a very short space of time extended up almost the entire length of his arm, producing an extensive ulcer of the most foul and frightful appearance, which continued for several months, and reduced him to a miserable state of emaciation. The same writer mentions a celebrated professor who was attacked with a violent inflammation of the nerves and fauces, from which he with difficulty recovered, merely by stooping for an instant over a body which was beginning to give forth this deleterious fluid. Hence he infers, that the same gas modified or mixed, or united with others, may be the occasion of the plague, which has so often threatened to annihilate the human species. It is happy, however, for mankind that this particular stage of putrefaction continues but for a few hours; and what may appear very remarkable, this destructive gas is not very disagreeable in smell, and has nothing of that abominable and loathsome fetor produced by dead bodies in a less dangerous state of corruption; but has a certain smell totally peculiar to itself, by which it may be instantly discovered by any one that ever smelled it before. This is an object very worthy the attention of physicians: it is both extremely interesting, and very little known; but at the same time it is a study in the highest degree unpleasant, from the detestable smell and nastiness which attend the putrefaction of animal bodies; and a man must be armed with uncommon philanthropy and resolution to attempt it.

Dr St John thinks it probable that there is a rapid fixation of the basis of vital air in dead bodies at a certain state of putrefaction, on account of the luminous appearance which they sometimes make, and which exists but for a few hours: but whether this luminous appearance takes place in every body, or whether it precedes or follows the exhalations of the corrosive gas above mentioned, he had not, when he wrote his paper, been able to discover.

Fahrenheit's thermometer, became putrid in 14 hours, and that 60 grains of sea-salt preserved a similar mixture of beef and water more than 30 hours, he made the antiseptic power of the sea-salt a standard, to which he compared the powers of the other salts. The algebraic character + signifies, that the substance to which it is annexed had a greater antiseptic power than is expressed by the numbers:

Sea-salt, or the standard	1
Sal-gem	1+
Vitriolated tartar	2
Spiritus Mindereri	2
Soluble tartar	2
Sal diureticus	2+
Crude sal ammoniac	3
Saline mixture	3
Nitre	4+
Salt of hartshorn	4+
Salt of wormwood	4+
Borax	12
Salt of amber	20
Alum	30

N.B. The quantities of spiritus Mindereri and of the saline mixture were such, that each of them contained as much alkaline salt as the other neutral salts.

Myrrh, aloes, asafœtida, and terra Japonica were found to have an antiseptic power 30 times greater than the standard. Gum ammoniacum and sagapenum showed little antiseptic power.

Of all resinous substances, camphor was found to resist putrefaction most powerfully. Sir John Pringle believes that its antiseptic power is 300 times greater than that of sea-salt.

Chamomile flowers, Virginian snake-root, pepper, ginger, saffron, contrayerva root, and galls, were found to be 12 times more antiseptic than sea-salt.

Infusions of large quantities of mint, angelica, ground-ivy, green tea, red-roses, common wormwood, mustard, and horse-radish, and also decoctions of poppy-heads, were more antiseptic than sea-salt.

Decoctions of wheat, barley, and other farinaceous grains, checked the putrefaction by becoming sour.

Chalks and other absorbent powders, accelerated the putrefaction, and resolved meat into a perfect mucus. The same powders prevented an infusion of farinaceous grains, from becoming mucilaginous and sour.

One dram of sea-salt was found to preserve two drams of fresh beef in two ounces of water, above 30 hours, uncorrupted, in a heat equal to that of the human body, or above 20 hours longer than meat is preserved in water without salt: but half a dram of salt did not preserve it more than two hours longer than pure water. Twenty-five grains of salt had little or no antiseptic quality. Twenty grains, 15 grains, but especially 10 grains only of sea-salt, were found to accelerate and heighten the putrefaction of two drams of flesh. These small quantities of sea-salt did also soften the flesh more than pure water.

The same learned and ingenious physician made experiments to discover the effects of mixing vegetable with animal matters.

Two drams of raw beef, as much bread, and an ounce of water, being beat to the consistence of pap, and exposed to 90° of heat according to Fahrenheit's thermometer, began to ferment in a few hours, and continued in fermentation during two days. When it began to ferment and swell, the putrefaction had begun; and in a few hours afterwards, the smell was offensive. Next day the putrid smell ceased, and an acid taste and smell succeeded. Fresh alimentary vegetables, as spinach, asparagus, scurvy-grass, produced similar effects as bread on flesh, but in a weaker degree. From several other experiments he found, that animal substances excite the fermentation of vegetable substances, and that the latter substances correct the putrescency of the former.

By adding saliva to a similar mixture of flesh, bread, and water, the fermentation was retarded, moderated, but rendered of twice the usual duration, and the acid produced at last was weaker than when no saliva was used.

By added an oily substance to the common mixture of flesh, bread, and water, a stronger fermentation was produced, which could not be moderated by the quantity of saliva used in the following experiment, till some fixed alkaline salt was added; which salt was found, without saliva, to stop suddenly very high fermentations.

He did not find that small quantities of the following salts, sal ammoniac, nitre, vitriolated tartar, sal diureticus, salt of hartshorn, salt of wormwood, were septic, as small quantities of sea-salt were.

Sugar was found to resist putrefaction at first, as other salts do, and also to check the putrefaction after it had begun by its own fermentative quality, like bread and other fermentative vegetables.

Lime-water made some small resistance to putrefaction.

Port-wine, small-beer, infusions of bitter vegetables, of bark, and the juice of antiscorbutic plants, retarded the fermentation of mixtures of flesh and bread. But an unstrained decoction of bark considerably increased that fermentation.

Crab-eyes accelerated and increased the fermentation of a mixture of flesh and bread.

Lime-water neither retarded nor hastened the fermentation of such a mixture: but when the fermentation ceased, the liquor was neither putrid nor acid, but smelt agreeably.

Flesh pounded in a mortar was found to ferment sooner than that which had not been bruised.

The tough inflammatory crust of blood was found to be most putrescent; next to which the crassamentum, or red coagulated mass; and lastly the serum.

Dr Macbride's experiments confirm many of those above related, especially those which show that the fermentation of vegetable substances is increased by a mixture of animal or purescent matter; that the putrescency of the latter is corrected by the fermentative quality of the former; and that the putrefaction and fermentation of mixtures of animal and vegetable substances were accelerated by additions of absorbent earths and of Peruvian bark. He also found, that although unburnt calcareous earths were septic, quicklime and lime-water prevented putrefaction, but that they destroyed or dissolved the texture of flesh.

The experiments of the author of the *Essai pour servir à l'Histoire de la Putrefaction*, show that metallic salts,

salts, resinous powders, extracts of bark, and opium, are very powerfully antiseptic, and that salts with earthy bases are less antiseptic than any other salts.

PUTTOCK-SHROUDS. See *Puttock-Shrouds*.

PUTTY, in its popular sense, is a kind of paste compounded of whiting and linseed oil, beaten together to the consistence of a thick dough.

It is used by glaziers for the fastening in the squares of glass in sash-windows, and by painters for stopping up the crevices and clefts in timber and wainscots, &c.

PUTTY sometimes also denotes the powder of calcined tin, used in polishing and giving the last gloss to works of iron and steel.

PUY DE DOME, a department in the south of France, forming part of the ancient province of Auvergne. The soil is mountainous, but fertile in all kinds of grain, vines, and fruits; and contains mines of iron, lead, coal, and many mineral springs. There are manufactures of cloth of various kinds, lace, serges, ribbons, &c. The territorial extent of this department is 794,370 hectares, and the population in 1817 was 548,834. The contributions for 1802 amounted to 3,656,547 francs. Clermont is the chief town.

TERRA PUZZULANA, or POZZOLANA, is a grayish kind of earth used in Italy for building under water. The best is found about Puteoli, Baiæ, and Cumæ, in the kingdom of Naples, from the first of which places it derives its name. It is a volcanic product, composed of heterogeneous substances, thrown out from the burning mouths of volcanoes in the form of ashes; sometimes in such large quantities, and with so great violence, that whole provinces have been covered with it at a considerable distance. In the year 79 of the common era, the cities of Herculaneum, Pompeii, and Stabia, although at the distance of many miles from Vesuvius, were, nevertheless, buried under the matters of these dreadful eruptions; as Bergman relates in his Treatise of the Volcanic Products. This volcanic earth is of a gray, brown, or blackish colour; of a loose glanular, or dusty and rough, porous or spongy texture, resembling a clay hardened by fire, and then reduced to a gross powder. It contains various heterogeneous substances mixed with it. Its specific gravity is from 2500 to 2800; and it is, in some degree, magnetic: it scarcely effervesces with acids, though partially soluble in them. It easily melts *per se;* but its most distinguishing property is, that it hardens very suddenly when mixed with $\frac{1}{3}$ of its weight of lime and water; and forms a cement which is more durable in water than any other.

According to Bergman's Analysis, 100 parts of it contain from 55 to 60 of siliceous earth, 20 of argillaceous, five or six of calcareous, and from 15 to 20 of iron. Its effects, however, in cement may perhaps depend only on the iron it contains.

It is evidently a martial argillaceous marl, that has suffered a moderate heat. Its hardening power arises from the dry state of the half-baked argillaceous particles, which makes them imbibe water rapidly, and thus accelerates the desiccation of the calcareous part; and also from the quantity and peculiar state of the iron and manganese which it contains; on which metals its properties chiefly depend. It is found not only in Italy but in France, and also in England and elsewhere.

PUZZUOLI. See PUTEOLI.

PYANEPSIA, in antiquity, an Athenian festival celebrated on the seventh day of the month *Pyanepsion;* which, according to the generality of critics, was the same with our September.

Plutarch refers the institution of this feast to Theseus, who, after the funeral of his father, on this day paid his vows to Apollo, because the youths who returned with him safe from Crete then made their entry into the city. On this occasion, these young men putting all that was left of their provisions into one kettle, feasted together on it, and made great rejoicing. Hence was derived the custom of boiling pulse on this festival. The Athenians likewise carried about an olive branch, bound about with wood, and crowned with all sorts of first-fruits, to signify that scarcity and barrenness were ceased, singing in procession a song. And when the solemnity was over, it was usual to erect the olive branch before their doors, as a preservative against scarcity and want.

PYCNOSTYLE, in the ancient architecture, is a building where the columns stand very close to each other; only one diameter and a half of the column being allowed for the intercolumniations.

According to Mr Evelyn, the pycnostyle chiefly belonged to the Composite order, and was used in the most magnificent buildings; as at present in the peristyle at St Peter's at Rome, which consists of near 300 columns; and in such as yet remain of the ancients, among the ruins of Palmyra.

PYGARGUS, a species of falco. See ORNITHOLOGY *Index*.

PYGMALION, in fabulous history, a king of Cyprus, who, being disgusted at the dissolute lives of the women of his island, resolved to live in perpetual celibacy; and making a statue of ivory, he fell so passionately in love with it, that the high festival of Venus being come, he fell down before the altar of that goddess, and besought her to give him a wife like the statue he loved. At his return home, he embraced, as usual, his ivory form, when he perceived that it became sensible by degrees, and was at last a living maid, who found herself in her lover's arms the moment she saw the light. Venus blessed their union; and, at the end of nine months, she was delivered of a boy, who was named *Paphos*.

PYGMY, a person not exceeding a cubit in height. This appellation was given by the ancients to a fabulous nation inhabiting Thrace; who brought forth young at five years of age, and were old at eight: these were famous for the bloody war they waged with the cranes. As to this story, and for the natural history of the true pygmy, see SIMIA, MAMMALIA *Index*.

PYKAR, a broker in India, inferior to those called *dallals*, who transacts the business at first hand with the manufacturer, and sometimes carries goods about for sale.

PYKE, a watchman in India, employed as a guard at night. Likewise a footman or runner on business. They are generally armed with a spear.

PYLADES, a son of Strophius, king of Phocis, by one of the sisters of Agamemnon. He was educated together with his cousin Orestes, with whom he formed the most inviolable friendship, and whom he assisted to revenge the murder of Agamemnon, by assassinating Clytemnestra and Ægysthus. He also accompanied him into Taurica Chersonesus; and for his ser-

 vices

vices Orestes rewarded him, by giving him his sister Electra in marriage. Pylades had by her two sons, Medon and Strophius. The friendship of Orestes and Pylades became proverbial.

PYLORUS, in *Anatomy*, the under orifice of the stomach. See ANATOMY, N° 91.

PYLUS, in *Ancient Geography*, a town of Elis; its ruins to be seen on the road from Olympia to Elis, (Pausanias); situated between the mouths of the Peneus and Selles, near Mount Scollis, (Strabo). Built by Pylas of Megara, and destroyed by Hercules, (Pausanias). Another Pylus in Triphylia, (Strabo); by which the Alpheus runs, (Pausanias); on the confines of Arcadia, and not in Arcadia itself, (id.).—A third in Messenia, (Strabo, Ptolemy); situated at the foot of Mount Ægaleus on the sea coast, over-against the island Sphagea or Sphacteria: built by Pylas, and settled by a colony of Leleges from Megara; but thence expelled by Neleus and the Pelasgi, and therefore called *Nelea*, (Homer.) A sandy territory. The royal residence of Neleus, and of Nestor his son: the more ancient and more excellent Pylus; whence the proverb *Pylus ante Pylum* (Aristophanes, Plutarch), used when we want to repress the arrogance and pride of any one: said to be afterwards called *Coryphasium*. It made a figure in the Peloponnesian war; for being rebuilt by the Athenians, it proved of great benefit to them for the space of 15 years, and of much annoyance to the Lacedæmonians, (Thucydides). All the three *Pyli* were subject to Nestor, (Strabo).

PYRAMID, in *Geometry*, a solid standing on a triangular, square, or polygonal basis, and terminating in a point at the top; or, according to Euclid, it is a solid figure, consisting of several triangles, whose bases are all in the same plane, and have one common vertex.

Pyramids are sometimes used to preserve the memory of singular events, and sometimes to transmit to posterity the glory and magnificence of princes. But as they are esteemed a symbol of immortality, they are most commonly used as funeral monuments and temples to the gods. Such is that of Cestius at Rome; the pyramids of Dashur drawn by Pococke; and those other celebrated ones of Egypt, as famous for the enormity of their size as their antiquity. Of these the largest are the pyramids of *Geeza*, so called from a village of that name on the banks of the Nile, distant from them about 11 miles. The three which most attract the attention of travellers stand near one another on the west side of the river, almost opposite to Grand Cairo, and not far from the place where the ancient Memphis stood. They were visited by M. Savary, of whose description of them we shall here give an abstract.

He took his journey in the night time, in order to get up to the top of the great one by sunrise. Having got within sight of the two great ones, while the full moon shone upon them, he informs us, that they appeared, at the distance of three leagues, like two points of rock crowned by the clouds.

It is in the rich territory which surrounds them that fable has placed the Elysian fields. The canals which intersect them are the Styx and Lethe.

" The aspects of the pyramids, varied according to the circuits he made in the plain, and the position of the clouds, displayed themselves more and more to view. At half past three in the morning we arrived (says he) at the foot of the greatest. We left our clothes at the gate of the passage which leads to the inside, and descended, carrying each of us a flambeau in his hand. Towards the bottom you must creep like serpents to get into the interior passage, which corresponds with the former. We mounted it on our knees, supporting ourselves with our hands against the sides. Without this precaution one runs the risk of slipping on the inclined plane, where the slight notches are insufficient to stop the foot, and one might fall to the bottom. Towards the middle we fired a pistol, the frightful noise of which, repeated in the cavities of this immense edifice, continued a long time, and awakened thousands of bats, which flying round us, struck against our hands and faces, and extinguished several of our wax candles. They are much larger than the European bats. Arrived above, we entered a great hall, the gate of which is very low. It is an oblong square, wholly composed of granite. Seven enormous stones extend from one wall to the other, and form the roof. A sarcophagus made of a single block of marble lies at one end of it. It is empty; and the lid of it has been wrenched off. Some pieces of earthen vases lie around it. Under this beautiful hall is a chamber not so large, where you find the entrance to a conduit filled with rubbish. After examining these caves, where daylight never penetrated, we descended the same way, taking care not to fall into a well, which is on the left, and goes to the very foundations of the pyramid. Pliny makes mention of this well, and says it is 26 cubits deep. The internal air of this edifice never being renewed, is so hot and mephitic that one is almost suffocated. When we came out of it, we were dropping with sweat, and pale as death. After refreshing ourselves with the external air, we lost no time in ascending the pyramid. It is composed of more than 200 layers of stone. They overlap each other in proportion to their elevation, which is from two to four feet. It is necessary to climb up all these enormous steps to reach the top. We undertook it at the north-east angle, which is the least damaged. It took us, however, half an hour with great pains and many efforts to effect it.

" The sun was rising, and we enjoyed a pure air, with a most delicious coolness. After admiring the prospect around us, and engraving our names on the summit of the pyramid, we descended cautiously, for we had the abyss before us. A piece of stone detaching itself under our feet or hands might have sent us to the bottom.

" Arrived at the foot of the pyramid, we made the tour of it, contemplating it with a sort of horror. When viewed close, it seems to be made of masses of rocks; but at a hundred paces distance, the largeness of the stones is lost in the immensity of the whole, and they appear very small.

" To determine its dimensions is still a problem. From the time of Herodotus to our days it has been measured by a great number of travellers and learned men, and their different calculations, far from clearing up doubts, have only increased the uncertainty. The following table will serve at least to prove how difficult it is to come at the truth.

Pyramid.

Height of the great Pyramid.		*Width of one of its sides.*
Ancients.		French Feet.
Herodotus	800	800
Strabo	625	600
Diodorus Siculus	600 and a fraction	700
Pliny	-	708
Moderns.		
Le Bruyn	616	704
Prosper Alpinus	625	750
Thevenot	520	682
Niebuhr	440	710
Greaves	444	648

Number of layers of Stone which form it.

Greaves	207
Maillet	208
Albert Liewenstein	260
Pococke	212
Belon	250
Thevenot	208

"It appears that Messrs Greaves and Niebuhr have prodigiously deceived themselves in measuring the perpendicular height of the great pyramid. All the travellers allow that it has at least 200 layers of stone. These layers are from two to four feet high. According to Pococke, they are from four feet and a half to four feet high, being not so high at the top as at the base. Prosper Alpinus informs us, that the elevation of the first layer is five feet, but it diminishes insensibly in proportion as one mounts. Thevenot mentions 208 steps of large stones, the thickness of which makes the height of them about two feet and a half one with another: He measured some of them more than three feet high. I have measured several of them which were more than three feet high, and I found none less than two; the least height of them we can take as a medium therefore is two feet and a half, which, even according to Mr Greaves's calculation, who reckons 207 layers, would make 517 feet 6 inches perpendicular height. Messrs Greaves, Maillet, Thevenot, and Pococke, who only differ in the number of the layers from 207 to 212, all mounted by the north-east angle, as the least injured. I followed the same route, and counted only 208 steps. But if we reflect that the pyramid has been open on the side next the desert, that the stones on that side have been thrown down, that the sand which covers them has formed a considerable hill, we shall not be astonished that Albert Liewenstein, Belon, and Prosper Alpinus, who must have mounted by the south-east or south-west angle, which are less exposed to the sands of Libya, should have found a greater number of steps: so that the calculation of these travellers, agreeing with that of Diodorus Siculus and Strabo, appears to be nearest the true height of the pyramid taken at its natural base; whence we may conclude with reason that it is at least 600 feet high. Indeed this is authenticated by a passage of Strabo. These are his words: 'Towards the middle of the height of one of the sides is a stone that may be raised up. It shuts an oblique passage which leads to a coffin placed in the centre of the pyramid.' This passage, open in our days, and which in the time of Strabo was towards the middle of one face of the pyramid, is at present only 100 feet from the base. So that the ruins of the covering of the pyramid, and of the stones brought from within, buried by the sand, have formed a hill in this place 200 feet high. Pliny confirms this opinion. The great sphynx was in his time upwards of 62 feet above the surface of the ground. Its whole body is at present buried under the sand. Nothing more appears of it than the neck and head, which are 27 feet high. If even the sphynx, though defended by the pyramids against the northerly winds, which bring torrents of sand from Libya, be covered as high as 38 feet, what an immense quantity must have been heaped up to the northward of an edifice whose base is upwards of 700 feet long? It is to this we must attribute the prodigious difference between the accounts of the historians who have measured the great pyramid at distant periods, and at opposite angles. Herodotus, who saw it in the age nearest to its foundation, when its true base was still uncovered, makes it 800 feet square. This opinion appears very probable. Pliny also says that it covered the space of eight acres.

"Messrs Shaw, Thevenot, and the other travellers who pretend that this pyramid was never finished, because it is open and without coating, are in an error. It is only necessary to observe the remains of the mortar, with the splinters of white marble which are to be found in many parts of the steps, to see that it has been coated. After reading attentively the description given of it by the ancients, every doubt vanishes, and the truth is as clear as day-light. Herodotus tells us, 'The great pyramid was covered with polished stones, perfectly well jointed, the smallest of which was 30 feet long. It was built in the form of steps, on each of which were placed wooden machines to raise the stones from one to another.' According to Diodorus, 'The great pyramid is built of stones, very difficult of workmanship, but of an eternal duration. It is preserved to our days (towards the middle of the Augustan age) without being in the least injured. The marble was brought from the quarries of Arabia.' This historian thought that the whole building was composed of stones, similar to those of the coating, which were of very hard marble. Had there been some pieces torn off, he would have perceived under that covering a calcareous stone rather soft. Pliny says that it 'is formed of stones brought from the quarries of Arabia. It is not far from the village of Busiris (which still exists under the name of *Bousir*), where those persons reside who are so skilful as to climb up the top.'

"This passage shows that Pliny, deceived by the appearance, was in the same error with Diodorus Siculus. It demonstrates also that it was covered: for what difficulty would there have been for the inhabitants of Busiris to scale a building raised by steps? but it was really a prodigy for them to get up it when it formed a mountain, the four inclined planes of which presented a surface covered with polished marble. It is indeed, an incontestable fact, that the great pyramid was coated. It is as certain too that it has been shut, as Strabo gives us to understand; and that by removing a stone placed in the middle of one of the sides, one found a passage which led to the tomb of the king. But I shall leave Mr Maillet, who visited it 40 times with all imaginable

imaginable attention, the honour of relating the means employed to open it. I have examined the inside of it in two different journeys: twice I have mounted it: and I cannot help admiring the sagacity with which that author has developed the mechanism of that astonishing edifice."

Our author next proceeds to give a particular description of the methods by which it is most probable that the pyramids were closed, and the immense labour requisite to open them. We must remark, that the final outlet to the workmen he supposes to have been the well at the entrance formerly mentioned. This well descends towards the bottom of the pyramid by a line not quite perpendicular to the horizon, but slanting a little, in such a manner as to resemble the figure of the Hebrew letter Lamed. About 60 feet from the aperture there is a square window in this passage, from whence we enter a small grotto hewn out of the mountain; which in this place is not a solid stone, but a kind of gravel concreted together. The grotto extends about 15 feet from east to west, where there is another groove hollowed likewise, but almost perpendicular. It is two feet four inches wide by two and a half in height. It descends through a space of 123 feet, after which we meet with nothing but sand and stones. M. Savary is convinced that the only use of this passage was to serve as a retreat for the labourers who constructed the pyramid; and of this he looks upon the slope of the conduit, its winding road, its smallness, and its depth, to be certain proofs. The way out of it he supposes to have been formed by a passage over which hung a row of stones, which they had discovered the secret of suspending, and which falling down into the passage by the means of some spring they set in motion, shut up the entrance for ever, as soon as the workmen were withdrawn from the pyramid.

It is not known in Europe when the pyramids were built; but we have reason to expect a history of them soon from Shanscrit records examined by Mr Wilford lieutenant of engineers. It is as little known at what time, or from what motive, the great pyramid was opened. Some think it was done by one of the khalifs about the beginning of the eighth century, in expectation of finding a great treasure; but all he met with was the king's body, with some golden idols which had been buried along with it.—By others, it is supposed to have been done by the celebrated Harun Al Raschid khalif of Bagdad; but all are agreed that this pyramid was opened in the time of the Arabs. The second pyramid has likewise been opened; and an attempt was made not long ago upon the third by one of the Beys of Cairo: but after removing a number of stones at a considerable expence, he thought proper to desist from the enterprise.—Mr Bryant is of opinion that the pyramids, at least the three great ones, are not artificial structures of stone and mortar, but solid rocks cut into a pyramidal shape, and afterwards cased with stone; and to this we find that Mr Bruce likewise assents. The reason given for this opinion is, that the passages within it seem rather to answer to the natural cavities and rents in rocks than to the artificial ones in buildings. The opinion, however, we think sufficiently confuted by Savary and Maillet: and, as an acute critic observes, it is in itself as improbable, as that the caverns inhabited by the *Troglodytes* were dug by the hands of man. See TROGLODYTES.

On the east side of the second pyramid is the sphynx, an enormous mass of one solid stone, but so buried in the sand that only the top of the back is visible, which is 100 feet long. Its head rises, as we have seen, 27 feet above the sand; and its face has been disfigured by the Arabs, who hold all representations of men and living animals in detestation. This figure was more completely exposed by digging round it in 1816.

In the desert of Saccara there is a great number of pyramids, which, in Mr Bruce's opinion, are composed of clay. They terminate in what the inhabitants call a *dagiour* or *false pyramid*, about two miles from the Nile, between Suf and Woodan. This is no other than a hill cut into the shape of a pyramid, or naturally so formed, for a considerable height; on the top of which is a pyramidal building of brick terminating in a point, and having its basis so exactly adapted to the top of the hill, that at a distance the difference cannot be perceived; especially as the face of the stones resembles very nearly the clay of which the pyramids of the Saccara are composed.

But a very different opinion concerning the purposes to which the great pyramid was originally destined, and the period in which that extraordinary edifice was erected, is held by Mr Gabb, who has not long since published an elaborate treatise on this subject. According to this author not only the great pyramid, but also the smaller pyramids are of antediluvian origin; the immense accumulation of sand around those stupendous structures took place at the time of the deluge; the height of this sand, when the waters subsided, probably reached the summit of the pyramid, and the apex of the great pyramid was torn off by the violent agitation of the waters.

But the most curious part of this author's disquisition concerning the pyramid relates to the purpose for which that stupendous fabric was raised; and here he is decidedly of opinion, that it was originally intended as a standard of measure, and not as has been more generally supposed as a sepulchral monument; and farther that the excavation of the celebrated granite chest in the interior of the pyramid was intended not for the repository of a corpse, but for a standard measure of capacity, as its length was for linear measure. This is also the opinion of the French sçavans who accompanied the army of Bonaparte to Egypt, and very successfully ascertained the dimensions of that remarkable building. The plan of the pyramid is a geometrical square, the side of which is equal to 400 cubits of Cairo, or the great Egyptian stadium. The length of the granite chest in the upper chamber of the pyramid is exactly four cubits, which is precisely one hundredth part of the base of the side of the pyramid. The commensurability of the component parts of the pyramid now mentioned, as well as of others discussed by the author, is undoubtedly a curious circumstance.

These wondrous structures still excite the curiosity of ingenious and enterprising men. In 1816 some researches were made by Mr Caviglia, who discovered a chamber in the pyramid of Cheops which had not been visited by any modern traveller. But the most interesting discovery was made by Mr Belzoni in March

1818. Long investigations among the monuments of Egypt had enabled this traveller to detect certain relations in their construction, from which he divined that an entrance existed into the interior of the pyramid of Cephrenes, and that this entrance was to be sought in a particular part of the north side, though no outward marks of it appeared, and though preceding travellers had acquiesced in the opinion that no chambers were to be found in it. With incredible labour, and after many discouragements, he was so fortunate as to find a passage which first led downward, at an angle of 26 degrees, and then horizontally to the centre of the pyramid. Here he entered a chamber 46 feet 3 inches long, 16 feet 3 inches wide, and 23 feet 6 inches high, for the most part cut out of the solid rock, except that part of the roof towards the western end. In the midst was a sarcophagus of granite, partly buried in the ground to the level of the floor, 8 feet long, 3 feet six inches wide, and 2 feet 3 inches deep inside, surrounded by large blocks of granite, being placed apparently to guard it from being taken away. The lid of it had been opened. He found in it only a few bones, supposed to be those of a human skeleton, but which it is said have since been found to belong to the skeleton of a bull. On the wall of the western side of the chamber is an Arabic inscription, a translation of which was said to be sent to the British Museum, but has not yet been published. It testifies that this pyramid was opened by Mahomet El Aghar, and Otman, and that it was inspected in presence of the sultan Ali Mahomet the first, Ugloch (a Tartaric title). There were several other inscriptions on the walls, supposed to be Coptic. Another chamber was found nearer the exterior of the pyramid on the north side, but sunk farther into the rock. It was smaller in size, and contained some inscriptions, but no sarcophagus was observed.

In the various exterior passages opened, it has been remarked that they have nearly all the same degree of declivity, forming an angle of about 26 degrees with the horizon. There is reason to suppose that this coincidence is not accidental, but that it was connected with astronomical purposes. It may have been intended to observe the passage over the meridian of a particular star. The dip gives a line of direction not very different from that point in the heavens where the north pole star now crosses the meridian below the pole.

These researches tend to confirm the opinions of Strabo and Diodorus Siculus, that the pyramids are sepulchral monuments. Some of them were probably destined to receive the bodies of their deities, and others those of their kings. But the cells discovered yet in the interior of these immense structures, occupy so small a part of their solid contents, that it is probable many more remain to be laid open. It is probable some will yet be found which have never been entered by the Arabs, or any of the other conquerors whose lust for hidden treasures made them ransack these mysterious depositories; and when some of these unviolated chambers are found, we will have a better idea of the original destination and use of these singular monuments. See DENON'S TRAVELS, and QUARTERLY REVIEW, N° 37 and 38.

PYRAMIDALES, in *Anatomy*, one of the muscles of the abdomen. See ANATOMY, *Table of the Muscles*.

PYRAMIDOID, a term which is occasionally employed to denote the parabolic spindle, or the solid formed by the rotation of a semiparabola about its base or greatest ordinate.

PYRENEAN MOUNTAINS, or **PYRENEES**, are the mountains which divide France from Spain, and are the most celebrated in Europe, except the Alps. They reach from the Mediterranean sea as far as the ocean, and are about 212 miles in length. They have different names, according to the different places wherein they stand. Mount Perdu, the highest of the Pyrenees, has an elevation of 1763 French toises, or 11,270 English feet.

PYRENEES, *Lower*, a department of France, lying at the foot of the Western Pyrenees. The country is beautifully diversified with mountains, valleys, forests, and wastes. The soil is better adapted for pasturage than tillage; but barley, wheat, oats, and maize, and vines, are cultivated; and there are mines of iron, copper, cobalt, with coal, slate, and marble. There are manufactories of coarse cloth, druggets, hosiery, linen, dimity, cotton yarn, &c. The superficial extent of this department is 755,950 hectares. The population in 1817 was 383,502; and the contributions for the year 1802 amounted to 1,523,760 francs. Pau is the chief town.

PYRENEES, *Upper*, a department in the south of France, lying at the foot of the mountains of the same name. The surface of the ground is mountainous, and feeds great numbers of cattle and sheep. Rye and barley are raised, but little wheat. Vines, mulberries, and flax are also cultivated. There are in the department 45 lead mines, 13 of iron, and 9 of copper, few of which however are wrought. It has few manufactures. Its territorial extent is 469,915 hectares; and the population in 1817 was 198,763. The contributions for 1802 amounted to 893,637 francs. Tarbes is the chief town.

PYRENEES, *Eastern*, a department in the south of France, at the eastern extremity of the mountains whose name it bears. The soil, though mountainous, produces corn, wine, oil, barley, flax, hemp, and legumes. Irrigation is practised here, and the lands to which it is applied yield two or three crops a-year. Oranges, lemons, and pomegranates are also produced here. There are many mines of iron; besides some of copper, lead, and coal. Wood is scarce. There are few manufactures. The extent of this department is 411,376 hectares. The population in 1817 was 126,625. Perpignan is the chief town.

PYRITES, a metallic substance combined with sulphur; as iron pyrites, composed of sulphur and iron; copper pyrites, of sulphur and copper. See MINERALOGY *Index*.

PYRMONT, a town of Lippe in Germany, in the circle of Westphalia, and capital of a country of the same name. It has a castle, kept by a governor, who is under the counts of Waldeck. At a small distance from hence there are mineral waters, which are much esteemed. The Protestants have here the free exercise of their religion. It is seated on the confines of the duchy of Brunswick, 40 miles south-west of Hanover. E. Long. 9. 0. N. Lat. 52. 0.

PYROLA, a genus of plants belonging to the decandria class, and in the natural method ranking under the 18th order, *Bicornes*. See BOTANY *Index*.

PYROMANCY,

Pyromancy, Pyrometer.

PYROMANCY, a kind of divination by means of fire. See DIVINATION, N° 6.

PYROMETER, an instrument for measuring the expansion of bodies by heat. See CHEMISTRY *Index*. Muschenbroeck, who was the original inventor of this machine, has given a table of the expansion of the different metals in the same degree of heat. Having prepared cylindric rods of iron, steel, copper, brass, tin, and lead, he exposed them first to a pyrometer with one flame in the middle; then with two flames; and successively to one with three, four, and five flames. But previous to this trial, he took care to cool them equally, by exposing them some time upon the same stone, when it began to freeze, and Fahrenheit's thermometer was at 32 degrees. The effects of which experiment are digested in the following table, where the degrees of expansion are marked in parts equal to the $\frac{1}{12500}$ part of an inch.

Expansion of	Iron.	Steel.	Copper.	Brass.	Tin.	Lead.
By one flame	80	85	89	110	153	155
By two flames placed close together.	117	123	115	220		274
By two flames $2\frac{1}{2}$ inches distant.	109	94	92	141	219	263
By three flames placed close together.	142	168	193	275		
By four flames placed close together.	211	270	270	361		
By five flames.	230	310	310	377		

It is to be observed of tin, that it will easily melt when heated by two flames placed together. Lead commonly melts with three flames placed together, especially if they burn long.

From these experiments, it appears at first view that iron is the least rarefied of any of these metals, whether it be heated by one or more flames; and therefore is most proper for making machines or instruments which we would have free from any alterations by heat or cold, as the rods of pendulums for clocks, &c. So likewise the measures of yards or feet should be made of iron, that their length may be as nearly as possible the same summer and winter.

The expansion of lead and tin, by only one flame, is nearly the same; that is, almost double of the expansion of iron. It is likewise observable, that the flames placed together, cause a greater rarefaction than when they have a sensible interval between them; iron in the former case, being expanded 117 degrees, and only 109 in the latter; the reason of which difference is obvious.

By comparing the expansions of the same metal produced by one, two, three, or more flames, it appears that two flames do not cause double the expansion of one, nor three flames three times that expansion, but always less; and these expansions differ so much the more from the ratio of the number of flames as there are more flames acting at the same time.

It is also observable, that metals are not expanded equally at the time of their melting, but some more some less. Thus tin began to run when rarefied 219 degrees; whereas brass was expanded 377 degrees, and yet was far from melting.

Mr Ellicot found, upon a medium, that the expansion of bars of different metals, as nearly of the same dimensions as possible, by the same degree of heat, were as follow:

Gold,	Silver,	Brass,	Copper,	Iron,	Steel,	Lead,
73	103	95	89	60	56	149

The great difference between the expansions of iron and brass has been applied with good success to remedy the irregularities in pendulums arising from heat. See PENDULUM.

Mr Graham used to measure the minute alterations, in length, of metal bars, by advancing the point of a micrometer-screw, till it sensibly stopped against the end of the bar to be measured. This screw, being small and very lightly hung, was capable of agreement within the three or four thousandth part of an inch. On this general principle Mr Smeaton contrived his pyrometer, in which the measures are determined by the contact of a piece of metal with the point of a micrometer-screw.

The following table shows how much a foot in length of each metal grows longer by an increase of heat, corresponding to 180° of Fahrenheit's thermometer, or to the difference between freezing and boiling water, expressed in such parts of which the unit is equal to the 10,000th part of an inch.

1. White-glass barometer tube,	100
2. Martial regulus of antimony,	130
3. Blistered steel,	138
4. Hard steel,	147
5. Iron,	151
6. Bismuth,	167
7. Copper hammered,	204
8. Copper eight parts, with tin one,	218
9. Cast brass,	225
10. Brass sixteen parts, with tin one,	229
11. Brass-wire,	232
12. Speculum metal,	232
13. Spelter solder, viz. brass two parts, zinc one,	247
14. Fine pewter,	274
15. Grain tin,	298
16. Soft solder, viz. lead two, tin one,	301
17. Zinc eight parts, with tin one, a little hammered,	323
18. Lead,	344
19. Zinc or spelter,	353
20. Zinc hammered half an inch per foot,	373

We shall close this article with a brief description of a pyrometer invented by M. De Luc, in consequence of a hint suggested to him by Mr Ramsden. The basis of this instrument is a rectangular piece of deal-board two feet and a half long, 15 inches broad, and one inch and a half thick; and to this all the other parts are fixed. This is mounted in the manner of a table, with four deal legs, each a foot long and an inch

Pyrometer. inch and a half square, well fitted near its four angles, and kept together at the other ends by four firm cross-pieces. This small table is suspended by a hook to a stand; the board being in a vertical situation in the direction of its grain, and bearing its legs forward in such a manner as that the cross-pieces which join them may form a frame, placed vertically facing the observer. This frame sustains a microscope, which is firmly fixed in another frame that moves in the former by means of grooves, but with a very considerable degree of tightness; the friction of which may be increased by the pressure of four screws. The inner sliding frame, which is likewise of deal, keeps the tube of the microscope in a horizontal position, and in great part without the frame, insomuch that the end which carries the lens is but little within the space between the frame and the board. This microscope is constructed in such a manner as that the object observed may be an inch distant from the lens: and it has a wire which is situated in the focus of the glasses, in which the objects appear reversed. At the top of the apparatus there is a piece of deal, an inch and a half thick and two inches broad, laid in a horizontal direction from the board to the top of the frame. To this piece the rods of the different substances, whose expansion by heat is to be measured, are suspended: one end of it slides into a socket, which is cut in the thickness of the board; and the other end, which rests upon the frame, meets there with a screw, which makes the piece move backward and forward, to bring the objects to the focus of the microscope. There is a cork very strongly driven through a hole bored vertically through this piece; and in another vertical hole made through the cork, the rods are fixed at the top; so that they hang only, and their dilatation is not counteracted by any pressure. In order to heat the rods, a cylindrical bottle of thin glass, about 21 inches high, and four inches in diameter, is placed in the inside of the machine, upon a stand independent of the rest of the apparatus. In this bottle the rods are suspended at a little less than an inch distance from one of the insides, in order to have them near the microscope. Into this bottle is poured water of different degrees of heat, which must be stirred about, by moving upwards and downwards, at one of the sides of the bottle, a little piece of wood, fastened horizontally at the end of a stick: in this water is hung a thermometer, the ball of which reaches to the middle of the height of the rods. During these operations the water rises to the cork, which thus determines the length of the heated part; the bottle is covered, to prevent the water from cooling too rapidly at the surface; and a thin case of brass prevents the vapour from fixing upon the piece of deal to which the rods are fixed.

Pyrometer. Pyrophorus.

PYROPHORUS, formed of πυρ, "fire," and φερω, "I bear," in *Chemistry*, the name usually given to that substance called by some black phosphorus; a chemical preparation possessing the singular property of kindling spontaneously when exposed to the air. See CHEMISTRY *Index*.

PYROTECHNY,

1 Definition.

LITERALLY signifies the art of fire, and is derived from πυρ, "fire," and τεχνη, "art." The term is now, however, generally confined to denote the art of making artificial fire-works, which has become a particular trade.

As this art depends chiefly on chemical principles, and as the objects about which it is employed afford some of the most gratifying spectacles on occasions of public rejoicing, we have not considered it unworthy of a place in our Encyclopædia; and we shall endeavour to give such an account of the operations and principles of the art as may satisfy those who wish to practise it by way of rational amusement.

2 Origin of the art uncertain.

Of the origin of artificial fire-works nothing certain appears to be recorded. We know that in Europe their invention is of a recent date, and appears due to the Italians. The use of fire-works in China seems to have been very general long before their invention in Europe, and that ingenious people have carried these exhibitions to a degree of perfection which European artists have yet scarcely attained. The following description of a Chinese display of fire-works by one of the gentlemen who accompanied Lord Macartney's embassy to Pekin, will give our readers some idea of the state of the art among that people.

3 Description of Chinese fire-works.

"The fire-works in some particulars, exceeded any thing of the kind I had ever seen. In grandeur, magnificence, and variety, they were, I own, inferior to the Chinese fire-works we had seen at Batavia, but infinitely superior in point of novelty, neatness, and ingenuity of contrivance. One piece of machinery I greatly admired; a green chest of five feet square was hoisted up by a pulley to the height of 50 or 60 feet from the ground; the bottom was so constructed as then suddenly to fall out, and make way for 20 or 30 strings of lanterns enclosed in the box to descend from it, unfolding themselves from one another by degrees, so as at last to form a collection of at least 500, each having a light of a beautifully coloured flame burning brightly within it. This devolution and developement of lanterns (which appeared to me to be composed of gauze and paper) were several times repeated, and every time exhibited a difference of colour and figure. On each side was a correspondence of smaller boxes, which opened in like manner as the others, and let down an immense net-work of fire, with divisions and compartments of various forms and dimensions, round and square, hexagons, octagons, and lozenges, which shone like the brightest burnished copper, and flashed like prismatic lightning, with every impulse of the wind. The diversity of colours indeed with which the Chinese have the secret of clothing fire seems one of the chief merits of their pyrotechny. The whole concluded with a volcano, or general explosion and discharge of suns and stars, squibs, bouncers, crackers, rockets, and grenadoes, which involved the gardens for above an hour after in a cloud of intolerable smoke *."

* Barrow's Travels in China, p. 106.

4 Till of late the French and Italian makers of fire-works

Apparatus, Materials, &c. of Fire-works.

works much excelled our British artists, and even now, though the practice of the art is well understood among us, its principles are almost entirely unknown; and no English work of any respectability has appeared on the subject. In France, the art has been more fortunate, and several men of eminent literary abilities have condescended to make it an object of their attention. It will be sufficient, in proof of this, to mention the names of Ozanam and Montucla. The following works are recommended by the latter, as containing the best account of this amusing art; viz.

Traité des Feux d'Artifice (Treatise on Artificial Fire-works), by M. Frezier, a new edition of which appeared in 1745.

Traité des Feux d'Artifice pour le Spectacle et pour la Guerre, (Treatise on Artificial Fire-Works, employed in Exhibitions and in War), by M. Perrinet d'Orval.

Manuel d'Artificier, (Artificial Fire-Work-Maker's Manuel), published at Paris in 1757, by Father d'Incarville.

Indeed most of the written information which we possess on the making of fire-works, is derived from the French; and many of these productions still retain French names, such as *gerbes*, *balloons*, *marroons*, *tourbillons*, *saucissons*, &c.

5 We shall divide this article into two chapters; in the first of which we shall consider the apparatus required for forming the cases or shells of artificial fire-works, and the materials employed in their construction; and in the second we shall describe the different kinds of fire works and the most approved methods of constructing them.

Chap. I. *Of the Apparatus and Materials employed in making Fire-Works.*

Sect. I. *Of Apparatus.*

6 Apparatus.

The apparatus used in making fire-works consists chiefly of solid wooden cylinders, called *formers*, for rolling the cases on; similar cylinders either of wood or metal for ramming down the composition; moulds for holding the cases while filling, a machine for *choaking* or contracting the cavity of the cases, another for grinding the materials, and a particular apparatus for boring some cases after they are filled.

7 Rocket moulds Plate CCCLII. fig. 1.

We shall begin with describing the moulds, as on the size of these depends that of the *formers* and *rammers*. As the performance of rockets depend much on their moulds, it is requisite to give a description of them and their proportions: They are made and proportioned by the diameter of their orifice, which is divided into equal parts. Fig. 1. represents a mould made by its diameter AB: its height from C to D is six diameters and two-thirds; from D to E is the height of the foot, which is one diameter and two-thirds; F the *choak* or cylinder, whose height is one diameter and one third; it must be made out of the same piece as the foot, and fit tight in the mould; G is an iron pin that goes through the cylinder to keep the foot fast; H the nipple, which is half a diameter high, and two-thirds thick, and of the same piece of metal as the *piercer* I, whose height is three diameters and a half, and at the bottom it is one-third of the diameter thick, from thence tapering to one-sixth of the diameter. The piercer is an iron pin rising from the nipple, and intended to preserve a vacuity in the centre of the charge. The best way to fix the piercer in the cylinder, is to make that part below the nipple long enough to go quite through the foot, and rivet it at bottom. Fig. 2. is a *former* or roller for the cases, whose length from the handle is seven diameters and a half, and its diameter two-thirds of the bore. Fig. 3. is a part attached to the former, which is of the same thickness, and one diameter and two-thirds long; the small part, which fits into the hole in the end of the roller when the case is pinching is one-sixth, and one half of the mould's diameter thick. Fig. 4. the first drift or rammer, which must be six diameters from the handle; and this, as well as all other rammers, must be a little thinner than the former, to prevent the sacking of the paper when driving in the charge. In the end of this rammer is a hole to fit over the piercer: the line K marked on this is two diameters and one-third from the handle; so that, when filling the rocket, this line appears at top of the case: you must then take the second rammer, (fig. 5.) which from the handle is four diameters, and the hole for the piercer is one diameter and a half long. Fig. 6. is the short and solid drift which is used when the case has been filled as high as the top of the piercer.

Fig. 2. Fig. 3. Fig. 4. Fig. 5, 6.

Rammers must have a collar of brass at the bottom, to keep the wood from spreading or splitting, and the same proportion must be given to all moulds, from one ounce to six pounds. We mentioned nothing concerning the handles of the rammers; however, if their diameters be equal to the bore of the mould, and two diameters long, it will be a very good proportion: but the shorter they can be used, the better; for the longer the drift, the less will be the pressure on the composition by the blow given with the mallet.

The following are the dimensions for rocket moulds, when the rockets are rammed solid.

Weight of Rockets		Length of the moulds without their feet.	Interior diameter of the moulds.	Height of the nipples.
lb	oz.	Inches.	Inches.	Inches
6	0	34,7	3,5	1,5
4	0	38,6	2,9	1,4
2	0	13,35	2,1	1,0
1	0	12,25	1,7	0,85
0	8	10,125	1,333	0,6
0	4	7,75	1,125	0,5
0	2	6,2	0,9	0,45
0	1	4,9	0,7	0,33
0	½	3,9	0,55	0,25
6 drams		3,5	0,5	0,225
4 drams		2,2	0,3	0,2

N. B. The diameter of the nipple must always be equal to that of the former.

We shall now show the method of finding the diameters or calibres of rockets, according to their weight; but we must first observe, that a pound rocket, is that just

just capable of admitting a leaden bullet of a pound weight, and so of the rest. The calibre for the different sizes may be found in the two following tables, one of which is calculated for rockets of a pound weight and under; and the other for those from a pound to 50 pounds.

8 Method of finding the diameters of rockets according to their weight.

TABLE I. *Of the Calibre of Moulds of a pound weight and below.*

Ounces.	Lines.	Drams.	Lines.
16	19½	14	7¼
12	17	12	7
8	15	10	6⅓
7	14¾	8	6¼
6	14¼	6	5⅔
5	13	4	4½
4	12⅔	2	3¼
3	11½		
2	9⅙		
1	6½		

The use of this table will be understood merely by inspection; for it is evident that the mould for a rocket of 12 ounces ought to be 17 lines in diameter; one of eight ounces, 15 lines; one of 10 drams, 6⅓ lines; and so of the rest.

On the other hand, if the diameter of the rocket be given, it will be easy to find the weight of the ball corresponding to that calibre. For example, if the diameter be 13 lines, it will be immediately seen, by looking for that number in the column of lines, that it corresponds to a ball of five ounces.

II. *Table of the Calibre of Moulds from one to 50 pounds ball.*

Pounds.	Calibre.	Pounds.	Calibre.	Pounds.	Calibre.
1	100	18	262	35	326
2	126	19	267	36	330
3	144	20	271	37	333
4	158	21	275	38	336
5	171	22	280	39	339
6	181	23	284	40	341
7	191	24	288	41	344
8	200	25	292	42	347
9	208	26	296	43	350
10	215	27	300	44	353
11	222	28	304	45	355
12	228	29	307	46	358
13	235	30	310	47	361
14	241	31	314	48	363
15	247	32	317	49	366
16	252	33	320	50	368
17	257	34	323		

The use of this second table is as follows: If the weight of the ball be given, which we shall suppose to be 24 pounds, seek for that number in the column of pounds, and opposite to it, in the column of calibres, will be found the number 288. Then say, as 100 is to 19½, so is 288 to a fourth term, which will be the number of lines of the calibre required; or multiply the number found, that is 288, by 19½, and from the produce 5616, cut off the two last figures; the required calibre, therefore, will be 56,16 lines, or four inches eight lines.

On the other hand, the calibre being given in lines, the weight of the ball may be found with equal ease. If the calibre, for example, be 28 lines, say as 19½ is to 28, so is 100 to a fourth term, which will be 143.5, or nearly 144. But in the above table, opposite to 144 in the second column, will be found the number 3 in the first; which shows that a rocket, the diameter or calibre of which is 28 lines, is a rocket of a three pounds ball.

Fig. 7. represents a mould, in which the cases are driven solid; L the nipple, with a brass point at top, (flat at top, and of the same length as the neck of the case), which, when the case is filling, serves to stop the neck, and prevent the composition from falling out, as without this point it would; and, in consequence, the air would get into the vacancy in the charge, and at the time of firing cause the case to be burst. These moulds are made of any length or diameter, according as the cases are required; but the diameter of the rollers must be equal to half the bore, and the rammers made quite solid. The nipple and cylinders must bear the same proportion as those for rockets.

Fig. 7. 9 Moulds for serpents & wheel-cases.

The rolling and formation of cases is so intimately connected with the construction of *moulds* and *formers*, that we shall introduce what we have to say on that subject into the same section.

Sky-rocket cases are to be made 6½ of their exterior diameter long; and all other cases that are to be filled in moulds must be as long as the moulds, within half its interior diameter.

10 Method of rolling cases.

Rocket cases from the smallest to four or six pounds, are generally made of the strongest sort of cartridge-paper, and rolled dry; but the large sort are made of pasted pasteboard. As it is very difficult to roll the ends of the cases quite even, the best way will be to keep a pattern of the paper for the different sorts of cases; which pattern should be somewhat longer than the case it is designed for, and on it marked the number of sheets required, which will prevent any paper being cut to waste. Having cut the papers of a proper size, and the last sheet for each case with a slope at one end, so that when the cases are rolled it may form a spiral line round the outside, and that this side may always be the same, let the pattern be so cut for a guide. Before you begin to roll, fold down one end of the first sheet, so far that the fold will go two or three times round the former: then, on the double edge, lay the former with its handle off the table; and when you have rolled on the paper within two or three turns, lay the next sheet on that part which is loose, and roll it all on.

Having thus done, you must have a smooth board, about 20 inches long, and equal in breadth to the length of the case. In the middle of this board must be a handle placed lengthwise. Under this board lay the case, and let one end of the board lie on the table; then press hard on it, and push it forwards, which will roll the paper very tight; do this three or four times before you roll on any more paper. This must be repeated with every other sheet of paper, till the case is thick enough;

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enough; but if the rolling board be drawn backwards, it will loosen the paper: you are to observe when you roll on the last sheet, that the point of the slope be placed at the small end of the roller. Having rolled your case to fit the mould, push in the small end of the former F, about one diameter from the end of the case, and put in the end-piece within a little distance of the former; then give the pinching cord one turn round the case, between the former and the end-piece; at first pull gently, and keep moving the case, which will make the neck smooth, and without large wrinkles. When the cases are hard to choak, let each sheet of paper (except the first and last, in that part where the neck is formed) be a little moistened with water: immediately after you have struck the concave stroke, bind the neck of the case round with small twine, which must not be tied in a knot, but fastened with two or three hitches.

Having thus pinched and tied the case, so as not to give way, put it into the mould without its foot, and with a mallet drive the former hard on the end-piece, which will force the neck close and smooth. This done, cut the case to its proper length, allowing from the neck to the edge of the mouth half a diameter, which is equal to the height of the nipple; then take out the former, and drive the case over the piercer with the long rammer, and the vent will be of a proper size. Wheel-cases must be driven on a nipple with a point to close the neck, and make the vent of the size required; which, in most cases, is generally one fourth of their interior diameter. As it is very often difficult, when the cases are rolled, to draw the roller out, you may make a hole through the handle, and put in it a small iron pin, by which you may easily turn the former round and pull it out. Fig. 8. shows the method of pinching cases; P a treddle, which, when pressed hard with the foot will draw the cord tight, and force the neck as close as you please; Q a small wheel or pulley, with a groove round it for the cord to run in.

Fig. 8.

Cases for wheels and fixed pieces are commonly rolled wet; and when they are required to contain a great length of charge, the method of making those cases is this: The paper must be cut as usual, only the last sheet must not be cut with a slope: Having the paper ready, paste each sheet on one side; then fold down the first sheet as before directed: but be careful that the paste does not touch the upper part of the fold; for if the roller be wetted, it will tear the paper in drawing it out. In pasting the last sheet, observe not to wet the last turn or two in that part where it is to be pinched; for if that part be damp, the pinching cord will stick to it, and tear the paper: therefore when you choke those cases, roll a bit of dry paper once round the case before you put on the pinching cord; but this bit of paper must be taken off after the case is choked. The rolling board, and all other methods, according to the former directions for the rolling and pinching of cases, must be used to these as well as all other cases.

11 Tourbillon cases.

Tourbillon cases are generally made about eight diameters long; but if very large, seven will be sufficient: tourbillons will answer very well from four ounces to two pounds; but when larger there is no certainty. The cases are best rolled wet with paste, and the last sheet must have a straight edge, so that the case may be all of a thickness: when the cases have been rolled in the manner of wheel cases, pinch them at one end quite close; then with the rammer drive the ends down flat, and afterwards ram in about one-third of a diameter of dried clay. The diameter of the former for these cases must be the same as of that for sky-rockets.

N. B. Tourbillons are to be rammed in moulds without a nipple, or in a mould without its foot.

12 Balloon cases, or paper shells.

For *balloons*, first prepare an oval former turned of smooth wood; over which pasting a quantity of brown or cartridge paper, let it lie till the paste has quite soaked through; this done, rub the former with soap or grease, to prevent the paper from sticking to it; then lay the paper on in small slips till you have made it one-third of the thickness of the intended shell. This being done, set it to dry; and when dry, cut it round the middle, and the two halves will easily come off; but observe, when you cut, to leave about one inch uncut, which will make the halves join much better than if they had been quite separated. When there are some ready to join, place the halves evenly together, paste a slip of paper round the opening to hold them together, and let that dry; then lay on paper all over as before, everywhere equal, excepting that end which goes downwards in the mortar, which may be a little thicker than the rest; for that part which receives the impulse from the powder in the chamber of the mortar requires the greatest strength. When the shell is thoroughly dry, burn a round hole at top, with square iron, large enough for the fuze: this method will do for balloons from four inches two-fifths, to eight inches diameter; but if they are larger, or required to be thrown a great height, let the first shell be turned of elm, instead of being made of paper.

For a balloon of four inches two-fifths, let the *former* be three inches one-eighth diameter, and five inches and a half long. For a balloon of five inches and a half, the diameter of the *former* must be four inches, and eight inches long. For a balloon of eight inches, let the diameter of the *former* be five inches and 15-16ths, and 11 inches seven-eighths long. For a 10-inch balloon, let the *former* be seven inches three-sixteenths diameter, and 14 inches and a half long. The thickness of a shell for a balloon of four inches two-fifths, must be one-half inch. For a balloon of five inches and a half, let the thickness of the paper be five-eighths of an inch. For an eight-inch balloon, seven-eighths of an inch. And for a 10-inch balloon, let the shell be one inch one-eighth thick.

Shells that are designed for stars only, may be made quite round, and the thinner they are at the opening, the better; for if they are too strong, the stars are apt to break at the bursting of the shell: when making the shell, use a pair of calibre compasses, or a round gage, so that the paper may not be laid thicker in one place than another; and also to know when the shell is of a proper thickness. Balloons must always be made to go easy into the mortars.

13 Cases for port-fires.

Port-fire cases must be made very thin, and rolled on *formers*, from two inches to $\frac{5}{8}$ of an inch diameter, and from two to six inches long: they are pinched close at one end, and left open at the other. When they are to be filled, put in but little composition at a time, and ram it lightly, so as not to break the case: three or four rounds of paper, with the last round pasted, will be strong enough for these cases.

Common port-fires are intended for the purpose of firing

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ing the works, their fire being very slow, and the heat of the flame so intense, that, if applied to rockets, leaders, &c. it will fire them immediately. Portfires may be made of any length, but are seldom made more than 21 inches long: the interior diameter of portfire moulds should be 10-16ths of an inch, and the diameter of the former half an inch. The cases must be rolled wet with paste, and one end pinched, or folded down. The moulds should be made of brass, and such as will take in two pieces lengthwise; when the case is in the two sides, they are held together by brass rings, or hoops, which are made to fit over the outside. The bore of the mould must not be made quite through, so that there will be no occasion for a foot. These portfires, when used, are held in copper sockets, fixed on the end of a long stick: these sockets are made like port crayons, only with a screw instead of a ring.

14 For common portfires.

15 Method of grinding the ingredients.

There have been many methods contrived for grinding the ingredients for fire-works to a powder, such as large mortars and pestles made of ebony and other hard wood, and horizontal mills with brass barrels; but none have proved so effectual and speedy, as that of the mealing-table, represented in fig. 9. made of elm, with a rim round its edge four or five inches high; and at the narrow end A, furnished with a slider that runs in a groove, and forms part of the rim: so that when you have taken out of the table as much powder as you can with the copper shovel (fig. 10.), sweep all clean out at the slider A. When about to meal a quantity of powder, observe not to put too much in the table at once; but when you have put in a good proportion, take the muller (fig. 11.) and rub it till all the grains are broken; then sift it in a lawn sieve that has a receiver and top to it, such as is used by the apothecaries, and that which does not pass through the sieve, must be returned again to the table, and ground till it is fine enough to go through the sieve. Sulphur and charcoal are ground in the same manner, only the muller must be made of ebony; for these ingredients being harder than powder, would stick in the grain of elm, and be difficult to grind. As sulphur is apt to stick and clod to the table, it will best to keep one for that purpose, by which means you will always have your brimstone clean and well ground.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

16 Apparatus for boring rockets that are rammed solid.

Fig. 12. represents the plan of an apparatus, or lathe, for boring rockets. A the large wheel, which turns the small one B, that works the rammer C: these rammers are of different sizes according to the rockets; they must be of the same diameter as the top of the intended bore, and continue that thickness a little longer than the depth of the bore required, and their points must be like that of an augre: the thick end of each rammer must be made square, and all of the same size, so as to fit into one socket, into which they are fastened by a screw D. E the guide for the rammer, which is made to move backwards and forwards; so that, after the rammer has been marked three diameters and a half of the rocket from the point, set the guide, allowing for the thickness of the fronts of the rocket boxes, and the neck and mouth of the rocket; so that when the front of the large box is close to the guide, the rammer may not go too far up the charge. F, boxes for holding the rockets, which are made so as to fit one within; their sides must be equal in thickness to the difference of the diameters of the rockets, and their interior diameters equal to the exterior diameters of the rockets. To prevent the rocket from turning round while boring, a piece of wood must be placed against the end of the box in the inside, and pressed against the tail of the rocket. This will also hinder the rammer from forcing the rocket backwards. G, a rocket in the box. H, a box that slides under the rocket-boxes to receive the borings for the rockets, which fall through holes made on purpose in the boxes; these holes must be just under the mouth of the rocket, one in each box, and all to correspond with each other.

Fig. 13. is a front view of the large rocket-box. I, an iron plate, in which are holes of different sizes, through which the rammer passes; this plate is fastened with a screw in the centre, so that when the rammer is changed the plate is turned round, but the hole you are going to use must always be at the bottom: the fronts of the other boxes must have holes in them to correspond with those in the plate. K, the lower part of the large box; which is made to fit the inside of the lathe, that all the boxes may move quite steadily. Fig. 13.

Fig. 14. is a perspective view of the lathe. L, the guide for the rammer, which is set by the screw at bottom. Fig. 14.

Fig. 15. A view of the front of the guide facing the rammer. M, an iron plate, of the same dimensions as that on the front of the box, and placed in the same direction, and also to turn on a screw in the centre. N, the rocket-box which slides backwards and forwards: when a rocket is fixed in the box, it is to be pushed forwards against the rammer; and when the scoop of the rammer appears to be full, draw the box back, and knock out the composition: this must be done till the rocket is bored, or it will be in danger of taking fire; and if the boring be done in a hurry, wet the end of the rammer now and then with oil to keep it cool. Fig. 15.

Having bored a number of rockets, you must have taps of different sorts according to the rockets. These taps are a little longer than the bore: but when used they must be marked 3½ diameters from the point, allowing for the thickness of the rocket's neck; then, holding the rocket in one hand, tap it with the other. One of these taps is represented by fig. 16. They are made in the same proportion as the fixed piercers, and are hollowed their whole length. Fig. 16.

17 Hand machine for boring. Fig. 17.

There are hand machines for boring, which answer very well, though not so expeditious as the lathes. But they are not so expensive, and they may be worked by one man; whereas the lathe will require three. Fig. 17. represents the machine. O, the rocket boxes, which are to be fixed, and not to slide as those in the lathe. PQ are guides for the rammers, that are made to slide together, as the rammer moves forward; the rammers for these machines must be made of a proper length, allowing for the thickness of the front of the boxes, and the length of the mouth and neck of the case; on the square end of these rammers must be a round shoulder of iron, to turn against the outside of the guide Q, by which means the guides are forced forwards. R, the stock which turns the rammer, and which while turning, must be pressed towards the rocket by the body of the man who works it; all the rammers are to be made to fit one stock.

SECT.

Apparatus, Materials, &c of Fire-works.

Sect. II. *Of the Ingredients for composing the Charges of Fire-works.*

18
Ingredients for the charges of fire works.

The charges or compositions with which the cases that we have described are to be filled, consist chiefly of gunpowder, or of a powder composed of the same materials in various proportions, and some other combustible substances, intended either to give the composition a stronger impelling force, or to increase the beauty and splendour of the exhibition. As the nature and composition of gunpowder have been fully explained under the article Gunpowder, it is unnecessary to consider them in this place; but as the makers of fire-works commonly employ considerable quantities of the substances of which gunpowder is composed, it may be proper to give some directions for obtaining these in the greatest purity. We may also notice, that gunpowder, in its ordinary state, is called *corn-powder;* while, when ground down, as directed in N° 15. it is denominated *meal-powder.*

19
Nitre.

The ingredient on which the force of the compositions chiefly depends, is nitre or saltpetre; but as this substance, in its usual state, is very impure, being much contaminated with earthy matter, and as pure nitre is now become very expensive, it is of consequence to know how the nitre of commerce may be purified.

20
Method of purifying nitre.

Nitre, like most other saline bodies, is much more soluble in boiling water, than in water of the ordinary temperature. If, therefore, the nitre of commerce be dissolved in a small quantity of boiling water, and the solution be properly strained, the liquor, when cold, will afford crystals that are very pure. The following is the most convenient method of proceeding. Dissolve the nitre in boiling water, in the proportion of about an English quart, or Scotch chopin, to each pound of nitre; and that the solution may be more easily effected, let the nitre be reduced to powder, and let the vessel containing the nitre and water be kept at the boiling heat till all the salt is dissolved. Then strain the liquor while hot through thick blotting paper, placed in a clean funnel, and set by the filtered liquor in a shallow vessel, in some cold place, till crystals are formed. These must be removed from the liquor, and dried with a gentle heat; and if the remaining liquor be slowly evaporated over the fire, in an earthen unglazed vessel, till a film appears on the top, and then set by to crystallize as before, an additional quantity of pure nitre will be procured; and thus, by repeated evaporations and crystallizations, the whole of the salt will be obtained.

21
Method of procuring nitre from damaged gunpowder.

Nitre may be obtained in great purity from damaged gunpowder, which may often be bought at a cheap rate. The damaged powder must be ground with a small quantity of hot water, in a large wooden or stone mortar, or it may be boiled over a gentle fire, with as much water as will cover it. When the water seems to have dissolved as much of the nitre as it will retain, it is to be poured off from the sediment, and filtered or strained through a flannel bag, then heated again, and, while hot, filtered through blotting paper, and set by to crystallize, as in the former case. Fresh quantities of hot water are to be successively added to the sediment, and strained as before, till the whole of the nitre is obtained.

22
Speedy method of powdering nitre.

Nitre may be speedily reduced to a fine powder, by dissolving it in a little more than its own weight of boiling water, in a kettle with a round bottom, keeping the solution over a gentle fire, and continually stirring it with a wooden spatula till all the water is evaporated, and the remaining powder is pretty well dried. Care must be taken, however, not to suffer it to remain too long, or expose it to too great a heat, otherwise it will be melted into a firm cake. The drying may be completed by suffering it to lie for a sufficient time on paper before the fire.

23
Sulphur.

Sulphur or brimstone, may be employed in three states. 1. As it is brought from the neighbourhood of volcanoes, or what is called *sulphur vivum.* 2. Roll brimstone, which is sold by most grocers, and is employed for making matches; and, 3. Flowers of sulphur, or sublimed sulphur. The first of these is the cheapest, and answers very well for coarse fire-works; the second is considered as the strongest, and is most used; but the third is the purest sulphur, and will answer best for the nicer and more delicate fire-works. It also has the advantage of being in a state of fine powder, whereas the two former require to be ground or mealed, as directed in N° 15.

24
Charcoal.

Charcoal may, in general, be procured at the shops of founders and hardware dealers; but when this is not the case, it may easily be prepared by putting a quantity of small pieces of wood into a large earthen crucible or iron pot, and covering them to the head with sand, and placing the crucible or the pot in the middle of a strong fire, where it must be kept red hot for an hour or two, in proportion to the quantity of wood. Charcoal should be chosen soft and light, and such as may easily be reduced to powder. It should be kept in a dry place, but is always best when fresh burned.

Several other ingredients are employed in the composition of fire-works, such as camphor, antimony (*sulphuret of antimony*), raspings of ivory, yellow amber, sal ammoniac, verdigris, common pitch, and Greek pitch, all of which are used on different occasions, to produce a change of colour in the fire; filings of iron and copper, for giving a sparkling appearance to the flame, and salt of benjamin (*benzoic acid*) to produce an agreeable odour. 25

26
Method of powdering cast-iron.

Iron filings answer very well for ordinary fire-works; but they do not produce such a brilliant appearance as powdered cast-iron. The introduction of this latter is an improvement of the Chinese, and its use is now very general.

Cast-iron being of so hard a nature as not to be cut by a file, we are obliged to reduce it into grains, though this is rather difficult to perform; but if we consider what beautiful sparks this iron yields, no pains should be spared to granulate such an essential material: to do this, procure at an iron-foundery some thin pieces of iron, such as generally run over the mould at the time of casting: then have a square block made of cast-iron, and an iron square hammer about four lb. weight; then, having covered the floor with cloth or something to catch the beatings, lay the thin pieces of iron on the block, and beat them with the hammer till reduced into small grains; which afterwards sift with a very fine sieve, to separate the fine dust, which is sometimes used in small cases of brilliant fire, instead of steel dust; and when you have got out all the dust, sift what remains with a sieve

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sieve a little larger, and so on with sieves of different sizes, till the iron passes through about the bigness of small bird-shot: the iron, thus beaten and sifted, is to be put separately, according to its fineness, into wooden boxes or oiled paper, to keep it from rusting. When used, observe the difference of its size, in proportion to the cases for which the charge is intended; for the coarse sort is proper only for very large gerbes of six or eight pounds.

When these pieces of iron cannot be procured, an old cast-iron pot may be employed; but care must be taken that its surface be perfectly freed from rust. This pulverized cast iron is sometimes called *iron sand*, and is denominated, according to its fineness, sand of the first, second, third, &c. order, that of the first order being the finest.

It sometimes happens, that fire-works may be required to be kept a long time, or sent abroad; neither of which could be done with brilliant fires, if made with filings unprepared, for this reason; that the saltpetre being of a damp nature, it causes the iron to rust; the consequence of which is, that when the works are fired, there will appear but very few brilliant sparks, but instead of them a number of red and drossy sparks; and besides, the charge will be so much weakened, that if this were to take place in wheels, the fire would scarcely be strong enough to force them round. But to prevent such accidents, the filings may be thus prepared: Melt in a glazed earthen pan some brimstone over a slow fire, and when melted throw in some filings; which keep stirring till they are covered with brimstone: this must be done while it is on the fire; then take it off, and stir it very quickly till cold, when it must be rolled on a board with a wooden roller, till broken as fine as corn powder; after which sift from it as much of the brimstone as possible. There is another method of preparing filings, so as to keep two or three months in winter; this may be done by rubbing them between strong brown paper, which before has been moistened with linseed oil.

N. B. If the brimstone should take fire, it may be extinguished, by covering the pan close at top: it does not signify what quantity of brimstone is used, provided there is enough to give each grain of iron a coat; but as much as will cover the bottom of a pan of about one foot diameter, will do for five or six pounds of filings or cast-iron for gerbes.

28 Chinese fire.

Before we enumerate the various compositions generally employed in filling cases for rockets, wheels, &c. we shall describe two compositions that are much valued for the brilliancy of their appearance. One of these is called *Chinese fire*, and is either red or white. The following tables shew the proportions of the different ingredients for each of these compositions; as they are adapted to rockets (in the construction of which the Chinese fire is much employed) of from 12 to 36 lbs.

Composition of Red Chinese Fire.

Calibres.	Saltpetre	Sulphur.	Charcoal.	Sand of the first order.	
Pounds.	Pounds.	Ounces.	Ounces.	Oz.	Dr.
12 to 15	1	3	4	7	0
18 to 21	1	3	5	7	8
24 to 36	1	4	6	8	0

For White Chinese Fire.

Calibres.	Saltpetre.	Bruised Gunpowder.	Charcoal.		Sand of the third order.	
Pounds.	Pounds.	Ounces.	Oz.	Dr.	Oz.	Dr.
12 to 15	1	12	7	8	11	0
18 to 21	1	11	8	0	11	8
14 to 36	1	11	8	8	12	0

The other composition is called spur-fire, because the sparks yielded by it have a starry appearance like the rowel of a spur. 29 Spur-fire.

Spur-fire.—This fire is the most beautiful and curious of any yet known; and was invented by the Chinese, but now is in greater perfection in England than in China. As it requires great trouble to make it to perfection, it will be necessary that beginners should have full instructions; therefore care should be taken that all the ingredients are of the best, that the lamp black is not damp and clodded, that the saltpetre and brimstone are thoroughly refined. This composition is generally rammed in one or two ounce cases about five or six inches long, but not drove very hard; and the cases must have their concave stroke struck very smooth, and the choak or vent not quite so large as the usual proportion: this charge, when driven and kept a few months, will be much better than when rammed; and will not spoil, if kept dry, in many years.

As the beauty of this composition cannot be seen at so great a distance as brilliant fire, it has a better effect in a room than in the open air, and may be fired in a chamber without any danger: it is of so innocent a nature, that, though with an improper phrase, it may be called a *cold fire;* and so extraordinary is the fire produced from this composition, that, if well made, the sparks will not burn a handkerchief when held in the midst of them; you may hold them in your hand while burning, with as much safety as a candle; and if you put your hand within a foot of the mouth of the case, you will feel the sparks like drops of rain.—When any of these spur-fires are fired singly, they are called *artificial flower-pots;* but some of them placed round a transparent pyramid of paper, and fired in a large room, make a very pretty appearance.

The composition consists of saltpetre, four pounds eight ounces; sulphur two pounds, and lamp-black one pound eight ounces; or, saltpetre one pound, sulphur, half a pound, and lamp-black four quarts.—This composition is very difficult to mix. The saltpetre and brimstone must be first sifted together, and then put into a marble mortar, and the lamp-black with them, which you work down by degrees with a wooden pestle, till all the ingredients appear of one colour, which will be something grayish, but very near black: then drive a little into a case for trial, and fire it in a dark place; and if the sparks which are called *stars*, or *pinks*, come out in clusters, and afterwards spread well without any other sparks, it is a sign of its being good, otherwise not; for if any drossy sparks appear, and the stars not full, it is then not mixed enough; but if the pinks are very small, and soon break, it is a sign that it has been rubbed too much.

This

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This mixture, when rubbed too much, will be too fierce, and hardly show any stars; and, on the contrary, when not mixed enough, will be too weak, and throw out an obscure smoke, and lumps of dross, without any stars.

The following compositions are those commonly employed in ordinary fire-works.

30 Charges for sky-rockets.

Rockets of four ounces.—Mealed powder 1 lb. 4 oz. saltpetre 4 oz. and charcoal 2 oz.

Rockets of eight ounces.—I. Mealed powder 1 lb. saltpetre 4 oz. brimstone 3 oz. and charcoal $1\frac{1}{2}$ oz. II. Meal-powder $1\frac{1}{2}$ lb. and charcoal $4\frac{1}{4}$ oz.

Rockets of one pound.—Meal-powder 2 lb. saltpetre 8 oz. brimstone 4 oz. charcoal 2 oz. and steel-filings $1\frac{1}{2}$ oz.

Sky-rockets in general.—I. Saltpetre 4 lb. brimstone 1 lb. and charcoal $1\frac{1}{2}$ lb. II. Saltpetre 4 lb. brimstone $1\frac{1}{2}$ lb. charcoal 1 lb. 12 oz. and meal-powder 2 oz.

Large sky-rockets.—Saltpetre 4 lb. meal-powder 1 lb. and brimstone 1 lb.

Rockets of a middling size.—I. Saltpetre 8 lb. sulphur 3 lb. meal-powder 3 lb. II. Saltpetre 3 lb. sulphur 2 lb. meal-powder 1 lb. charcoal 1 lb.

31 For rocket stars.

White stars.—Meal-powder 4 oz. saltpetre 12 oz. sulphur vivum 6 oz. oil of spike 2 oz. and camphor 5 oz.

Blue stars.—Meal-powder 8 oz. saltpetre 4, sulphur 2, spirit of wine 2, and oil of spike 2.

Coloured or *variegated stars.*—Meal-powder 8 drams, rochpetre 4 oz. sulphur vivum 2, and camphor 2.

Brilliant stars.—Saltpetre $3\frac{1}{2}$ oz. sulphur $1\frac{1}{2}$, and meal-powder $\frac{1}{4}$, worked up with spirits of wine only.

Common stars.—Saltpetre 1 lb. brimstone 4 oz. antimony $4\frac{3}{4}$, isinglass $\frac{1}{2}$, camphor $\frac{1}{2}$, and spirit of wine $\frac{3}{4}$.

Tailed stars.—Meal-powder 3 oz. brimstone 2, saltpetre 1, and charcoal (coarsely ground) $\frac{3}{4}$.

Drove stars.—I. Saltpetre 3 lb. sulphur 1 lb. brass dust 12 oz. antimony 3. II. Saltpetre 1 lb. antimony 4 oz. and sulphur 8.

Fixed pointed stars.—Saltpetre $8\frac{1}{2}$ oz. sulphur 2, antimony 1 oz. 10 dr.

Stars of a fine colour.—Sulphur 1 oz. meal-powder 1, saltpetre 1, camphor 4 dr. oil of turpentine 4 dr.

32 Rains.

Gold rain for sky-rockets.—I. Saltpetre 1 lb. meal-powder 4 oz. sulphur 4, brass-dust 1, saw-dust $2\frac{1}{4}$, and glass-dust 6 dr. II. Meal-powder 12 oz. saltpetre 2, charcoal 4. III. Saltpetre 8 oz. brimstone 2, glass-dust 1, antimony $\frac{3}{4}$, brass-dust $\frac{1}{4}$, and saw-dust 12 dr.

Silver rain.—I. Saltpetre 4 oz. sulphur, meal-powder, and antimony, of each 2 oz. sal prunella $\frac{1}{2}$ oz. II. Saltpetre $\frac{1}{2}$ lb. brimstone 2 oz. and charcoal 4. III. Saltpetre 1 lb. brimstone $\frac{1}{4}$ lb. antimony 6 oz. IV. Saltpetre 4 oz. brimstone 1, powder 2, and steel-dust $\frac{3}{4}$ oz.

33 For water rockets.

I. Meal-powder 6 lb. saltpetre 4, brimstone 3, charcoal 5. II. Saltpetre 1 lb. brimstone $4\frac{1}{2}$ oz. charcoal 6. III. Saltpetre 1 lb. brimstone 4 oz. charcoal 12. IV. Saltpetre 4 lb. brimstone $1\frac{1}{2}$ lb. charcoal 1 lb. 12 oz. V. Brimstone 2 lb. saltpetre 4 lb. and meal-powder 4. VI. Saltpetre 1 lb. meal-powder 4 oz. brimstone $8\frac{1}{2}$, charcoal 2. VII. Meal-powder 1 lb. saltpetre 3, brimstone 1; sea-coal 1 oz. charcoal $8\frac{1}{2}$, saw-dust $\frac{3}{4}$, steel-dust $\frac{1}{2}$, and coarse charcoal $\frac{1}{4}$ oz. VIII. Meal-powder $1\frac{1}{4}$ lb. saltpetre 3, sulphur $1\frac{1}{2}$, charcoal 12 oz. saw-dust 2.

Sinking charge for water-rockets.—Meal-powder 8 oz. charcoal $\frac{1}{4}$ oz.

Wheel-cases from two ounces to four pounds.—I. Meal-powder 2 lb. saltpetre 4 oz. iron-filings 7. II. Meal-powder 2 lb. saltpetre 12 oz. sulphur 4, steel-dust 3. III. Meal-powder 4 lb. saltpetre 1 lb. brimstone 8 oz. charcoal $4\frac{1}{2}$. IV. Meal-powder 8 oz. saltpetre 4, saw-dust $1\frac{1}{2}$, sea-coal $\frac{3}{4}$. V. Meal-powder 1 lb. 4 oz. brimstone 4 oz. 10 dr. saltpetre 8 oz. glass-dust $2\frac{1}{2}$. VI. Meal-powder 12 oz. charcoal 1, saw-dust $\frac{1}{2}$. VII. Saltpetre 1 lb. 9 oz. brimstone 4 oz. charcoal $4\frac{1}{2}$. VIII. Meal-powder 2 lb. saltpetre 1, brimstone $\frac{1}{2}$, and sea-coal 2 oz. IX. Saltpetre 2 lb. brimstone 1, meal-powder 4, and glass-dust 4 oz. X. Meal-powder 1 lb. saltpetre 2 oz. and steel-dust $3\frac{1}{2}$. XI. Meal-powder 2 lb. and steel-dust 2 and a half oz. with 2 and a half of the fine dust of beat iron. XII. Saltpetre 2 lb. 13 oz. brimstone 8 oz. and charcoal. 34 For wheels.

Slow fire for wheels.—I. Saltpetre 4 oz. brimstone 2, and meal-powder 1 and a half. II. Saltpetre 4 oz. brimstone 1, and antimony 1 oz. 6 dr. III. Saltpetre 4 oz. and a half, brimstone 1 oz. and mealed powder 1 and a half.

Dead fire for wheels.—I. Saltpetre $1\frac{1}{4}$ oz. brimstone $\frac{1}{4}$, lapis-calaminaris $\frac{1}{4}$, and antimony 2 dr.

35 For fixed or standing cases.

I. Meal-powder 4 lb. saltpetre 2, brimstone and charcoal 1. II. Meal-powder 2 lb. saltpetre 1, and steel-dust 8 oz. III. Meal-powder 1 lb. 4 oz. and charcoal 4 oz. IV. Meal-powder 1 lb. and steel-dust 4 oz. V. Meal-powder $2\frac{1}{2}$ lb. brimstone 4 oz. and sea-coal 6. VI. Meal-powder 3 lb. charcoal 5 oz. and saw-dust 1 and a half.

36 For sun cases.

I. Meal-powder $8\frac{1}{2}$ lb. saltpetre 1 lb. 2 oz. steel-dust 2 lb. 10 oz. brimstone 4. II. Meal-powder 3 lb. saltpetre 6 oz. and steel-dust $7\frac{1}{2}$.

37 For a brilliant fire.

Meal-powder 11 lb. saltpetre 1, brimstone 4 oz. steel-dust 1 lb. and a half.

38 For gerbes.

Meal-powder 6 lb. and beat-iron 2 lb. 1 oz. and a half.

39 For tourbillons.

Charge for four ounce Tourbillons.—Meal-powder 2 lb. 4 oz. and charcoal 4 oz. and a half.

Eight ounce Tourbillons.—Meal-powder 2 lb. and charcoal $4\frac{1}{4}$ oz.

Large Tourbillons.—Meal-powder 2 lb. saltpetre 1, brimstone 8 oz. and beat iron 8.

N. B. Tourbillons may be made very large, and of different-coloured fires: only you are to observe, that the larger they are, the weaker must be the charge; and, on the contrary, the smaller, the stronger their charge.

40 For water balloons.

I. Saltpetre 4 lb. brimstone 2, meal-powder 2, antimony 4 oz. saw-dust 4, and glass-dust 1 and a fourth. II. Saltpetre 9 lb. brimstone 3 lb. meal-powder 6 lb. rosin 12 oz. and antimony 8 oz.

41 For water squibs.

I. Meal-powder 1 lb. and charcoal 1 lb. II. Meal-powder 1 lb. and charcoal 9 oz.

42 Mine ports or serpents.

I. Meal-powder 1 lb. and charcoal 1 oz. II. Meal-powder 9 oz. charcoal 1 oz.

43 Port-fires.

For firing rockets, &c.—I. Saltpetre 12 oz. brimstone 4 oz. and meal-powder 2 oz. II. Saltpetre 8 oz. brimstone 4 oz. and meal-powder 2 oz. III. Saltpetre 1 lb. 2 oz. meal-powder 1 lb. and a half, and brimstone 10 oz. This composition must be moistened with one gill of linseed oil. IV. Meal-powder 6 oz. saltpetre 2 lb. 2 oz. and brimstone 10 oz. V. Saltpetre 1 lb. 4 oz. meal-powder 4 oz. brimstone 5 oz. saw-dust 8 oz. VI. Saltpetre 8 oz. brimstone 2 oz. and meal-powder 2 oz.

For illuminations.—Saltpetre 1 lb. brimstone 8 oz. and meal-powder 6 oz.

Saltpetre.

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Saltpetre 1 lb. and a half, brimstone 6 oz. meal-powder 14 oz. and glass-dust 14 oz.

Saltpetre 6 oz. brimstone 2 lb. antimony 4 oz. and camphor 2 oz.

44 Cones or spiral wheels. I. Saltpetre 1 lb. 10 oz. brimstone 8 oz. and meal-powder 1 lb. 6 oz. II. Saltpetre 1 lb. and a half, brimstone 8 oz. and meal-powder 1 lb. 8 oz.

45 Crowns or globes. Meal-powder 1 lb. 8 oz. saltpetre 12 oz. and charcoal 2 oz.

46 Air balloon fuzes. I. Saltpetre 5 lb. brimstone 1 lb. meal-powder 1 lb. and a half, and glass-dust 1 lb. II. Saltpetre 5 lb. 8 oz. brimstone 2 lb. meal-powder 1 lb. 8 oz. and glass-dust 1 lb. 8 oz.

47 Serpents for pots des brin. I. Saltpetre 2 lb. brimstone 3 lb. antimony 1 lb. II. Saltpetre 3½ lb. sulphur 2½ lb. meal-powder 1 lb. antimony half a lb. glass-dust 4 oz. brass-dust 1 oz.

48 Fire pumps. N. B. These compositions, driven 1½ inch in a 1 oz.
49 A slow white flame. case, will burn one minute, which is much longer time than an equal quantity of any composition yet known will last.

50 Amber lights. Meal-powder 9 oz. amber 3 oz. This charge may be drove in small cases, for illuminations.

51 Other lights. Saltpetre 3 lb. brimstone 1 lb. meal-powder 1 lb. antimony 10½ oz. All these must be mixed with the oil of spike.

52 A red fire. Meal-powder 3 lb. charcoal 12 oz. and saw-dust 8 oz.

53 A common fire. Saltpetre 3 lb. charcoal 10 oz. and brimstone 2 oz.

54 For stars of different colours. I. Meal-powder 4 oz. saltpetre 2 oz. brimstone 2 oz. steel-dust 1 oz. and a half, and camphor, white amber, antimony, and mercury-sublimate, of each ½ oz. II. Rochepetre 10 oz. brimstone, charcoal, antimony, meal-powder, and camphor, of each ½ oz. moistened with oil of turpentine. These compositions are made into stars, by being worked to a paste with aqua vitæ, in which has been dissolved some gum-tragacanth; and after you have rolled them in powder, make a hole through the middle of each, and string them on quick-match, leaving about 2 inches between each. III. Saltpetre 8 oz. brimstone 2 oz. yellow amber 1 oz. antimony 1 oz. and powder 3 oz. IV. Brimstone 2½ oz. saltpetre 6 oz. olibanum or frankincense in drops 4 oz.; mastick, and mercury-sublimate, of each 4 oz. meal-powder 5 oz. white amber, yellow amber, and camphor, of each 1 oz. antimony and orpiment half an oz. each. V. Saltpetre 1 lb. brimstone half a lb. and meal-powder 8 oz. moistened with petrolio-oil. VI. Powder half a lb. brimstone and saltpetre, of each 4 oz. VII. Saltpetre 4 oz. brimstone 2 oz. and meal-powder 1 oz.

Stars that carry tails of sparks.—I. Brimstone 6 oz. crude antimony 2 oz. saltpetre, 4 oz. and rosin 4 oz. II. Saltpetre, rosin, and charcoal, of each 2 oz. brimstone 1 oz. and pitch 1 oz.

These compositions are sometimes melted in an earthen pan, and mixed with chopped cotton-match, before they are rolled into stars; but will do as well if wetted, and worked up in the usual manner.

Stars that yield some sparks.—I. Camphor 2 oz. saltpetre 1 oz. meal-powder 1 oz. II. Saltpetre 1 oz. ditto melted half an oz. and camphor 2 oz. When you would make stars of either of these compositions, you must wet them with gum-water, or weak spirits, in which has been dissolved some gum-arabic, or gum-tragacanth, that the whole may have the consistence of a pretty thick liquid; having thus done, take 1 oz. of lint, and stir it about in the composition till it becomes dry enough to roll into stars.

Stars of a yellowish colour.—Take 4 oz. of gum-tragacanth or gum-arabic, pounded and sifted through a fine sieve, camphor dissolved in braudy 2 oz. saltpetre 1 lb. sulphur half a lb. coarse powder of glass 4 oz. white amber 1 oz. and a half, orpiment 2 oz. Being well incorporated, make them into stars after the common method.

Stars of another kind.—Take 4 oz. of camphor, and melt it in half a pint of spirit of wine over a slow fire; then add to it ½ lb. of gum-arabic that has been dissolved; with this liquor mix 1 lb of saltpetre, 6 oz. of sulphur, and 5 oz. of meal-powder; and after you have stirred them well together, roll them into stars proportionable to the rockets for which you intend them.

As variety of fires adds greatly to a collection of works, it is necessary that every artist should know the different effect of each ingredient. For which reason, we shall here explain the colours they produce of themselves; and likewise how to make them retain the same when mixed with other bodies: as for example, sulphur gives a blue, camphor a white or pale colour, saltpetre a clear white-yellow, amber a colour inclining to yellow, sal-ammoniac a green, antimony a reddish, rosin a copper colour, and Greek pitch a kind of bronze, or between red and yellow. All these ingredients are such as show themselves in a flame, viz.

White flame.—Saltpetre, sulphur, meal-powder, and camphor; the saltpetre must be the chief part.

Blue flame.—Meal-powder, saltpetre, and sulphur vivum; sulphur must be the chief: or meal-powder, saltpetre, brimstone, spirit of wine, and oil of spike; but let the powder be the principal part.

Flame inclining to red.—Saltpetre, sulphur, antimony, and Greek-pitch; saltpetre the chief.

By the above method may be made various colours of fire, as the practitioner pleases; for, by making a few trials, he may cause any ingredient to be predominant in colour.

The set colours of fire produced by sparks are divided into four sorts, viz. the black, white, gray, and red. The black charges are composed of two ingredients, which are meal-powder and charcoal; the white of three, viz. saltpetre, sulphur, and charcoal; the gray of four, viz. meal-powder, saltpetre, brimstone, and charcoal; and the red of three, viz. meal-powder, charcoal, and saw-dust.

There are, besides these four regular or set charges, two others, which are distinguished by the names of *compound* and *brilliant charges;* the compound being made of many ingredients, such as meal-powder, saltpetre, brimstone, charcoal, saw-dust, sea-coal, antimony, glass-dust, brass-dust, steel filings, cast-iron, tanner's dust, &c. or any thing that will yield sparks; all which must be managed with discretion. The brilliant fires are composed of meal-powder, saltpetre, brimstone, and steel-dust; or with meal-powder and steel-filings only.

The beauty of fire-works depends much on the compositions being well mixed; therefore great care must be taken in this part of the work, particularly for the composition for sky-rockets. When there are four or five pounds of ingredients to be mixed, which is a sufficient quantity at a time (for a larger proportion will not do so pparatus, aterials, &c. of Fire-Works.

so well), first put the different ingredients together; then work them with your hands, till you think they are pretty well incorporated: after which put them into a lawn sieve with a receiver and top to it; and if, after it is fitted, any remains that will not pass through the sieve, grind it again till fine enough; and if it be twice sifted, it will not be amiss; but the compositions for wheels and common works are not so material, and need not be so fine. But in all fixed works, from which the fire is to play regularly, the ingredients must be very fine, and great care taken in mixing them well together; and in all compositions in which are iron filings, the hands must not touch; nor will any works which have iron or steel in their charge keep long in damp weather, unless properly prepared, according to the former directions.

58 tton ck-match.

Cotton quick-match is generally made of such cotton as is put in candles, of several sizes, from one to six threads thick, according to the pipe for which it is designed; which pipe must be large enough for the match, when made, to be pushed in easily without breaking. Having doubled the cotton into as many threads as is proper, coil it very lightly into a flat-bottomed copper or earthen pan; then put in the saltpetre and the liquor, and boil them about twenty minutes; after which coil it again into another pan, as in fig. . and pour on it what liquor remains; then put in some meal powder, and press it down with the hand till it is quite wet; afterwards place the pan before the wooden frame (fig. 18.) which must be suspended by a point in the centre of each end; and place yourself before the pan, tying the upper end of the cotton to the end of one of the sides of the frame.

When every thing is ready, an assistant must turn the frame round, while the cotton passes through the hand, holding it very lightly, and at the same time keeping the hand full of the wet powder; but if the powder should be too wet to stick to the cotton, more must be added, so as to keep a continual supply till the match is all wound up; it may be wound as close on the frame as you please, so that it may not stick together; when the frame is full, take it off the points, and sift dry meal-powder on both sides the match, till it seem quite dry: in winter the match will be a fortnight before it is fit for use; when it is thoroughly dry, cut it along the outside of one of the sides of the frame, and tie it up in skains for use.

N. B. The match must be wound tight on the frames.

The ingredients for the match, are, cotton 1 lb. 12 oz. saltpetre 1 lb. spirit of wine 2 quarts, water 3 quarts, isinglass 3 gills, and meal powder 10 lb. To dissolve 4 oz. of isinglass, take 3 pints of water.

59 uch paper for capping fire-works.

Dissolve in spirit of wine or vinegar, a little saltpetre; then take some purple or blue paper, and wet it with this liquor, and when dry it will be fit for use; when this paper is to be pasted on any fire-works, take care that the paste does not touch that part which is to burn. The method of using this paper is by cutting it into slips, long enough to go once round the mouth of a serpent, cracker, &c. When these slips are pasted on, leave a little above the mouth of the case not pasted; then prime the case with meal-powder, and twist the paper to a point.

60 ste for present- g objects fire.

We are indebted to the Chinese for the contrivance of a paste which may be employed for representing animals and other objects in fire. To prepare this paste, take sulphur reduced to a very fine powder, or flowers of sulphur, and having formed it into a paste with starch, cover with it the figure you are desirous of representing on fire: it is here to be observed, that the figure must first be coated over with clay, to prevent it from being burnt.

When the figure has been covered with this paste, besprinkle it while still moist with pulverized gunpowder; and when the whole is perfectly dry, arrange some small matches on the principal parts of it, that the fire may be speedily communicated to it on all sides.

The same paste may be employed on figures of clay, to form devices and various designs. Thus, for example, festoons, garlands, and other ornaments, the flowers of which might be imitated by fire of different colours, could be formed on the frieze of a piece of architecture covered with plaster. The Chinese imitate grapes exceedingly well, by mixing pounded sulphur with the pulp of the jujube, instead of flour paste.

61 Method of preserving fire-works from being easily burnt by accident.

It is usual to paint the frames or stands of large fire-works of some dark colour, but this renders them very combustible. It would be better to wash them with the following composition, which will both give them a proper colour, and render them less combustible. Take equal parts of brick-dust, coal-ashes, and iron-filings, and mix them with a double size while hot. With this wash over the frames, &c. and when dry repeat the washing.

Chap. II. *Of the principal varieties of Fire-Works, and the most approved Methods of constructing them.*

62 Division of fire-works.

Artificial fire-works differ from each other very much in point of simplicity of construction. Some require very little dexterity in the preparation; and are either employed as appendages to works of greater importance, or, if used by themselves, are confined to the sports of schoolboys. Of this nature are *squibs*, *serpents*, *crackers*, *stars*, *sparks*, *marrons*, *saucissons*, *pin wheels*, *leaders*, and *gerbes* or *Roman candles*. Others are very complex in their structure, require considerable address and ingenuity, and form the amusement of fashionable circles on occasion of public rejoicings or private festivity: Such are *rockets*, of various kinds, *wheels*, *suns*, *globes*, *balloons*, *pyramids*, &c. We shall first describe the more simple kinds, and then give an account of the method of constructing those of a more complex nature.

Sect. I. *Of Simple Fire-Works.*

63 Leaders.

As in the subsequent directions for fire-works, we shall have frequent occasion to mention pipes of communication commonly called *leaders*, by which the several parts of a compound fire-work are connected with each other, it will be proper to show how these are constructed. Leaders consist of small tubes of paper of different lengths, according to the distance to which they must extend; and these tubes are filled with a combustible composition that will not burn too fast.

The best paper for leaders is that called elephant; which is cut into long slips 2 or 3 inches broad, so that they may go 3 or 4 times round the *former*, but not more: when they are very thick, they are too strong for

Varieties of Construction.

for the paper which fastens them to the works, and will sometimes fly off without leading the fire. The *formers* for these leaders are made from 2 to 6-16ths of an inch diameter; but 4-16ths is the size generally used. The *formers* are made of smooth brass wire: when used, rub them over with grease, or keep them wet with paste, to prevent their sticking to the paper, which must be pasted all over. In rolling pipes, make use of a rolling-board, but use it lightly: having rolled a pipe, draw out the former with one hand, holding the pipe as light as possible with the other; for if it press against the former, it will stick and tear the paper.

N. B. Make the leaders of different lengths, or in clothing works many will be wasted. Leaders for marron batteries must be made of strong cartridge paper.

Joining and placing leaders is a very essential part of fire-works, as it is on the leaders that the performance of all complex works depends; for which reason the method of conducting pipes of communication shall be here explained in as plain a manner as possible. Your works being ready to be clothed, proceed thus: Cut your pipes of a sufficient length to reach from one case to the other; then put in the quick-match, which must always be made to go in very easy: when the match is in, cut it off within about an inch of the end of the pipe, and let it project as much at the other end: then fasten the pipe to the mouth of each case with a pin, and put the loose ends of the match into the mouths of the cases, with a little meal-powder: this done to all the cases, paste over the mouth of each two or three bits of paper. The preceding method is used for large cases, and the following for small, and for illuminations: First thread a long pipe; then lay it on the tops of the cases, and cut a bit off the under side, over the mouth of each case, so that the match may appear; then pin the pipe to every other case; but before you put on the pipes, put a little meal-powder in the mouth of each case. If the cases thus clothed are port-fires or illuminated works, cover the mouth of each case with a single paper; but if they are choked cases, situated so that a number of sparks from other works may fall on them before they are fired, secure them with three or four papers, which must be pasted on very smooth, that there may be no creases for the sparks to lodge in, which often set fire to the works before their time. Avoid as much as possible placing the leaders too near, or one across the other so as to touch, as it may happen that the flash of one will fire the other; therefore if your works should be so formed that the leaders must cross or touch, be sure to make them very strong, and secure at the joints, and at every opening.

When a great length of pipe is required, it must be made by joining several pipes in this manner: Having put on one length of match as many pipes as it will hold, paste paper over every joint; but, if a still greater length is required, more pipes must be joined, by cutting about an inch off one side of each pipe near the end, and laying the quick-match together, and tying them fast with small twine; after which, cover the joining with pasted paper.

64 Serpents.

One of the simplest fire-works is what is called a *serpent*, which consists of a cylindrical paper case, about 4 or 5 inches long, and not made very thick. AC, fig. 19. represents the usual form of the serpent, except that in general they have not the contraction in the middle, represented in this figure. The name serpent has been given to this fire-work, either from the hissing noise which it makes when fired, or from the zigzag or undulating direction in which it moves, when properly constructed. The case or cartridge is rolled round a cylindrical stick, rather larger than a goose quill, and provided at one end with a narrow appendage, such as that used for rockets, fig. 3. by means of which it is choked at one end. This case is filled about half way with some of the compositions described for making small rockets, see N° 30, rammed moderately hard in the proper mould, and then it is either choked in the middle, or some obstructing body, such as a small piece of paper, is introduced, and the remainder of the case is filled with grained or corn powder. Lastly, this other extremity is well secured with twine, and commonly dipt into melted pitch; a little moistened meal powder is introduced into the extremity next the choak, and a piece of touch-paper being properly fastened on this end, the serpent is complete.

65 Crackers.

Crackers are composed of a pretty long paper case, filled with the proper composition, as will be described immediately, and folded up in such a manner as, when fired, to make successive reports at short intervals. To construct these crackers, cut some cartridge paper into pieces $3\frac{1}{2}$ inches broad, and one foot long; one edge of each fold down lengthwise about $\frac{1}{4}$ of an inch broad; then fold the double edge down $\frac{1}{4}$ of an inch, and turn the single edge back half over the double fold; then open it and lay all along the channel, which is formed by the folding of the paper, some meal-powder; then fold it over and over till all the paper is doubled up, rubbing it down every turn; this done, bend it backwards and forwards, 2 inches and a half, or thereabouts, at a time, as oft as the paper will allow; then hold all these folds flat and close, and with a small pinching cord give one turn round the middle of the cracker, and pinch it close; then bind it with a packthread as tight as possible; then in the place where it was pinched, prime one end of it, and cap it with touch-paper. When these crackers are fired, they will give a report at every turn of the paper: if you would have a great number of reports, the paper must be cut longer, or join them after they are made; but if they are made very long before they are pinched, you must have a piece of wood with a groove in it, deep enough to let in half the cracker; this will hold it straight while it is pinching. Fig. 20. represents a cracker complete. Plate CCCCLIII.

66 Stars.

Stars are small balls, prepared of a composition which emits a brilliant, radiating light, and are much employed in the construction of rockets, Roman candles, and similar fire-works. They are made of various sizes, but generally about as large as a musket bullet. Compositions for stars have been described in N° 31. and 54. The ingredients must be thoroughly incorporated, and in forming the ball, unless the paste is sufficiently glutinous, it must be wrapped up in a piece of paper, or linen rag, tied closely round with pack thread, and a hole must be pierced through its middle for the insertion of a piece of match. These stars, when lighted, will exhibit a most beautiful appearance; for the fire, as it issues from the two ends of the hole in the middle, will extend to a

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a great distance, and thus make the fiery ball appear much larger.

Strung stars. First take some thin paper, and cut it into pieces of one inch and a half square, or thereabouts; then on each piece lay as much dry star-composition as the paper will easily contain; then twist up the paper as tight as possible; when done, rub some paste on your hands, and roll the stars between them; then set them to dry: the stars being thus made, get some flax or fine tow, and roll a little of it over each star; then paste the hand and roll the stars as before, and set them again to dry; when they are quite dry, with a piercer make a hole through the middle of each, into which run a cotton quick-match, long enough to hold 10 or 12 stars at 3 or 4 inches distance: but any number of stars may be strung together by joining the match.

Tailed stars. These are called *tailed stars*, because there are a great number of sparks issuing from them, which represent a tail like that of a comet. Of these there are two sorts; which are *rolled*, and *driven*: when rolled, they must be moistened with a liquor made of half a pint of spirit of wine and half a gill of thin size, of this as much as will wet the composition enough to make it roll easy; when they are rolled, sift meal powder over them, and set them to dry.

When tailed stars are driven, the composition must be moistened with spirit of wine only, and not made so wet as for rolling: 1 and 2 oz. cases, rolled dry, are best for this purpose: and when they are filled, unroll the case within 3 or 4 rounds of the charge, and all that are unrolled cut off; then paste down the loose edge: 2 or 3 days after the cases are filled, cut them in pieces 5 or 6 8ths of an inch in length: then melt some wax, and dip one end of each piece into it, so as to cover the composition: the other end must be rubbed with meal-powder wetted with spirit of wine.

Driven stars. Cases for driven stars are rolled with paste, but are made of paper very thin. Before they are filled, damp the composition with spirit of wine that has had some camphor dissolved in it: ram them indifferently hard, so that the case be not broken or sacked; to prevent which, they should fit tight in the mould. They are driven in cases of several sizes, from 8 drams to 4 oz. When they are filled in half ounce cases, cut them in pieces of three fourths of an inch long; if 1 oz. cases, cut them in pieces of 1 inch; if 2 oz. cases, cut them in pieces of 1 and one fourth inch long; and if 4 oz. cases, cut them in pieces of 1 inch and a half long: having cut the stars of a proper size, prime both ends with wet meal-powder. These stars are seldom put in rockets, they being chiefly intended for air-balloons, and driven in cases, to prevent the composition from being broken by the force of the blowing powder in the shell.

Rolling stars are commonly made about the size of a musket ball; though they are rolled of several sizes, from the bigness of a pistol ball to 1 inch diameter; and sometimes very small, but are then called *sparks*. Great care must be taken in making stars, first, that the several ingredients are reduced to a fine powder; secondly, that the composition may be well worked and mixed. Before beginning to roll, take about a pound of composition, and wet it with the following liquid, enough to make it stick together and roll easy: Spirit of wine 1 quart, in which dissolve one fourth of an ounce of isinglass. If a great quantity of composition be wetted at once, the spirit will evaporate, and leave it dry, before it is rolled into stars: having rolled up one proportion, shake the stars in meal-powder, and set them to dry, which they will do in 3 or 4 days; but if they should be wanted for immediate use, dry them in an earthen pan over a slow heat, or in an oven. It is very difficult to make the stars all of an equal size when the composition is taken up promiscuously with the fingers; but by the following method they may be made very exactly. When the mixture is moistened properly, roll it on a flat smooth stone and cut it into square pieces, making each square large enough for the stars intended. There is another method used by some to make stars, which is by rolling the composition in long pieces, and then cutting off the star, so that each star will be of a cylindrical form: but this method is not so good as the former; for, to make the composition roll this way, it must be made very wet, which makes the stars heavy, as well as weakens them. All stars must be kept as much from air as possible, otherwise they will grow weak and bad.

67 Sparks.

Sparks differ from stars, only in their size and duration, as they are made smaller than stars, and are sooner extinguished. The following is the most approved method of making them. Having put into an earthen vessel an ounce of mealed gunpowder, 3 oz. of powdered saltpetre, and 4 oz. of camphor, reduced to powder by rubbing it in a mortar with a little spirit of wine; pour over this mixture some weak gum water, or some weak brandy, in which some gum dragant has been dissolved, till the composition acquires the consistence of thick soup. Then take some lint or caddice, which has been boiled in brandy, vinegar, or with saltpetre, and afterwards dried and unravelled, and throw into the composition as much of it as is necessary to absorb the whole, taking care to stir it well. This matter is to be formed into small balls of about the size of a pea, which being dried in the air, are to be sprinkled with meal gunpowder, that they may more readily take fire.

Another method of making sparks is, to take some saw dust of any wood that burns readily, such as fir, and boil it in water that has been saturated with saltpetre. When it has been boiled for some time, the vessel is to be removed from the fire, and the solution of nitre poured off, so as to leave the saw dust at the bottom. The saw dust thus impregnated with nitre, is then to be poured on a table, and, while moist, to be sprinkled with powdered sulphur, to which a little bruised gunpowder has been added; and when the whole is well mixed, and of a proper consistence, sparks are to be made of it as before.

68 Marroons.

Marroons are small boxes made either of paper or pasteboard, and of a roundish or cubical form, so prepared as when fired to make a loud and sudden report. They are usually employed either as appendages to other fire-works, or a great many of them are so arranged, as to explode successively at certain intervals.

Formers for marroons are from three fourths of an inch to one and a half diameter; but the paper for the cases twice the diameter of the *former* broad, and long enough to go three times round. When you have rolled a case, paste down the edge and tie one end close; then with the *former* drive it down to take away the wrinkles,

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kles, and make it flat at bottom; then fill the case with corn-powder one diameter and one fourth high, and fold down the rest of the case tight on the powder. The marroon being thus made, wax some strong pack-thread with shoemakers wax: this thread wind up in a ball, then unwind two or three yards of it, and that part which is near the ball make fast to a hook; then take a marroon, and stand as far from the hook as the packthread will reach, and wind it lengthwise round the marroon as close as possible, till it will hold no more that way; then turn it, and wind the packthread on the short way, then lengthwise again, and so on till the paper is all covered; then make fast the end of the packthread, and beat down both ends of the marroon to bring it in shape. The method of firing marroons is by making a hole at one end with an awl, and putting in a piece of quick-match; then taking a piece of strong paper, in which wrap up the marroon with two leaders, which must be put down to the vent, and the paper tied tight round them with small twine: these leaders are bent on each side, and their loose ends tied to the other marroons, and are nailed in the middle to the rail of the stand, as in fig. 21. The use of winding the packthread in a ball is, that it may be let out as wanted, according to the quantity the marroon may require; and that it may not be tied in knots, which would spoil the marroon. These oblong marroons are, by the French, called *Saucissons*, as they are supposed to resemble a saussage.

Fig. 21.

69 Marroon batteries.

Batteries of Marroons.—These, if well managed, will keep time to a march, or a slow piece of music. Marroon batteries are made of several stands, with a number of cross rails for the marroons; which are regulated by leaders, by cutting them of different lengths, and nailing them tight, or loose, according to the time of the music. In marroon batteries you must use the large and small marroons, and the nails for the pipes must have flat heads.

The proper marroon boxes are made of strong pasteboard, cut as represented in fig. 22. so as to fold up in the form of a cube, one side of which is to be left uncemented till the box be filled. The cavity being filled with gun-powder, strong paper is to be pasted over the box in various directions, and the whole is to be wrapped round with strong pack-thread dipt in glue. Lastly, a hole is to be made in the corner of the box, and a piece of match introduced, by which it may be fired.

Sometimes it is required to render marroons luminous, or to prepare them in such a way, that they shall emit a brilliant light before they burst. To effect this, they are to be covered on the outside with one of the compositions directed for stars, and then rolled in bruised gunpowder.

70 Pin-wheels.

For Pin-Wheels.—First roll some paper pipes about 14 inches long each; these pipes must not be made thick of paper, two or three rounds of elephant paper being sufficient. When the pipes are thoroughly dried, you must have a tin tube 12 inches long, to fit easy into the pipes; at one end of this tube fix a small conical cup, called a *funnel*; then bend one end of one of the pipes, and put the funnel in at the other as far as it will reach, and fill the cup with composition: then draw out the funnel by a little at a time, shaking it up and down, and it will fill the pipe as it comes out. Having filled some pipes, have some small circular blocks made about one inch diameter and half an inch thick: round one of these blocks wind and paste a pipe, and to the end of this pipe join another; which must be done by twisting the end of one pipe to a point, and putting it into the end of the other with a little paste: in this manner join four or five pipes, winding them one upon the other so as to form a spiral line. Having wound on your pipes, paste two slips of paper across them to hold them together: besides these slips of paper, the pipes must be pasted together.

There is another method of making these wheels, viz. by winding on the pipes without paste, and sticking them together with sealing-wax at every half turn; so that when they are fired, the end will fall loose every time the fire passes the wax, by which means the circle of fire will be considerably increased. The formers for these pipes are made from one and a half to 4-16ths of an inch diameter; and the composition for them is as follows: Meal-powder 8 oz. saltpetre 2 oz. and sulphur 1; among these ingredients may be mixed a little steel-filings or the dust of cast iron: this composition should be very dry, and not made too fine, or it will stick in the funnel. These wheels may be fired on a large pin, and held in the hand with safety.

71 Shower of fire or rain.

There is a pleasing decoration frequently added to rockets, called a *shower of fire*, rain, or rain fall, and it is called gold or silver rain, according as its colour is more or less intense. It consists of several small cases filled with a brilliant composition, such as the following variety of Chinese fire, viz. meal powder 1 pound, flower of sulphur 2 oz. and iron sand of the first order, 5 oz.

Gold and silver rain compositions are rammed in cases that are pinched quite close at one end; if rolled dry, 4 or 5 rounds of paper will be strong enough; but if they are pasted, 3 rounds will do; and the thin sort of cartridge-paper is best for those small cases, in rolling which you must not turn down the inside edge as in other cases, for a double edge would be too thick for so small a bore. The moulds for rain-falls should be made of brass, and turned very smooth in the inside; or the cases, which are so very thin, would tear in coming out; for the charge must be rammed in tight; and the better the case fits the mould, the more driving it will bear. These moulds have no nipple, but instead of it they are made flat. As it would be very tedious and troublesome to shake the composition out of such small ladles as are used for these cases, it will be necessary to have a funnel made of thin tin, to fit on the top of the case, by the help of which they may be filled very fast. For single rain-falls for 4 oz. rockets, let the diameter of the former be 2-16ths of an inch, and the length of the case 2 inches; for 8 oz. rockets, 4-16ths and 2 diameters of the rocket long; for 1 lb. rockets, 5-16ths, and 2 diameters of the rocket long; for 2 lb. rockets, 5-16ths, and 3 inches and a half long; for 4 lb. rockets, 6-16ths, and 4 inches and a half long; and for 6-pounders, 7-16ths diameter, and 5 inches long.

Of double rain-falls there are two sorts. For example, some appear first like a star, and then the rain; and some appear first like rain, and then like a star. When you would have stars first, you must fill the cases, within half an inch of the top, with rain-composition, and the remainder with star-composition; but when you intend

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tend the rain should be first, drive the case half an inch with star-composition, and the rest with rain. By this method may be made many changes of fire; for in large rockets you may make them first burn as stars, then rain, and again as stars; or they may first show rain, then stars, and finish with a report; but when thus managed, cut open the first rammed end, after they are filled and bounced, at which place prime them. The star-composition for this purpose must be a little stronger than for rolled stars.

72 Gerbes.

Gerbes consist of a strong case of thick paper or pasteboard, filled with a brilliant composition, and generally with stars or balls placed at small distances, so that the composition and the balls are introduced alternately. Immediately below each ball is placed a little grained powder. These last gerbes are sometimes called Roman candles. When fired, they first throw up a beautiful jet of flame, which in some measure resembles a water-spout, whence the name. Gerbes are either employed singly, or batteries are formed of them, and frequently those filled with brilliant fire without balls, are placed in rows along the front of the frames of large compound fire-works. They are sometimes made perfectly cylindrical; at others they have a contracted part at the top called the *neck*.

Fig. 23. and 24.

Fig. 23. represents a wooden *former;* fig. 24. a gerbe complete with its foot or stand. The cases for gerbes are made very strong, on account of the strength of the composition; which, when fired, comes out with great velocity; therefore, to prevent their bursting, the paper should be pasted, and the cases made as thick at the top as at the bottom. They should also have very long necks, for this reason; first, that the particles of iron will have more time to be heated, by meeting with greater resistance in getting out, than with a short neck, which would be burnt too wide before the charge be consumed, and spoil the effect: secondly, that with long necks the stars will be thrown to a great height, and will not fall before they are spent, or spread too much; but, when made to perfection, will rise and spread in such a manner as to form exactly a wheat sheaf.

In ramming of gerbes, there will be no need of a mould, the cases being sufficiently strong to support themselves. But you must be careful, before you begin to ram, to have a piece of wood made to fit in the neck; for if this be not done, the composition will fall into the neck, and leave a vacancy in the case, which will cause the case to burst as soon as the fire arrives at the vacancy. You must likewise observe, that the first ladleful of charge, or second, if proper, be of some weak composition. When the case is filled, take out the piece of wood, and fill the neck with some slow charge. Gerbes are generally made about six diameters long, from the bottom to the top of the neck: their bore must be one-fifth narrower at top than at bottom. The neck S is one-sixth diameter and three-fourths long. T, a wooden foot or stand, on which the gerbe is fixed. This may be made with a choak or cylinder four or five inches long to fit the inside of the case, or with a hole in it to put in the gerbe; both these methods will answer the same purpose. Gerbes produce a most brilliant fire, and are very beautiful when a number of them are fixed in the front of a building or a collection of fire-works.

N. B. Gerbes are made by their diameters, and their cases at bottom one-fourth thick. The method of finding the interior diameter of a gerbe is this: Supposing the exterior diameter of the case, when made, to be five inches, then, by taking two-fourths for the sides of the case, there will remain $2\frac{1}{2}$ inches for the bore, which will be a very good size. These gerbes should be rammed very hard.

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Small Gerbes, or *white Fountains*.

May be made of four ounces, eight ounces, or one pound cases, pasted and made very strong, of any length: but before they are filled, drive in clay one diameter of their orifice high; and when the case is filled, bore a vent through the centre of the clay to the composition: the common proportion will do for the vent, which must be primed with a slow charge. These cases, without the clay, may be filled with Chinese fire.

Sect. II. *Of Compound Fire-works.*

Among the most pleasing compound fire-works are rockets, which are of various kinds. Some are made to ascend to a great height in the air, where they burst, and throw out the contents of the head with which they are provided. These are called *sky-rockets*. Others are so constructed as to run with great velocity along a line, and are called *line-rockets*. Some are arranged at the extremities of the spokes of a wheel, and are denominated *wheel-rockets;* while a fourth variety have their cases made water tight, and are filled with a very strong composition, so as to admit of their burning below water. These last are called *water-rockets*. Sky rockets are tied to a stick, which renders their ascent into the air more equable and steady. 73 Rockets.

Fig. 25. represents a rocket complete without its stick. Its length from the neck is five diameters one-sixth: the cases should always be cut to this length after they are filled. M is the head, which is two diameters high, and one diameter one-sixth and a half in breadth; N the cone or cap, whose perpendicular height must be one diameter one-third. Fig. 26. the collar to which the head is fixed: this is turned out of fir or any light wood, and its exterior diameter must be equal to the interior diameter of the head; one-sixth will be sufficient for its thickness, and round the outside edge must be a groove; the interior diameter of the collar must not be quite so wide as the exterior diameter of the rocket: when this is to be glued on the rocket, two or three rounds of paper must be cut off the case, which will make a shoulder for it to rest upon. Fig. 27. a *former* for the head: two or three rounds of paper well pasted will be enough for the head, which, when rolled, put the collar on that part of the *former* marked O, which must fit the inside of it; then, with the pinching cord, pinch the bottom of the head into the groove, and tie it with small twine. Fig. 28. a *former* for the cone. To make the caps, cut the paper in round pieces, equal in diameter to twice the length of the cone to be made; which pieces being cut into halves, will make two caps each, without wasting any paper; having formed the caps, paste over each of them a thin white paper, which must be a little longer than the cone, so as to project about half an inch below the bottom: this projection of paper, being notched and pasted, serves to fasten the cap to the head.

74 Sky-rockets. Fig. 25. Fig. 26. Fig. 27. Fig. 28.

When

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When you load the heads of the rockets with stars, rains, serpents, crackers, or any thing else, according to fancy, remember always to put one ladleful of meal-powder into each head, which will be enough to burst the head, and disperse the stars, or whatever it contains: when the heads are loaded with any cases, let their mouths be turned downwards; and after the heads are filled, paste on the top of them a piece of paper before putting on the caps. As the size of the stars often differs, it would be needless to give an exact number for each rocket; but this rule may be observed, that the heads may be nearly filled with whatever they are to contain.

75 Dimensions and poise of rocket-sticks.

Dimensions and Poise of Rocket-sticks.

Weight of the Rocket.		Length of the stick.		Thickness at top.	Breadth at top.	Square at bottom.	Poise from the point of the cone.	
lb.	oz	Ft.	in.	Inches.	Inches.	Inches.	Ft.	in.
6	0	14	0	1,5	1,85	0,75	4	1,5
4	0	12	10	1,25	1,40	0,625	3	9,
2	0	9	4	1,125	1,	0,525	2	9,
1	0	8	2	0,725	0,80	0,375	2	1,
	8	6	6	0,5	0,70	0,25	1	10,5
	4	5	3	0,3750	0,55	0,35	1	8,5
	2	4	1	0,3	0,45	0,15	1	3,
	1	3	6	0,25	0,35	0,10	11	0,
	½	2	4	0,125	0,20	0,16	8	0,
	¼	1	10½	0,1	0,15	0,5	5	0,5

Fig. 25.

The last column on the right, in the above table, expresses the distance from the top of the cone, where the stick, when tied on, should balance the rocket, so as to stand in an equilibrium on one's finger, or the edge of a knife. The best wood for the sticks is dry fir, and they are thus made: When you have cut and planned the stick, according to the dimensions given in the table, cut, on one of the flat sides at the top, a groove the length of the rocket, and as broad as the stick will allow; then on the opposite flat side, cut two notches for the cord, which ties on the rocket, to lie in; one of these notches must be near the top of the stick, and the other facing the neck of the rockets; the distance between these notches may easily be known, for the top of the stick should always touch the head of the rocket. When the rockets and sticks are ready, lay the rockets in the grooves in the sticks and tie them on. Those who, merely for curiosity, may choose to make rockets of different sizes from those expressed in the table of dimensions, may find the length of their sticks, by making them for rockets, from half an ounce to one pound, 60 diameters of the rocket long; and for rockets above one pound 50 or 52 diameters will be a good length; their thickness at top may be about half a diameter, and their breadth a very little more; their square at bottom is generally equal to half the thickness at top. But although the dimensions of the sticks be very nicely observed, we can depend only on their balance; for, without a proper counterpoise, the rockets, instead of mounting perpendicularly, will take an oblique direction, and fall to the ground before they are burnt out.

Rockets rammed over a piercer must not have so much composition put into them at a time as when rammed solid; for the piercer, taking up great part of the bore of the case, would cause the rammer to rise too high; so that the pressure of it would not be so great on the composition, nor would it be rammed everywhere equal. To prevent this, observe the following rule: That for those rockets which are rammed over a piercer, let the ladle hold as much composition as, when drove, will raise the drift one-half the interior diameter of the case, and for those rammed solid to contain as much as will raise it one-half the exterior diameter of the case: ladles are generally made to go easy in the case, and the length of the scoop about one and a half of its own diameter.

76 Method of ramming rockets.

The charge of rockets must always be rammed one diameter above the piercer, and on it must be rammed one-third of a diameter of clay; through the middle of which bore a small hole to the composition, that, when the charge is burnt to the top, it may communicate its fire, through the hole, to the stars in the head. Great care must be taken to strike with the mallet, and with an equal force, the same number of strokes to each ladleful of charge; otherwise the rockets will not rise with an uniform motion, nor will the composition burn equally and regularly: for which reason they cannot carry a proper tail: for it will break before the rocket has got half way up, instead of reaching from the ground to the top, where the rocket breaks and disperses the stars, rains, or whatever is contained in the head. When ramming, keep the drift constantly turning or moving; and when you use the hollow rammers, knock out of them the composition now and then, or the piercer will split them. To a rocket of four ounces, give to each ladleful of charge, 16 strokes; to a rocket of one pound, 28; to a two pounder, 36; to a four pounder, 42; and to a six pounder, 56; but rockets of a larger sort cannot be rammed well by hand, but must be rammed with a machine made in the same manner as those for driving piles.

The method of ramming wheel cases, or any other sort, in which the charge is rammed solid, is much the same as in sky-rockets; for the same proportion may be observed in the ladle, and the same number of strokes given, according to their diameters, all cases being distinguished by their diameters. In this manner, a case, whose bore is equal to a rocket of four ounces, is called a four ounce case, and that which is equal to an eight ounce rocket an eight ounce case, and so on, according to the different rockets.

Having taught the method of ramming cases in moulds, we shall here say something concerning those filled without moulds; which method, for strong pasted cases, will do extremely well, and save the expence of making so many moulds. The reader must here observe, when filling any cases, to place the mould on a perpendicular block of wood, and not on any place that is hollow; for we have found by experience, that when cases were rammed on driving benches, which were formerly used, the works frequently miscarried, on account of the hollow resistance of the benches, which often jarred and loosened the change in the cases; but this accident never happens when the driving blocks are used.

When cases are to be filled without moulds, proceed thus: Have some nipples made of brass or iron, of

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of several sizes, in proportion to the cases, and to screw or fix in the top of the driving block; when you have fixed in a nipple, make, at about one inch and a half from it, a square hole in the block, six inches deep and one inch diameter; then have a piece of wood, six inches longer than the case intended to be filled, and two inches square; on one side of it cut a groove almost the length of the case, whose breadth and depth must be sufficient to cover near one-half of the case; then cut the other end to fit the hole in the block, but take care to cut it so that the groove may be at a proper distance from the nipple; this half mould being made and fixed tight in the block, cut, in another piece of wood nearly of the same length as the case, a groove of the same dimensions as that in the fixed piece; then put the case on the nipple, and with a cord tie it and the two half moulds together, and the case will be ready for filling.

The dimensions of the above-described half-moulds are proportionable for cases of eight ounces, but notice must be taken, that they differ in size in proportion to the cases.

The best wood for mallets is dry beech. If a person uses a mallet of a moderate size, in proportion to the rocket, according to his judgment, and if the rocket succeeds, he may depend on the rest, by using the same mallet; yet it will be necessary that cases of different sorts be driven with mallets of different sizes.

The following proportion of the mallets for rockets of any size, from one oz. to six lb. may be observed; but as rockets are seldom made less than one oz. or larger than six lb. we shall leave the management of them to the curious; but all cases under one oz. may be rammed with an ounce rocket mallet. The mallets will strike more solid, by having their handles turned out of the same piece with the head, and made in a cylindrical form. Let their dimensions be worked by the diameters of the rockets: for example; let the thickness of the head be three diameters, and its length four, and the length of the handle five diameters, whose thickness must be in proportion to the hand.

77 Ascent of sky-rockets explained.

As the cause which occasions the ascent of a rocket into the air is the same as that which makes a musket recoil when fired, it will be proper, before explaining the ascent of rockets, to show how the recoil of fire-arms is produced. When the powder is suddenly inflamed in the chamber, or at the bottom of the barrel, it necessarily exercises an action two ways at the same time; that is to say, against the breech of the piece, and against the bullet or wadding, which is placed above it. Besides this, it acts also against the sides of the chamber which it occupies; and as they oppose a resistance almost insurmountable, the whole effort of the elastic fluid, produced by the inflammation, is exerted in the two derections above mentioned. But the resistance opposed by the bullet, being much less than that opposed by the mass of the barrel or cannon, the bullet is forced out with great velocity. It is impossible, however, that the body of the piece itself should not experience a movement backwards; for if a spring is suddenly let loose, between two moveable obstacles, it will impel them both, and communicate to them velocities in the inverse ratio of their masses; the piece, therefore, must acquire a velocity backwards nearly in the inverse ratio of its mass to that of the bullet. We make use of the term *nearly*, because there are various circumstances which give to this ratio certain modifications; but it is always true that the body of the piece is driven backwards, and that if it weighs with its carriage 1000 times more than the bullet, it acquires a velocity which is 1000 times less, and which is soon annihilated by the friction of the wheels against the ground, &c.

The cause of the ascent of a rocket is nearly the same. At the moment when the powder begins to inflame, its expansion produces a torrent of elastic fluid, which acts in every direction; that is, against the air which opposes its escape from the cartridge, and against the upper part of the rocket; but the resistance of the air is more considerable than the weight of the rocket, on account of the extreme rapidity with which the elastic fluid issues through the neck of the rocket to throw itself downwards, and therefore the rocket ascends by the excess of the one of these forces above the other.

This however would not be the case, unless the rocket were pierced to a certain depth. A sufficient quantity of elastic fluid would not be produced; for the composition would inflame only in circular coats of a diameter equal to that of the rocket; and experience shews that this is not sufficient. Recourse then is had to the very ingenious idea of piercing the rocket with a conical hole, which makes the composition burn in conical strata which have much greater surface, and therefore produce a much greater quantity of inflamed matter and fluid. This expedient was certainly not the work of a moment *.

* Hutton's Recreations, vol. iii. p. 461.

78 To fix one rocket on the top of another.

When sky-rockets are fixed one on the top of another, they are called *towering rockets*, on account of their mounting so very high. Towering rockets are made after this manner: Fix on a pound-rocket a head without a collar; then take a four ounce rocket, which may be headed or bounced, and rub the mouth of it with meal-powder wetted with spirit of wine: this done, put it in the head of the large rocket with its mouth downwards; but before it is put in, stick a bit of quick-match in the hole of the clay of the pound-rocket, which match should be long enough to go a little way up the bore of the small rocket, to fire it when the large rocket is burnt out. As the four ounce rocket is too small to fill the head of the other, roll round it as much tow as will make it stand upright in the centre of the head: the rocket being thus fixed, paste a single paper round the opening of the top of the head of the large rocket. The large rocket must have only half a diameter of charge rammed above the piercer; for, if filled to the usual height, it would turn before the small one takes fire, and entirely destroy the intended effect: when one rocket is headed with another, there will be no occasion for any blowing powder; for the force with which it goes off will be sufficient to disengage it from the head of the first fired rocket. The sticks for these rockets must be a little longer than for those headed with stars, rains, &c.

79 Caduceus rockets.

Caduceus rockets are such as, in rising, form two spiral lines, by reason of their being placed obliquely, one opposite to the other; and their counterpoise in their centre, which causes them to rise in a vertical direction. Rockets for this purpose must have their ends choaked close, without either head or bounce, for a weight at top would be a great obstruction to their mounting. No caduceus rockets ascend so high as single, because of their

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their serpentine motion, and likewise the resistance of air, which is much greater than two rockets of the same size would meet with if fired singly.

Fig. 30. shews the method of fixing these rockets: the sticks for this purpose must have all their sides equal, and the sides should be equal to the breadth of a stick proper for a sky-rocket of the same weight as those you intend to use, and made to taper downwards as usual, long enough to balance them, one length of a rocket from the cross stick; which must be placed from the large stick six diameters of one of the rockets, and its length seven diameters; so that each rocket, when tied on, may form with the large stick an angle of 60 degrees. In tying on the rockets, place their heads on the opposite sides of the cross stick, and their ends on the opposite sides of the long stick; then carry a leader from the mouth of one into that of the other. When these rockets are to be fired, suspend them between two hooks or nails, then burn the leader through the middle, and both will take fire at the same time. Rockets of one lb. are a good size for this use.

80 Honorary rockets.

Honorary rockets are the same as sky-rockets, except that they carry no head nor report, but are closed at top, on which is fixed a cone: then on the case, close to the top of the stick is tied on a two ounce case, about five or six inches long, filled with a strong charge, and pinched close at both ends; then in the reverse sides, at each end, bore a hole in the same manner as in tourbillons, to be presently described; from each hole carry a leader into the top of the rocket. When the rocket is fired, and arrived to its proper height, it will give fire to the case at top; which will cause both rocket and stick to spin very fast in their return, and represent a worm of fire descending to the ground.

There is another method of placing the small case, which is by letting the stick rise a little above the top of the rocket, and tying the case to it, so as to rest on the rocket: these rockets have no cones.

A third method by which they are managed is this; In the top of a rocket fix a piece of wood, in which drive a small iron spindle; then make a hole in the middle of the small case, through which put the spindle: then fix on the top of it a nut, to keep the case from falling off; when this is done, the case will turn very fast, without the rocket: but this method does not answer so well as either of the former.

Fig. 31. is the honorary rocket complete. The best sized rockets for this purpose are those of one lb.

81 To make a rocket form an arch in rising.

Having some rockets made, and headed according to fancy, and tied on their sticks; get some sheet tin, and cut it into round pieces about three or four inches diameter; then on the stick of each rocket, under the mouth of the case, fix one of these pieces of tin 16 inches from the rocket's neck, and support it by a wooden bracket, as strong as possible: the use of this is, that when the rocket is ascending the fire may play with great force on the tin, which will divide the tail in such a manner that it will form an arch as it mounts, and will have a very good effect when well managed: if there is a short piece of port-fire, of a strong charge, tied to the end of the stick, it will make a great addition; but this must be lighted before the rocket is fired.

82 To make several rockets rise in the same direction, and at the same distance.

Take six, or any number of sky-rockets, of any size; then cut some strong packthread into pieces of three or four yards long, and tie each end of these pieces to a rocket in this manner; Having tied one end of the packthread round the body of one rocket, and the other end to another, take a second piece of packthread, and make one end of it fast to one of the rockets already tied, and the other end to a third rocket, so that all the rockets, except the two on the outside, will be fastened to two pieces of packthread: the length of thread from one rocket to the other may be what the maker pleases; but the rockets must be all of a size, and their heads filled with the same weight of stars, rains, &c.

Having thus done, fix in the mouth of each rocket a leader of the same length; and when about to fire them, hang them almost close; then tie the ends of the leaders together, and prime them: this prime being fired, all the rockets will mount at the same time, and divide as far as the strings will allow; and this division they will keep, provided they are all rammed alike, and well made. They are sometimes called *chained rockets*.

83 Signal rockets.

Signal rockets are made of several kinds, according to the different signals intended to be given; but in artificial fire-works, two sorts are only used, which are one with reports and the other without; but those for the use of the navy and army are headed with stars, serpents, &c.—Rockets which are to be bounced must have their cases made one and a half or two diameters longer than the common proportion; and after they are filled, drive in a double quantity of clay, then bounce and pinch them after the usual manner, and fix on each a cap.

Signal sky-rockets without bounces, are only sky-rockets closed and capped: these are very light, therefore do not require such heavy sticks as those with loaded heads; for which reason the rocket may be cut from the stick, or else be made thinner.

Signal rockets with reports are fired in small flights; and often both these, and those without reports, are used for a signal to begin firing a collection of works.

84 To fix several rockets to the same stick.

Two, three, or six sky-reckets, fixed on one stick, and fired together, make a grand and beautiful appearance; for the tails of all will seem but as one of an immense size, and the breaking of so many heads at once will resemble the bursting of an air-balloon. The management of this device requires a skilful hand; but if the following instructions be well observed, even by those who have not made a great progress in this art, there will be no doubt of the rockets having the desired effect.

Rockets for this purpose must be made with the greatest exactness, all rammed by the same hand, in the same mould, and filled with the same proportion of composition; and after they are filled and headed, must all be of the same weight. The stick must also be well made (and proportioned) to the following directions: first, supposing the rockets to be half pounders, whose sticks are six feet six inches long, then if two, three, or six of these are to be fixed on one stick, let the length of it be nine feet nine inches: then cut the top of it into as many sides as there are rockets, and let the length of each side be equal to the length of one of the rockets without its head; and in each side cut a groove (as usual); then from the grooves plane it round, down to the bottom, where its thickness must be equal to half the top of the round part. As their thickness cannot be exactly ascertained, we shall give a rule which generally answers for

for any number of rockets above two: the rule is this; that the stick at top must be thick enough, when the grooves are cut, for all the rockets to lie, without pressing each other, though as near as possible.

When only two rockets are to be fixed on one stick, let the length of the stick be the last given proportion, but shaped after the common method, and the breadth and thickness double the usual dimensions. The point of poise must be in the usual place (let the number of rockets be what they will): if sticks made by the above directions should be too heavy, plane them thinner; and if too light, make them thicker; but always make them of the same length.

When more than two rockets are tied on one stick, there will be some danger of their flying up without the stick, unless the following precaution is taken: For cases being placed on all sides, there can be no notches for the cord which ties on the rockets to lie in; therefore, instead of notches, drive a small nail in each side of the stick, between the necks of the cases: and let the cord, which goes round their necks, be brought close under the nails; by this means the rockets will be as secure as when tied on singly. The rockets being thus fixed, carry a quick-match, without a pipe, from the mouth of one rocket to the other; this match being lighted will give fire to all at once.

Though the directions already given may be sufficient for these rockets, we shall here add an improvement on a very essential part of this device, which is, that of hanging the rockets to be fired; for before the following method was contrived, many attempts proved unsuccessful. Instead, therefore, of the old and common manner of hanging them on nails or hooks, make use of the following contrivance: Have a ring made of strong iron wire large enough for the stick to go in as far as the mouths of the rockets; then have another ring supported by a small iron, at some distance from the post or stand to which it is fixed: then have another ring fit to receive and guide the small end of the stick. Rockets thus suspended will have nothing to obstruct their fire; but when they are hung on nails or hooks, in such a manner that some of their mouths are against or upon a nail, there can be no certainty of their rising in a vertical direction.

85 To fire rockets without sticks.

To fire rockets without sticks, you must have a stand, of a block of wood, a foot diameter, and make the bottom flat, so that it may stand steady: in the centre of the top of this block draw a circle two inches and a half diameter, and divide the circumference of it into three equal parts; then take three pieces of thick iron wire, each about three feet long, and drive them into the block, one at each point made on the circle; when these wires are driven in deep enough to hold them fast and upright, so that the distance from one to the other is the same at top as at bottom, the stand is complete.

The stand being thus made, prepare the rockets thus: Take some common sky-rockets of any size, and head them as you please; then get some balls of lead, and tie to each a small wire two or two feet and a half long, and the other end of each wire tie to the neck of a rocket. These balls answer the purpose of sticks when made of a proper weight, which is about two-thirds the weight of the rocket; but when they are of a proper size, they will balance the rocket in the same manner as a stick, at the usual point of poise. To fire these, hang them, one at a time, between the tops of the wires, letting their heads rest on the point of the wires, and the balls hang down between them: if the wires should be too wide for the rockets, press them together till they fit; and if too close, force them open; the wires for this purpose must be softened, so as not to have any spring, or they will not keep their position when pressed close or opened.

86 Scrolls for rockets.

Cases for scrolls should be made four or five inches in length, and their interior diameters three-eighths of an inch: one end of these cases must be pinched quite close before beginning to fill; and when filled, close the other end: then in the opposite sides make a small hole at each end, to the composition, as in tourbillons; and prime them with wet meal-powder. You may put in the head of a rocket as many of these cases as it will contain: being fired they turn very quick in the air, and form a scroll or spiral line. They are generally filled with a strong charge, as that of serpents or brilliant fire.

87 Swarmers.

Rockets that pass under the denomination of *swarmers*, are those from two ounces downwards. These rockets are fired sometimes in flights, and in large water-works, &c. Swarmers of one and two ounces are bored, and made in the same manner as large rockets, except that, when headed, their heads must be put on without a collar: the number of strokes for driving one ounce must be eight, and for two ounces twelve.

All rockets under one ounce are not bored, but must be filled to the usual height with composition, which generally consists of fine meal-powder four ounces, and charcoal or steel-dust two drams: the number of strokes for ramming these small swarmers is not material, provided they are rammed truly, and moderately hard. The necks of unbored rockets must be in the same proportion as in common cases.

88 Stands for rockets.

Care must be taken, in placing the rockets, when they are to be fired, to give them a vertical direction at their first setting out; which may be managed thus: Have two rails of wood, of any length, supported at each end by a perpendicular leg, so that the rails may be horizontal, and let the distance from one to the other be almost equal to the length of the sticks of the rockets intended to be fired; then in the front of the top rail drive square hooks at eight inches distance, with their points turning sidewise, so that when the rockets are hung on them, the points will be before the sticks and keep them from falling or being blown off by the wind; in the front of the rail at bottom must be staples, driven perpendicular under the hooks at top; through these staples put the small ends of the rocket sticks. Rockets are fired by applying a lighted port-fire to their mouths.

N. B. When sky-rockets are made to perfection, and fired, they will stand two or three seconds on the hook before they rise, and then mount up briskly, with a steady motion, carrying a large tail from the ground all the way up, and just as they turn, break, and disperse the stars.

89 Girandole chests for flights of rockets.

Girandole chests are generally composed of four sides of equal dimensions; but may be made of any diameter, according to the number of rockets designed to be fired; their height must be in proportion to the rockets, but must always be a little higher than the rockets with their sticks. When the sides are joined, fix in the top as

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To prepare the chest, a quick match must be laid in all the grooves, from hole to hole: then take some sky-rockets, and rub them in the mouth with wet meal-powder, and put a bit of match up the cavity of each; which match must be long enough to hang a little below the mouth of the rocket. The rockets and chest being prepared according to the above directions, put the sticks of the rockets through the holes in the top and bottom of the chest, so that their mouths may rest on the quick-match in the grooves: by which all the rockets will be fired at once; for by giving fire to any part of the match, it will communicate to all the rockets in an instant. As it would be rather troublesome to direct the sticks from the top to the proper holes in the bottom, it will be necessary to have a small door in one of the sides, through which, when opened, you may see how to place the sticks. Flights of rockets being seldom set off at the beginning of any fire-works, they are in danger of being fired by the sparks from wheels, &c.; therefore, to preserve them, a cover should be made to fit on the chest, and the door in the side kept shut.

90 Line-rockets. Line-rockets are made and rammed as the sky-rockets, but have no heads, and the cases must be cut close to the clay: they are sometimes made with six or seven changes, but in general not more than four or five. The method of managing these rockets is the following: First, have a piece of light wood, the length of one of the rockets turned round about two inches and a half diameter, with a hole through the middle lengthwise, large enough for the line to go easily through; if four changes are intended, have four grooves cut in the swivel, one opposite the other, in which to lay the rockets.

The mouths of the rockets being rubbed with wet meal-powder, lay them in the grooves head to tail, and tie them fast; from the tail of the first rocket carry a leader to the mouth of the second, and from the second to the third, and so on to as many as there are on the swivel, making every leader very secure; but in fixing these pipes, take care that the quick-match does not enter the bores of the rockets: the rockets being fixed on the swivel and ready to be fired, have a line 100 yards long, stretched and fixed up tight, at any height from the ground; but be sure to place it horizontally: this length of line will do for half-pound rockets; but if larger, the line must be longer. Before you put up the line, put one end of it through the swivel; and when you fire the line rocket, let the mouth of that rocket which is first fired face that end of the line where you stand; then the first rocket will carry the rest to the other end of the line, and the second will bring them back; and so they will run out and in according to the number of rockets: at each end of the line there must be a piece of flat wood for the rocket to strike against, or its force will cut the line. Let the line be well soaped, and the hole in the swivel very smooth. Varieties of Construction.

To line rockets may be fixed a great variety of figures, such as flying dragons, Mercuries, ships, &c.; or they may be made to run on the line like a wheel; which is done in this manner. Have a flat swivel made very exactly, and on it tie two rockets obliquely one on each side, which will make it turn round as it goes, and form a circle of fire; the charge for these rockets should be a little weaker than common. If you would show two dragons fighting, get two swivels made square, and on each tie three rockets together on the under side; then have two flying dragons made of tin, and fix one of them on the top of each swivel, so as to stand upright; in the mouth of each dragon put a small case of common fire, and another at the end of the tail; put two or three port-fires, of a strong charge, on one side of their bodies, to show them. This done, put them on the line, one at each end; but let there be a swivel in the middle of the line to keep the dragons from striking together: before firing the rockets, light the cases on the dragons; and if care be taken in firing both at the same time, they will meet in the middle of the line, and seem to fight. Then they will run back and return with great violence, which will have a very pleasing effect. The line for these rockets must be very long, or they will strike too hard together. 91 Different decorations for line rockets.

Cases for Chinese flyers may be made of different sizes, from one to eight ounces; they must be made thick of paper, and eight interior diameters long; they are rolled in the same manner as tourbillons, with a straight pasted edge, and pinched close at one end. The method of filling them is, the case being put in a mould, whose cylinder, or foot, must be flat at top without a nipple, fill it within half a diameter of the middle; then ram in half a diameter of clay, on that as much composition as before, on which drive half a diameter of clay; then pinch the case close, and drive it down flat: after this is done, bore a hole exactly through the centre of the clay in the middle; then in the opposite sides, at both ends, make a vent; and in that side intended to be fired first make a small hole to the composition near the clay in the middle, from which carry a quick-match, covered with a single paper, to the vent at the other end; then, when the charge is burnt on one side, it will, by means of the quick-match, communicate to the charge on the other (which may be of a different sort). The flyers being thus made, put an iron pin, that must be fixed in the work on which they are to be fired, and on which they are to run, through the hole in the middle; on the end of this pin must be a nut to keep the flyer from running off. If they are to turn back again after they are burnt, make both the vents at the ends on the same side, which will alter its course the contrary way. 92 Cases for Chinese flyers.

Table rockets are designed merely to show the truth of driving, and the judgment of a fire-worker; they having no other effect, when fired, than spinning round in the same place where they begin, till they are burnt out, and showing nothing more than an horizontal circle of fire. 93 Table rockets.

The method of making these rockets is,—Have a cone turned out of hard wood two inches and a half in diameter, and as much high; round the base of it drive a line;

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line; on this line fix four spokes, each two inches long, so as to stand one opposite the other; then fill four nine-inch one pound cases with any strong composition, within two inches of the top: these cases are made like tourbillons, and must be rammed with the greatest exactness.

The rockets being filled, fix their open ends on the short spokes; then in the side of each case bore a hole near the clay; all these holes, or vents, must be so made that the fire of each case may act the same way; from these vents carry leaders to the top of the cone, and tie them together. When the rockets are to be fired, set them on a smooth table, and light the leaders in the middle, and all the cases will fire together (see fig. 32.) and spin on the point of the cone.

These rockets may be made to rise like tourbillons, by making the cases shorter, and boring four holes in the under side of each at equal distances: this being done they are called *double tourbillons*.

Note, All the vents in the under side of the cases must be lighted at once; and the sharp point of the cone cut off, at which place make it spherical.

94 Aerial globes or bombs.

Fireworks called aerial globes or bombs consist of a spherical case made of strong paper, or of wood, prepared as will be immediately described, and thrown from a mortar commonly made of pasteboard, with a copper chamber to contain the charge, such as AB, fig. 33. (Fig. 33.) This small mortar must be made of light wood, or of paper pasted together, and rolled up in the form of a cylinder, or truncated cone, the bottom excepted; which, as already said, must be of wood. The chamber for the powder AC must be pierced obliquely, with a small gimlet, as seen at BC; so that the aperture B corresponding to the aperture of the metal mortar, in which this paper mortar must be placed when the globe is fired, the fire applied to the latter may be communicated to the powder which is at the bottom of the chamber AC, immediately below the globe. By these means the globe will catch fire and make an agreeable noise as it rises into the air; but it would not succeed so well if any vacuity were left between the powder and globe.

A profile or perpendicular section of such a globe is represented by the right-angled parallelogram ABCD, fig. 34.; the breadth of which AB is nearly equal to the height AD. The thickness of the wood towards the two sides L, M, is equal to about the twelfth part of the diameter of the globe; and the thickness E, F, of the cover, is double the preceding, or equal to a sixth part of the diameter. The height GK, or HI of the chamber GHIK, where the match is applied, and which is terminated by the semicircle LGKM, is equal to the fourth part of the breadth AB, and its breadth GH is equal to the sixth part of AB.

We must here observe, that it is dangerous to put wooden covers, such as EF, on aerial balloons or globes, for these covers may be so heavy as to wound those on whom they happen to fall. It will be sufficient to place turf or hay above the globe, in order that the powder may experience some resistance.

The globe must be filled with several pieces of cane or common reed, equal in length to the interior height of the globe, and charged with a slow composition, made of three ounces of pounded gunpowder, an ounce of sulphur moistened with a small quantity of petroleum oil, and two ounces of charcoal; and in order that these reeds or canes may catch fire sooner, and with more facility, they must be charged at the lower ends, which rest on the bottom of the globe, with pulverized gunpowder moistened in the same manner with petroleum oil, or well besprinkled with brandy, and then dried.

The bottom of the globe ought to be covered with a little gunpowder half pulverized and half grained; which, when set on fire by means of a match applied to the end of the chamber GH, will set fire to the lower part of the reed. But care must have been taken to fill the chamber with a composition similar to that in the reeds, or with another slow composition made of eight ounces of gunpowder, four ounces of saltpetre, two ounces of sulphur, and one ounce of charcoal: the whole must be well pounded and mixed.

Instead of reeds, the globe may be charged with running rockets, or paper petards, and a quantity of fiery stars or sparks mixed with the pulverized gunpowder, placed without any order above these petards, which must be choked at unequal heights, that they may perform their effect at different times.

These globes may be constructed in various other ways, which it would be tedious here to enumerate. We shall only observe, that when loaded they must be well covered at the top; they must be wrapped up in a piece of cloth dipped in glue, and a piece of woollen cloth must be tied round them, so as to cover the hole which contains the match.

95 Fuzes for globes or air balloons.

Fuzes for air balloons are sometimes turned out of dry beech, with a cup at top to hold the quick-match, or other firing material; but if made with pasted paper, they will do as well: the diameter of the *former* for fuzes for coehorn balloons must be half an inch; for a royal fuze, five-eighths of an inch; for an eight inch fuze, three-fourths of an inch; and for a ten inch fuze, seven-eighths of an inch. Having rolled the cases, pinch and tie them almost close at one end: then drive them down, and let them dry. Before beginning to fill them, mark on the outside of the case the length of the charge required, allowing for the thickness of the bottom; and when the composition is rammed in, take two pieces of quick-match about six inches long, and lay one end of each on the charge, and then a little meal-powder, which ram down hard; the loose ends of the match double up into the top of the fuze, and cover it with a paper cap to keep it dry. When the shells are put into the mortars, uncap the fuzes, and pull out the loose ends of the match, and let them hang on the sides of the balloons. The use of the match is, to receive the fire from the powder in the chamber of the mortar, in order to light the fuze: the shell being put in the mortar with the fuze uppermost, and exactly in the centre, sprinkle over it a little meal-powder, and it will be ready to be fired. Fuzes made of wood must be longer than those of paper, and not bored quite through, but left solid about half an inch at bottom; and when used saw them off to a proper length, measuring the charge from the cut at top.

96 Tourbillons.

To make Tourbillons.—Having filled some cases within about one diameter and a half, drive in a ladleful of clay; then pinch the ends close, and drive them down with a mallet. When done, find the centre of gravity of each case: where the nail and stick are tied, which should

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should be half an inch broad at the middle, and run a little narrower to the ends: these sticks must have their ends turned upwards, so that the cases may turn horizontally on their centres: at the opposite sides of the cases, at each end, bore a hole close to the clay with a gimblet, the size of the neck of a common case of the same nature: from these holes draw a line round the case, and at the under part of the case bore a hole with the same gimblet, within half a diameter of each line towards the centre; then from one hole to the other draw a right line. Divide this line into three equal parts; and at X and Y (fig. 35.) bore a hole; then from these holes to the other two lead a quickmatch, over which paste a thin paper. Fig. 36. represents a tourbillon as it should lie to be fired, with a leader from one side hole A to the other B. When tourbillons are fired lay them on a smooth table, with their sticks downwards, and burn the leader through the middle with a portfire. They should spin three or four seconds on the table before they rise, which is about the time the composition will be burning from the side holes to those at bottom.

To tourbillons may be fixed reports in this manner: In the centre of the case at top make a small hole, and in the middle of the report make another; then place them together, and tie on the report, and with a single paper secure it from fire: this done, the tourbillon is completed. By this method you may fix on tourbillons small cones of stars, rains, &c. but be careful not to load them too much. One eighth of an inch will be enough for the thickness of the sticks, and their length equal to that of the cases.

97 Aigrettes.

Mortars to throw aigrettes are generally made of pasteboard, of the same thickness as balloon mortars, and two diameters and a half long in the inside from the top of the foot: the foot must be made of elm without a chamber, but flat at top, and in the same proportion as those for balloon mortars; these mortars must also be bound round with a chord: sometimes eight or nine of these mortars, of about three or four inches diameter, are bound all together, so as to appear but one: but when they are made for this purpose, the bottom of the foot must be of the same diameter as the mortars, and only half a diameter high. The mortars being bound well together, fix them on a heavy solid block of wood. To load these mortars, first put on the inside bottom of each a piece of paper, and on it spread one ounce and a half of meal and corn powder mixed; then tie the serpents up in parcels with quickmatch, and put them in the mortar with their mouths downwards; but take care the parcels do not fit too tight in the mortars, and that all the serpents have been well primed with powder wetted with spirit of wine. On the top of the serpents in each mortar lay some paper or tow; then carry a leader from one mortar to the other all round, and then from all the outside mortars into that in the middle: these leaders must be put between the cases and the sides of the mortar, down to the powder at bottom: in the centre of the middle mortar fix a fire pump, or brilliant fountain, which must be open at bottom, and long enough to project out of the mouth of the mortar; then paste paper on the tops of all the mortars.

Mortars thus prepared are called a *nest of serpents*, as represented by fig. 37. When these mortars are to be fired, light the fire pump C, which when consumed will communicate to all the mortars at once by means of the leaders. For mortars of 8, 9, or 10 inches diameter, the serpents should be made in one and two ounce cases, six or seven inches long, and fired by a leader brought out of the mouth of the mortar, and turned down the outside, and the end of it covered with paper, to prevent the sparks of the other works from setting it on fire. For a six-inch mortar, let the quantity of powder for firing be two ounces; for an eight-inch, two ounces and three quarters; and for a ten-inch, three ounces and three quarters. Care must be taken in these, as well as small mortars, not to put the serpents in too tight for fear of bursting the mortars. These mortars may be loaded with stars, crackers, &c.

If the mortars, when loaded, are sent to any distance, or liable to be much moved, the firing powder should be secured from getting amongst the serpents, which would endanger the mortars, as well as hurt their performance. To prevent this, load the mortars thus: First put in the firing powder, and spread it equally about; then cut a round piece of blue touch-paper, equal to the exterior diameter of the mortar, and draw on it a circle equal to the interior diameter of the mortar, and notch it all round as far as that circle: then paste that part which is notched, and put it down the mortar close to the powder, and stick the pasted edge to the mortar; this will keep the powder always smooth at bottom, so that it may be moved or carried anywhere without receiving damage. The large single mortars are called *pots des aigrettes*.

Pots des Brins are formed of pasteboard, and must be rolled pretty thick. They are usually made three or four inches diameter, and four diameters long; and pinched with a neck at one end, like common cases. A number of these are placed on a plank thus: Having fixed on a plank two rows of wooden pegs, cut in the bottom of the plank a groove the whole length under each row of pegs; then, through the centre of each peg, bore a hole down to the groove at bottom, and on every peg fix and glue a pot, whose mouth must fit tight on the peg; through all the holes run a quickmatch, one end of which must go into the pot, and the other into the groove, which must have a match laid in it from end to end, and covered with paper, so that when lighted at one end it may discharge the whole almost instantaneously: in all the pots put about one ounce of meal and corn powder; then in some put stars, and in others rains, snakes, serpents, crackers, &c.: when they are all loaded, paste paper over their mouths. Two or three hundred of these pots being fired together make a very pretty show, by affording so great a variety of fires. Fig. 38. is a range of pots des brins, with a leader A, by which they are fired. 98 Pots des brins.

Pots des Saucissons are generally fired out of large mortars without chambers, the same as those for aigrettes, only somewhat stronger. Saucissons are made of one and two ounce cases, five or six inches long, and choked in the same manner as serpents. Half the number which the mortar contains must be driven one diameter and a half with composition, and the other half two diameters, so that when fired they may give two volleys of reports. But if the mortars are very strong, and will bear a sufficient charge to throw the saucissons very high, you may make three volleys of reports, by dividing the number of cases into three parts, and making a difference 99 Pots des saucissons.

difference in the height of the charge. After they are filled, pinch and tie them at top of the charge almost close; only leaving a small vent to communicate the fire to the upper part of the case, which must be filled with corn-powder very near the top; then pinch the end quite close, and tie it: after this is done, bind the case very tight with waxed packthread, from the choke at top of the composition to the end of the case; this will make the case very strong in that part, and cause the report to be very loud. Saucissons should be rolled a little thicker of paper than the common proportion. When they are to be put in the mortar, they must be primed in their mouths, and fired by a case of brilliant fire fixed in their centre.

The charge for these mortars should be one-sixth or one-eighth more than for *pots des aigrettes* of the same diameter.

100 **Single vertical wheels.**

There are different sorts of vertical wheels; some having their fells of a circular form, others of an hexagonal, octagonal, or decagonal form, or of any number of sides, according to the length of the cases you design for the wheel: the spokes being fixed in the nave, nail slips of tin, with their edges turned up so as to form grooves for the cases to lie in, from the end of one spoke to that of another; then tie the cases in the grooves head to tail, in the same manner as those on the horizontal water-wheel, so that the cases successively taking fire from one another, will keep the wheel in an equal rotation. Two of these wheels are very often fired together, one on each side of a building; and both lighted at the same time, and all the cases filled alike, to make them keep time together; as they will, if made by the following directions: In all the cases of both wheels, except the first, on each wheel drive two or three ladlesful of slow fire, in any part of the cases; but be careful to ram the same quantity in each case, and in the end of one of the cases, on each wheel, you may ram one ladleful of dead-fire composition, which must be very lightly driven; you may also make many changes of fire by this method.

Let the hole in the nave of the wheel be lined with brass, and made to turn on a smooth iron spindle. On the end of this spindle let there be a nut, to screw off and on; when you have put the wheel on the spindle, screw on the nut, which will keep the wheel from flying off. Let the mouth of the first case be a little raised. See fig. 39. Vertical wheels are made from ten inches to three feet diameter, and the size of the cases must differ accordingly; four-ounce cases will do for wheels of 14 or 16 inches diameter, which is the proportion generally used. The best wood for wheels of all sorts is a light and dry beech.

101 **Horizontal wheels.**

Horizontal wheels are best when their fells are made circular; in the middle of the top of the nave must be a pintle, turned out of the same piece as the nave, two inches long, and equal in diameter to the bore of one of the cases of the wheel: there must be a hole bored up the centre of the nave, within half an inch of the top of the pintle. The wheel being made, nail at the end of each spoke (of which there should be six or eight) a piece of wood, with a groove cut in it to receive the case. Fix these pieces in such a manner that half the cases may incline upwards and half downwards, and that, when they are tied on, their heads and tails may come very nearly together; from the tail of one case to the mouth of the other carry a leader, which should be secured with pasted paper. Besides these pipes, it will be necessary to put a little meal-powder within the pasted paper, to blow off the pipe, that there may be no obstruction to the fire from the cases. By means of these pipes the cases will successively take fire, burning one upwards and the other downwards. On the pintle fix a case of the same sort as those on the wheel; this case must be fired by a leader from the mouth of the last case on the wheel, which case must play downwards: instead of a common case in the middle, you may put a case of Chinese fire, long enough to burn as long as two or three of the cases on the wheel.

Horizontal wheels are often fired two at a time, and made to keep time like vertical wheels, only they are made without any slow or dead fire; 10 or 12 inches will be enough for the diameter of wheels with six spokes. Fig. 40. represents a wheel on fire, with the first case burning. Plate CCCCLIV. fig. 40.

102 **Spiral wheels.**

Spiral wheels, are only double horizontal wheels, and made thus: The nave must be about six inches long, and rather thicker than the single sort; instead of the pintle at top, make a hole for the case to be fixed in, and two sets of spokes, one set near the top of the nave, and the other near the bottom. At the end of each spoke cut a groove wherein you tie the cases, there being no fell; the spokes should not be more than two inches and a half long from the naves, so that the wheel may not be more than eight or nine inches diameter; the cases are placed in such a manner, that those at top play down, and those at bottom play up, but let the third or fourth case play horizontally. The case in the middle may begin with any of the others: six spokes will be enough for each set, so that the wheel may consist of 12 cases, besides that on the top: the cases six inches each.

103 **Plural wheels.**

Plural wheels are made to turn horizontally, and to consist of three sets of spokes, placed six at top, six at bottom, and four in the middle, which last must be a little shorter than the rest: let the diameter of the wheel be 10 inches; the cases must be tied on the ends of the spokes in grooves cut on purpose, or in pieces of wood nailed on the end of the spokes, with grooves cut in them as usual: in clothing these wheels, make the upper set of cases play obliquely downwards, the bottom set obliquely upwards, and the middle set horizontally. In placing the leaders, they must be managed so that the cases may burn thus, viz. first up, then down, then horizontal, and so on with the rest. But another change may be made, by driving in the end of the eighth case two or three ladlesful of slow fire, to burn till the wheel has stopped its course; then let the other cases be fixed the contrary way, which will make the wheel run back again: for the case at top you may put a small gerbe; and let the cases on the spokes be short, and filled with a strong brilliant charge.

104 **Illuminated spiral wheels.**

Illuminated spiral wheels.—First have a circular horizontal wheel made two feet diameter, with a hole quite through the nave,; then take three thin pieces of deal, three feet long each, and three-fourths of an inch broad each: one end of each of these pieces nail to the fell of the wheel, at an equal distance from one another, and the other end nail to a block with a hole in its bottom, which must be perpendicular to that in the block of the wheel, but not so large. The wheel being thus made, have

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have a hoop planed down very thin and flat; then nail one end of it into the fell of the wheel, and wind it round the three sticks in a spiral line from the wheel to the block at top: on the top of this block fix a case of Chinese fire; on the wheel you may place any number of cases, which must incline downwards, and burn two at a time. If the wheel should consist of ten cases, you may let the illuminations and Chinese fire begin with the second cases. The spindle for this wheel must be a little longer than the cone, and made very smooth at top, on which the upper block is to turn, and the whole weight of the wheel to rest. See fig. 41.

105 Double spiral wheel.

Double spiral wheel.—For this wheel the block, or nave, must be as long as the height of the worms, or spiral lines, but must be made very thin, and as light as possible. In this block must be fixed several spokes, which must diminish in length, from the wheel to the top, so as not to exceed the surface of a cone of the same height. To the ends of these spokes nail the worms, which must cross each other several times: clothe these worms with illuminations, the same as those on the single wheels; but the horizontal wheel you may clothe as you like. At top of the worm place a case of spur-fire, or an amber light, see fig. 42. This figure is shown without leaders, to prevent a confusion of lines.

106 Balloon wheels.

Balloon wheels are made to turn horizontally: they must be made two feet diameter, without any spokes; and very strong, with any number of sides. On the top of a wheel range and fix in pots, three inches diameter and seven inches high each, as many of these as there are cases on the wheel: near the bottom of each pot make a small vent; into each of these vents carry a leader from the tail of each case; load some of the pots with stars, and some with serpents, crackers, &c. As the wheels turn, the pots will successively be fired, and throw into the air a great variety of fires.

107 Fruiloni wheels.

For fruiloni wheels first have a nave made nine inches long and three in diameter: near the bottom of this nave fix eight spokes, with a hole in the end of each, large enough to receive a two or four ounce case: each of these spokes may be 14 inches long from the block. Near the top of this block fix eight more of the same spokes, exactly over the others, but not so long by two inches. As this wheel is to run horizontally, all the cases in the spokes must play obliquely upwards, and all those in the spokes at bottom obliquely downwards. This being done, have a small horizontal wheel made with eight spokes, each five inches long from the block: on the top of this wheel place a case of brilliant fire: all the cases on this wheel must play in an oblique direction downwards, and burn two at a time, and those on the large wheel four at a time; that is, two of those in the top set of spokes, and two of those in the bottom set of spokes.

The four first cases on the large wheel, and the two first on the small, must be fired at the same time, and the brilliant fire at top at the beginning of the last cases. The cases of the wheels may be filled with a gray charge. When these wheels are completed, you must have a strong iron spindle, made four feet six inches long, and fixed perpendicularly on the top of a stand: on this put the large wheel, whose nave must have a hole quite through from the bottom to the top. This hole must be large enough to turn easily round the bottom of the spindle, at which place there must be a shoulder, to keep the wheel from touching the stand: at the top of the spindle put the small wheel, and join it to a large one with a leader, in order that they may be fired both together.

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Cascades of fire are made of any size; but one made according to the dimensions of that shown in fig. 43. will be large enough for eight-ounce cases. Let the distance from A to B be three feet; from B to C two feet six inches; and from C to D two feet; and let the cross piece at A be four feet long: then from each end of this piece draw a line to D; then make the other cross pieces so long as to come within those lines. The top piece D may be of any length, so as to hold the cases, at a little distance from each other; all the cross pieces are fixed horizontally, and supported by brackets; the bottom cross piece should be about one foot six inches broad in the middle, the second one foot, the third nine inches, and the top piece four inches: the cases may be made of any length, but must be filled with a brilliant charge. On the edges of the cross pieces must be nailed bits of wood, with a groove cut in each piece, large enough for a case to lie in. These bits of wood are fixed so as to incline downwards, and that the fire from one tier of cases may play over that of the other. All the cases being tied fast on, carry leaders from one to the other; and let there be a pipe hung from the mouth of one of the cases, covered at the end with a single paper, which you burn to fire the cascade. 108 Cascades of fire.

The Fire Tree.—To make a fire tree, as shown by fig. 44. you must first have a piece of wood six feet long, and three inches square; then at E, nine inches from the top, make a hole in the front, and in each side; or, instead of holes, you may fix short pegs, to fit the inside of the cases. At F, nine inches from E, fix three more pegs; at G, one foot nine inches from F, fix three pegs; at H nine inches from G, fix three pegs; at I, nine inches from H, fix three pegs, inclining downwards; but all the other pegs must incline upwards, that the cases may have the same inclination as is seen in the figure: then at top place a four-inch mortar, loaded with stars, rains, or crackers. In the middle of this mortar place a case filled with any sort of charge, but let it be fired with the other cases: a brilliant charge will do for all the cases; but the mortar may be made of any diameter, and the tree of any size; and on it any number of cases, provided they are placed in the manner described. 109 Fire tree.

Chinese Fountains.—To make a Chinese fountain, you must have a perpendicular piece of wood seven feet long and two inches and a half square. Sixteen inches from the top, fix on the front a cross piece one inch thick, and two and a half broad, with the broad side upwards; below this, fix three more pieces of the same width and thickness, at sixteen inches from each other; let the bottom rail be five feet long, and the others of such a length as to allow the fire-pumps to stand in the middle of the intervals of each other. The pyramid being thus made, fix in the holes made in the bottom rail five fire pumps, at equal distances; on the second rail, place four pumps; on the third, three; on the fourth, two; and on the top of the post, one; but place them all to incline a little forwards, that, when they throw out the stars, they may not strike against the 110 Chinese fountains.

the cross rails. Having fixed your fire-pumps, clothe them with leaders, so that they may all be fired together. See fig. 45.

111 Illuminated globes with horizontal wheels.

Of illuminated Globes with horizontal Wheels.—The hoops for these globes may be made of wood, tin, or iron wire, about two feet in diameter. For a single globe, take two hoops, and tie them together, one within the other, at right angles; then have a horizontal wheel made, whose diameter must be a little wider than the globe, and its nave six inches long; on the top of which the globe is fixed, so as to stand three or four inches from the wheel: on this wheel you may put any number of cases, filled with what charge you please; but let two of them burn at a time: they may be placed horizontally, or to incline downwards, just as you choose. Now, when the wheel is clothed, fix on the hoops as many illuminations as will stand within two inches and a half of each other: fasten these on the hoops with small iron binding wire; and when they are all on, put on the pipes of communication, which must be so managed as to light them all with the second or third case on the wheel. The spindle on which the globe is to run must go through the block of the wheel, up to the inside of the top of the globe; where must be fixed a bit of brass, or iron, with a hole in it to receive the point of the spindle, on which the whole weight of the wheel is to bear, as in fig. 46. which represents a globe on its spindle. By this method may be made a crown, which is done by having the hoops bent in the form of a crown. Sometimes globes and crowns are managed so as to stand still, and the wheel only to turn round; but when you would have the globe or crown to stand still, and the wheel to run by itself, the block of the wheel must not be so long, nor the spindle any longer than just to raise the globe a little above the wheels; and the wheel cases and illumination must begin together.

112 Dodecahedron.

The Dodecahedron.—So called because it nearly represents a twelve-sided figure, is made thus: First have a ball turned out of some hard wood, 14 inches diameter: divide its surface into 14 equal parts, from which bore holes one inch and a half diameter, perpendicular to the centre, so that they may all meet in the middle: then let there be turned in the inside of each hole a female screw; and to all the holes but one must be made a round spoke five feet long, with four inches of the screw at one end to fit the holes; then in the screw-end of all the spokes bore a hole, five inches up, which must be bored slanting, so as to come out at one side, a little above the screw; from which cut a small groove along the spoke, within six inches of the other end, where make another hole through to the other side of the spoke. In this end fix a spindle, on which put a small wheel of three or four sides, each side six or seven inches long; these sides must have grooves cut in them, large enough to receive a two or four ounce case. When these wheels are clothed, put them on the spindles, and at the end of each spindle put a nut to keep the wheel from falling off. The wheels being thus fixed, carry a pipe from the mouth of the first case on each wheel, through the hole in the side of the spoke, and from thence along the groove, and through the other hole, so as to hang out at the screw-end about an inch. The spokes being all prepared in this manner, you must have a post, on which you intend to fire the work, with an iron screw in the top of it, to fit one of the holes in the ball: on the screw fix the ball; then in the top hole of the ball put a little meal-powder, and some loose quick-match: then screw in all the spokes; and in one side of the ball bore a hole, in which put a leader, and secure it at the end; and the work will be ready to be fired. By the leader the powder and match in the centre is fired, which will light the match at the ends of the spokes all at once, whereby all the wheels will be lighted at once. There may be an addition to this piece, by fixing a small globe on each wheel, or one on the top wheel only. A gray charge will be proper for the wheel cases.

113 Yew tree of brilliant fire.

The Yew Tree of Brilliant Fire is represented by fig. 47. as it appears when burning. First, let A be an upright piece of wood, four feet long, two inches broad, and one thick: at top of the piece, on the flat side, fix a hoop 14 inches diameter; and round its edge and front place illuminations, and in the centre a five-pointed star; then at E, which is one foot and a half from the edge of the hoop, place two cases of brilliant fire, one on each side; these cases should be one foot long each: below these fix two more cases of the same size, and at such a distance that their mouths may almost meet them at top: then close to the ends of these fix two more of the same cases; they must stand parallel to them at E. The cases being thus fixed, clothe them with leaders; so that they, with the illuminations and stars at top, may all take fire together.

114 Stars with points.

Stars with Points for regulated Pieces, &c.—These stars are made of different sizes, according to the work for which they are intended; they are made with cases from one ounce to one pound, but in general with four-ounce cases, four or five inches long: the case must be rolled with paste, and twice as thick as that of a rocket of the same bore. Having rolled a case, pinch one end of it quite close: then drive in half a diameter of clay; and when the case is dry, fill it with composition two or three inches to the length of the cases with which it is to burn: at top of the charge drive some clay; as the ends of these cases are seldom pinched, they would be liable to take fire. Having filled a case, divide the circumference of it at the pinched end close to the clay into five equal parts; then bore five holes with a gimblet about the size of the neck of a common four-ounce case, into the composition: from one hole to the other carry a quick-match, and secure it with paper: this paper must be put on in the manner of that on the end of wheel-cases, so that the hollow part, which projects from the end of the case, may serve to receive a leader from any other work, to give fire to the points of the stars. These stars may be made with any number of points.

115 Fixed sun with a transparent face.

Fixed Sun with a transparent Face.—To make a sun of the best kind, there should be two rows of cases, as in fig. 48. which will show a double glory, and make the rays strong and full. The frame or sun-wheel, must be made thus: Have a circular flat nave made very strong, 12 inches diameter: to this fix six strong flat spokes, A, B, C, D, E, F. On the front of these fix a circular fell, five feet diameter; within which fix another fell, the length of one of the sun-cases less in diameter; within this fix a third fell, whose diameter must be less than the second by the length of one case and one-third. The wheel being made, divide the fells into so many equal

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parts as there are to be cases (which may be done from 24 to 44): at each division fix a flat iron staple; these staples must be made to fit the cases, to hold them fast on the wheel; let the staples be so placed, that one row of cases may lie in the middle of the intervals of the other.

In the centre of the block of the sun drive a spindle, on which put a small hexagonal wheel, whose cases must be filled with the same charge as the cases of the sun: two cases of this wheel must burn at a time, and begin with them on the fells. Having fixed on all the cases, carry pipes of communication from one to the other, as you see in the figure, and from one side of the sun to the wheel in the middle, and from thence to the other side of the sun. These leaders will hold the wheel steady while the sun is fixing up, and will also be a sure method of lighting both cases of the wheel together. A sun thus made is called a *brilliant sun*, because the wood work is entirely covered with fire from the wheel in the middle, so that there appears nothing but sparks of brilliant fire: but if you would have a transparent face in the centre, you must have one made of pasteboard of any size. The method of making a face is, by cutting out the eyes, nose, and mouth for the sparks of the wheel to appear through; but instead of this face, you may have one painted on oiled paper, or Persian silk, strained tight on a hoop; which hoop must be supported by three or four pieces of wire at six inches distance from the wheel in the centre, so that the light of it may illuminate the face. By this method may be shown in the front of a sun, VIVAT REX, cut in pasteboard, or Apollo painted on silk; but, for a small collection, a sun with a single glory, and a wheel in front, will be most suitable. Half pound cases, filled ten inches with composition, will be a good size for a sun of five feet diameter; but if larger, the cases must be greater in proportion.

116 Three vertical wheels illuminated.

Three Vertical Wheels illuminated, which turn on their own Naves upon a horizontal Table.—A plan of this is shown by fig. 49. Let D be a fir table three feet in diameter: this table must be fixed horizontally on the top of a post; on this post must be a perpendicular iron spindle, which must come through the centre of the table: then let A, B, C, be three spokes joined to a triangular flat piece of wood, in the middle of which make a hole to fit easily over the spindle: let E, F, G, be pieces of wood, four or five inches long each, and two inches square, fixed on the under sides of the spokes; in these pieces make holes lengthwise to receive the thin part of the blocks of the wheels, which, when in, are prevented from coming out by a small iron pin being run through the end of each. K, L, M, are three vertical octagonal wheels, 18 inches diameter each: the blocks of these wheels must be long enough for three or four inches to rest on the table; round which part drive a number of sharp points of wire, which must not project out of the blocks more than 1-16th of an inch: the use of these points is, that, when the blocks run round, they will stick in the table, and help the wheels forward: if the naves are made of strong wood, one inch will be enough for the diameter of the thin part, which should be made to turn easily in the holes of the pieces E, F, G. On the front of the wheels make four or five circles of strong wire, or flat hoops, and tie on them as many illuminations as they will hold at two inches distant from each other: instead of circles, you may make spiral lines, clothed with illuminations, at the same distance from each other as those on the hoops. When illuminations are fixed on a spiral line in the front of a wheel, they must be placed a little on the slant, the contrary way from that in which the wheel runs; the cases for these wheels may be filled with any coloured charge, but must burn only one at a time.

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The wheels being thus prepared, you must have a globe, crown, or spiral wheel, to put on the spindle in the middle of the table: this spindle should be just long enough to raise the wheel of the globe, crown, or spiral wheel, so high that its fire may play over the three vertical wheels: by this means their fires will not be confused, nor will the wheels receive any damage from the fire of each other. In clothing this work, let the leaders be so managed, that all the wheels may light together, and the illuminations after two cases of each wheel are burned.

117 Illuminated chandelier.

Illuminated works are much admired by the Italians, and indeed are a great addition to a collection of works: in a grand exhibition an illuminated piece should be fired after every two or three wheels, or fixed pieces of common and brilliant fires; and likewise illuminated works may be made cheap, quick, and easy.

To make an illuminated chandelier, you must first have one made of thin wood (see fig. 50.). The chandelier being made, bore in the front of the branches, and in the body, and also in the crown at top, as many holes for illuminations as they will contain at three inches distance from each other: in these holes put illuminations filled with white, blue, or brilliant charge. Having fixed in the port-fires, clothe them with leaders. so that the chandelier and crown may light together The small circles on this figure represent the mouths of the illuminations, which must project straight from the front.

118 Flaming star with brilliant wheels.

To make a flaming star with brilliant wheels, you must first have made a circular piece of strong wood about one inch thick and two feet diameter? round this block fix eight points, two feet six inches long each; four of these points must be straight and four flaming: these points being joined on very strong, and even with the surface of the block, nail tin or pasteboard on their edges, from the block to the end of each, where they must be joined; this tin must project in front eight inches, and be joined where they meet at the block; round the front of the block fix four pieces of thick iron wire, eight inches long each, equally distant from each other: this being done, cut a piece of pasteboard round, two feet diameter, and draw on it a star, as may be seen in fig. 51. Cut out this star, and on the back of it paste oiled paper; then paint each point half red and half yellow, lengthwise; but the body of the star must be left open, wherein must run a brilliant wheel, made thus: Have a light block turned nine inches long: at each end of it fix six spokes; at the end of each spoke put a two ounce case of brilliant fire: the length of these cases must be in proportion to the wheel, and the diameter of the wheel when the cases are on must be a little less than the diameter of the body of the small star: the cases on the spokes in front must have their mouths incline outwards, and those on the inside spokes must be placed so as to form a vertical circle of fire. When you place the leaders, carry the first pipe from the tail of one of the cases

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cases in front to the mouth of one of the inside cases, and from the tail of that to another in front, and so on to all the cases. The wheel being made, put it on a spindle, in the centre of the star; this spindle must have a shoulder at bottom, to keep the wheel at a little distance from the block. The wheel must be kept on the spindle by a nut at the end; having fixed on the wheel, fasten the transparent star to the four pieces of wire: when you fire it, you will only see a common horizontal wheel; but when the first case is burnt out, it will fire one of the vertical cases, which will show the transparent star, and fill the large flames and points with fire; then it will again appear like a common wheel, and so on for 12 charges.

119 Projected regulated piece with mutations.

A regulated piece, if well executed, is as curious as any in fire-works: it consists of fixed and moveable pieces on one spindle, representing various figures, which take fire successively one from another, without any assistance after lighting the first mutation. See fig. 53.

Fig. 53. Plate CCCCLV.

I. Names of the mutations, with the colour of fire and size of the case belonging to each.

First mutation is a hexagon vertical wheel, illuminated in front with small portfires tied on the spokes; this wheel must be clothed with two ounce cases, filled with black charge; the length of these cases is determined by the size of the wheel, but must burn singly.

Second mutation is a fixed piece, called a *golden glory*, by reason of the cases being filled with spur-fire. The cases must stand perpendicular to the block on which they are fixed, so that, when burning, they may represent a glory of fire. This mutation is generally composed of five or seven two ounce cases.

Third mutation is moveable; and is only an octagon vertical wheel, clothed with four ounce cases, filled with brilliant charge: two of these cases must burn at a time. In this wheel you may make changes of fire.

Fourth mutation is a fixed sun of brilliant fire, consisting of 12 four ounce cases; the necks of these cases must be a little larger than those of four ounce wheel-cases. In this mutation may be made a change of fire, by filling the cases half with brilliant charge, and half with gray.

Fifth mutation is a fixed piece, called the *porcupine's quills*. This piece consists of 12 spokes, standing perpendicular to the block on which they are fixed; on each of those spokes, near the end, must be placed a four ounce case of brilliant fire. All these cases must incline either to the right or left, so that they may all play one way.

Sixth mutation is a standing piece, called the *cross-fire*. This mutation consists of eight spokes fixed in a block; near the end of each of those spokes must be tied two four ounce cases of white charge, one across the other, so that the fires from the cases on one spoke may may intersect the fire from the cases on the other.

Seventh mutation is a fixed wheel, with two circular fells, on which are placed 16 eight ounce cases of brilliant fire, in the form of a star. This piece is called a *fixed star of wild fire*.

Eighth mutation.—This is a beautiful piece, called a *brilliant star-piece*. It consists of six spokes, which are strengthened by two fells of a hexagon form, at some distance from each other: at the end of each spoke, in the front, is fixed a brilliant star of five points; and on each side of every star is placed a four ounce case of black or gray charge; these cases must be placed with their mouths sidewise, so that their fires may cross each other.

Ninth mutation is a wheel-piece. This is composed of six long spokes, with a hexagon vertical wheel at the end of each: these wheels run on spindles in the front of the spokes; all the wheels are lighted together: two ounce cases will do for these wheels, and may be filled with any coloured charge.

II. Proportions of the mutations, with the method of conveying the fire from one to the other, and the distance at which they stand one from the other on the spindle.

First mutation must be a hexagon vertical wheel, 14 inches diameter; on one side of the block, whose diameter is two inches and a quarter, is fixed a tin barrel A (see fig. 53. N° 1.). This barrel must be a little less in diameter than the nave; let the length of the barrel and block be six inches. Having fixed the cases on the wheel, carry a leader from the tail of the last case into the tin barrel through a hole made on purpose, two inches from the block; at the end of this leader let there be about one inch or two of loose match, but take care to securé well the hole wherein the pipe is put, to prevent any sparks falling in, which would light the second mutation before its time, and confuse the whole.

Second mutation is thus made: Have a nave turned two inches and a half diameter, and three long; then let half an inch of that end which faces the first wheel be turned so as to fit easy into the tin barrel of the first mutation, which must turn round it without touching. On the other end of the block fix a tin barrel B, N° 2. This barrel must be six inches long, and only half an inch of it to fit on the block. Round the nave fix five spokes, one inch and a half long each; the diameter of the spokes must be equal to a two ounce *former*. On these spokes put five seven inch two ounce cases of spur-fire, and carry leaders from the mouth of one to the other, that they may all light together. Then from the mouth of one of the cases carry a leader through a hole bored slantwise in the nave, from between the spokes, to the front of the block near the spindle hole: the end of this leader must project out of the hole into the barrel of the first mutation, so that when the pipe which comes from the end of the last case on the first wheel flashes, it may take fire, and light the second mutation. To communicate the fire to the third mutation, bore a hole near the bottom of one of the five cases to the composition, and from thence carry a leader into a hole made in the middle of the barrel B: this hole must be covered with pasted paper.

Third mutation may be either an octagon or hexagon wheel, 20 inches diameter; let the nave be three inches and a quarter diameter, and three and a half in length; one inch and a half of the front of the nave must be made to fit in the barrel B. On the other end of the block fix a tin barrel C, N° 3. This barrel must be six inches and a half in length, one inch of which must fit over the block. The cases of this wheel must burn two at a time; and from the mouths of the first two cases carry a leader, through holes in the nave, into the barrel of the second mutation, after the usual manner: but besides these leaders let a pipe go across the wheel from the first case to the other; then from the tail of one of the

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the last cases carry a pipe into a hole in the middle of the barrel C: at the end of this pipe let there be some loose quick-match.

Fourth and fifth mutations.—These may be described under one head, as their naves are made of one piece, which from E to F is 14 inches; E, a block four inches diameter, with 10 or 12 short spokes, on which are fixed 11 inch eight ounce cases: let the front of this block be made to fit easily in the barrel C, and clothe the cases so that they may all light together; and let a pipe be carried through a hole in the block into the barrel C, in order to receive the fire from the leader brought from the last case on the wheel. G is the nave of the 5th mutation; whose diameter must be four inches and a half: in this nave fix 10 or 12 spokes, one foot and a half in length each; these spokes must stand seven inches distant from the spokes of the 4th mutation; and at the end of each spoke tie a four ounce case, as N° 5. All these cases are to be lighted together, by a leader brought from the end of one of the cases on N° 4. Let F and H be of the same piece of wood as E and G, but as much thinner as possible, to make the work light.

Sixth and seventh mutations.—The blocks of these two mutations are turned out of one piece of wood, whose length from F to P is 15 inches. L, a block five inches diameter, in which are fixed eight spokes, each two feet four inches long; at the end of each spoke tie two four ounce cases, as in N° 6. All these cases must be fired at the same time, by a pipe brought from the end of one of the cases on the 5th mutation. Let the distance between the spokes at L, and those in the 5th mutation, be seven inches. M, the nave of the 7th mutation, whose diameter must be five inches and a half: in this nave fix eight spokes, and on the front of them two circular fells, one of four feet eight inches diameter, and one of three feet 11 diameter; on these fells tie 16 eight ounce or pound cases, as in N° 7. and carry leaders from one to the other, so that they may be all fired together. This mutation must be fired by a leader brought from the tail of one of the cases on the 6th mutation.

Eighth and ninth mutations.—The blocks of these may be turned out of one piece, whose length from P to D must be 12 inches. O, the block of the 8th mutation, which must be six inches diameter; and in it must be fixed six spokes, each three feet in length, strengthened by a hexagon fell within three or four inches of the ends of the spokes: close to the end of each spoke, in the front, fix a five-pointed brilliant star; then seven inches below each star tie two 10 inch eight ounce cases, so that the upper ends of the cases may rest on the fells, and their ends on the spokes. Each of these cases must be placed parallel to the opposite fell (see N° 8.) NNN, &c. are the cases, and kkk, &c. the stars.

The 9th mutation is thus made: Let D be a block seven inches diameter. In this block must be screwed six spokes, six feet long each, with holes and grooves for leaders, as those in the dodecahedron; at the end of each spoke, in the front, fix a spindle for a hexagon vertical wheel, 10 inches diameter, as in N° 9. When these wheels are on, carry a leader from each into the block, so that they may all meet; then lead a pipe from the end of one of the cases of the 8th mutation, through a hole bored in the block D, to meet the leaders from the vertical wheels, so that they may all be fired together.

The spindles for larger pieces are required to be made very strong, and exact as possible; for a piece of nine mutations, let the spindle be at the large end one inch diameter, and continue that thickness as far as the 7th mutation; and thence to the 5th, let its diameter be three-fourths of an inch; from the fifth to the fourth, five-eighths of an inch; from the fourth to the second half an inch; and from the second to the end three eighths of an inch. At the small end must be a nut to keep on the first wheel, and at the thick end must be a large nut, as shown by the figure; so that the screw part of the spindle being put through a post, and a nut screwed on tight, the spindle will be held fast and steady: but you are to observe, that that part of the spindle on which the moveable pieces are to run, be made long enough for the wheels to run easy without sticking; the fixed pieces being made on different blocks, the leaders must be joined after they are fixed on the spindle. The best method of preventing the fixed mutations from moving on the spindle, is to make that part of the spindle which goes through them square; but as it would be difficult to make square holes through such long blocks as are sometimes required, it will be best to make them thus: Bore a hole a little larger than the diameter of the spindle; and at each end of the block, over the hole, fasten a piece of brass with a square hole in it to fit the spindle.

120 Horizontal changed to a vertical wheel.

To make a horizontal wheel change to a vertical wheel with a sun in front.—The sudden change of this piece is very pleasing; and gives great surprise to those who are not acquainted with the contrivance. A wheel for this purpose should be about three feet diameter, and its fell circular: on which tie 16 half pound cases filled with brilliant charge: two of these cases must burn at a time: and on each end of the nave must be a tin barrel of the same construction as those on the regulated piece. The wheel being completed, prepare the post or stand thus: First have a stand made of any height, about three or four inches square; then saw off from the top a piece two feet long; this piece join again at the place where it was cut with a hinge on one side, so that it may lift up and down in the front of the stand; then fix on the top of the bottom part of the stand, on each side, a bracket; and these brackets must project at right angles with the stand, one foot from the front, for the short piece to rest on. These brackets must be placed a little above the joint of the post, so that when the upper stand falls, it may lie between them at right angles with the bottom stand; which may be done by fixing a piece of wood, one foot long, between the brackets, and even with the top of the bottom stand; then, as the brackets rise above the bottom stand, they will form a channel for the short post to lie, and keep it steady without straining the hinge. On the side of the short post, opposite the hinge, nail a piece of wood, of such a length, that, when the post is perpendicular, it may reach about one foot and a half down the long post; to which being tied, it will hold the short stand upright. The stand being thus prepared, in the top of it fix a spindle 10 inches long: on this spindle put the wheel: then fix on a brilliant sun with a single glory; the diameter of this sun must be six inches less than that of the wheel. When you fire this piece, light the wheel first, and let it run horizontally till four cases are consumed: then from the end of the fourth case carry a leader into the tin barrel that turns over the end of the stand: this leader must be met by another brought through the top of

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of the post, from a case filled with a strong port-fire charge, and tied to the bottom post, with its mouth facing the packthread which holds up the stand; so that when this case is lighted, it will burn the packthread, and let the wheel fall forward, by which means it will become vertical: then from the last case of the wheel, carry a leader into the barrel next the sun, which will begin as soon as the wheel is burnt out.

121 Grand illuminated volute.

Grand volute illuminated with a projected wheel in front.—First have two hoops made of strong iron wire, one of six feet diameter, and one of four feet two inches; these hoops must be joined to scrolls A, A, A, &c. as in fig. 54. These scrolls must be made of the same sort of wire as the hoops; on these scrolls tie, with iron-binding wire, as many illuminating port-fires as they will hold, at two inches distance; clothe these port-fires with leaders, so that they may all take fire together.—Then let C be a circular wheel of four spokes, three feet six inches diameter; and on its fell tie as many four ounce cases, head to tail, as will complete the circle, only allowing a sufficient distance between the cases, that the fire may pass free; which may be done by cutting the upper part of the end of each case a little shelving: on each spoke fix a four ounce case, about three inches from the fell of the wheel: these cases are to burn one at a time, and the first of them to begin with those on the fell, of which four are to burn at a time; so that the wheel will last no longer than one-fourth of the cases on the fell, which in number should be 16 or 20. On the front of the wheel form a spiral line with strong wire, on which tie port fires, placing them on a slant, with their mouths to face the same way as the cases on the wheel: all these port-fires must be fired with the second cases of the wheel. Let D, D, D, &c. be spokes of wood, all made to screw into a block in the centre; each of these spokes may be in length about four feet six inches; in the top of each fix a spindle, and on each spindle put a spiral wheel of eight spokes, such as E, E, E, &c. The blocks of these wheels must have a hole at top for the centre case, and the spindle must have nuts screwed on their ends; which nuts should fit in the holes at top of the blocks, so that all the wheels must be put on before you fix in the centre cases: as some of these wheels, from their situation, will not bear on the nut, it will be necessary to have smooth shoulders made on the spindles for the blocks to run on. The cases of these wheels are to burn double; and the method of firing them, is by carrying a leader from each down the spokes into the block in the centre, as in the dodecahedron, but the centre case of each wheel must begin with the two last cases as usual. It is to be observed, that the large circular wheel in front must have a tin barrel on its block, into which a pipe must be carried from one of the second cases on the wheel; this pipe being met by another from the large block, in which the eight spokes are screwed, will fire all the spiral wheels and the illuminating port-fires at the same time. The cases of the projected wheel may be filled with a white charge, and those of the spiral wheels with a gray charge.

Fig. 54.

122 Moon and seven stars.

Fig. 55.

Let fig. 55. be a smooth circular board six feet diameter: out of the middle of it cut a circular piece 12 or 14 inches diameter; and over the vacancy put white Persian silk, on which paint a moon's face: then let I, I, I, &c. be stars, each four or five inches diameter, cut out with five points, and covered with oiled silk: on the front of the large circular board draw a seven pointed star as large as the circle will allow; then on the lines which form this star bore holes, wherein fix pointed stars. When this case is to be fired, it must be fixed upon the front of a post, on a spindle, with a wheel of brilliant fire behind the face of the moon; so that while the wheel burns, the moon and stars will appear transparent: and when the wheel has burnt out, they will disappear, and the large star in front, which is formed of pointed stars, will begin, being lighted by a pipe of communication from the last case of the vertical wheel, behind the moon; this pipe must be managed in the same manner as those in regulated pieces.

123 Double cone wheel illuminated.

Fig. 56.

Double cone-wheel illuminated.—This piece is represented by fig. 56. Let A be a strong decagonal or ten-sided wheel, two feet six inches diameter; then on each side of it fix a cone B and C: these cones are to consist of a number of hoops, supported by three or four pieces of wood, in the manner of the spiral wheels. Let the height of each cone be three feet six inches; and on all the hoops tie port-fires horizontally, with their mouths outwards, and clothe the wheel with eight-ounce cases, all to play horizontally, two at a time: the cones may be fired with the first or second cases. The spindle for this piece must go through both the cones, and rise three feet above the point of the cone at top; so that its length will be 10 feet four inches from the top of the post H, in which it is fixed, allowing four inches for the thickness of the block of the wheel. The whole weight of the wheel and cones must bear on a shoulder in the spindle, on which the block of the wheel must turn.—Near the top of the spindle must be a hole in the front, into which screw a small spindle, after the cones are on: then on this small spindle fix a sun D, composed of sixteen nine inch four-ounce cases of brilliant fire; which cases must not be placed on a fell, but only stuck into a block of six inches diameter: then in the front of this sun must be a circular vertical wheel, 16 inches diameter; on the front of this wheel form with iron-wire a spiral line, and clothe it with illuminations after the usual method. As this wheel is not to be fired till the cones are burnt out, the method of firing it is this: Let the hole in the block, at the top of the uppermost cone, be a little larger than the spindle which passes through it. Then, from the first case of the vertical wheel before the sun, carry a leader down the side of the spindle to the top of the block of the horizontal wheel, on which must be a tin barrel: then this leader being met by another brought from the end of the last case of the horizontal wheel, will give fire to the vertical wheel as soon as the cones are extinguished: but the sun D must not be fired till the vertical wheel is quite burned out.

124 Fire pumps.

Cases for fire pumps are made as those for tourbillons; only they are pasted, instead of being rolled dry. Having rolled and dried the cases, fill them: first put in a little meal-powder, and then a star; on which ram lightly a ladleful or two of composition, then a little meal-powder, and on that a star, then again composition; and so on till the cases are filled. Stars for fire pumps should not be round; but must be made either square, or flat and circular, with a hole through the middle: the quantity of powder for throwing the stars must increase near the top of the case; for, if much powder be put at the bottom, it will burst the case. The stars must differ in size in this manner: Let the star which is put

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put in first be about a quarter less than the bore of the case; but let the next star be a little larger, and the third star a little larger than the second, and so on: let them increase in diameter till within two of the top of the case, which two must fit in tight. As the loading of fire-pumps is rather difficult, it will be necessary to make two or three trials before depending on their performance: when you fill a number of pumps, take care not to put in each an equal quantity of charge between the stars, so that when they are fired, they may not throw up too many stars together. Cases for fire-pumps should be made very strong, and rolled on four or eight ounce formers, 10 or 12 inches long each.

125 Vertical scroll wheel, Fig. 57.

A vertical scroll wheel may be made of any diameter, but must be constructed as in fig. 57. to do which proceed thus: Have a block made of a moderate size, in which fix four flat spokes, and on them fix a flat circular fell of wood; round the front of this fell place port-fires; then on the front of the spokes form a scroll, either with a hoop or strong iron wire; on this scroll tie cases of brilliant fire, in proportion to the wheel, head to tail, as in the figure. When you fire this wheel, light the first case near the fell; then, as the cases fire successively, the circle of fire will gradually diminish; but whether the illuminations on the fell begin with the scroll or not, is immaterial.

N. B. This wheel may be put in the front of a regulated piece, or fired by itself, occasionally.

126 Fire-globe.

There are two sorts of *fire-globes;* one with projected cases; the other with the cases concealed. For the latter have a globe made of wood, of any diameter, and divide the surface of it into 14 equal parts, and at each division bore a hole perpendicular to the centre: these holes must be in proportion to the cases intended to be used: in every hole, except one, put a case filled with brilliant or any other charge, and let the mouths of the cases be even with the surface of the globe; then cut in the globe a groove, from the mouth of one case to the other, for leaders which must be carried from case to case, so that they may all be fired together; this done, cover the globe with a single paper, and paint it. These globes may be used to ornament a building.

Fire-globes with projected cases are made thus: the globe being made with 14 holes bored in it as usual, fix in every hole except one, a case, and let each case project from the globe two-thirds of its length; then clothe all the cases with leaders, so that they may all take fire at the same time. Fire-globes are supported by a pintle, made to fit the hole in which there is no case.

127 Method of placing fire-works to be exhibited.

Nothing adds more to the appearance of fire-works than placing them properly; though this chiefly depends on the judgment of the maker. The following are the rules generally observed, whether the works are to be fired on a building or on stands: if they are a double set, place one wheel of a sort on each side of the building; and next to each of them, towards the centre, place a fixed piece, then wheels, and so on; leaving a sufficient distance between them for the fire to play from one without burning the other. Having fixed some of the works thus in front, place the rest behind them, in the centre of their intervals: The largest piece, which is generally a regulated or transparent piece, must be placed in the centre of the building, and behind it a sun, which must always stand above all the other works. A little before the building, or stands, place the large gerbes; and at the back of the works six marroon batteries, *pots des aigrettes, pots des brins, pots des saucissons*, air-balloons, and flights of rockets: the rocket stands may be fixed behind, or anywhere else, so as not to be in the way of the works.

Single collections are fired on stands; which are made in the same manner as theodolite stands, only the top part must be long or short occasionally: these stands may be fixed up very soon without much trouble.

The following order of Firing will serve as a specimen of the Plan to be pursued in an exhibition of Fire-works.

1. Two signal } rockets
2. Six sky } rockets
3. Two honorary } rockets
4. Four caduceus } rockets
5. } Two { vertical } wheels illuminated
6. } Two { spiral } wheels illuminated
7. } Two { transparent stars
8. A line rocket of five changes
9. Four tourbillons
10. } Two { horizontal wheels
11. } Two { air balloons illuminated
12. } Two { Chinese fountains
13. } Two { regulating pieces of four mutations each
14. } Two { *pots des aigrettes*
15. Three large gerbes
16. A flight of rockets
17. } Two { balloon wheels
18. } Two { cascades of brilliant fire
19. Twelve sky rockets
20. } Two { illuminated yew trees
21. } Two { air-balloons of serpents and two compound
22. Four tourbillons
23. } Two { Fruiloni wheels
24. } Two { illuminated globes with horizontal wheels
25. One *pot des saucissons*
26. Two plural wheels
27. Marroon battery
28. Two chandeliers illuminated
29. Range of *pots des brins*
30. Twelve sky-rockets
31. Two yew-trees of fire
32. Nest of serpents
33. Two double cones illuminated
34. Regulating piece of seven mutations, viz.
    1. Vertical wheel illuminated
    2. Golden glory
    3. Octagon vertical wheel
    4. Porcupine's quills
    5. Cross fires
    6. Star-piece with brilliant rays
    7. Six vertical wheels
35. Brilliant sun
36. Large flight of rockets.

When water-works are to be exhibited, divide them into several sets, and fire one set after every fifth or sixth change of land and air-works. Observe this rule in firing a double set of works: Always begin with sky-rockets, then two moveable pieces, then two fixed pieces, and so on; ending with a large flight of rockets, or a marroon battery: if a single collection, fire a fixed piece after every wheel or two, and now and then some air and water-works.

Fig.

'arieties of Con-ruction.

128 ountain of rockets. ℥. 58.

Fig. 58. represents a fountain of 30 rockets. Let A be a perpendicular post, 16 feet high from the ground, and 4 inches square. Let the rail, or cross piece C, be one foot six inches long, three inches broad, and one thick. The rail D, at bottom, must be six feet long, one foot broad, and one inch thick. F and G are the two sides which serve to supply the rails D, E, H, I, C: these sides are one foot broad at bottom, and cut in the front with a regular slope, to three inches at top; but their back edges must be parallel with the front of the pots A. The breadth of the rails E, H, I, will be determined by the breadth of the sides: all the rails must be fixed at two feet distance from each other, and at right angles with the pots, Having placed the rails thus, bore in the bottom rail 10 holes, at equal distances, large enough to receive the stick of a one pound rocket: in the back edge of this rail cut a groove from one end to the other, fit to contain a quick-match; then cut a groove in the top of the rail, from the edge of each hole, into the groove in the back: in the same manner cut in the second rail, E, eight holes and grooves; in the third rail, H, six holes and grooves; in the fourth rail, I, four holes and grooves; and in the top rail, two holes and grooves. B, a rail with holes in it to guide the ends of the rocket sticks; this rail must be fixed six feet from the rail D. The fountain frame being thus made, prepare the rockets thus: Tie round the mouth of each a piece of thin paper, large enough to go twice round, and to project about an inch and a half from the mouth of the rocket, which must be rubbed with wet meal-powder; in the mouth of each rocket put a leader, which secure well with the paper that projects from the mouth of the case: these leaders must be carried into the grooves in the back of the rails, in which lay a quick-match from one end to the other, and cover it with pasted paper: holes must be made in the rail D, to receive the ends of the sticks of the rockets in the rail E, and so on to the fourth rail; so that the sticks of the rockets at top may go through all the rails. The rockets being so prepared, fix a gerbe, or white flower-pot, on each rail, before the post, with its mouth inclining a little forwards: these gerbes must be lighted all at once. Behind or before each gerbe, fix a case of brilliant or slow fire: these cases must be filled so that they may burn out one after the other, to regulate the fountain; which may be done by carrying a leader from the end of each slow or brilliant fire, into the groove in the back of each rail. Different fixed rockets may be used in these fountains: but it will be best to fill the heads of the rockets on each rail with different sorts of things, in this manner; those at top with crackers, the next with rains, the third with serpents, the fourth with tailed stars, and the last flight with common or brilliant stars.

29 ı tree.

The piece called a *palm tree*, though made of common fires, and of a simple construction, has a very pleasing effect; from the fires intersecting so often, that
59. they resemble the branches of trees. Let A (fig. 59.) be a perpendicular post, of any thickness, so that it be sufficiently strong to hold the cases; let the distance from B to C be two feet six inches, and from C to D two feet six inches, and let the length of each cross-piece be two feet; on each end of each fix a five-pointed star: then fix, on pegs made for the purpose, twelve inch half-pound cases of brilliant fire, as in the figure. All the cases and stars must be fired at once. This piece should be fixed high from the ground.

Varieties of Construction.

130 Illuminated pyramid. Fig. 60. Plate CCCCLVI.

An illuminated pyramid, with Archimedian screws, a globe, and vertical sun, may be of any size. One made according to the dimensions of fig. 60. will be of a good proportion, whose height is 21 feet; from C to D, six feet; from E to F, nine feet: the space between the rails must be six inches, and the rails as thin as possible: in all the rails stick portfires at four inches distance. The Archimedian screws, G, K, are nothing more than double spiral wheels, with the cases placed on their wheels horizontally instead of obliquely. The vertical sun, I, need not consist of more than 12 rays, to form a single glory. The globe at top must be made in proportion to the pyramid; which being prepared according to the preceding directions, place the leaders so that all the illuminating portfires, screws, globe, and sun, may take fire together. The pyramid must be supported by the two sides, and by a support brought from a pole, which must be placed two feet from the back of the pyramid, that the wheels may run freely.

131 Rose piece and sun. Fig. 61.

A rose-piece may be used for a mutation of a regulated piece, or fired by itself: it makes the best appearance when made large; if its exterior diameter be six feet, it will be of a good size. Fig. 61. shows the manner in which it appears before it is fired. Let the outer fell be made of wood, and supported by four wooden spokes: all the other parts, on which the illuminations are fixed, must be made of strong iron wire: on the outer fell place as many half-pound cases of brilliant charge as you think proper, but the more the better; for the nearer the cases are placed, the stronger will be the rays; the illuminations should be placed within three inches of each other: they must all be fired together, and burn some time before the sun is lighted: which may be done by carrying a leader from the middle of one of the illuminations, to the mouth of one of the sun cases.

132 Transparent stars with illuminated rays. Fig. 62.

Fig. 62. represents an *illuminated star*. Let the diameter from A to B be two feet, and from C to D seven feet. First make a strong circular back or body of the star, two feet diameter, to which fix the illuminated rays: in the centre of the front of the body fix a spindle, on which put a double triangular wheel, six inches diameter, clothed with two ounce cases of brilliant charge: the cases on this wheel must burn but one at a time. Round the edge of the body, nail a hoop made of thin wood or tin: this hoop must project in front six or seven inches; in this hoop cut three or four holes to let out the smoke from the wheel. The star and garter may be cut out of strong pasteboard or tin, made in this manner: Cut a round piece of pasteboard or tin, two feet diameter, on which draw a star, and cut it out; then over the vacancy paste Persian silk; paint the letters yellow; four of the rays yellow, and four red; the cross in the middle may be painted half red and half yellow, or yellow and blue. This transparent star must be fastened to the wooden hoop by a screw, made so as to take off and on; the illuminated rays are made of thin wood, with tin sockets fixed on their sides within four inches of each other; in these sockets stick illuminating portfires: behind the point of each ray fix a half-pound case of gray, black, or Chinese fire.

N. B. The illuminated rays are to be lighted at the same

Varieties of Construction. same time as the triangular wheel, or after it is burnt out; which may be done by a tin barrel being fixed to the wheel, after the manner of those in the regulated pieces. Into this barrel carry a leader from the illuminated rays, through the back of the star; and this leader must be met by another, brought from the tail of the last case on the wheel.

133 Transparent illuminated table star. Fig. 63.

Fig. 63. represents a *table star*, whose diameter from E to F, is 12 feet; and from E to I, four feet. This proportion, observed on each side, will make the centre frame four feet square: in this square fix a transparent star, as in the figure. This star may be painted blue, and its rays made as those of the flaming stars described before. The wheel for this star may be composed of different coloured fires, with a charge or two of slow fire; the wheels *a, a, a, a*, may be clothed with any number of cases, so that the star-wheel consist of the same: the illuminating portfires, which must be placed very near each other on the frames, must be so managed as to burn as long as the wheels, and lighted at the same time.

134 Regulated illuminated spiral piece. Fig. 64.

The regulated illuminated spiral piece, with a projected star-wheel illuminated, is represented by fig. 64. and is thus made. Have a block made eight inches diameter; in this block screw six iron spokes, which must serve for spindles for the spiral wheels: these wheels are made as usual, each one foot and a half diameter, and three feet in height: the spindles must be long enough to keep the wheels four or five inches from one another: at the end of each spindle must be a screw-nut, on which the wheels that hang downwards will run; and on the spindles which stand upwards must be a shoulder, for the blocks of the wheels to run on.

The projected star-wheel must turn on the same spindle on which the large block is fixed; this spindle must be long enough to allow the star-wheel to project a little before the spiral wheels: the exterior diameter of the star-wheel must be three feet five inches. On this wheel fix three circles of iron wire, and on them portfires; on the block place a transparent star, or a large five-pointed brilliant star. The cases on this wheel may burn four at once, as it will contain nearly twice the number of one of the spiral wheels: the cases on the spiral wheels must be placed parallel to their fells, and burn two at a time.

135 Illuminated figure piece. Fig. 65.

A figure piece illuminated with five-pointed stars.—The construction of this piece is very easy, as shown by fig. 65. whose diameter from B to C is eight feet, and from D to F two feet: the vertical wheel in the centre must be one foot diameter, and consist of six four-ounce cases of different coloured charge, which cases must burn double: on the frames fix five-pointed brilliant or blue stars, rammed four inches with composition: let the space between each star be eight inches; at each point fix a gerbe, or case of Chinese fire. When to be fired, let the gerbe, stars, and wheel, be lighted at the same time.

136 Illuminated star-wheel. Fig. 66.

The star-wheel illuminated, is shown by fig. 66. Its exterior fell is made of wood, three feet six inches or four feet diameter; within this fell, form with iron wire three circles, one less than the other, so that the diameter of the least may be about 10 inches: place the portfires on these fells with their mouths inclining outwards, and the portfires on the points of the star with their mouths projecting in front; let the exterior fell be clothed with four-ounce cases of gray charge: these cases must burn four at a time, and be lighted at the same time as the illuminations.

Pyramid of flower-pots is represented at fig. 67. and made thus. Let the distance from A to B be six feet; and from one rail to the other, two: on the bottom rail fix five paper mortars, each three inches and a half diameter; these mortars load with serpents, crackers, stars, &c.

In the centre of each mortar fix a case of spur-fire: on the second rail fix four mortars, so as to stand exactly in the middle of the intervals of those on the bottom rail; on the third rail place three mortars; on the fourth, two; and on the top of the posts, 1; the bottom rail must be six feet long: all the mortars must incline a little forwards, that they may be easily discharged; and the spur-fires rammed exactly alike, that the mortars may all be fired at the same time. Having prepared the pyramid according to the preceding directions, carry pipes of communication from one spur-fire to the other.

Fig. 68. represents one half of *the illuminated regulating piece.*—A, A, A, A, are flat wooden spokes, each five feet long: at the end of each place a vertical wheel, 10 inches diameter, clothed with six four-ounce cases of brilliant fire: these cases must burn but one at a time: on two of the spokes of each wheel place two portfires, which must be lighted with the first case of the wheel: on each spoke A, A, &c. behind the wheels, place six cases of the same size with those on the wheels: these cases must be tied across the spokes with their mouths all one way, and be made to take fire successively one after the other, so that they may assist the whole piece to turn round.

The diameter of the large wheel must be two feet and a half; and its fell made of wood, which must be fixed to the large spokes: on this wheel place 24 cases of the same sort with those on the small wheels; these cases must burn four at a time: in this wheel make three circles with iron wire, and on them place illuminating portfires, as in the figure: the star-points on the large spokes may be made of thin ash-hoops; the diameter of these points close to the centre-wheel must be 11 inches: on these points place portfires, at three inches and a half distance one from the other.

Fig. 69. represents the blocks of this piece. The diameters of these blocks, at A and B, must be eight inches; and C and D, four inches and a half: the length of each of those blocks must be six inches: at the small ends of these blocks fix an iron wheel, five inches diameter, and these wheels must have teeth, to turn the wheel F: this wheel is fixed on a small spindle screwed into the large spindle, which goes through the two blocks, and on which they run.

Supposing fig. 68. to be on the block A, in fig. 69. and to turn to the right, and another piece of the same construction on the block B, with its fires placed so as to turn it to the left; you will find them move very true and fast, by the help of the three iron wheels, which serve to regulate their motions, as well as to assist them in turning: let the iron circles in the front of the great wheels be of different diameters, so that when fired there may appear six circles. When this piece is fired all the wheels and illuminations must be lighted at one time.

atic works.

Aquatic Fireworks.

139 Works that sport in the water are much esteemed by most admirers of fire-works, particularly water-rockets; and as they seem of a very extraordinary nature to those who are unacquainted with this art, they merit a particular explanation.

40 r-roc- *Water-rockets*, may be made from four ounces to two pounds. If larger, they are too heavy; so that it will be difficult to make them keep above water without a cork float, which must be tied to the neck of the case; but the rockets will not dive so well with as without floats.

Cases for these are made in the same manner and proportion as sky-rockets, only a little thicker of paper. When you fill those which are driven solid, put in first one ladleful of slow fire, then two of the proper charge, and on that one or two ladles of sinking charge, then the proper charge, then the sinking charge again, and so on, till you have filled the case within three diameters; then drive on the composition one ladleful of clay; through which make a small hole to the charge; then fill the case, within half a diameter, with corn-powder, on which turn down two or three rounds of the case in the inside; then pinch and tie the end very tight; having filled the rockets (according to the above directions), dip their ends in melted rosin or sealing-wax, or else secure them well with grease. When you fire those rockets, throw in six or eight at a time; but, if you would have them all sink, or swim, at the same time, you must fill them with an equal quantity of composition, and fire them altogether.

1 of uni- for *Pipes of communication, which may be used under water*, must be a little thicker in the paper than those for land. Having rolled a sufficient number of pipes, and kept them till dry, wash them over with drying oil, and set them to dry; but when you oil them, leave about an inch and a half at each end dry, for joints; as if they were oiled all over, when you come to join them, the paste would not stick where the paper is greasy; after the leaders are joined, and the paste dry, oil the joints. These pipes will lie many hours under water, without receiving any damage.

2 ntal *To make horizontal wheels for the water*, first get a large wooden bowl without a handle; then have an eight-sided wheel made of a flat board 18 inches diameter, so that the length of each side may be near seven inches: in all the sides cut a groove for the cases to lie in. This wheel being made, nail it on the top of the bowl; then take four eight-ounce cases, filled with a proper charge, each about six inches in length. Now, to clothe the wheel with these cases, get some whitish-brown paper, and cut it into slips four or five inches broad and seven or eight long: these slips being pasted all over on one side, take one of the cases, and roll one of the slips of paper about an inch and a half on its end, so that there will remain about two inches and a half of the paper hollow from the end of the case: tie this case on one of the sides of the wheel, near the corners of which must be holes bored, through which put the packthread to tie the cases: having tied on the first case at the neck and end, put a little meal powder in the hollow paper; then paste a slip of paper on the end of another case, the head of which put into the hollow paper on the first, allowing a sufficient distance from the tail of one to the head of the other for the pasted paper to bend without tearing: tie on the second case as you did the first: and so on with the rest, except the last, which must be closed at the end, unless it is to communicate to any thing on the top of the wheel, such as fire-pumps or brilliant fires, fixed in holes cut in the wheel, and fired by the last or second case, as the fancy directs: six, eight, or any number, may be placed on the top of the wheel, provided they be not too heavy for the bowl. Aquatic Fireworks.

Before tying on the cases, cut the upper part of all their ends, except the last, a little shelving, that the fire from one may play over the other, without being obstructed by the case. Wheel cases have no clay drove in their ends, nor pinched, but are always left open, only the last, or those which are not to lead fire, which must be well secured. 143

For water mines you must have a bowl with a wheel on it, made in the same manner as the water-wheel; only in its middle there must be a hole, of the same diameter as that of the intended mine. These mines are tin pots, with strong bottoms, and a little more than two diameters in length: the mine must be fixed in the hole in the wheel, with its bottom resting on the bowl; then loaded with serpents, crackers, stars, small water-rockets, &c. in the same manner as pots of aigrettes; but in their centre fix a case of Chinese fire, or a small gerbe, which must be lighted at the beginning of the last case on the wheel. These wheels are to be clothed as usual. Water mines.

Bowls for water-globes must be very large, and the wheels on them of ten sides; on each side nail a piece of wood four inches long; and on the outside of each piece cut a groove, wide enough to receive about one-fourth of the thickness of a four-ounce case: these pieces of wood must be nailed in the middle of each face of the wheel, and fixed in an oblique direction, so that the fire from the cases may incline upwards: the wheel being thus prepared, tie in each groove a four-ounce case filled with a gray charge; then carry a leader from the tail of one case to the mouth of the other. 144 Fire-globes for the water.

Globes for these wheels are made of two tin hoops, with their edges outwards, fixed one within the other, at right angles. The diameter of these hoops must be rather less than that of the wheel. Having made the globe, drive in the centre of a wheel an iron spindle, which must stand perpendicular, and its length four or six inches more than the diameter of the globe.

The spindle serves for an axis, on which is fixed the globe, which must stand four or six inches from the wheel: round one side of each hoop must be soldered little bits of tin, two inches and a half distance from each other; which pieces must be two inches in length each, and only fastened at one end, the other ends being left loose, to turn round the small portfires, and hold them on: these portfires must be made of such a length as will last out the cases on the wheel. There need not be any portfires at the bottom of the globe within four inches of the spindle; as they would have no effect, but to burn the wheel: all the portfires must be placed perpendicularly from the centre of the globe, with their mouths outwards; and must be clothed with leaders so as all to take fire with the second case of the wheel; and the cases must burn two at a time, one opposite the other. When two cases of a wheel begin together, two will

Aquatic Fireworks.

will end together; therefore the two opposite end cases must have their ends pinched and secured from fire. The method of firing such wheels is, by carrying a leader from the mouth of one of the first cases to that of the other; and the leader being burnt through the middle, will give fire to both at the same time.

145 Odoriferous water-balloons.

Odoriferous water balloons are made in the same manner as air balloons, but very thin of paper, and in diameter one inch and three-fourths, with a vent of half an inch diameter. The shells being made, and quite dry, fill them with any of the following compositions, which must be rammed in tight: these balloons must be fired at the vent, and put into a bowl of water. Odoriferous works are generally fired in rooms.

Composition I. Saltpetre two ounces, flour of sulphur one ounce, camphor half an ounce, yellow amber half an ounce, charcoal-dust three-fourths of an ounce, salt of benjamin half an ounce, all powdered very fine and well mixed.

II. Saltpetre 12 ounces, meal-powder three ounces, frankincense one ounce, myrrh half an ounce, camphor half an ounce, charcoal three ounces, all moistened with the oil of spike.

III. Saltpetre two ounces, sulphur half an ounce, antimony half an ounce, amber half an ounce, cedar raspings one-fourth of an ounce, all mixed with the oil of roses and a few drops of bergamot.

IV. Saltpetre four ounces, sulphur one ounce, saw-dust of juniper half an ounce, saw-dust of cypress one ounce, camphor one-fourth of an ounce, myrrh two drams, dried rosemary one-fourth of an ounce, all moistened a little with the oil of roses.

N. B. Water-rockets may be made with any of the above compositions, with a little alteration, to make them weaker or stronger, according to the size of the cases.

146 A sea-fight with small ships and a fire-ship.

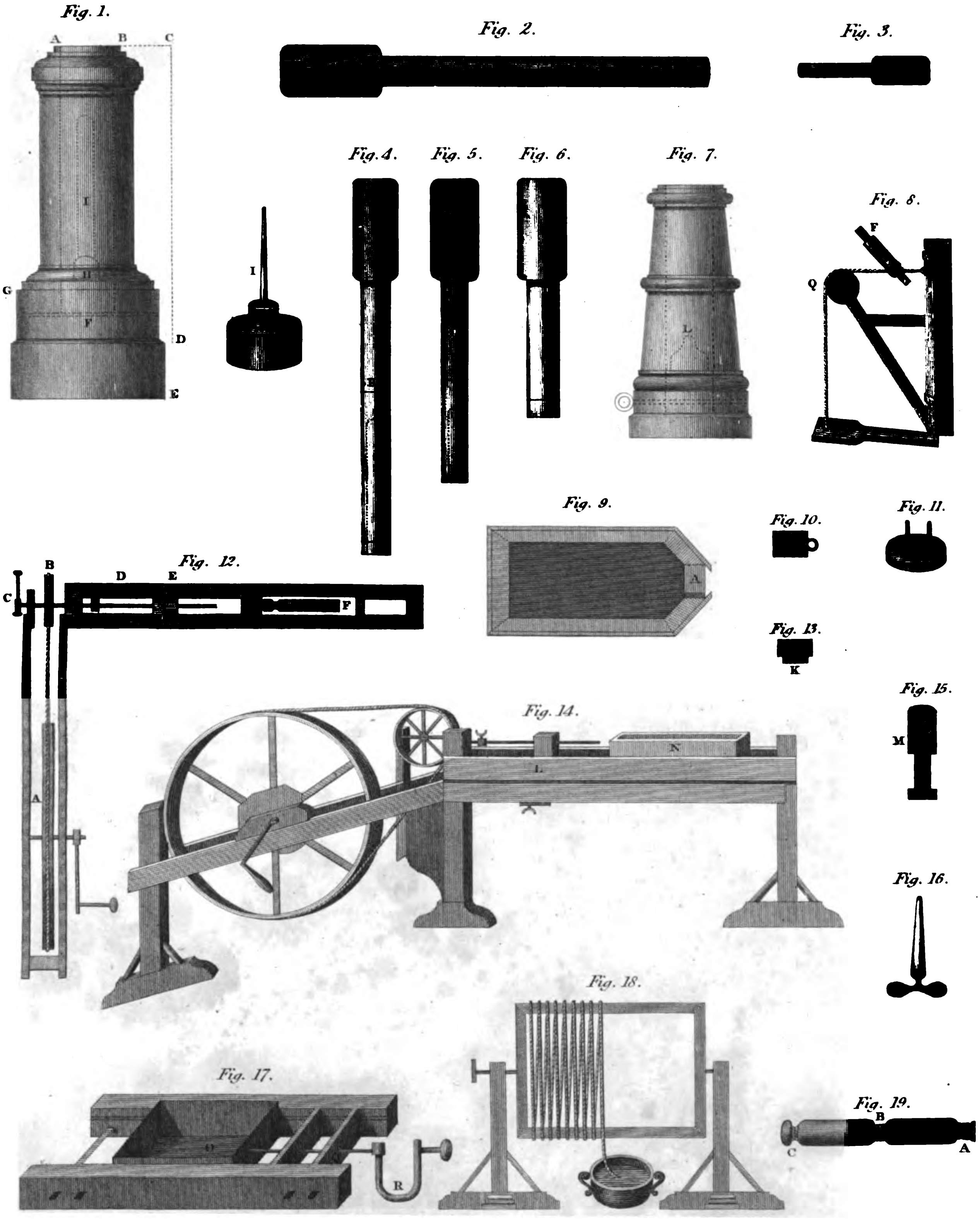
Having procured four or five small ships, of two or three feet in length, make a number of small reports, which are to serve for guns. Of these range as many as you please on each side of the upper decks; then at the head and stern of each ship fix a two-ounce case, eight inches long, filled with a slow portfire composition; but take care to place it in such a manner that the fire may fall in the water, and not burn the rigging: in these cases bore holes at unequal distances from one another, but make as many in each case as half the number of reports, so that one case may fire the guns on one side, and the other those on the opposite. The method of firing the guns is, by carrying a leader from the holes in the cases to the reports on the decks; you must make these leaders very small, and be careful in calculating the burning of the slow fire in the regulating cases, that more than two guns be not fired at a time. When you would have a broadside given, let a leader be carried to a cracker, placed on the outside of the ship; which cracker must be tied loose, or the reports will be too slow: in all the ships put artificial guns at the port-holes (A).

Having filled and bored holes in two portfires for regulating the guns in one ship, make all the rest exactly the same; then, when you begin the engagement, light one ship first, and set it a sailing, and so on with the rest, sending them out singly, which will make them fire regularly, at different times, without confusion; for the time between the firing of each gun will be equal to that of lighting the slow fires.

The fire-ship may be of any size; and need not be very good, for it is always lost in the action. To prepare a ship for this purpose, make a portfire equal in size with those in the other ships, and place it at the stern; in every port place a large portfire, filled with a very strong composition, and painted in imitation of a gun, and let them all be fired at once by a leader from the slow fire, within two or three diameters of its bottom; all along both sides, on the top of the upper deck, lay star-composition about half an inch thick and one broad, which must be wetted with thin size, then primed with meal-powder, and secured from fire by pasting paper over it; in the place where you lay this composition, drive some little tacks with flat heads, to hold it fast to the deck: this must be fired just after the sham guns, and when burning will show a flame all round the ship: at the head take up the decks, and put in a tin mortar loaded with crackers, which mortar must be fired by a pipe from the end of the slow fire; the firing of this mortar will sink the ship, and make a pretty conclusion. The regulating portfire of this ship must be lighted at the same time with the first fighting ship.

Having prepared all the ships for fighting, we shall next proceed with the management of them when on the water. At one end of the pond, just under the surface of the water, fix two running blocks, at what distance you choose the ships should fight; and at the other end of the pond, opposite to each of these blocks, under the water, fix a double block; then on the land, by each of the double blocks, place two small windlasses; round one of them turn one end of a small cord, and put the other end through one of the blocks; then carry it through the single one at the opposite end of the pond, and bring it back through the double block again, and round the other windlass: to this cord, near the double block, tie as many small strings as half the number of the ships, at any distance; but these strings must not be more than two feet long each: make fast the loose end of each to a ship, just under her bowsprit; for if tied to the keel, or too near the water, it will overset the ship. Half the ships being thus prepared, near the other double block fix two more windlasses, to which fasten a cord, and to it tie the other half of the ships as before: when you fire the ships, pull in the cord with one of the windlasses, to get all the ships together; and when you have set fire to the first, turn that windlass which draws them out, and so on with the rest, till they are all out in the middle of the pond; then, by turning the other windlass, you will draw them back again; by which method you may make them change sides, and tack about backwards and forwards at pleasure. For the fire ship fix the blocks and windlasses between the others;

(A) Reports for these and similar occasions are made, by filling small cartridges with grained powder; pinching them close at each end, and, when used, boring a hole in the side, to which is placed a match or leader for firing them.



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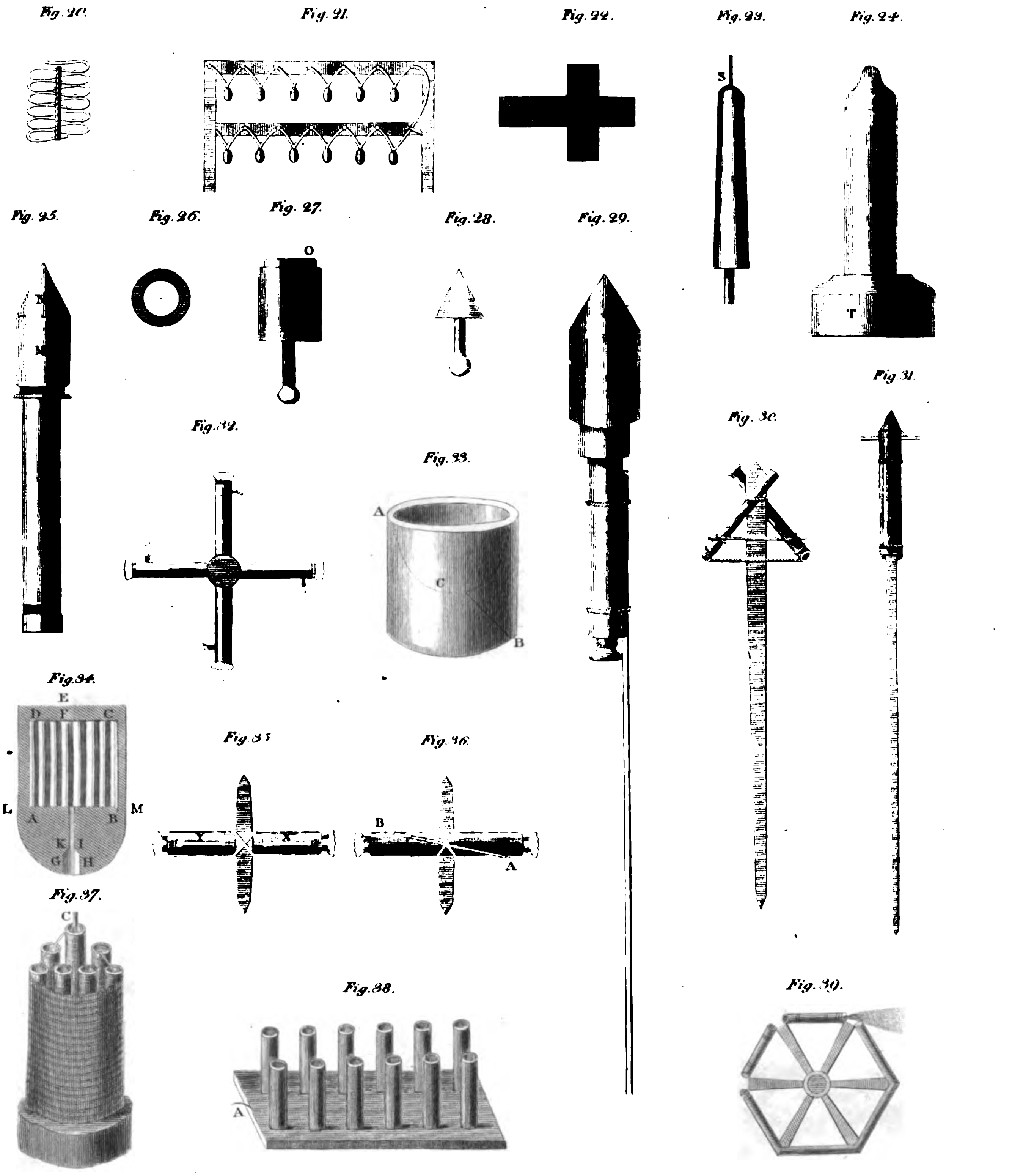
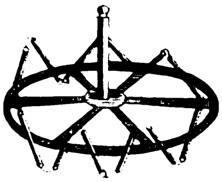


E. Mitchell sculp[t]

Fig. 40.



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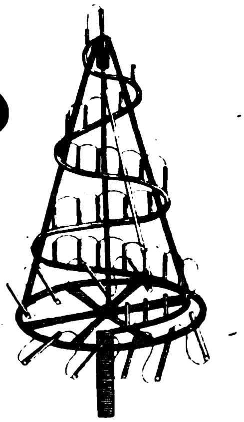

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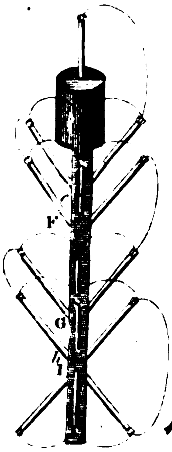

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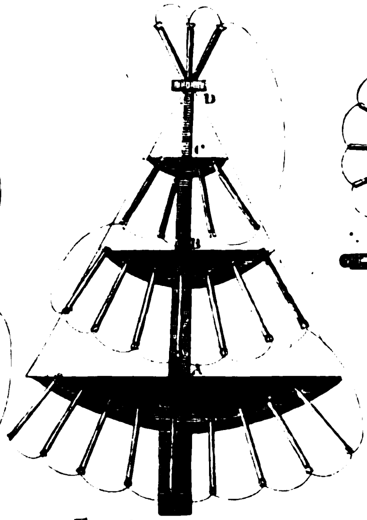

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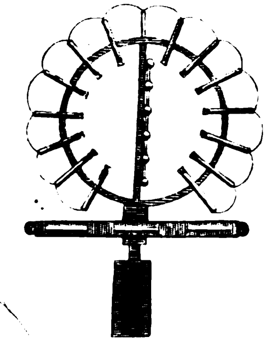

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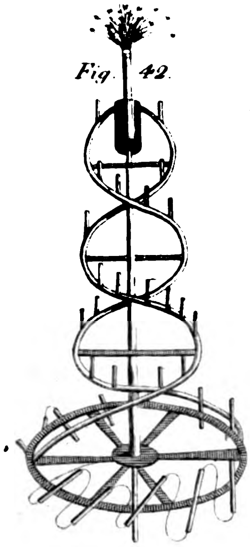

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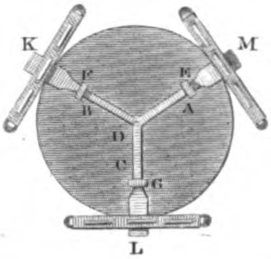

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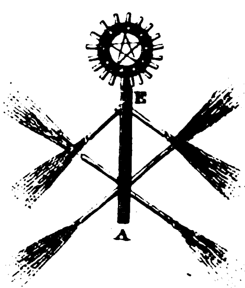

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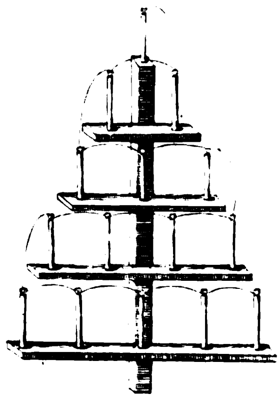

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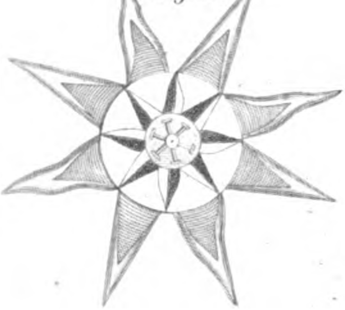

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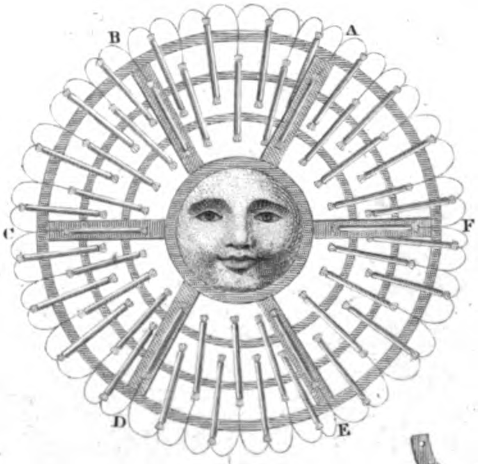

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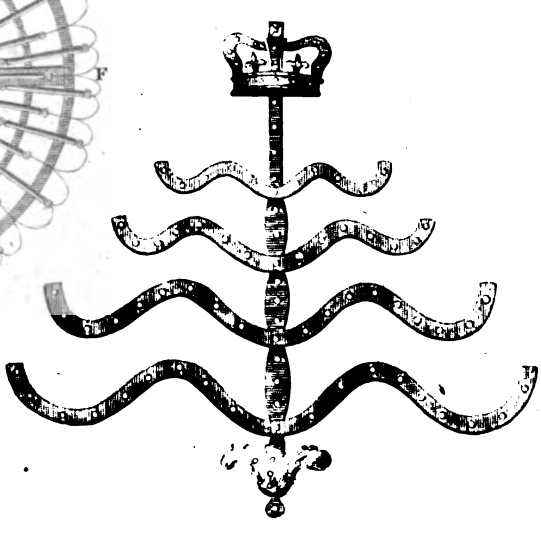


Fig. 52.

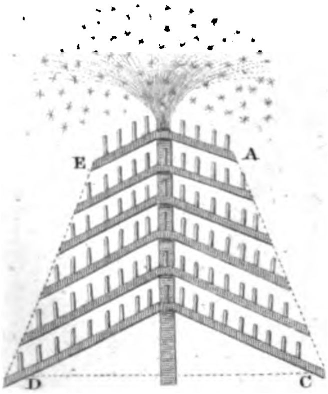
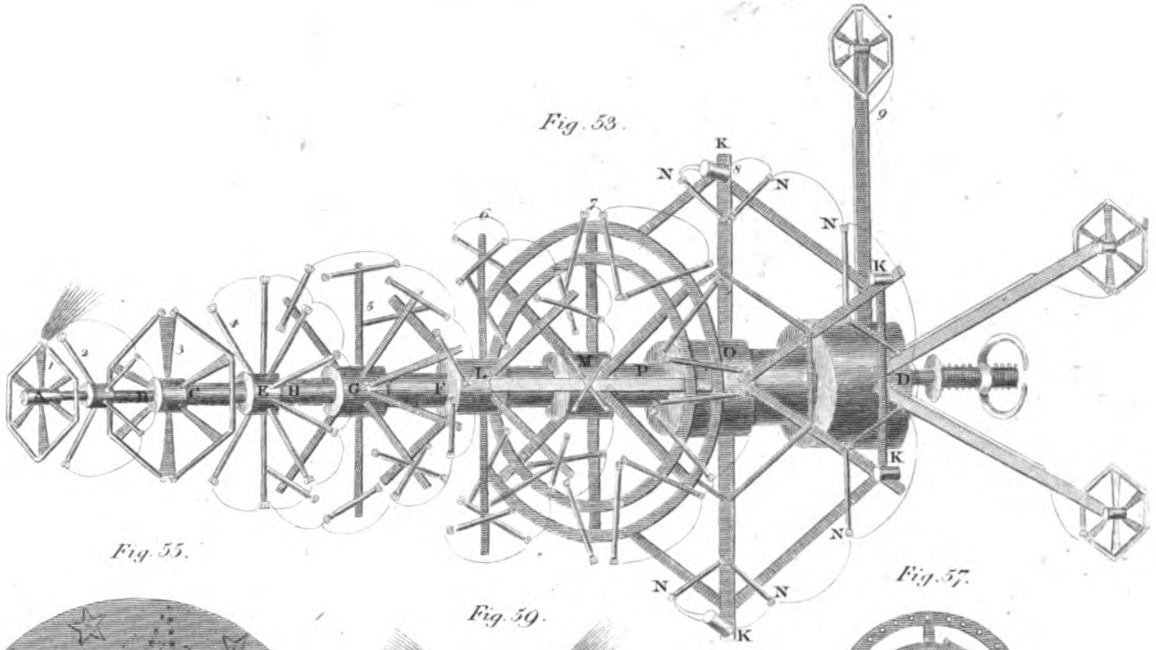


Fig. 53.



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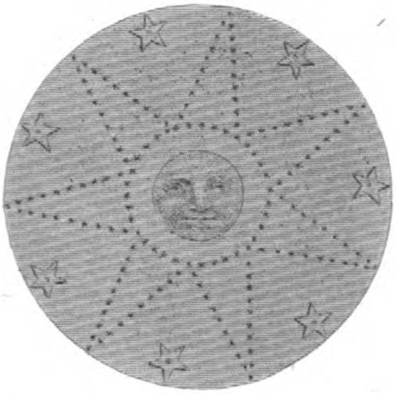

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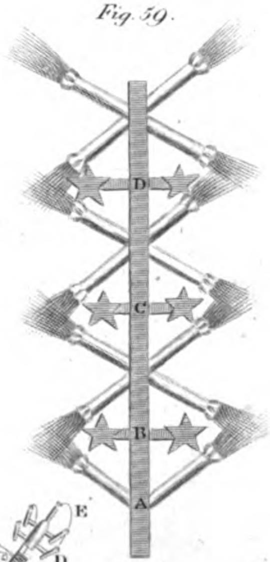
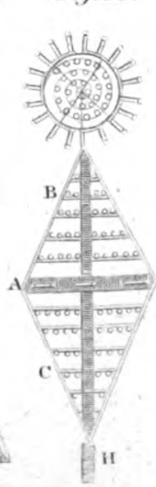


Fig. 57.

Fig. 56.



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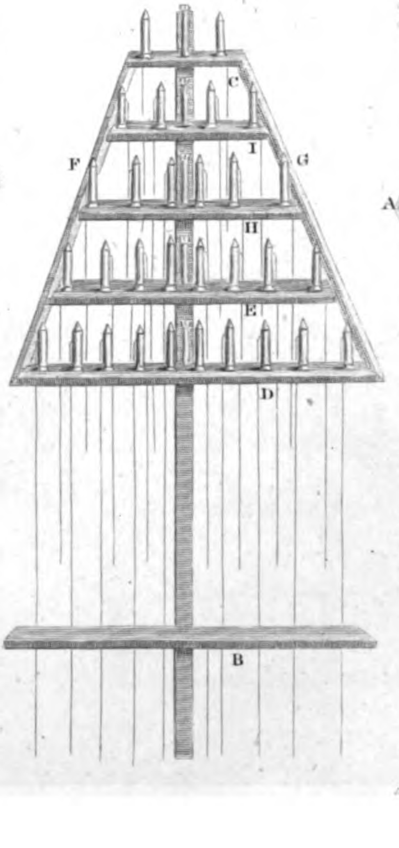
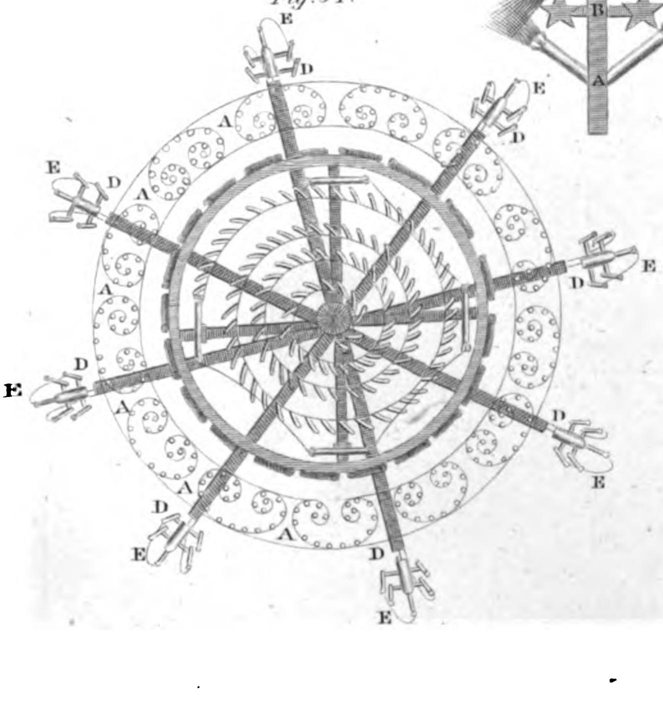


Fig. 54.



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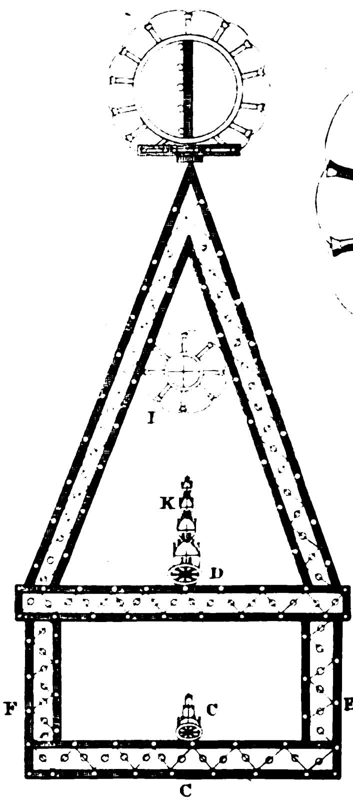

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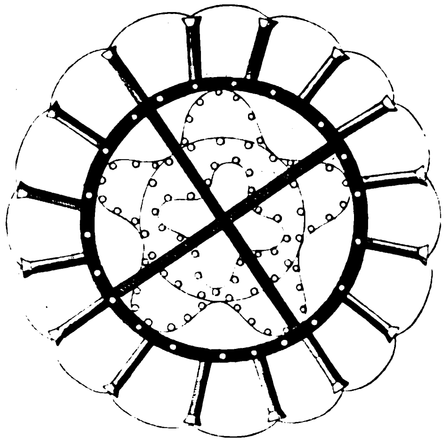

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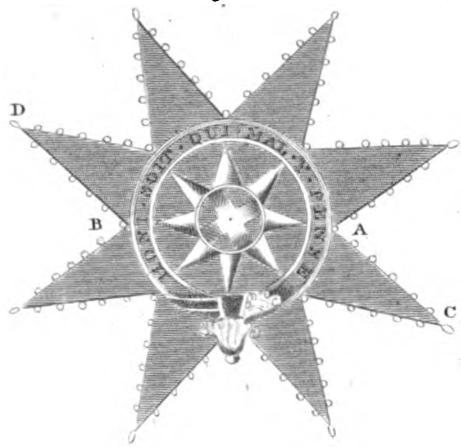

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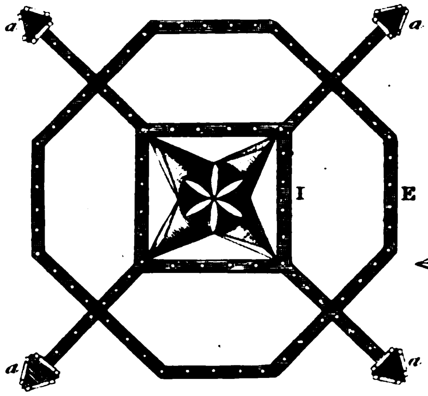

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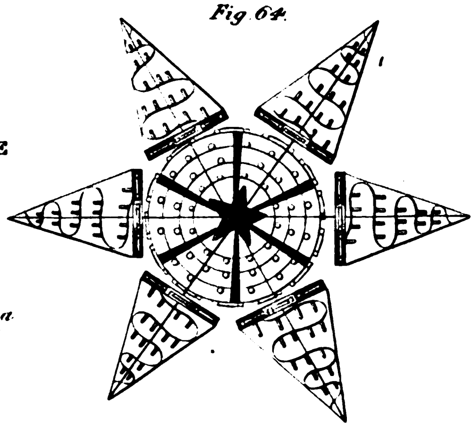
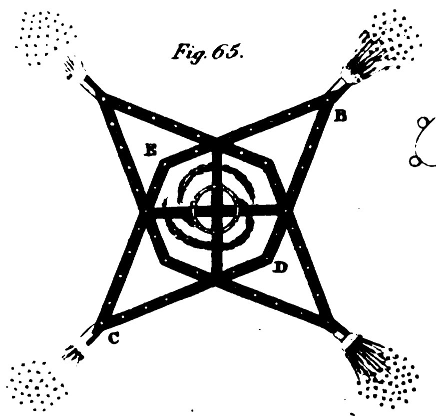


Fig. 65.



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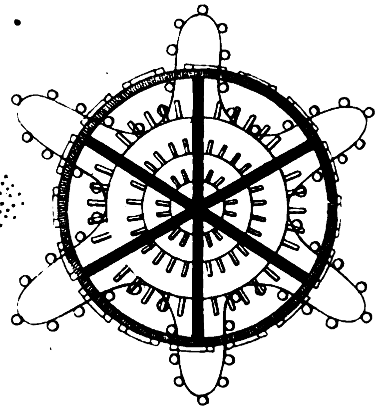

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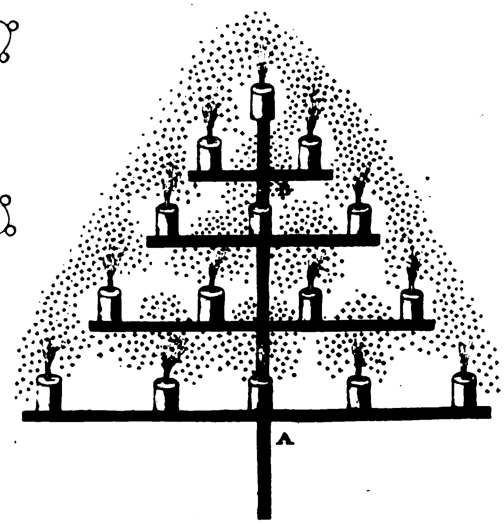


E. Mitchell, sculp.t

Fig. 70.

Fig. 69.

Fig. 68.

Fig. 71.

Fig. 72.

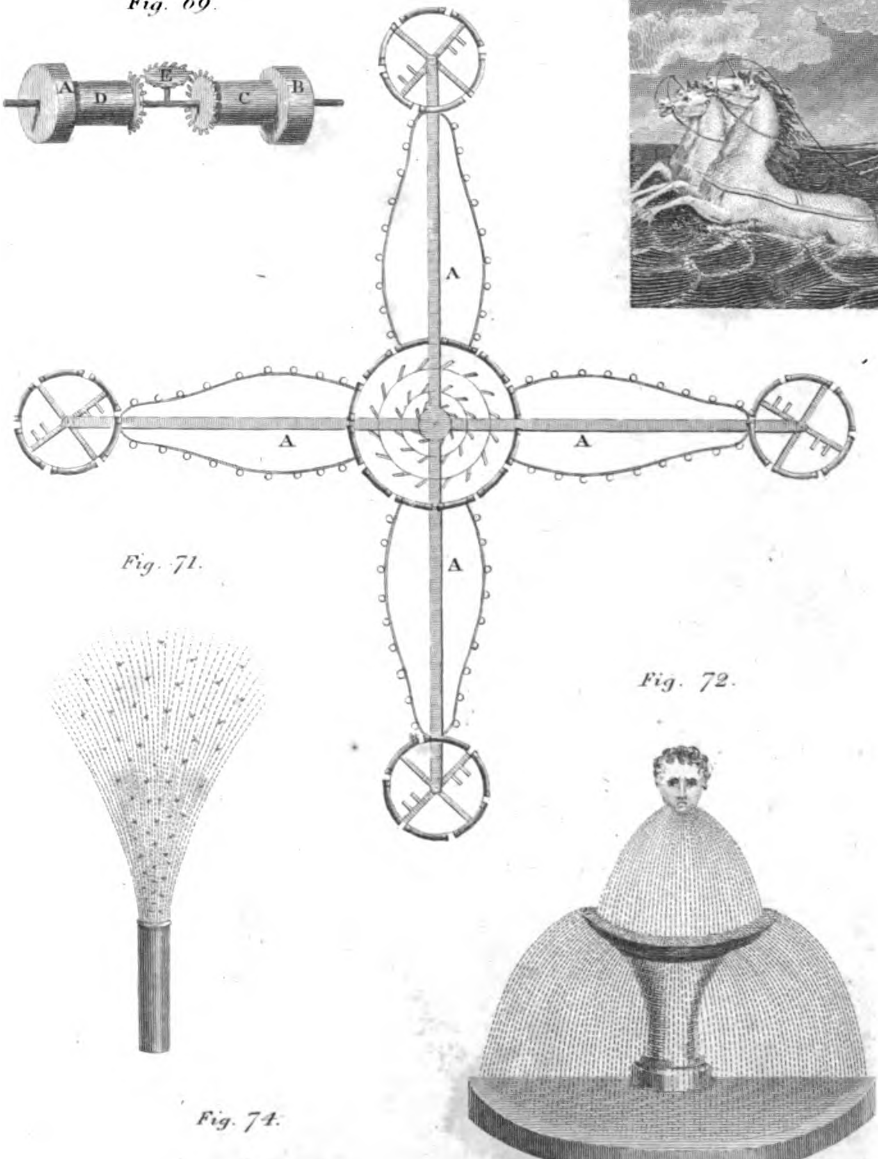


Fig. 73.

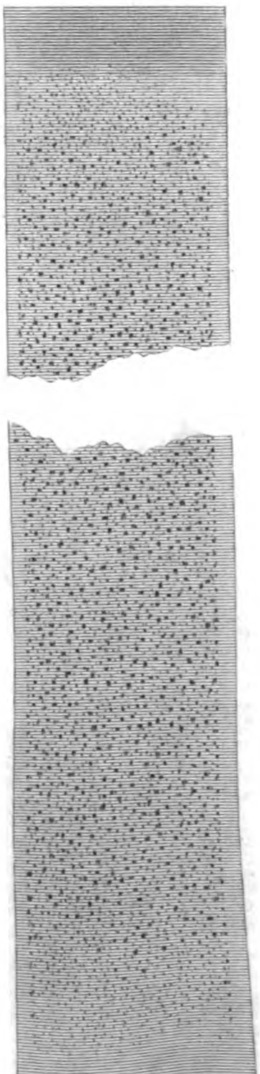
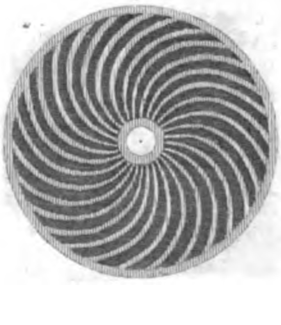


Fig. 74.



Aquatic Fireworks. others; so that when she sails out, she will be between the other ships: you must not let this ship advance till the guns at her ports take fire.

147 To fire sky-rockets under water. *To fire sky-rockets under water*, you must have stands made as usual, only the rails must be placed flat instead of edgewise, and have holes in them for the rocket-sticks to go through; for if they were hung upon hooks, the motion of the water would throw them off: the stands being made, if the pond is deep enough, sink them at the sides so deep, that, when the rockets are in, their heads may just appear above the surface of the water; to the mouth of each rocket fix a leader, which put through the hole with the stick; then a little above the water must be a board, supported by the stand, and placed along one side of the rockets; then the ends of the leaders are turned up through holes made in this board, exactly opposite the rockets. By this means you may fire them singly or all at once. Rockets may be fired by this method in the middle of a pond, by a Neptune, a swan, a water-wheel, or any thing else you choose.

148 Neptune in his chariot. *To represent Neptune in his chariot*, you must have a Neptune (made of wood, or basket work) as big as life, fixed on a float large enough to bear his weight; on which must be two horses heads and necks, so as to seem swimming, as shown by fig. 70. Fig. 70. For the wheels of the chariot, there must be two vertical wheels of black fire, and on Neptune's head a horizontal wheel of brilliant fire, with all its cases, to play upwards. When this wheel is made, cover it with paper or pasteboard, cut and painted like Neptune's coronet; then let the trident be made without prongs, but instead of them, fix three cases of a weak gray charge, and on each horse's head put an eight ounce case of brilliant fire, and on the mouth of each fix a short case, of the same diameter, filled with the white-flame composition enough to last out all the cases on the wheels: these short cases must be open at bottom, that they may light the brilliant fires; for the horses eyes put small portfires, and in each nostril put a small case half filled with gray charge, and the rest with portfire composition.

If Neptune is to give fire to any building on the water; at his first setting out, the wheels of the chariot, and that on his head, with the white flames on the horses heads, and the portfires in their eyes and nostrils, must all be lighted at once; then from the bottom of the white flames carry a leader to the trident. As Neptune is to advance by the help of a block and cord, you must manage it so as not to let him turn about, till the brilliant fires on the horses and the trident begin; for it is by the fire from the horses (which plays almost upright) that the building, or work, is lighted; which must be thus prepared. From the mouth of the case which is to be first fired, hang some loose quick-match to receive the fire from the horses. When Neptune is only to be shown by himself, without setting fire to any other works, let the white flames on the horses be very short, and not to last longer than one case of each wheel, and let two cases of each wheel burn at a time.

149 Swans and ducks in water. If you would have swans or ducks discharge rockets into the water, they must be made hollow, and of paper, and filled with small water rockets, with some blowing powder to throw them out: but if this is not done, they may be made of wood, which will last many times. Having made and painted some swans, fix them on floats: then in the places where their eyes should be, bore holes two inches deep, inclining downwards, and wide enough to receive a small portfire; the portfire cases for this purpose must be made of brass, two inches long, and filled with a slow bright charge. In the middle of one of these cases make a little hole; then put the portfire in the eye-hole of the swan, leaving about half an inch to project out; and in the other eye put another portfire, with a hole made in it: then in the neck of the swan, within two inches of one of the eyes, bore a hole slantwise, to meet that in the portfire; in this hole put a leader, and carry it to a water-rocket, that must be fixed under the tail with its mouth upwards. On the top of the head place two one-ounce cases, four inches long each, drove with brilliant fire; one of these cases must incline forwards, and the other backwards: these must be lighted at the same time as the water-rocket; to do which, bore a hole between them in the top of the swan's head, down to the hole in the portfire, to which carry a leader: if the swan is filled with rockets, they must be fired by a pipe from the end of the water-rocket under the tail. When you set the swan a swimming, light the two eyes.

To make a fire-fountain for the water, first have a float made of wood, three feet diameter; then in the middle fix a round perpendicular post, four feet high, and two inches diameter; round this post fix three circular wheels made of thin wood, without any spokes. 150 Water fire-fountains. The largest of these wheels must be placed within two or three inches of the float, and must be nearly of the same diameter. The second wheel must be two feet two inches diameter, and fixed at two feet distance from the first. The third wheel must be one foot four inches diameter, and fixed within six inches of the top of the post: the wheels being fixed, take 18 four or eight-ounce cases of brilliant fire, and place them round the first wheel with their mouths outwards, and inclining downwards; on the second wheel place 13 cases of the same, and in the same manner as those on the first; on the third, place eight more of these cases, in the same manner as before, and on the top of the post fix a gerbe; then clothe all the cases with leaders, so that both they and the gerbe may take fire at the same time. Before firing this work, try it in the water to see whether the float is properly made, so as to keep the fountain upright.

151 Optical imitations of fire-works. As the artificial fire-works which we have described, require considerable caution in their preparation and management, and are attended with great expence, attempts have been made to imitate some of the more simple kinds by optical delusion, and to give to the objects represented the appearance of moving fire, though they be really fixed, and no fire be employed. These attempts have been tolerably successful; and by means of this invention, a spectacle of artificial fire-works may be apparently exhibited at a trifling expence; and if the pieces employed are constructed with ingenuity, and with a proper attention to the rules of perspective, while in viewing them we employ glasses which magnify the objects, and prevent them from being too distinctly seen, a very agreeable illusion will be produced.

Optical Imitations of Fire-works. The artificial fire-works imitated with most success by this invention, are fixed suns, gerbes, and jets of fire, cascades, globes, pyramids, and columns, moveable around their axes. To represent a gerbe of fire, take paper

Optical Imitations of Fire-works

Fig. 71.

paper blackened on both sides, and very opaque; and having delineated on a piece of white paper the figure of a gerbe of fire, apply it to the black paper, and with the point of a very sharp penknife make several slashes (Plate CCCCLVII. fig. 71.) in it, as 3, 5, or 7, proceeding from the origin of the gerbe: these lines must not be continued, but cut through at unequal intervals. Pierce these intervals with unequal holes made with a pinking iron, in order to represent the sparks of such a gerbe. In short, you must endeavour to paint, by these lines and holes, the well known effect of the fire of inflamed gunpowder, when it issues through a small aperture.

According to the same principles, you may delineate the cascades (fig. 72.) and jets of fire which you are desirous of introducing into this exhibition, which is purely optical; and those jets of fire which proceed from the radii of suns, either fixed or moveable. It may easily be conceived, that in this operation taste must be the guide.

If you are desirous of representing globes, pyramids, or revolving columns, draw the outlines of them on paper, and then cut them out in a helical form; that is, cut out spirals with the point of a penknife, and of a size proportioned to that of the piece.

It is to be observed also, that as these different pieces have different colours, they may be easily imitated by pasting on the back of the paper, cut as here described, very fine silk paper coloured in the proper manner. As jets, for example, when loaded with Chinese fire, give a reddish light, you must paste to the back of these jets transparent paper, slightly tinged with red; and proceed in the same manner in regard to the other colours by which the different fire-works are distinguished.

When these preparations have been made, the next thing is to give motion, or the appearance of motion, to this fire, which may be done two ways, according to circumstances.

If a jet of fire, for example, is to be represented, prick unequal holes, and at unequal distances from each other, in a band of paper, fig. 73. and then move this band, making it ascend between a light and the above jet; the rays of light which escape through the holes of the moveable paper will exhibit the appearance of sparks rising into the air. It is to be observed that one part of the paper must be whole; that another must be pierced with holes thinly scattered; that in another place they must be very close, and then moderately so: by these means it will represent those sudden jets of fire observed in fire-works.

To represent a cascade, the paper pierced with holes, instead of moving upwards, must be made to descend.

This motion may be easily produced by means of two rollers, on one of which the paper is rolled up, while it is unrolled from the other.

Suns are attended with some more difficulty; because in these it is necessary to represent fire, proceeding from the centre to the circumference. The artifice for this purpose is as follows.

On strong paper describe a circle, equal in diameter to the sun which you are desirous to exhibit, or even somewhat larger; then trace out on this circle two spirals, at the distance of a line or half a line from each other, and open the interval between them with a penknife, in such a manner, that the paper may be cut from the circumference, decreasing in breadth to a certain distance from the centre, fig. 74.: cut the remainder of the circle into spirals of the same kind, open and close alternately; then cement the paper circle to a small iron hoop, supported by two pieces of iron, crossing each other in its centre, and adjust the whole to a small machine, which will suffer it to revolve round its centre. If this moveable paper circle, cut in this manner, be placed before the representation of your sun, with a light behind it, as soon as it is made to move towards that side to which the convexity of the spirals is turned, the luminous spirals, or those which afford a passage to the light, will give, on the image of the radii or jets of fire of your sun, the appearance of fire in continual motion, as if undulating from the centre to the circumference.

The appearance of motion may be given to columns, pyramids, and globes, cut through in the manner above described, by moving in a vertical direction a band of paper cut through into apertures, inclined at an angle rather different from that of the spirals. By these means the spectators will suppose that they see fire continually circulating and ascending along the spirals; and thus will be produced an optical illusion, in consequence of which the columns or pyramids will seem to revolve.

We have thus briefly explained the principle on which artificial fire-works may be imitated; and as the taste of the artist may suggest to him many circumstances which may improve the representation, and render the illusion stronger, we shall not enlarge further on the subject, but shall conclude this article with a few observations on illuminated prints and drawings, which are sometimes introduced as accompaniments in these imitations of artificial fire-works.

The mode of preparing these illuminations is thus described in Hutton's translation of Montucla's *Recreations*. Take some prints representing a castle, or palace, &c.; and having coloured them properly, cement paper to the back of them, in such a manner that they shall be only semitransparent; then, with pinking irons of different sizes, prick small holes in the places and on the lines where the lamps are generally placed, as along the sides of the windows, on the cornices or balustrades, &c. But care must be taken to make these holes smaller and closer, according to the perspective diminution of the figure. With other irons of a larger size, cut out, in other places, some stronger lights, so as to represent fire-pots, &c. Cut out also the panes in some of the windows, and cement to the back of them transparent paper of a green or red colour, to represent curtains drawn before them, and concealing an illuminated apartment.

When the print is cut in this manner, place it in the front of a sort of small theatre, strongly illuminated from the back part, and look at it through a convex glass of a pretty long focus, like that used in those small machines called optical boxes. If the rules of perspective have been properly observed in the prints, and if the lights and shades have been distributed with taste, this spectacle will be highly agreeable.

151 Management of burns from fire-works.

Before dismissing this subject, it may not be improper to point out the most effectual means of relieving those burns, to which fire-workers are so much exposed. When the burn is first received, and before blisters arise, the best applications are *oil of turpentine*, *strong*

spirits,

spirits, *rectified spirit of wine*, or *camphorated spirit*, with which linen rags must be wetted and kept moist on the part till the pain abates. If no other remedy can be procured, immersing the part for a long time in cold water will often afford great relief. When these means have been neglected, and blisters arise, if these are small, they should not be opened; but if large, the water must be let out, and the sore covered with rags, spread with a mixture of *linseed oil* and *lime water*, in the proportion of one part of the former to three of the latter. We must remark, however, that in all cases of extensive burns, or where some very delicate part is injured, speedy recourse should be had to medical assistance.

Management of Burns.

P Y R — P Y T

PYROTICS, in *Medicine*, caustics, or remedies either actually or potentially hot; and which accordingly will burn the flesh, and raise an eschar. See CAUSTICITY.

PYRRHICA, in antiquity, a kind of exercise on horseback, or a feigned combat, for the exercise of the cavalry.

It was thus called from its inventor Pyrrhichus, or Pyrrhus of Cydonia, who first taught the Cretans to march in measure and cadence to battle, and to observe the pace of the Pyrrhic foot.—Others derive the name from Pyrrhus the son of Achilles, who instituted this exercise at the obsequies of his father.—Aristotle says, that it was Achilles himself who invented it.

The Romans also called it *ludus Trojanus*, "the Trojan game;" and Aulus Gellius *decursus*.—It is doubtless this exercise that we see represented on medals by two cavaliers in front running with lances, and the word *decursio* in the exergum.

PYRRHICHIUS, in the Greek and Latin poetry, a foot consisting of two syllables, both short;—as, *Deus*.—Among the ancients this foot is also called *periambus*; by others *hegemona*.

PYRRHO, a Greek philosopher, born at Elis in Peloponnesus, flourished about 300 B. C. He was the disciple of Anaxarchus, whom he accompanied as far as India, where he conversed with the Brachmans and Gymnosophists. He had made painting his profession before he devoted himself to the study of philosophy. He established a sect whose fundamental principle was, That there is nothing true or false, right or wrong, honest or dishonest, just or unjust; or that there is no standard of any thing beyond law or custom, and that uncertainty and doubt belong to every thing. From this continual seeking after truth and never finding it, the sect obtained the name of *Sceptics* or *Pyrrhonians*, from the founder, who is said to have acted upon his own principles, and to have carried his scepticism to such a ridiculous extreme, that his friends were obliged to accompany him wherever he went, that he might not be run over by carriages, or fall down precipices. If this was true, it was not without reason that he was ranked among those whose intellects were disturbed by intense study. But it is treated by a modern writer as a mere calumny invented by the dogmatists; and we are strongly inclined to be of his opinion, (see SCEPTICS). Pyrrho died about the 90th year of his age, when his memory was honoured with a statue at Athens, and a monument erected to him in his own country.

Pyrrhus ‖ Pythagoras

PYRRHUS, the name of two kings of Epirus. See EPIRUS.

PYRUS, the PEAR-TREE. See BOTANY *Index*; and for the culture of this fruit, see GARDENING. For an account of the processes followed in making perry, see AGRICULTURE.

PYTHAGORAS, a celebrated philosopher of antiquity, respecting the time and place of whose birth the learned are much divided. Eratosthenes asserts, that in the 48th Olympiad *, when he was very young, he was a victor at the Olympic games. Hence Dr Bentley † determines the date of his birth to be the 4th year of the 43d Olympiad; whilst Lloyd ‡, who denies that the Olympic victor was the same person with the philosopher places it about the 3d year of the 48th Olympiad. Mr Dodwell § differs from both, and wishes to fix the birth of Pythagoras in the 4th year of the 52d Olympiad. Of the arguments of these learned writers, Le Clerc has given a summary in the *Bibliotheque Choisée*, tom. x. p. 81. &c. and from a review of the whole, it would appear that he was not born earlier than the 4th year of the 43d Olympiad, or later than the 4th year of the 52d; but in what particular year of that period his birth took place, cannot with any degree of certainty be ascertained. It is generally believed that he was born in the island of Samos, and that he flourished about 500 years before Christ, in the time of Tarquin the last king of Rome *. His father Mnesarchus, who is thought by some to have been a lapidary, and by others a merchant of Tyre, appears to have been a man of some distinction, and to have bestowed upon his son the best eduction.

* An. ante Chr. 588.

† *Dissert. on the Ep. of Phalaris.*

‡ *Chron. of Pythagoras.*

§ *Two Dissertations on the age of Phalereus and Pythagoras.*

* *Tusc. Quæst.* lib. iv. cap. 1.

Jamblicus† relates a number of wonderful stories respecting Pythagoras's descent from Jupiter, his birth, and early life; and represents him even in his youth as a prodigy of wisdom and manly seriousness. But most of these idle tales confute themselves, afford nothing of importance to be depended upon, and only prove the credulity, carelessness, and prejudice of their author. Of his childhood and early education we know nothing, except that he was first instructed in his own country by Creophilus, and afterwards in Scyrus by Pherecydes (see PHERECYDES). According to the custom of the times he was made acquainted with poetry and music; eloquence and astronomy became his private studies, and in gymnastic exercises he often bore the palm for strength and dexterity. He first distinguished himself in Greece at the Olympic games, where, beside gaining the prize, he is said to have excited the highest admiration by the elegance and dignity of his person, and the brilliancy of his understanding.

† *Vit Pythag.* 6. n.

Soon after his appearance at these games, Pythagoras commenced his travels in quest of knowledge. He first visited Egypt, where, through the interest of Polycrates tyrant of Samos, he obtained the patronage of Amasis king of Egypt, by whose influence, combined with his own assiduity, patience, and perseverance, he at length gained the confidence of the priests; from whom he learned their sacred mysteries, theology, and the whole system of symbolical learning. In Egypt, too, he became acquainted with geometry and the true solar system; and, before he left that country, made himself master of all the learning for which it was so famed among the nations of antiquity.

He afterwards visited Persia and Chaldea, where from the Magi he learnt divination, the interpreting of dreams, and astronomy. He is likewise said to have travelled into India, to have conversed with the Gymnosophists, and to have acquired from them a knowledge of the philosophy and literature of the east; and such was his ardour in the pursuit of science, that in quest of it, we are told by Cicero *, he crossed many seas, and travelled on foot through many barbarous nations.

* *De Finibus*, lib. iv. § 29.

After Pythagoras had spent many years in gathering information on every subject, especially respecting the nature of the gods, the rites of religion, and the immortality of the human soul, he returned to his native island, and attempted to make his knowledge useful by instituting a school for the instruction of his countrymen. Failing of success in this laudable undertaking, he repaired to Delos, where he pretended to receive moral dogmas from the priestess of Apollo. He also visited Crete, where he was initiated into the most sacred mysteries of Greece. He went likewise to Sparta and Elis, and again assisted at the Olympic games; where in the public assembly he was saluted with the title of *sophist* or *wise man*, which he declined for one more humble. See PHILOLOGY, N° 1. and PHILOSOPHY, N° 1.

He returned to Samos enriched with mythological learning and mysterious rites, and again instituted a school. His mysterious symbols and oracular precepts made this attempt more successful than the former had been; but meeting with some opposition, or being detected in some pious frauds, he suddenly left Samos, retired to Magna Grecia, and settled at Crotona.

Here he founded the Italic sect (see PHILOSOPHY, N° 20.); and his mental and personal accomplishments, the fame of his distant travels, and his Olympic crown, soon procured him numerous pupils. His bold and manly eloquence and graceful delivery attracted the most dissolute, and produced a remarkable change in the morals of the people of Crotona. His influence was increased by the regularity of his own example, and its conformity to his precepts. He punctually attended the temples of the gods, and paid his devotions at an early hour; he lived upon the purest and most innocent food, clothed himself like the priests of Egypt, and by his continual purifications and regular offerings appeared to be superior in sanctity to the rest of mankind. He endeavoured to assuage the passions of his scholars with verses and numbers, and made a practice of composing his own mind every morning, by playing on his harp, and singing along with it the pæans of Thales. To avoid the temptations of ease and the seductions of idleness, bodily exercises also made a considerable part of his discipline.

At Crotona he had a public school for the general benefit of the people, in which he taught them their duty, praising virtue and condemning vice; and particularly instructing them in the duties of social life. Besides this, he had a college in his own house, which he denominated κοινοβιον, in which there were two classes of students, viz. εξωτερικοι, who were also called *auscultantes*, and εσωτερικοι. The former of these were probationers, and were kept under a long examen. A silence of five years was imposed upon them; which Apuleius thinks was intended to teach them modesty and attention; but Clemens Alexandrinus thinks it was for the purpose of abstracting their minds from sensible objects, and inuring them to the pure contemplation of the Deity. The latter class of scholars were called *genuini*, *perfecti*, *mathematici*, and, by way of eminence, *Pythagoreans*. They alone were admitted to the knowledge of the arcana and depths of Pythagoric discipline, and were taught the use of ciphers and hieroglyphic writings.

Clemens observes, that these orders corresponded very exactly to those among the Hebrews: for in the schools of the prophets, there were two classes, viz. the sons of the prophets, who were the scholars, and the doctors or masters, who were also called *perfecti*; and among the Levites, the novices or tyros, who had their quinquennial exercises, by way of preparation. Lastly, even among the proselytes there were two orders; *exoterici*, or proselytes of the gate; and *intrinseci* or *perfecti*, proselytes of the covenant. He adds, it is highly probable, that Pythagoras himself had been a proselyte of the gate, if not of the covenant. Gale endeavours to prove that Pythagoras borrowed his philosophy from that of the Jews; to this end producing the authorities of many of the fathers and ancient authors, and even pointing out the tracks and footsteps of Moses in several parts of Pythagoras's doctrine. But we believe the learned author was misled by the Christian Platonists.

The authority of Pythagoras among his pupils was so great, that it was even deemed a crime to dispute his word; and their arguments were considered as infallibly convincing, if they could enforce them by adding, that "the master said so;" an expression which afterwards became proverbial in *jurare in verba magistri*. This influence over his school was soon extended to the world, and even his pupils themselves divided the applause and approbation of the people with their master; and the rulers and legislators of all the principal towns of Greece, Sicily, and Italy, boasted of being the disciples of Pythagoras. To give more weight to his exhortations, as some writers mention, Pythagoras retired into a subterraneous cave, where his mother sent him intelligence of every thing which happened during his absence. After a certain number of months he again re-appeared on the earth with a grim and ghastly countenance, and declared in the assembly of the people that he was returned from hell. From similar exaggerations it has been asserted that he appeared at the Olympic games with a golden thigh, and that he could write in letters of blood whatever he pleased on a looking-glass; and that by setting it opposite to the moon, when full, all the characters which were on the glass became

became legible on the moon's disc. They also relate, that by some magical words he tamed a bear, stopped the flight of an eagle, and appeared on the same day and at the same instant in the cities of Crotona and Metapontum, &c.

At length his singular doctrines, and perhaps his strenuously asserting the rights of the people against their tyrannical governors, excited a spirit of jealousy, and raised a powerful party against him; which soon became so outrageous as to oblige him to fly for his life. His friends fled to Rhegium; and he himself, after being refused protection by the Locrians, fled to Metapontum, where he was obliged to take refuge in the temple of the muses, and where it is said he died of hunger about 497 years before Christ. Respecting the the time, place, and manner of his death, however, there are various opinions, and many think it uncertain when, where, or in what manner he ended his days. After his death his followers paid the same respect to him as was paid to the immortal gods; they erected statues in honour of him, converted his house at Crotona into a temple to Ceres, appealed to him as a deity, and swore by his name.

Pythagoras married Theano of Crotona, or, according to others, of Crete, by whom he had two sons, Telauges and Mnesarchus, who, after his death, took care of his school. He is said also to have had a daughter called *Damo*.

Whether he left any writings behind him is disputed. It seems probable, however, that he left none, and that such as went under his name were written by some of his followers. The *golden verses* which Hierocles illustrated with a commentary, have been ascribed to Epicharmus or Empedocles, and contain a brief summary of his popular doctrines. From this circumstance, and from the mysterious secrecy with which he taught, our information concerning his doctrine and philosophy is very uncertain, and cannot always be depended on.

The purpose of philosophy, according to the system of Pythagoras, is to free the mind from incumbrances, and to raise it to the contemplation of immutable truth and the knowledge of divine and spiritual objects. To bring the mind to this state of perfection is a work of some difficulty, and requires a variety of intermediate steps. Mathematical science was with him the first step to wisdom, because it inures the mind to contemplation, and takes a middle course between corporeal and incorporeal beings. The whole science he divided into two parts, *numbers* and *magnitude;* and each of these he subdivided into two others, the former into *arithmetic* and *music*, and the latter into *magnitude at rest and in motion;* the former of which comprehends *geometry*, and the latter *astronomy*. Arithmetic he considered as the noblest science, and an acquaintance with numbers as the highest good. He considered numbers as the principles of every thing; and divided them into scientific and intelligible. Scientific number is the production of the powers involved in unity, and its return to the same; number is not infinite, but is the source of that infinite divisibility into equal parts which is the property of all bodies. Intelligible numbers are those which existed in the divine mind before all things. They are the model or archetype of the world, and the cause of the essence of beings. Of the Monad, Duad, Triad, Tetrad, and Decad, various explanations have been given by various authors; but nothing certain or important is known of them. In all probability, numbers were used by Pythagoras as symbolical representations of the first principles and forms of nature, and especially of those eternal and immutable essences which Plato denominated ideas; and in this case the Monad was the simple root from which he conceived numbers to proceed, and as such, analogous to the simple essence of deity; from whence, according to his system, the various properties of nature proceed.

Music followed numbers, and was useful in raising the mind above the dominion of the passions. Pythagoras considered it as a science to be reduced to mathematical principles and proportions, and is said to have discovered the musical chords from the circumstance of several men successively striking with hammers a piece of heated iron upon an anvil. This story Dr Burney * discredits; but allows, from the uniform testimony of writers ancient and modern, that he invented the *harmónical canon* or monochord, (see MONOCHORD). The music of the spheres, of which every one has heard, was a most fanciful doctrine of Pythagoras. It was produced, he imagined, by the planets striking on the ether through which in their motion they passed; and he considered their musical proportions as exact, and their harmony perfect.

* *History of Music*, vol. i. p. 441.

Pythagoras, as we have already seen, learned geometry in Egypt; but by investigating many new theorems, and by digesting its principles, he reduced it to a more regular science. A geometrical point, which he defines to be a monad, or unity with position, he says corresponds to unity in arithmetic, a line to two, a superficies to three, and a solid to four. He discovered several of the propositions of Euclid; and on discovering the 47th of book 1st, he is said to have offered a hecatomb to the gods; but as he was averse to animal sacrifices, this assertion is surely false. His great progress in astronomical science has been mentioned elsewhere. See ASTRONOMY, N° 11, 22. and PHILOSOPHY, N° 15, 16.

Wisdom, according to Pythagoras, is conversant with those objects which are naturally immutable, eternal, and incorruptible; and its end is to assimilate the human mind to the divine, and to qualify us to join the assembly of the gods. Active and moral philosophy prescribes rules and precepts for the conduct of life, and leads us to the practice of public and private virtue.—On these heads many of his precepts were excellent, and some of them were whimsical and useless. Theoretical philosophy treats of nature and its origin, and is, according to Pythagoras, the highest object of study. It included all the profound mysteries which he taught, of which but little is now known. God he considers as the universal mind, diffused through all things, and the self-moving principle of all things (αυτοματισμος τῶν παντῶν), and of whom every human soul is a portion *. It is very probable, that he conceived of the Deity as a subtle fire, eternal, active, and intelligent; which is not inconsistent with the idea of incorporeality, as the ancients understood that term. This Deity was primarily combined with the chaotic mass of passive matter, but he had the power of separating himself, and since the separation he has remained distinct. The learned Cudworth

* *Cicero de Senect.* § 21.

Pythagoras. worth contends, that Pythagoras maintained a trinity of hypostases in the divine nature, similar to the Platonic triad (see PLATONISM). We cannot say that his arguments appear to have much force; but we think the conclusion which he wishes to establish extremely probable, as Plato certainly drew his doctrine from some of the countries which Pythagoras had visited before him.

Subordinate to the Deity there were in the Pythagorean creed three orders of intelligences, gods, demons, and heroes, of different degrees of excellence and dignity. These, together with the human soul, were considered as emanations from the Deity, the particles of subtle ether assuming a grosser clothing the farther they receded from the fountain. Hierocles defines a hero to be a rational mind united with a luminous body. God himself was represented under the notion of monad, and the subordinate intelligences as numbers derived from and included in unity. Man is considered as consisting of an elementary nature and a divine or rational soul. His soul, a self moving principle, is composed of two parts; the rational, seated in the brain; and the irrational, including the passions, in the heart. In both these respects he participates with the brutes, whom the temperament of their body, &c. allows not to act rationally. The sensitive soul perishes; the other assumes an ethereal vehicle, and passes to the region of the dead, till sent back to the earth to inhabit some other body, brutal or human. See METEMPSYCHOSIS. It was unquestionably this notion which led Pythagoras and his followers to deny themselves the use of flesh, and to be so peculiarly merciful to animals of every description. Some authors, however, say, that flesh and beans, the use of which he also forbade, were prohibited, because he supposed them to have been produced from the same putrified matter, from which, at the creation of the world, man was formed.

Of the symbols of Pythagoras little is known. They have been religiously concealed; and though they have awakened much curiosity, and occasioned many ingenious conjectures, they still appear to us dark and trifling. As a specimen we give the following: "Adore the sound of the whispering wind. Stir not the fire with a sword. Turn aside from an edged tool. Pass not over a balance. Setting out on a journey, turn not back, for the furies will return with you. Breed nothing that hath crooked talons. Receive not a swallow into your house. Look not in a mirror by the light of a candle. At a sacrifice pare not your nails. Eat not the heart or brain. Taste not that which hath fallen from the table. Break not bread. Sleep not at noon. When it thunders touch the earth. Pluck not a crow. Roast not that which has been boiled. Sail not on the ground. Plant not a palm. Breed a cock, but do not sacrifice it, for it is sacred to the sun and moon. Plant mallows in thy garden, but eat them not. Abstain from beans."

The following precepts are more important: "Discourse not of Pythagorean doctrines without light. Above all things govern your tongue. Engrave not the image of God in a ring. Quit not your station without the command of your general. Remember that the paths of virtue and of vice resemble the letter Y. To this symbol Persius refers *, when he says,

* Sat. iii. 56.

Et tibi quæ Samios diduxit litera ramos,
Surgentem dextro monstravit limite collem.

There has the Samian Y's instructive make
Pointed the road thy doubtful foot should take;
There warn'd thy raw and yet unpractis'd youth,
To tread the rising right-hand path of truth.

Pythagoras ‖ Python.

The scantiness and uncertainty of our information respecting Pythagoras, renders a regular and complete account of his life and doctrines impossible. A modern author † of profound erudition, pronounces him to have been *unquestionably* the wisest man that ever lived, if his masters the Egyptian priests must not be excepted. This is saying a great deal too much; but that he was one of the most distinguished philosophers of antiquity, or, as Cicero expresses it, *vir præstanti sapientia*, appears very evident; and his moral character has never been impeached. The mysterious air which he threw over his doctrines, and the apparent inanity of some of his symbols, have indeed subjected him to the charge of imposture, and perhaps the charge is not wholly groundless; but when we consider the age in which he lived, and the nature of the people with whom he had to deal, who would in all probability have resisted more open innovations, even this will not appear so blameable as at first sight we are apt to think it; and it is worthy of notice, that the worst stories of this kind have come down to us in a very questionable shape, and with much probability appear to be false.

† *Ancient Metaphysics.*

PYTHAGOREANS, a sect of ancient philosophers, so called from being the followers of Pythagoras. See the preceding article.

PYTHIA, the priestess of Apollo at Delphi, by whom he delivered oracles. She was so called from Pythius, a name of that god, which is said to have been given him on account of his victory over the serpent Python.

The Pythia was at first required to be a young girl, but in latter times she was a woman of 50 years of age. The first and most famous Pythia was Phemonöe. Oracles were at first delivered by her in hexameter verse. All the pythias were to be pure virgins, and all of them delivered their oracles with great enthusiasm and violent agitations. See ORACLE and DELPHI.

PYTHIAN GAMES, in Grecian antiquity, sports instituted near Delphos in honour of Apollo, on account of his slaying the serpent Python. See APOLLO.—These games, at their first institution, were celebrated only once in nine years; but afterwards every fifth year, from the number of the Parnassian nymphs who came to congratulate Apollo, and to make him presents on his victory. The victor was crowned with garlands.

PYTHON, in fabulous history, a monstrous serpent, produced by the earth after Deucalion's deluge. Juno being exasperated at Latona, who was beloved by Jupiter, commanded this serpent to destroy her; but flying from the pursuit of the monster, she escaped to Delos, where she was delivered of Diana and Apollo; the latter of whom at length destroyed Python with his arrows, in memory of which victory the Pythian games were instituted. See APOLLO.

Q.

Q, or *q*, the 16th letter and 12th consonant of our alphabet; but is not to be found either in the Greek, old Latin, or Saxon alphabets; and indeed some would entirely exclude it, pretending that k ought to be used wherever this occurs. However, as it is formed in the voice in a different manner, it is undoubtedly a distinct letter: for, in expressing this sound, the cheeks are contracted, and the lips, particularly the under one, are put into a canular form, for the passage of the breath.

The q is never sounded alone, but in conjunction with u, as in *quality, question, quite, quote*, &c. and never ends any English word.

As a numeral, Q stands for 500; and with a dash over it, thus $\bar{Q}$, for 500,000.

Used as an abbreviature *q* signifies *quantity*, or *quantum*. Thus, among physicians, *q. pl.* is *quantum placet*, i. e. "as much as you please" of a thing; and *q. s.* is *quantum sufficit*, i.e. "as much as is necessary." Q. E. D. among mathematicians, is *quod erat demonstrandum*, i. e. "which was to be demonstrated:" and Q. E. F. is *quod erat faciendum*, i. e. "which was to be done." Q. D. among grammarians is *quasi dictum*, i. e. "as if it were said;" or, "as who should say." In the notes of the ancients, Q stands for *Quintus*, or *Quintius;* Q. B. V. for *quod bene vertat;* Q. S. S. S. for *quæ supra scripta sunt;* Q. M. for *Quintus Mutius*, or *quomodo;* Quint. for *Quintilius;* and Quæs. for *quæstor*.

QUAB, in *Ichthyology*, the name of a Russian fish, which is said to be at first a tadpole, then a frog, and at last a fish. Dr Mounsey, who made many inquiries concerning these pretended changes, considers them all as fabulous. He had opportunity of seeing the fish itself, and found that they spawned like other fishes, and grew in size, without any appearances to justify the report. He adds, that they delight in very clear water, in rivers with sandy or stony bottoms, and are never found in standing lakes, or in rivers passing through marshes or mossy grounds, where frogs choose most to be.

QUABES, are a free people of Africa, inhabiting the southern banks of the river Sestos, and between that and Sierra Leona. They are under the protection of the emperor of Manow.

QUACHA, or QUAGGA. See EQUUS, MAMMALIA *Index*.

QUACHILTO, in *Ornithology*, is the name of a very beautiful Brasilian bird, called also *yacazintli* and *porphyrio Americanus*. It is of a fine blackish purple colour, variegated with white; its beak is white while young, but becomes red as it grows older, and has a naked space at its basis, resembling in some sort the coot; its legs are of a yellowish green; it lives about the waters, and feeds on fish, yet is a very well tasted bird. It imitates the crowing of a common cock, and makes its music early in the morning.

Marc-grave's Hist. Bra-

QUACK, among physicians, the same with empiric. See EMPIRIC.

QUADI, (Tacitus); a people of Germany, situated to the south-east of the mountains of Bohemia, on the banks of the Danube, and extending as far as the river Marus, or March, running by Moravia, which country they occupied.

QUADRAGESIMA, a denomination given to lent, from its consisting of 40 days. See LENT.

QUADRANGLE, in *Geometry*, the same with a quadrilateral figure, or one consisting of four sides and four angles.

QUADRANS, the quarter or fourth part of any thing, particularly the *as*, or pound.

QUADRANS, in English money, the fourth part of a penny. Before the reign of Edward I. the smallest coin was a *sterling*, or penny, marked with a cross; by the guidance of which a penny might be cut into halves for a halfpenny, or into quarters or four parts for farthings; till, to avoid the fraud of unequal cuttings, that king coined halfpence and farthings in distinct round pieces.

QUADRANT, in *Geometry*, the arch of a circle, containing 90°, or the fourth part of the entire periphery.

Sometimes also the space or area, included between this arch and two radii drawn from the centre to each extremity thereof, is called a *quadrant*, or, more properly, a *quadrantal space*, as being a quarter of an entire circle.

QUADRANT, also denotes a mathematical instrument, of great use in astronomy and navigation, for taking the altitudes of the sun and stars, as also for taking angles in surveying, &c.

This instrument is variously contrived, and furnished with different apparatus, according to the various uses it is intended for; but they all have this in common, that they consist of a quarter of a circle, whose limb is divided into 90°. Some have a plummet suspended from the centre, and are furnished with sights to look through.

The principal and most useful quadrants are the common surveying quadrant, astronomical quadrant, Adams's quadrant, Cole's quadrant, Gunter's quadrant, Hadley's quadrant, horodictical quadrant, Sutton's or Collins's quadrant, and the sinical quadrant, &c. Of each of which in order.

1. The common surveying quadrant, is made of brass, wood, or any other solid substance; the limb of which is divided into 90°, and each of these farther divided into as many equal parts as the space will allow, either diagonally or otherwise. On one of the semidiameters are fitted two moveable sights; and to the centre is sometimes also fixed a label, or moveable index, bearing two other sights; but in lieu of these last sights there is sometimes fitted a telescope: also from the centre there is hung a thread with a plummet; and on the under side or face of the instrument is fitted a ball and socket, by means of which it may be put into any position. The general use of it is for taking angles in a vertical plane, comprehended under right lines going from

Quadrant. from the centre of the instrument, one of which is horizontal, and the other is directed to some visible point. But besides the parts already described, there is frequently added to the face, near the centre, a kind of compartment, called the *quadrat*, or *geometrical square*. See QUADRAT.

This quadrant may be used in different situations: for observing heights or depths, its plane must be disposed perpendicularly to the horizon; but to take horizontal distances, its plane is disposed parallel thereto. Again, heights and distances may be taken two ways, viz. by means of the fixed sights and plummet, or by the label: As to which, and the manner of measuring angles, see GEOMETRY and MENSURATION.

2. The astronomical quadrant is a large one, usually made of brass, or wooden bars faced with iron plates; having its limb nicely divided, either diagonally or otherwise, into degrees, minutes, and seconds; and furnished with two telescopes, one fixed on the side of the quadrant, and the other moveable about the centre, by means of the screw. There are also dented wheels which serve to direct the instrument to any object or phenomenon.—The use of this curious instrument, in taking observations of the sun, planets, and fixed stars, is obvious; for being turned horizontally upon its axis, by means of the telescope, till the object is seen through the moveable telescope, then the degrees, &c. cut by the index give the altitude required. See ASTRONOMY *Index*.

3. Cole's quadrant is a very useful instrument invented by Mr Benjamin Cole. It consists of six parts, viz. the staff AB (fig. 1.); the quadrantal arch DE; three vanes A, B, C; and the vernier FG. The staff is a bar of wood about two feet long, an inch and a quarter broad, and of a sufficient thickness to prevent it from bending or warping. The quadrantal arch is also of wood; and is divided into degrees, and third-parts of a degree, to a radius of about nine inches; to its extremities are fitted two radii, which meet in the centre of the quadrant by a pin, round which it easily moves. The sight-vane A is a thin piece of brass, almost two inches in height and one broad, placed perpendicularly on the end of the staff A, by the help of two screws passing through its foot. Through the middle of this vane is drilled a small hole, through which the coincidence or meeting of the horizon and solar spot is to be viewed. The horizon vane B is about an inch broad, and two inches and a half high, having a slit cut through it of near an inch long and a quarter of an inch broad; this vane is fixed in the centre-pin of the instrument, in a perpendicular position, by the help of two screws passing through its foot, whereby its position with respect to the sight-vane is always the same, their angles of inclination being equal to 45 degrees. The shade-vane C is composed of two brass plates. The one, which serves as an arm, is about four inches and a half long, and three quarters of an inch broad, being pinned at one end to the upper limb of the quadrant by a screw, about which it has a small motion; the other end lies in the arch, and the lower edge of the arm is directed to the middle of the centre-pin: the other plate, which is properly the vane, is about two inches long, being fixed perpendicularly to the other plate, at about half an inch distance from that end next the arch; this vane may be used either by its shade or by the solar spot cast by a convex lens placed therein. And, because the wood-work is often apt to warp or twist, therefore this vane may be rectified by the help of a screw, so that the warping of the instrument may occasion no error in the observation, which is performed in the following manner: Set the line G on a vernier against a degree on the upper limb of the quadrant, and turn a screw on the backside of the limb forward or backward, till the hole in the sight-vane, the centre of the glass, and the sunk spot in the horizon-vane, lie in a right line.

Plate CCCCLVIII. fig. 1.

To find the sun's altitude by this instrument: Turn your back to the sun, holding the instrument by the staff with your right hand, so that it be in a vertical plane passing through the sun; apply your eye to the sight-vane, looking through that and the horizon-vane till you see the horizon; with the left hand slide the quadrantal arch upwards, until the solar spot or shade, cast by the shade-vane, fall directly on the spot or slit in the horizon-vane; then will that part of the quadrantal arch, which is raised above G or S (according as the observation respected either the solar spot or shade) show the altitude of the sun at that time. But if the meridian altitude be required, the observation must be continued; and as the sun approaches the meridian, the sea will appear through the horizon-vane, and then is the observation finished; and the degrees and minutes, counted as before, will give the sun's meridian altitude: or the degrees counted from the lower limb upwards will give the zenith-distance.

4. Adams's quadrant differs only from Cole's quadrant in having an horizontal vane, with the upper part of the limb lengthened; so that the glass, which casts the solar spot on the horizon-vane, is at the same distance from the horizon-vane as the sight-vane at the end of the index.

5. Gunter's quadrant, so called from its inventor Edmund Gunter, besides the usual apparatus of other quadrants, has a stereographical projection of the sphere on the plane of the equinoctial. It has also a kalendar of the months, next to the divisions of the limb.

Use of Gunter's quadrant. 1. To find the sun's meridian altitude for any given day, or the day of the month for any given meridian altitude. Lay the thread to the day of the month in the scale next the limb; and the degree it cuts in the limb is the sun's meridian altitude. Thus the thread, being laid on the 15th of May, cuts 59° 30′, the altitude sought; and, contrarily, the thread, being set to the meridian altitude, shows the day of the month. 2. To find the hour of the day. Having put the bead, which slides on the thread, to the sun's place in the ecliptic, observe the sun's altitude by the quadrant; then, if the thread be laid over the same in the limb, the bead will fall upon the hour required. Thus suppose on the 10th of April, the sun being then in the beginning of Taurus, I observe the sun's altitude by the quadrant to be 36°; I place the bead to the beginning of Taurus in the ecliptic, and lay the thread over 36° of the limb; and find the bead to fall on the hour-line marked three and nine; accordingly the hour is either nine in the morning or three in the afternoon. Again, laying the bead on the hour given, having first rectified or put it to the sun's place, the degree cut by the thread on the limb gives the altitude. Note, the bead may be rectified otherwise, by bringing

bringing the thread to the day of the month, and the bead to the hour-line of 12. 3. To find the sun's declination from his place given, and contrariwise. Set the bead to the sun's place in the ecliptic, move the thread to the line of declination, and the bead will cut the degree of declination required. Contrarily, the bead being adjusted to a given declination, and the thread moved to the ecliptic, the bead will cut the sun's place. 4. The sun's place being given, to find his right ascension, or contrarily. Lay the thread on the sun's place in the ecliptic, and the degree it cuts on the limb is the right ascension sought. Contrarily, laying the thread on the right ascension, it cuts the sun's place in the ecliptic. 5. The sun's altitude being given, to find his azimuth, and contrariwise. Rectify the bead for the time, as in the second article, and observe the sun's altitude: bring the thread to the complement of that altitude; thus the bead will give the azimuth sought, among the azimuth lines. 6. To find the hour of the night from some of the five stars laid down on the quadrant. (1.) Put the bead to the star you would observe, and find how many hours it is off the meridian, by article 2. (2.) Then, from the right ascension of the star, subtract the sun's right ascension converted into hours, and mark the difference; which difference, added to the observed hour of the star from the meridian, shows how many hours the sun is gone from the meridian, which is the hour of the night. Suppose on the 15th of May the sun is in the 4th degree of Gemini, I set the bead to Arcturus; and, observing his altitude, find him to be in the west about 52° high, and the bead to fall on the hour-line of two in the afternoon; then will the hour be 11 hours 50 minutes past noon, or 10 minutes short of midnight: for 62°, the sun's right ascension, converted into time, makes four hours eight minutes; which, subtracted from 13 hours 58 minutes, the right ascension of Arcturus, the remainder will be nine hours 50 minutes; which added to two hours, the observed distance of Arcturus from the meridian, shows the hour of the night to be 11 hours 50 minutes.

The mural quadrant has been already described under the article ASTRONOMY. It is a most important instrument, and has been much improved by Mr Ramsden, who has distinguished himself by the accuracy of his divisions, and by the manner in which he finishes the planes by working them in a vertical position. He places the plumb-line behind the instrument, that there may be no necessity for removing it when we take an observation near the zenith. His manner of suspending the glass, and that of throwing light on the object-glass and on the divisions at the same time, are new, and improvements that deserve to be noticed. Those of eight feet, which he has made for the observatories of Padua and Vilna, have been examined by Dr Maskelyne; and the greatest error does not exceed two seconds and a half. That of the same size for the observatory of Milan is in a very advanced state. The mural quadrant, of six feet at Blenheim, is a most admirable instrument. It is fixed to four pillars, which turn on two pivots, so that it may be put to the north and to the south in one minute. It was for this instrument Mr Ramsden invented a method of rectifying the arc of 90 degrees, on which an able astronomer had started some difficulties; but by means of an horizontal line and a plumb-line, forming a kind of cross, without touching the circle, he showed him that there was not an error of a single second in the 90 degrees; and that the difference was occasioned by a mural quadrant of Bird, in which the arc of 90 degrees was too great by several seconds, and which had never been rectified by so nice a method as that of Mr Ramsden.

But the quadrant is not the instrument which stands highest in Mr Ramsden's opinion; it is the complete circle: and he has demonstrated to M. de la Lande, that the former must be laid aside, if we would arrive at the utmost exactness of which an observation is capable. His principal reasons are: 1. The least variation in the centre is perceived by the two diametrically opposite points. 2. The circle being worked on the turn, the surface is always of the greatest accuracy, which it is impossible to obtain in the quadrant. 3. We may always have two measures of the same arc, which will serve for the verification of each other. 4. The first point of the division may be verified every day with the utmost facility. 5. The dilatation of the metal is uniform, and cannot produce any error. 6. This instrument is a meridian glass at the same time. 7. It also becomes a moveable azimuth circle by adding a horizontal circle beneath its axis, and then gives the refractions independent of the mensuration of time.

6. Hadley's quadrant is an instrument of vast utility both in navigation and practical astronomy. It derives its name from Mr Hadley, who first published an account of it, though the first thought originated with the celebrated Dr Hooke, and was completed by Sir Isaac Newton (see ASTRONOMY, N° 32. and also N° 17. and 22.). The utility of this quadrant arises from the accuracy and precision with which it enable us to determine the latitude and longitude; and to it is navigation much indebted for the very great and rapid advances it has made of late years. It it easy to manage, and of extensive use, requiring no peculiar steadiness of hand, nor any such fixed basis as is necessary to other astronomical instruments. It is used as an instrument for taking angles in maritime surveying, and with equal facility at the mast head as upon the deck, by which its sphere of observation is much extended; for supposing many islands to be visible from the mast head, and only one from deck, no useful observation can be made by any other instrument. But by this, angles may be taken at the mast head from the one visible object with great exactness; and further taking angles from heights, as hills, or a ship mast's head, is almost the only way of describing exactly the figure and extent of shoals.

It has been objected to the use of this instrument for surveying, that it does not measure the horizontal angles, by which alone a plan can be laid down. This objection, however true in theory, may be reduced in practice by a little caution; and Mr Adams has given very good directions for doing so.

Notwithstanding, however, the manifest superiority of this instrument over those that were in use at the time of its publication, it was many years before the sailors could be persuaded to adopt it, and lay aside their imperfect and inaccurate instruments, so great is the difficulty to remove prejudice, and emancipate the mind from the slavery of opinion. No instrument has undergone, since the original invention, more changes than

than the quadrant of Hadley; of the various alterations, many had no better foundation than the caprice of the makers, who by these attempts have often rendered the instrument more complicated in construction, and more difficult in use, than it was in its original state.

It is an essential property of this instrument, derived from the laws of reflection, that half degrees on the arc answer to whole ones in the angles measured: hence an octant, or the eighth part of a circle, or 45 degrees on the arch, serves to measure 90 degrees; and sextants will measure an angular distance of 120 degrees, though the arch of the instrument is no more than 60 degrees. It is from this property that foreigners term that instrument an *octant*, which we usually call a *quadrant*, and which in effect it is. This property reduces indeed considerably the bulk of the instrument: but at the same time it calls for the utmost accuracy in the divisions, as every error on the arch is doubled in the observation.

Another essential, and indeed an invaluable, property of this instrument, whereby it is rendered peculiarly advantageous in marine observations, is, that it is not liable to be disturbed by the ship's motion; for provided the mariner can see distinctly the two objects in the field of his instrument, no motion nor vacillation of the ship will injure his observation.

Thirdly, the errors to which it is liable are readily discovered and easily rectified, while the application and use of it is facile and plain.

To find whether the two surfaces of any one of the reflecting glasses be parallel, apply your eye at one end of it, and observe the image of some object reflected very obliquely from it; if that image appear single, and well-defined about the edges, it is a proof that the surfaces are parallel: on the contrary, if the edge of the reflected images appear misted, as if it threw a shadow from it, or separated like two edges, it is a proof that the two surfaces of the glass are inclined to each other: if the images in the speculum, particularly if that image be the sun, be viewed through a small telescope, the examination will be more perfect.

To find whether the surface of a reflecting glass be plane. Choose two distant objects, nearly on a level with each other: hold the instrument in an horizontal position, view the left-hand object directly through the transparent part of the horizon-glass, and move the index till the reflected image of the other is seen below it in the silvered part; make the two images unite just at the line of separation, then turn the instrument round slowly on its own plane, so as to make the united images move along the line of separation of the horizon-glass. If the images continue united without receding from each other, or varying their respective position, the reflecting surface is a good plane.

To find if the two surfaces of a red or darkening glass are parallel and perfectly plane. This must be done by means of the sun when it is near the meridian, in the following manner: hold the sextant vertically, and direct the sight to some object in the horizon, or between you and the sky, under the sun; turn down the red glass and move the index till the reflected image of the sun is in contact with the object seen directly: fix then the index, and turn the red glass round in its square frame; view the sun's image and object immediately, and if the sun's image is neither raised nor depressed, but continues in contact with the object below, as before, then the surfaces of the darkening glass are true.

For a more particular description of Hadley's quadrant, and the mode of using it, see NAVIGATION, Book II. chap. i.

This instrument has undergone several improvements since its first invention, and among these improvers must be ranked Mr Ramsden. He found that the essential parts of the quadrant had not a sufficient degree of solidity; the friction at the centre was too great, and in general the alidada might be moved several minutes without any change in the position of the mirror; the divisions were commonly very inaccurate, and Mr Ramsden found that Abbé de la Caille did not exceed the truth in estimating at five minutes the error to which an observer was liable in taking the distance between the moon and a star; an error capable of producing a mistake of 50 leagues in the longitude. On this account Mr Ramsden changed the principle of construction of the centre, and made the instrument in such a manner as never to give an error of more than half a minute; and he has now brought them to such a degree of perfection as to warrant it not more than six seconds in a quadrant of fifteen inches. Since the time of having improved them, Mr Ramsden has constructed an immense number; and in several which have been carried to the East Indies and America, the deficiency has been found no greater at their return than it had been determined by examinations before their being taken out. Mr Ramsden has made them from 15 inches to an inch and a half, in the latter of which the minutes are easily distinguishable; but he prefers for general use those of 10 inches, as being more easily handled than the greater, and at the same time capable of equal accuracy. See SEXTANT.

A great improvement was also made in the construction of this quadrant by Mr Peter Dollond, famous for his invention of achromatic telescopes. The glasses of the quadrants should be perfect planes, and have their surfaces perfectly parallel to one another. By a practice of several years, Mr Dollond found out methods of grinding them of this form to great exactness; but the advantage which should have arisen from the goodness of the glasses was often defeated by the index-glass being bent by the frame which contains it. To prevent this, Mr Dollond contrived the frame so, that the glass lies on three points, and the part that presses on the front of the glass has also three points opposite to the former. These points are made to confine the glass by three screws at the back, acting directly opposite to the points between which the glass is placed. The principal improvements, however, are in the methods of adjusting the glasses, particularly for the back-observation. The method formerly practised for adjusting that part of the instrument by means of the opposite horizons at sea, was attended with so many difficulties that it was scarcely ever used: for so little dependence could be placed on the observations taken this way, that the best Hadley's sextants, made for the purpose of observing the distances of the moon from the sun or fixed stars, have been always made without the horizon-glass for the back-observation; for want of which, many valuable observations of the sun and moon have been lost, when their distance exceeded 120 degrees.

Quadrant. grees. To make the adjustment of the back-observation easy and exact, he applied an index to the back horizon-glass, by which it may be moved in a parallel position to the index-glass, in order to give it the two adjustments in the same manner as the fore horizon-glass is adjusted. Then, by moving the index to which the back horizon-glass is fixed exactly 90 degrees (which is known by the divisions made for that purpose), the glass will thereby be set at right angles to the index-glass, and will be properly adjusted for use; and the observations may be made with the same accuracy by this as by the fore-observation. To adjust the horizon-glasses in the perpendicular position to the plane of the instrument, he contrived to move each of them by a single screw, which goes though the frame of the quadrant, and is turned by means of a milled head at the back; which may be done by the observer while he is looking at the object. To these improvements also he added a method invented by Dr Maskelyne, of placing darkening-glasses behind the horizon-glasses. These, which serve for darkening the object seen by direct vision, in adjusting the instrument by the sun or moon, he placed in such a manner as to be turned behind the fore horizon-glass, or behind the back horizon-glass: there are three of these glasses of different degrees of darkness.

We have been the more particular in our description and use of Hadley's quadrant, as it is undoubtedly the best hitherto invented.

7. Horodictical quadrant, a pretty commodious instrument, so called from its use in telling the hour of the day.—Its construction is this: From the centre of the quadrant, C, fig. 3. whose limb AB is divided into 90°, describe seven concentric circles at intervals at pleasure; and to these add the signs of the zodiac, in the order represented in the figure. Then applying a ruler to the centre C and the limb AB, mark upon the several parallels the degrees corresponding to the altitude of the sun when therein, for the given hours; connect the points belonging to the same hour with a curve line, to which add the number of the hour. To the radius CA fit a couple of sights, and to the centre of the quadrant C tie a thread with a plummet, and upon the thread a bead to slide. If now the thread be brought to the parallel wherein the sun is, and the quadrant directed to the sun, till a visual ray pass through the sights, the bead will show the hour; for the plummet, in this situation, cuts all the parallels in the degrees corresponding to the sun's altitude. Since the bead is in the parallel which the sun describes, and through the degrees of altitude to which the sun is elevated every hour there pass hour lines, the bead must show the present hour. Some represent the hour-lines by arches of circles, or even by straight lines, and that without any sensible error. Fig. 3.

8. Sutton's or Collins's quadrant (fig. 4.) is a stereographic projection of one quarter of the sphere between the tropics, upon the plane of the ecliptic, the eye being in its north pole: it is fitted to the latitude of London. The lines running from the right hand to the left are parallels of altitude; and those crossing them are azimuths. The lesser of the two circles bounding the projection, is one-fourth of the tropic of Capricorn; the greater is one-fourth of that of Cancer. The two ecliptics are drawn from a point on the left edge of the quadrant, with the characters of the signs upon them; and the two horizons are drawn from the same point. The limb is divided both into degrees and time; and, by having the sun's altitude, the hour of the day may be found here to a minute. The quadrantal arches next the centre contain the kalendar of months; and under them, in another arch, is the sun's declination. On the projection are placed several of the most noted fixed stars between the tropics; and the next below the projection is the quadrant and line of shadows. To find the time of the sun's rising or setting, his amplitude, his azimuth, hour of the day, &c. by this quadrant: lay the thread over the day and the month, and bring the bead to the proper ecliptic, either of summer or winter, according to the season, which is called *rectifying*; then, moving the thread, bring the bead to the horizon, in which case the thread will cut the limb in the time of the sun's rising or setting before or after six; and at the same time the bead will cut the horizon in the degrees of the sun's amplitude.—Again, observing the sun's altitude with the quadrant, and supposing it found 45° on the fifth of May, lay the thread over the fifth of May, bring the bead to the summer ecliptic, and carry it to the parallel of altitude 45°; in which case the thread will cut the limb at 55° 15′, and the hour will be seen among the hour-lines to be either 41′ past nine in the morning, or 19′ past two in the afternoon.—Lastly, the bead among the azimuths shows the sun's distance from the south 50° 41′. But note, that if the sun's altitude be less than what it is at six o'clock, the operation must be performed among those parallels above the upper horizon, the bead being rectified to the winter ecliptic. Fig. 4.

9. Sinical quadrant (fig. 5.) consists of several concentric quadrantal arches, divided into eight equal parts by radii, with parallel right lines crossing each other at right angles. Now any one of the arches, as BC, may represent a quadrant of any great circle of the sphere, but is chiefly used for the horizon or meridian. If then BC be taken for a quadrant of the horizon, either of the sides, as AB, may represent the meridian; and the other side, AC, will represent a parallel, or line of east and west: and all the other lines, parallel to AB, will be also meridians; and all those parallel to AC, east and west lines, or parallels.—Again, the eight spaces into which the arches are divided by the radii, represent the eight points of the compass in a quarter of the horizon; each containing 11° 15′. The arch BC is likewise divided into 90°, and each degree subdivided into 12, diagonal-wise. To the centre is fixed a thread, which, being laid over any degree of the quadrant, serves to divide the horizon. Fig. 5.

If the sinical quadrant be taken for a fourth part of the meridian, one side thereof, AB, may be taken for the common radius of the meridian and equator; and then the other, AC, will be half the axis of the world. The degrees of the circumference, BC, will represent degrees of latitude; and the parallels to the side AB, assumed from every point of latitude to the axis AC, will be radii of the parallels of latitude, as likewise the sine complement of those latitudes.

Suppose, then, it be required to find the degrees of longitude contained in 83 of the lesser leagues in the parallel of 48°; lay the thread over 48° of latitude on the circumference, and count thence the 83 leagues on

AB, beginning at A; this will terminate in H, allowing every small interval four leagues. Then tracing out the parallel HE, from the point H to the thread; the part AE of the thread shows that 125 greater or equinoctial leagues make 60° 15′; and therefore that the 83 lesser leagues AH, which make the difference of longitude of the course, and are equal to the radius of the parallel HE, make 60° 15′ of the said parallel.

If the ship sails an oblique course, such course, besides the north and south greater leagues, gives lesser leagues easterly and westerly, to be reduced to degrees of longitude of the equator. But these leagues being made neither on the parallel of departure, nor on that of arrival, but in all the intermediate ones, we must find a mean proportional parallel between them. To find this, we have on the instrument a scale of cross latitudes. Suppose then it were required to find a mean parallel between the parallels of 40° and 60°; with your compasses take the middle between the 40th and 60th degree on this scale: the middle point will terminate against the 51st degree, which is the mean parallel required.

The principal use of the sinical quadrant is to form triangles upon, similar to those made by a ship's way with the meridians and parallels; the sides of which triangles are measured by the equal intervals between the concentric quadrants and the lines N and S, E and W: and every fifth line and arch is made deeper than the rest. Now, suppose a ship to have sailed 150 leagues north-east, one-fourth north, which is the third point, and makes an angle of 33° 44′ with the north part of the meridian: here are given the course and distance sailed, by which a triangle may be formed on the instrument similar to that made by the ship's course; and hence the unknown parts of the triangle may be found. Thus, supposing the centre A to represent the place of departure, count, by means of the concentric circles along the point the ship sailed on, viz. AD, 150 leagues: then in the triangle AED, similar to that of the ship's course, find AE=difference of latitude, and DE=difference of longitude, which must be reduced according to the parallel of latitude come to.

Fig. 6.

10. Gunner's quadrant (fig. 6.), sometimes called *gunner's square*, is that used for elevating and pointing cannon mortars, &c. and consists of two branches either of brass or wood, between which is a quadrantal arch divided into 90 degrees, beginning from the shorter branch, and furnished with a thread and plummet, as represented in the figure.—The use of the gunner's quadrant is extremely easy; for if the longest branch be placed in the mouth of the piece, and it be elevated till the plummet cut the degree necessary to hit a proposed object, the thing is done. Sometimes on one of the surfaces of the long branch are noted the division of diameters and weights of iron bullets, as also the bores of pieces.

QUADRANT *of Altitude*, is an appendage of the artificial globe, consisting of a lamina, or slip of brass, the length of a quadrant of one of the great circles of the globe, and graduated. At the end, where the division terminates, is a nut rivetted on, and furnished with a screw, by means whereof the instrument is fitted on the meridian, and moveable round upon the rivet to all points of the horizon.—Its use is to serve as a scale in measuring altitudes, amplitudes, azimuths, &c. See ASTRONOMY.

QUADRANTAL, in *Antiquity*, the name of a vessel in use among the Romans for the measuring of liquids. It was at first called *amphora*; and afterwards *quadrantal*, from its form, which was square every way like a die. Its capacity was 80 libræ, or pounds of water, which made 48 sextaries, two urnæ, or eight congii.

QUADRAT, a mathematical instrument, called also a *Geometrical Square*, and *Line of Shadows*: it is frequently an additional member on the face of the common quadrant, as also on those of Gunter's and Sutton's quadrants.

QUADRAT, in Printing, a piece of metal used to fill up the void spaces between words, &c. There are quadrats of different sizes; as m-quadrats, n-quadrats, &c. which are respectively of the dimensions of these letters, only lower, that they may not receive the ink.

QUADRATIC EQUATIONS, in *Algebra*, those wherein the unknown quantity is of two dimensions, or raised to the second power. See ALGEBRA.

QUADRATRIX, in *Geometry*, a mechanical line, by means whereof we can find right lines equal to the circumference of circles, or other curves, and their several parts.

QUADRATURE, in *Geometry*, denotes the squaring, or reducing a figure to a square. Thus, the finding of a square, which shall contain just as much surface or area as a circle, an ellipsis, a triangle, &c. is the quadrature of a circle, ellipsis, &c. The quadrature, especially among the ancient mathematicians, was a great postulatum. The quadrature of rectilineal figures is easily found, for it is merely the finding their areas or surfaces, i. e. their squares; for the squares of equal areas are easily found by only extracting the roots of the areas thus found. The quadrature of curvilinear spaces is of more difficult investigation; and in this respect extremely little was done by the ancients, except the finding the quadrature of the parabola by Archimedes. In 1657, Sir Paul Neil, Lord Brouncker, and Sir Christopher Wren, geometrically demonstrated the equality of some curvilinear spaces to rectilinear spaces; and soon after the like was proved both at home and abroad of other curves, and it was afterwards brought under an analytical calculus; the first specimen of which was given to the public in 1688 by Mercator, in a demonstration of Lord Brouncker's quadrature of the hyperbola, by Dr Wallis's reduction of a fraction into an infinite series by division. Sir Isaac Newton, however, had before discovered a method of attaining the quantity of all quadruple curves analytically by his fluxions before 1668. It is disputed between Sir Christopher Wren and Mr Huyghens which of them first discovered the quadrature of any determinate cycloidal space. Mr Leibnitz afterwards found that of another space; and in 1669 Bernoulli discovered the quadrature of an infinity of cycloidal spaces both segments and sectors, &c. See *SQUARING the Circle.*

QUADRATURE, in *Astronomy*, that aspect of the moon when she is 90° distant from the sun; or when she is in a middle point of her orbit, between the points of conjunction and opposition, namely, in the first and third quarters. See ASTRONOMY *Index*.

QUADRATUS,

QUADRANT. PLATE CCCCLVIII.

Fig. 6.
Gunners Quadrant.

Fig. 1.
Coles Quadrant.

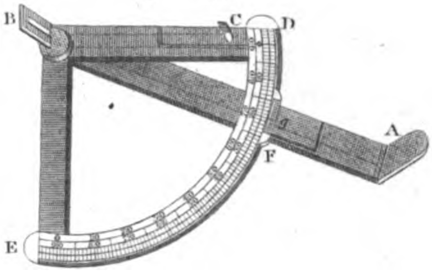


Fig. 4.
Suttons Quadrant.

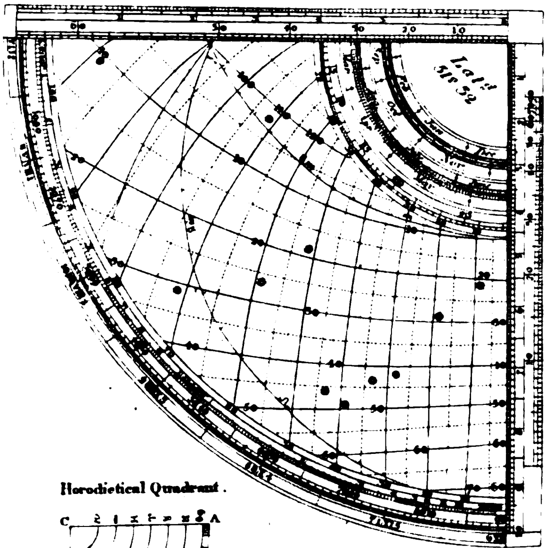


Fig. 5.
Sinical Quadrant.

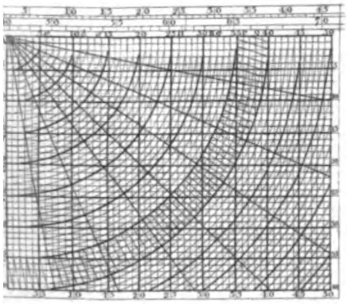
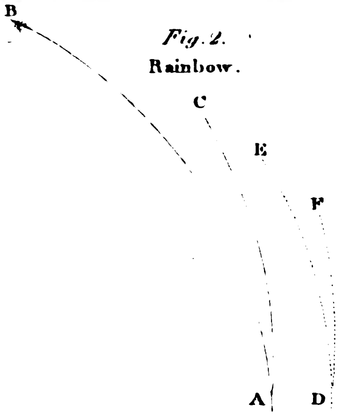


Fig. 2.
Rainbow.



Horodictical Quadrant.

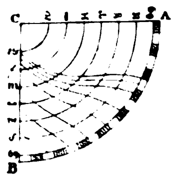


Fig. 3.

QUARTER.

Fig. 7.

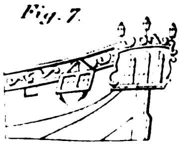


Fig. 4.

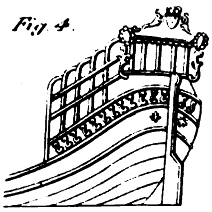


Fig. 8.

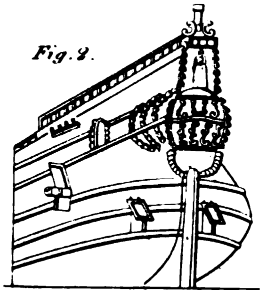


Fig. 1.

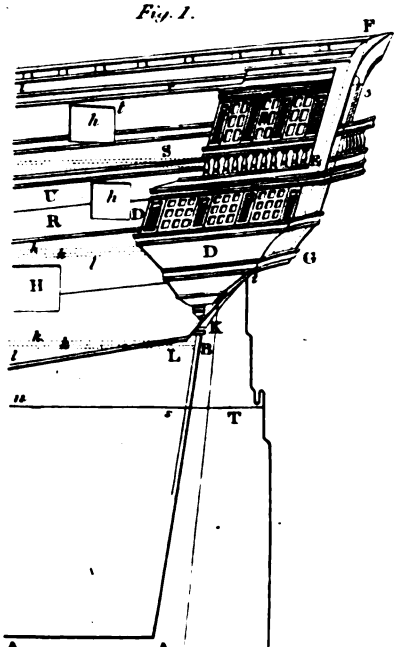


Fig. 3.

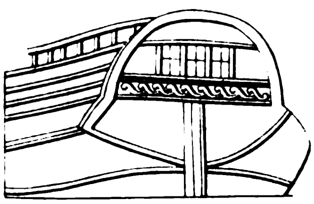


Fig. 5.

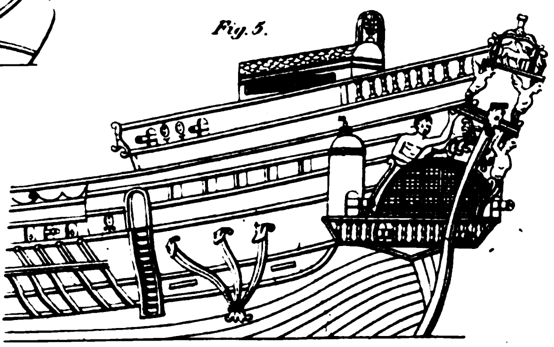
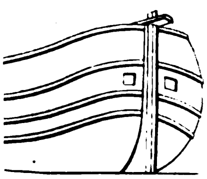


Fig. 6.



F. Mitchell sculp.

QUADRATUS, in *Anatomy*, a name given to several muscles on account of their square figure. See ANATOMY, *Table of the Muscles*.

QUADREL, in *Building*, a kind of artificial stone, so called from its being perfectly square. The quadrels are made of a chalky earth, &c. and dried in the shade for two years. These were formerly in great request among the Italian architects.

QUADRIGA, in *Antiquity*, a car or chariot drawn by four horses. On the reverses of medals, we frequently see the emperor or Victory in a quadriga, holding the reins of the horses; whence these coins are, among the curious, called *nummi quadrigati*, and *victoriati*.

QUADRILATERAL, in *Geometry*, a figure whose perimeter consists of four sides and four angles; whence it is also called a *quadrangular figure*.

QUADRILLE, a little troop or company of cavaliers, pompously dressed, and mounted for the performance of carousals, justs, tournaments, runnings at the ring, and other gallant divertisements.

QUADRILLE, a game played by four persons, with 40 cards; which are the remains of a pack after the four tens, nines, and eights are discarded; these are dealt three and three, and one round four, to the right-hand player; and the trump is made by him that plays with or without calling, by naming spades, clubs, diamonds, or hearts, and the suit named is trumps. If the person who names the trump should mistake, and say spades instead of clubs, or if he name two suits, the first named is the trump.

In this game the order of the cards, according to their natural value, is as follows: of hearts and diamonds, *king, queen, knave, ace, deuce, three, four, five, six, seven;* in all 10: of spades and clubs, *king, queen, knave, seven, six, five, four, three, deuce;* in all 9. The reason why the ace of spades and ace of clubs are not mentioned, is, because they are always trumps in whatever suit that is played. The ace of spades being always the first, and the ace of clubs the third trump, for the cards ranked according to their value when *trumps* stand in the following order.

Hearts and diamonds, SPADILL, or the *ace of spades;* MANILL, the *seventh* of the two *red suits;* BASTO, the *ace of clubs;* PONTO, the *ace of hearts and diamonds; king, queen, knave, deuce, three, four, five, six;* in all 12. Spades and clubs, SPADILL, the ace of spades, MANILL, the *deuce* of spades and clubs, BASTO the ace of clubs, *king, queen, knave, seven, six, five, four, three;* in all 11. It is here to be observed, that the card which is *manill* and the second trump, is always the lowest in its suit when not trumps; and that the ace of hearts or diamonds, which when trump is above the king, is below the knave when not trump.

There are three matadores; spadill, manill, and basto; the privilege of which is, that when the player has no other trumps but them, and trumps are led, he is not obliged to play them, but may play what card he thinks proper, provided, however, that the trump led is of an inferior rank; but if spadill should be led, he that has manill or basto only is obliged to play it; it is the same of manill basto, with respect to the superior matadore always forcing the inferior. Though there are properly but three matadores, nevertheless all those trumps which follow the three first without interruption, are likewise called matadores; but the three first only enjoy the privilege above mentioned.

Each person is to play as he judges most convenient for his own game. He is not to encourage his friend to play; but each person ought to know what to do when it is his turn to play. The stakes consist of seven equal mils or *contrats*, as they are sometimes called, comprising the ten counters and fishes, which are given to each player. A mil is equal to ten fish, and each fish to ten counters: the value of the fish is according to the players agreement, as also the number of tours, which are generally fixed at ten, and marked by turning the corners of a card.

If the cards should happen not to be dealt right, or that there should be two cards of the same sort, as two deuces of spades, for example, there must be a new deal; provided it is discovered before the cards are all played. The cards must likewise be dealt over again in case a card is turned in dealing, as it might be of prejudice to him who should have it, and of course if there should be several cards turned. There is no penalty for dealing wrong, he who does so must only deal again.

When each player has got his ten cards, he that is on the right hand of the dealer, after examining his game, and finding his hand fit to play, asks if they play; or if he has not a good hand, he passes, and so the second, third, and fourth. All the four may pass; but he that has spadill, after having shown or named it, is obliged to play by calling a king. Whether the deal is played in this manner, or that one of the players has asked leave, nobody choosing to play without calling, the eldest hand must begin the play, first naming the suit, and the king which he calls; he who wins the trick plays another card, and so of the rest till the game is finished. The tricks then are counted; and if the ombre, that is, he who stands the game, has together with him who is the king called, six tricks, they have won and are paid the game, the consolation, and the matadores, if they have them, and divide what is upon the game, and the beasts if there are any. But if they make only five tricks, it is a remise, and they are beasted, what goes upon the game, paying to the other players the consolation and the matadores. If the tricks are equally divided betwixt them, they are likewise beasted; and if they make only four tricks between them, it is a remise; if they make less they lose codill (A), and in that case they pay to their adversaries what they should have received if they had won; that is, the game, the consolation, and the matadores, if they have them, and are beasted what is upon the game: they who win codill, divide the stakes. The beast and every thing else that is paid, is paid equally betwixt the two losers; one half by him that calls, and the other half by him that is called, as well in case of codill as a remise;

(A) Codill is when those who defend the pool make more tricks than they who stand the game; which is called *winning the codill*.

Quadrille. mise; unless the ombre does not make three tricks, in which case he that is called is not only exempted from paying half the beast, but also the game, the consolation, and the matadores if there are any, which the ombre in that case pays alone; and as well in case of a codill as a remise. This is done in order to oblige players not to play games that are unreasonable. There is nevertheless, one case in which if the ombre makes only one trick, he is not beasted alone, and that is, when not having a good hand he passes, and all the other players have passed likewise; he having spadill is obliged to play. Here it would be unjust to oblige him to make three or four tricks; in this case, therefore, he that is called pays one half of the losings. For which reason he that has spadill with a bad hand, should pass, that if he is afterwards obliged to play by calling a king (which is called *forced spadill*), he may not be beasted alone. He that has once passed cannot be admitted to play; and he that has asked leave cannot refuse to play, unless any one should offer to play without calling.

He that has four kings, may call a queen to one of his kings, except that which is trump. He that wants one or more kings, may call one of those kings; but in that case, he must make six tricks alone, and consequently he wins or loses alone. The king of that suit in which he plays cannot be called. No one should play out of his turn, although he is not beasted for so doing. If he who is not the eldest hand has the king called, and plays spadill, manill, or basto, or even the king called in order to show that he is the friend, having other kings that he fears the ombre should trump, he is not to be allowed to go for the vole; he is even beasted, if it appears to be done with that intent. It is not permitted to show a hand though codill may already be won; that it may be seen whether the ombre is beasted alone. If the ombre or his friend shows their cards before they have made six tricks, thinking that they have made them, and there appears a possibility of preventing their making them, the other players can oblige them to play their cards as they think proper.

A player need only name his suit when he plays, without calling a king. He who plays without calling must make six tricks alone to win; for all the other players are united against him, and they are to do what they can to prevent his winning. He who plays without calling, is admitted to play in preference to him who would play with calling; however, if he that has asked leave will play without calling, he has the preference of the other who would force him. These are the two methods of play without calling that are called forced.

As he who plays without calling does not divide the winnings with any person, he consequently, when he loses, pays all by himself: if he loses by remise he is beasted, and pays each of the other players the consolation, the *sans appeller* (which is commonly, but improperly, called the *sans prendre*), and the matadores if there are any; if he loses codill he is likewise beasted and pays to each player what he would have received from each if he had won. They who win codill divide what there is; and if there are any counters remaining, they belong to him of the three who shall have spadill or the highest trump the next deal. It is the same with regard to him who calls one of his own kings; he wins alone or loses alone as in the other case, except the sans appeller, which he does not pay if he loses, or receive if he wins, although he plays alone. Quadrille.

If he plays sans appeller, though he may have a sure game, he is obliged to name his suit; which if he neglects to do, and shows his cards, and says "I play sans appeller;" in that case neither of the other players can oblige him to play in what suit he pleases, although he should not have one trump in that suit.

He who has asked leave is not permitted to play sans appeller, unless he is forced; in which case, as was said before, he has the preference of the other that forces him.

A player is not obliged to trump when he has none of the suit led, nor play a higher card in that suit if he has it, being at his option although he is the last player, and the trick should belong to the ombre; but he is obliged to play in the suit led if he can, otherwise he renounces. If he separates a card from his game and shows it, he is obliged to play it, if by not doing it the game may be prejudiced, or if he can give any intelligence to his friend; but especially if it should be a matadore.—He that plays sans appeller, or by calling himself, is not subject to this law. He may turn the tricks made by the other players, and count what has been played as often as it is his turn to play, but not otherwise. If instead of turning a player's tricks, he turns and see his game, or shows it to the other players, he is beasted, together with him whose cards he turned; and each of them must pay one half of the beast.

If any one renounces, he is beasted as often as he has renounced and it is detected; but a renounce is not made till the trick is turned. If the renounce is discovered before the deal is finished, and has been detrimental to the game, the cards must be taken up again, and the game replayed from that trick where the renounce was made; but if the cards are all played, the beast is still made, and the cards must not be replayed; except there should be several renounces in the same deal: then they are to be played again, unless the cards should be mixed. If several beasts are made in the same deal, they all go together, unless it is otherwise agreed at the beginning of the party; and when there are several beasts, the greatest always goes first.

A great advantage accrues from being eldest hand at quadrille, which often renders it very disagreeable to the rest of the players, being obliged to pass with a good hand unless they choose to play alone; and when it happens that the eldest hand having asked leave, the second player has three matadores, several trumps in back, and all small cards, he cannot then even play alone; and having no chance of being called, he must pass with this good hand. On account of which, this method has been thought expedient to remedy this defect of the game; each player having an opportunity of availing himself of the goodness of his game, by adding to the usual method of playing the game that of the mediateur, and the favourite suit.

The first thing to be observed is that of drawing for places, which is done in this manner: One of the players takes four cards; a king, a queen, a knave, and an ace; each player draws one of these cards; and commonly he who comes in last, draws first. The per-

son

son who draws the king sits where he pleases, the queen at his right hand, the knave next the queen, and the ace on the left of the king. The king draws the favourite suit. The number of cards and persons is the same at this game as the other, and is played in the same manner.

The favourite suit is determined by drawing a card out of the pack, and is of the same suit, during the whole party, of the card so drawn.

A king is the mediateur, which is demanded of the others by one of the players, who has a hand he expects to make five tricks of; and through the assistance of this king he can play alone and make six tricks.

In return for the king received, he gives what card he thinks proper with a fish; but must give two fish if it is in the favourite suit. He who asks by calling in the favourite suit, has the preference to him who asks by calling in another; he who asks with the mediateur, has the preference to him who asks by calling in the favourite suit, and by playing alone is obliged to make six tricks to win. He who asks with the mediateur in the favourite suit, has the preference to him who asks with the mediateur in any other suit, and is obliged to play alone, and to make six tricks.

If sans prendre is played in any other suit than the favourite, he who plays it has the preference to him who asks only, or with the mediateur, or even he who plays in the favourite suit with the mediateur; and the sans prendre in the favourite suit has the preference to all other players whatever.

The only difference between this method of playing the game and the other is, that when one of the players demands the mediateur he is obliged to play alone, and to make six tricks, as if he played sans prendre. In this case he should judge from the strength of his hand, whether the aid of the king will enable him to play alone or not.

With the mediateur and without the favourite suit it is played in this manner. The game is marked and played the same as in common, except that a fish extraordinary is given to him who plays the mediateur, and to him who plays sans prendre; that is, he who wins the mediateur receives 13 counters from each; and if he loses by remise he pays 12 to each; and 13 if by codill. The winner of sans prendre receives 17 counters from each; and if by remise he loses, he pays 16 to each, and 17 if by codill:

The vole with the mediateur receives one fish only, as at common quadrille. The beasts are also the same as the common game. The last game is generally played double, and is called *paulans;* but for those who choose to play a higher game, they may play the double colour, which is called the *Turk*, and is double of the favourite suit. There is also a higher game than this, called the *aubde*, which is paying whatever is agreed to him who happens to hold the two aces in his hand.

We have omitted many things respecting the mode of marking the game, and playing the vole, because these are different in different cases, and are to be learned only by practice. The game itself is a very inferior one; but he who wishes to know more of it, may consult Hoyle's games improved by James Beaufort, Esq, from which we have, with very little alteration, taken this article.

QUADRIPARTITION, the dividing by four, or into four equal parts. Hence comes the term *quadripartite*, the fourth part, or something divided into four.

QUADRUPEDS, in *Zoology;* those animals which have four limbs or legs proceeding from the trunk of their body. See MAMMALIA.

QUADRUPLE, four-fold, or something taken four times, or multiplied by four, on which account it is the converse of quadripartition.

QUÆSTOR, see QUESTOR.

QUAGGA, or QUACHA. See EQUUS, MAMMALIA *Index*.

QUAIL. See TETRAO, ORNITHOLOGY *Index*.

Quails are to be taken by means of the call during their whole wooing time, which lasts from April to August. The proper times for using the call are at sunrising, at nine o'clock in the morning, at three in the afternoon, and at sunset; for these are the natural times of the quail's calling. The notes of the cock and hen quail are very different; and the sportsman who expects to succeed in the taking them must be expert in both: for when the cock calls, the answer is to be made in the hen's note; and when the hen calls, the answer is to be made in the cock's. By this means they will come up to the person, so that he may, with great ease, throw the net over them and take them. If a cock-quail be single, on hearing the hen's note he will immediately come; but if he have a hen already with him, he will not forsake her. Sometimes, though only one quail answers to the call, there will three or four come up; and then it is best to have patience, and not run to take up the first, but stay till they are all entangled, as they will soon be.

The quail is a neat cleanly bird, and will not run much into dirty or wet places: in dewy mornings, they will often fly instead of running to the call; and in this case, it is best to let them go over the net, if it so happens that they fly higher than its top; and the sportsman then changing sides, and calling again, the bird will come back, and then will probably be taken in the net.

The calls are to be made of a small leather purse, about two fingers wide, and four fingers long, and made in the shape of a pear; that is to be stuffed half-full of horse-hair, and at the end of it is to be placed a small whistle, made of the bone of a rabbit's leg, or some other such bone: this is to be about two inches long, and the end formed like a flageolet, with a little soft wax. This is to be the end fastened into the purse; the other is to be closed up with the same wax, only that a hole is to be opened with a pin, to make it give a distinct and clear sound. To make this sound, it is to be held full in the palm of the hand, with one of the fingers placed over the top of the wax; then the purse is to be pressed, and the finger is to shake over the middle of it, to modulate the sound it gives into a sort of shake. This is the most useful call; for it imitates the note of the hen quail; and seldom fails to bring a cock to the net if there be one near the place.

The call that imitates the note of the cock, and is used to bring the hen to him, is to be about four inches long, and above an inch thick; it is to be made of a piece of wire turned round and curled, and covered with leather; and one end of it must be closed up with a piece of flat wood, about the middle of which there must

Quail, Quakers.

must be a small thread or strap of leather, and at the other end must be placed the same sort of pipe, made of bone, as is used in the other call. The noise is made by opening and closing the spiral, and gives the same sound that the cock does when he gives the hen a signal that he is near her.

QUAKERS, a religious society, which took its rise in England about the middle of the 17th century, and rapidly found its way into other countries in Europe, and into the English settlements in North America.—The members of this society, we believe, called themselves at first *seekers*, from their seeking the truth; but after the society was formed, they assumed the appellation of *friends*. The name of *quakers* was given to them by their enemies; and though an epithet of reproach, seems to be stamped upon them indelibly. Their founder is generally believed to have been George Fox, an illiterate shoemaker (see *George Fox*), but this opinion has been lately controverted. An ingenious writer * having found, or fancied, a similarity of sentiments among the ancient Druids and modern Quakers, seems to think that Fox must have been nothing more than a tool employed by certain deists to pave the way for their system of natural religion, by allegorizing the distinguishing article of the Christian faith.

* See *Month. Rev.* Sept. 1793, art. 5.

It must be confessed, for experience will not allow it to be denied, that extremes in religion are very apt to beget each other; and if the deists alluded to reasoned from this fact, they could not have pitched upon a tool fitter for their purpose than George Fox. From his works still extant he appears to have been one of the most extravagant and absurd enthusiasts that ever lived, and to have fancied himself, in his apostolic character, something infinitely superior to man. In a book called *News coming out of the North*, (p. 15.), he says of himself, "I am the Door that ever was, the same Christ yesterday, to-day, and for ever." And in the introduction to his *Battle-door for Teachers and Professors*, he says, "All languages are to me no more than dust, who was before languages were." But one of the most extraordinary and blasphemous things that he ever wrote, is an answer to the Protector, who had required him to promise not to disturb his goverment as then established. It is as follows:

"I who am of the world called G: F: doth deny the carrying or drawing any carnal sword against any, or against thee O: C: or any man, in the presence of the Lord I declare it, God is my witness, by whom I am moved to give this forth for the truth's sake, from him whom the world calls G: Fox, *who is the son of God*, who is sent to stand a witness against all violence and against the works of darkness, and to turn the people from darkness to light, and to bring them from the occasion of the war and from the occasion of the magistrates sword, which is a terror to the evil doer, which acts contrary to the light of the Lord *Jesus Christ;* which is a praise to them that do well; which is a protection to them that do well, and not the evil; and such soldiers as are put in place no false accusers must be, no violence must do, but be content with their wages: and that magistrate bears not the sword in vain, from under the occasion of that sword do I seek to bring people: my weapons are not carnal but spiritual, and *my kingdom is not of this world;* therefore with carnal weapon I do not fight, but am from those things dead, from him who is not of this world, called of the world by the name of G: F: and this I am ready to seal with my blood; this I am moved to give forth for the truth's sake, who a witness stands against all unrighteousness, and all ungodliness, who a sufferer is for the righteous seed's sake, waiting for the redemption of it, who a crown that is mortal seeks not, for that fadeth away; but in the light dwells which comprehends that crown, which light is the condemnation of all such, in which light I witness the crown that is immortal, which fades not away from him who to all your souls is a friend, for establishing of righteousness, and clearing the land of evil doers, and a witness against all the wicked inventions of man, and murderer's plots, which answer shall be with the light in all your consciences, which makes no covenant with death; to which light in you all I speak, and am clear, G: F: who a new name hath, which the world knows not (A)."

The Quakers, however, did not long entrust the defence of their principles to such senseless enthusiasts as George Fox: They were joined by a number of learned, ingenious, and pious men, who new-modelled their creed; and though they did not bring it to what is generally deemed the Christian standard, they so reformed it as that its tenets do not shock common sense, nor the duties prescribed scandalize a man of piety. The chief of these reformers were George Keith, the celebrated Penn, and our countryman Barclay. Keith was indeed excommunicated for the liberties which he took with the great apostle; but we have not a doubt but his writings contributed to the moderation of Penn, and to the elegant and masterly apology of Barclay. From that apology we selected the summary of their opinions which was given in the former edition of this work; but they have lately published such a summary themselves, of which the reader will be pleased with the following abstract:

They tell us, that about the beginning of the 17th century a number of men, dissatisfied with all the modes of religious worship then known in the world, withdrew from the communion of every visible church to seek the Lord in retirement. Among these was their *honourable elder George Fox*, who being quickened by the immediate touches of divine love, could not satisfy his apprehensions of duty to God without directing the people where to find the like consolation and instruction. In the course of his

(A) We have transcribed this letter from the theological works of Mr Leslie, where it is preserved in its original form. The Quakers, after the death of their apostle, expunged from their edition of it the words which we have printed in Italics; ashamed, as we hope, of the blasphemy imputed to them: but that Mr Leslie's copy is authentic, is thus attested by two of the friends, who saw Fox deliver it to the protector's messenger: "We are witnesses of this testimony, whose names in the flesh are, *Tho. Adam.* *Rob. Craven.*"

Quakers.

his travels, he met with many seeking persons in circumstances similar to his own, and these readily receivved his testimony. They then give us a short account of their sufferings and different settlements; and with a degree of candour which does them infinite credit, they vindicate Charles II. from the character of a persecutor; acknowledging, that though they suffered much during his reign, he gave as little countenance as he could to the severities of the legislature. They even tell us, that he exerted his influence to rescue their friends from the unprovoked and cruel persecutions of the New England fanatics; and they speak with becoming gratitude of the different acts passed in their favour during the reigns of William and Mary, and George I. They then proceed to give us the following account of their doctrine:

"We agree with other professors of the Christian name, in the belief in one eternal God, the Creator and Preserver of the universe; and in Jesus Christ his Son, the Messiah, and Mediator of the new covenant (Heb. xii. 24.).

"When we speak of the gracious display of the love of God to mankind, in the miraculous conception, birth, life, miracles, death, resurrection, and ascension of our Saviour, we prefer the use of such terms as we find in Scripture; and, contented with that knowledge which divine wisdom hath seen meet to reveal, we attempt not to explain those mysteries which remain under the veil, nevertheless, we acknowledge and assert the divinity of Christ, who is the wisdom and power of God unto salvation (1 Cor. i. 24.).

"To Christ alone we give the title of the Word of God (John i. 1.), and not to the Scriptures; although we highly esteem these sacred writings, in subordination to the Spirit (2 Pet. i. 21.), from which they were given forth; and we hold, with the apostle Paul, that they are able to make wise unto salvation, through faith which is in Christ Jesus (2 Tim. iii. 15.).

"We reverence those most excellent precepts which are recorded in Scripture to have been delivered by our great Lord, and we firmly believe that they are practicable, and binding on every Christian; and that in the life to come every man will be rewarded according to his works (Mat. xvi. 27.). And farther, it is our belief, that, in order to enable mankind to put in practice these sacred precepts, many of which are contradictory to the unregenerate will of man (John i. 9.), every man coming into the world is endued with a measure of the light, grace, or good Spirit of Christ; by which, as it is attended to, he is enabled to distinguish good from evil, and to correct the disorderly passions and corrupt propensities of his nature, which mere reason is altogether insufficient to overcome. For all that belongs to man is fallible, within the reach of temptation; but this divine grace, which comes by Him who hath overcome the world (John xvi. 33.) is, to those who humbly and sincerely seek it, an all-sufficient and present help in time of need. By this the snares of the enemy are detected, his allurements avoided, and deliverance is experienced through faith in its effectual operation; whereby the soul is translated out of the kingdom of darkness, and from under the power of Satan, into the marvellous light and kingdom of the Son of God.

"Being thus persuaded that man, without the Spirit of Christ inwardly revealed, can do nothing to the glory of God, or to effect his own salvation; we think this influence especially necessary to the performance of the highest act of which the human mind is capable, even the worship of the Father of lights and of spirits, in spirit and in truth; therefore we consider as obstructions to pure worship, all forms which divert the attention of the mind from the secret influence of this unction from the Holy One (1 John ii. 20, 27.). Yet, although true worship is not confined to time and place, we think it incumbent on Christians to meet often together (Heb. x. 25.) in testimony of their dependence on the heavenly Father, and for a renewal of their spiritual strength: nevertheless, in the performance of worship, we dare not depend for our acceptance with Him, on a formal repetition of the words and experiences of others; but we believe it to be our duty to cease from the activity of the imagination, and to wait in silence to have a true sight of our condition bestowed upon us: believing even a single sigh (Rom. viii. 26.) arising from such a sense of our infirmities, and of the need we have of divine help, to be more acceptable to God, than any performances, however specious, which originate in the will of man.

"From what has been said respecting worship, it follows, that the ministry we approve must have its origin from the same source; for that which is needful for a man's own direction, and for his acceptance with God (Jer. xxiii. 30, to 32.), must be eminently so to enable him to be helpful to others. Accordingly, we believe the renewed assistance of the light and power of Christ to be indispensably necessary for all true ministry: and that this holy influence is not at our command, or to be procured by study, but is the free gift of God to his chosen and devoted servants.—From hence arises our testimony against preaching for hire, and in contradiction to Christ's positive command, "Freely ye have received, freely give" (Mat. x. 8.); and hence our conscientious refusal to support such ministry by tithes or other means.

"As we dare not encourage any ministry but that which we believe to spring from the influence of the Holy Spirit, so neither dare we attempt to restrain this influence to persons of any condition in life, or to the male sex alone; but, as male and female are one in Christ, we allow such of the female sex as we believe to be endued with a right qualification for the ministry, to exercise their gifts for the general edification of the church: and this liberty we esteem to be a peculiar mark of the gospel dispensation, as foretold by the prophet Joel (Joel ii. 28, 29.), and noticed by the apostle Peter (Acts ii. 16, 17.).

"There are two ceremonies in use amongst most professors of the Christian name; Water-baptism, and what is termed the Lord's Supper. The first of these is generally esteemed the essential means of initiation into the church of Christ; and the latter of maintaining communion with him. But as we have been convinced, that nothing short of his redeeming power, inwardly revealed, can set the soul free from the thraldom of sin, by this power alone we believe salvation to be effected. We hold that as there is one Lord and one faith (Eph. iv. 5.), so his baptism is one in nature and operation; that nothing short of it can make us living members of his mystical body; and that the baptism with water, administered

nistered by his fore-runner John, belonged, as the latter confessed, to an inferior and decreasing dispensation (John iii. 30.).

"With respect to the other rite, we believe that communion between Christ and his church is not maintained by that nor any other external performance, but only by a real participation of his divine nature (2 Pet. i. 4.) through faith; that this is the supper alluded to in the Revelation (Rev. iii. 20.), "Behold I stand at the door and knock, if any man hear my voice, and open the door, I will come in to him, and will sup with him, and he with me;" and that where the substance is attained, it is unnecessary to attend to the shadow, which doth not confer grace, and concerning which opinions so different, and animosities so violent, have arisen.

"Now, as we thus believe that the grace of God, which comes by Jesus Christ, is alone sufficient for salvation, we can neither admit that it is conferred on a few only, whilst others are left without it; nor, thus, asserting its universality, can we limit its operation to a partial cleansing of the soul from sin, even in this life. We entertain worthier notions both of the power and goodness of our heavenly Father, and believe that he doth vouchsafe to assist the obedient to experience a total surrender of the natural will to the guidance of his pure unerring Spirit; through whose renewed assistance they are enabled to bring forth fruits unto holiness, and to stand perfect in their present rank (Mat. v. 48.; Eph. iv. 13.; Col. iv. 12.).

"There are not many of our tenets more generally known than our testimony against oaths and against war. With respect to the former of these, we abide literally by Christ's positive injunction, delivered in his sermon on the mount, "Swear not at all" (Mat. v. 34.)*. From the same sacred collection of the most excellent precepts of moral and religious duty, from the example of our Lord himself (Mat. chap. v. 39, 44, &c. ch. xxvi. 52, 53.; Luke xxii. 51.; John xviii. 11.), and from the correspondent convictions of his Spirit in our hearts, we are confirmed in the belief that wars and fightings are, in their origin and effects, utterly repugnant to the Gospel, which still breathes peace and good-will to men. We also are clearly of the judgment, that if the benevolence of the Gospel were generally prevalent in the minds of men, it would effectually prevent them from oppressing, much more from enslaving, their brethren, (of whatever colour or complexion), for whom, as for themselves, Christ died; and would even influence their conduct in their treatment of the brute creation, which would no longer groan the victims of their avarice, and of their false ideas of pleasure.

* See *Oath*.

"Some of our tenets have in former times, as hath been shown, subjected our friends to much suffering from government, though to the salutary purposes of government our principles are a security. They inculcate submission to the laws in all cases wherein conscience is not violated. But we hold, that as Christ's kingdom is not of this world, it is not the business of the civil magistrate to interfere in matters of religion; but to maintain the external peace and good order of the community. We therefore think persecution, even in the smallest degree, unwarrantable. We are careful in requiring our members not to be concerned in illicit trade, nor in any manner to defraud the revenue.

"It is well known that the society, from its first appearance, has disused those names of the months and days which, having been given in honour of the heroes or false gods of the heathens, originated in their flattery or superstition; and the custom of speaking to a single person in the plural number (B), as having arisen also from motives of adulation. Compliments, superfluity of apparel and furniture, outward shows of rejoicing and mourning, and observation of days and times, we esteem to be incompatible with the simplicity and sincerity of a Christian life; and public diversions, gaming, and other vain amusements of the world, we cannot but condemn. They are a waste of that time which is given us for nobler purposes, and divert the attention of the mind from the sober duties of life, and from the reproofs of instruction, by which we are guided to an everlasting inheritance.

"To conclude, although we have exhibited the several tenets which distinguish our religious society, as objects of our belief, yet we are sensible that a true and living faith is not produced in the mind of man by his own effort; but is the free gift of God (Eph. ii. 8.) in Christ Jesus, nourished and increased by the progressive operation of his spirit in our hearts, and our proportionate obedience (John vii. 17.). Therefore, although, for the preservation of the testimonies given us to bear, and for the peace and good order of the society, we deem it necessary that those who are admitted into membership with us, should be previously convinced of those doctrines which we esteem essential; yet we require no formal subscription to any articles, either as the condition of membership, or to qualify for the service of the church. We prefer the judging of men by their fruits, in a dependence on the aid of Him who, by his prophet, hath promised to be "a spirit of judgment to him that sitteth in judgment" (Isaiah xxviii. 6.). Without this, there is a danger of receiving numbers into outward communion, without any addition to that spiritual sheepfold, whereof our blessed Lord declared himself to be both the door and the shepherd (John x. 7, 11.), that is, such as know his voice, and follow him in the paths of obedience."

Such are the doctrines of this people as we find them stated in a small pamphlet lately presented by themselves to the public; and in the same tract they give the following account of their discipline.

"In the practice of discipline, we think it indispensable that the order recommended by Christ himself be invariably observed: (Matth. xviii. 15. to 17.). 'If thy brother shall trespass against thee, go and tell him his fault between thee and him alone: if he shall hear thee, thou hast gained thy brother; but if he will not hear thee, then take with thee one or two more, that in the mouth of two or three witnesses every word may be

(B) Speaking of this custom, Fox says; "When the Lord sent me into the world, he forbade me to put off my hat to any; and I was required to *thee* and *thou*, all men and women." *Journal*, p. 24.

be established; and if he shall neglect to hear them, tell it unto the church.'

"To effect the salutary purposes of discipline, meetings were appointed, at an early period of the society, which, from the times of their being held, were called quarterly meetings. It was afterwards found expedient to divide the districts of those meetings, and to meet more often; whence arose monthly meetings, subordinate to those held quarterly. At length, in 1669, a yearly meeting was established, to superintend, assist, and provide, rules for the whole; previous to which, general meetings had been occasionally held.

"A monthly meeting is usually composed of several particular congregations, situated within a convenient distance of each other. Its business is to provide for the subsistence of their poor, and for the education of their offspring; to judge of the sincerity and fitness of persons appearing to be convinced of the religious principles of the society, and desiring to be admitted into membership; to excite due attention to the discharge of religious and moral duty; and to deal with disorderly members. Monthly meetings also grant to such of their members as remove into other monthly meetings, certificates of their membership and conduct; without which they cannot gain membership in such meetings. Each monthly meeting is required to appoint certain persons under the name of *overseers*, who are to take care that the rules of our discipline be put in practice; and when any case of complaint or disorderly conduct comes to their knowledge, to see that private admonition, agreeable to the gospel rule before mentioned, be given previously to its being laid before the monthly meeting.

"When a case is introduced, it is usual for a small committee to be appointed to visit the offender, to endeavour to convince him of his error, and to induce him to forsake and condemn it. If they succeed, the person is by minute declared to have made satisfaction for the offence; if not, he is disowned as a member of the society.

"In disputes between individuals, it has long been the decided judgment of the society that its members should not sue each other at law. It therefore enjoins all to end their differences by speedy and impartial arbitration, agreeable to rules laid down. If any refuse to adopt this mode, or, having adopted it, to submit to the award, it is the direction of the yearly meeting that such be disowned.

"To monthly meetings also belongs the allowing of marriages; for our society hath always scrupled to acknowledge the exclusive authority of the priests in the solemnization of marriage. Those who intend to marry, appear together and propose their intention to the monthly meeting; and if not attended by their parents or guardians, produce a written certificate of their consent, signed in the presence of witnesses. The meeting then appoints a committee to inquire whether they are clear of other engagements respecting marriage; and if at a subsequent meeting, to which the parties also come and declare the continuance of their intention, no objections are reported, they have the meeting's consent to solemnize their intended marriage. This is done in a public meeting for worship; towards the close whereof the parties stand up, and solemnly take each other for husband and wife. A certificate of the proceedings is then publicly read, and signed by the parties, and afterwards by the relations and others as witnesses. Of such certificates the monthly meeting keeps a record; as also of the births and burials of its members. A certificate of the date, of the name of the infant, and of its parents, signed by those present at the birth, is the subject of one of these last-mentioned records; and an order for the interment, countersigned by the grave-maker, of the other. The naming of children is without ceremony. Burials are also conducted in a simple manner. The body, followed by the relations and friends, is sometimes, previously to interment, carried to a meeting; and at the grave a pause is generally made; on both which occasions it frequently falls out that one or more friends present have somewhat to express for the edification of those who attend; but no religious rite is considered as an essential part of burial.

"Several monthly meetings compose a quarterly meeting. At the quarterly meeting are produced written answers from the monthly meetings, to certain queries respecting the conduct of their members, and the meeting's care over them. The accounts thus received are digested into one, which is sent, also in the form of answers to queries, by representatives, to the yearly meeting.—Appeals from the judgment of monthly meetings are brought to the quarterly meetings; whose business also it is to assist in any difficult case, or where remissness appears in the care of the monthly-meetings over the individuals who compose them.

"The yearly meeting has the general superintendance of the society in the country in which it is established (c); and therefore, as the accounts which it receives discover the state of inferior meetings, as particular exigencies require, or as the meeting is impressed with a sense of duty, it gives forth its advice, makes such regulations as appear to be requisite, or excites to the observance of those already made; and sometimes appoints committees to visit those quarterly meetings which appear to be in need of immediate help. Appeals from the judgment of quarterly meetings are here finally determined; and a brotherly correspondence, by epistles, is maintained with other yearly meetings.

"In this place it is proper to add, that as we believe women may be rightly called to the work of the ministry, we also think, that to them belongs a share in the support of our Christian discipline; and that some parts of it, wherein their own sex is concerned, devolve on them with peculiar propriety. Accordingly they have monthly, quarterly, and yearly meetings of their own sex, held at the same time and in the same place with those of the men; but separately, and without the power of

(c) There are seven yearly meetings, 1st, London, to which come representatives from Ireland; 2d, New-England; 3d, New-York; 4th, Pennsylvania and New-Jersey; 5th, Maryland; 6th, Virginia; 7th, the Carolinas and Georgia.

Quakers.

of making rules: and it may be remarked, that during the persecutions, which in the last century occasioned the imprisonment of so many of the men, the care of the poor often fell on the women, and was by them satisfactorily administered.

"In order that those who are in the situation of ministers may have the tender sympathy and counsel of those of either sex, who, by their experience in the work of religion, are qualified for that service; the monthly meetings are advised to select such, under the denomination of *elders*. These, and ministers approved by their monthly meetings (D), have meetings peculiar to themselves, called meetings of ministers and elders; in which they have an opportunity of exciting each other to a discharge of their several duties, and of extending advice to those who may appear weak, without any needless exposure. These meetings are generally held in the compass of each monthly, quarterly, and yearly meeting. They are conducted by rules prescribed by the yearly meeting, and have no authority to make any alteration or addition to them. The members of them unite with their brethren in the meetings for discipline, and are equally accountable to the latter for their conduct.

"It is to a meeting of this kind held in London, called the second-day-morning-meeting, that the revisal of manuscripts concerning our principles, previously to publication, is intrusted by the yearly meeting held in London; and also the granting, in the intervals of the yearly meeting, certificates of approbation to such ministers as are concerned to travel in the work of the ministry in foreign parts When a visit of this kind doth not extend beyond Great Britain, a certificate from the monthly meeting of which the minister is a member is sufficient; if to Ireland, the concurrence of the quarterly meeting is also required. Regulations of similar tendency obtain in other yearly meetings.

"The yearly meeting held in London, in the year 1675, appointed a meeting to be held in that city, for the purpose of advising and assisting in cases of suffering for conscience sake, which hath continued with great use to the society to this day. It is composed of friends under the name of correspondents, chosen by the several quarterly meetings, and who reside in or near the city. The same meetings also appoint members of their own in the country as correspondents, who are to join their brethren in London on emergency. The names of all these correspondents, previous to their being recorded as such, are submitted to the approbation of the yearly meeting. Those of the men who are approved ministers are also members of this meeting, which is called the *meeting for sufferings;* a name arising from its original purpose, which is not yet become entirely obsolete.

"The yearly meeting has intrusted the meeting for sufferings with the care of printing and distributing books, and with the management of its stock; and considered as a standing committee of the yearly meeting, it hath a general care of whatever may arise, during the intervals of that meeting, affecting the society, and requiring immediate attention: particularly of those circumstances which may occasion an application to government.

Quakers, Quality.

"There is not in any of the meetings which have been mentioned any president, as we believe that Divine Wisdom alone ought to preside; nor hath any member a right to claim pre-eminence over the rest. The office of clerk, with a few exceptions, is undertaken voluntarily by some member; as is also the keeping of the records. Where these are very voluminous, and require a house for their deposite (as is the case in London, where the general records of the society in Great Britain are kept), a clerk is hired to have the care of them; but except a few clerks of this kind, and persons who have the care of meeting-houses, none receive any stipend or gratuity for their services in our religious society."

It is remarkable, that all the settlements of the Europeans in America, except the Quaker settlement of Pennsylvania, were made by force of arms, with very little regard to any prior title in the natives. The kings of Spain, Portugal, France, and Britain, together with the States of Holland, then the only maritime powers, gave grants of such parts of America as their people could lay hold on, studying only to avoid interference with their European neighbours. But Mr Penn, being a Quaker, did not think his power from King Chas. II. a sufficient title to the country since called *Pennsylvania:* He therefore assembled the sachems or princes then in that country, and purchased from them the extent of land that he wanted. The government of this province is mostly in the hands of the Quakers, who never have any quarrels with the natives. When they desire to extend their settlements, they purchase new lands of the sachems, never taking any thing from them by force. How unlike is this conduct to that of the Spaniards, who murdered millions of the natives of Mexico, Terra Firma, Peru, Chili, &c.

Quality characterized by Aristotle.

QUALITY is a word which, as used in philosophical disquisitions, cannot be explained by any periphrasis. That which is expressed by it must be brought into the immediate view of the senses or intellect, and the name properly applied, or he who is a stranger to the word will never be made to comprehend its meaning. Aristotle, who treated it as a general conception, second in order among the ten *predicaments* or *categories* (see CATEGORY), gives several characters of it; but though they are all in some respects just, no man could from them, without other assistance, learn what *quality* is. Thus he tells us *, 'Υπαρχει δε εναντιοτης κατα το ποιον; Επιδεχεται δε το μαλλον και το ἡττον τα ποια. And again, 'Ομοια δε ἡ ανομοια κατα μονας τας ποιοτητας λεγεται· ὁμοιοι γαρ ἑτερον ἑτερῳ ουκ εστι κατ' αλλο ουδεν, η καθ' ὁ ποιον εστιν.

* Pred. 8 Sylb p. 44 45.

When

(D) "Those who believe themselves required to speak in meetings for worship, are not immediately acknowledged as ministers by their monthly meetings; but time is taken for judgment, that the meeting may be satisfied of their call and qualification. It will sometimes happen, that such as are not approved, will obtrude themselves as ministers, to the grief of their brethern; but much forbearance is used towards these, before the disapprobation of the meeting is publicly testified.

When a man comprehends, by means of his senses and intellect, what it is which the word *quality* denotes, he will indeed perceive that the first of these characters is applicable to some qualities and not to others; that the second is more applicable to *quantity* than to quality; and that it is only the third which can with propriety be considered as the general characteristic of this predicament. Thus when we have learned by our sense of sight that *whiteness* is a quality of snow, and *blackness* of coal; and by means of observation and reflection, that *wisdom* is a quality of one man and *folly* of another—we must admit that the sensible quality of the snow is *contrary* to that of the coal; and the intellectual quality of wisdom contrary to that of folly. There is, however, no contrariety between *wisdom* and *whiteness* or *blackness*, nor between *hardness* or *softness* and *any particular colour;* for sensible and intellectual qualities can never be compared; and it is not easy, if possible, to make a comparison between qualities perceptible only by different senses: Nay, among qualities perceptible by the same sense, we often meet with a difference where there is no contrariety; for though the *figure* of a *cube* is *different* from that of a *sphere*, and the figure of a *square* from that of a *circle*, the sphere is not *contrary* to the cube, nor the circle to the square.

His second characteristic of this genus is still less proper than the first. It is indeed true that some qualities admit of *intension* and *remission;* for snow is whiter than paper, and one woman is handsomer than another; but of the species of quality called *figure* we cannot predicate either *more* or *less*. A crown-piece may have as much of the *circular quality* in it as the plane of the equator, and a musket-bullet as much of the *spherical quality* as the orb of the sun. It is indeed a property of all *quantity* to admit of *intension* and *remission;* and therefore this ought to have been given as the character not of the second but of the third category. See QUANTITY.

2 Nothing known but qualities.

That it is only from a *comparison of their qualities that things are denominated like or unlike*, or that *one thing cannot resemble another but in some quality*, is indeed a just observation. We know nothing directly but qualities sensible and intellectual (see METAPHYSICS, N° 149, 150, 151, and 227); and as these have no resemblance to each other, we conclude that body or matter, the subject of the former, is a being unlike mind, the subject of the latter. Even of bodies themselves we can say, that one is like or unlike another only by virtue of their qualities. A ball of ivory resembles a ball of snow in its *figure* and *colour*, but not in its *coldness* or *hardness;* a ball of lead may resemble a ball of snow in its *figure* and *coldness*, but not in its *colour;* and a cube of ivory resembles not a ball of lead either in *figure*, *colour*, or *coldness*. The mind of a brute resembles that of a man in its powers of *sensation* and *perception*, but does not resemble it in the powers of *volition* and *reasoning;* or at least the resemblance, in this latter instance, is very slight. All bodies resemble one another in being solid and extended, and all minds in being more or less active. *Likeness* or *unlikeness* therefore is the universal characteristic of the category *quality*.

3 Important of quality.

Aristotle has other speculations respecting quality, which are worthy of notice. He distinguishes between qualities which are *essential* and those which are *accidental;* between qualities which are *natural* and those which are *acquired;* and he speaks of the qualities of *capacity* and those of *completion*. *Extension* and *figure* in *general* are qualities essential to all bodies: but a *particular* extension, such as an *inch* or an *ell*, and a *particular* figure, such as a *cube* or a *sphere*, are qualities accidental to bodies. Among the *natural* qualities of glass it is one to transmit objects of vision; but to enlarge these objects is an *adventitious* or *acquired* quality. The same quality may be *natural* in one substance, as attraction in the magnet; and *acquired* in another, as the same attraction in the magnetic bar. *Docility* may be called a quality *natural* to the mind of man, science an *acquired* one. To understand what he means by qualities of *capacity* and *completion*, it may be sufficient to observe that every piece of iron has the qualities of a razor in *capacity*, because it may be converted into steel, and formed into a razor: when it is so formed, it has, in the language of this sage, the quality of a razor in *completion*. Among the qualities of *capacity* and *completion*, the most important, and what may lead to interesting speculations, is the reasoning faculty of man. A *capacity* of reasoning is essential to the human mind; but the *completion* of this capacity or *actual reasoning* is not, otherwise *infants* and persons *asleep* would be excluded from the human species.

4 overlooked by Locke.

Mr Locke has puzzled his readers, and perhaps himself, with a question respecting the species of an idiot or changeling, whom he pronounces to be something between a man and a brute *. It is not often that we feel ourselves inclined to regret Locke's ignorance of Aristotle's distinctions; but we cannot help thinking, that had the British philosopher attended to the Stagyrite's account of qualities in *capacity* and qualities in *completion*, this perplexing question would never have been started. It is justly observed in the Essay on Human Understanding, that of *real essences* we know nothing: but that every man selects a certain number of qualities which he has always perceived united in certain beings; and forming these into one complex conception, gives to this conception a *specific* name, which he applies to every being in which he finds those qualities united. This is undoubtedly the process of the mind in forming genera and species; and as the excellent author refuses the name of *man* to the changeling, it is obvious that the complex conception, to which he gives that name, must imply *rationality* or the *actual exercise* of reason. But this limitation will exclude many beings from the species *man*, whom Mr Locke certainly considered as men and women. Not to mention infants and persons in sound sleep, how shall we class those who, after having lived 30 or 40 years in the full exercise of reason, have been suddenly or by degrees deprived of it by some disorder in the brain?

* Book iv. ch. 4. § 13. &c.

5 Strange consequence of this oversight.

> From Marlb'rough's eyes the streams of dotage flow;
> And Swift expires a driveller and a show. JOHNSON.

But were the hero and the wit in those deplorable circumstances excluded from the human species, and classed between men and brutes? No surely; they were both acknowledged to be men, because they were known to have the quality of reason in what Aristotle would have called *capacity*. Their dotage and drivelling originated from some disorder in their bodies, probably in the region of the brain; and Locke himself contends that no defect in body is sufficient to degrade a person from the rank

rank of manhood. Again, lunatics have the exercise of reason, except at new and full moon. Are these unhappy beings sometimes men and sometimes a species by themselves between men and brutes?

6 Fallacy of his doctrine respecting the human species.

It appears, therefore, that *not* the *actual exercise* of reason, but reason in *capacity*, ought to be included in the complex conception to which we give the specific name of *man*, as some of the greatest men that ever lived have been during parts of their lives deprived of the power of *actual reasoning*. This, however, it will be said, does not remove the difficulty; for the occasional exercise of reason in lunatics, and the great exertions of it in such men as Swift and Marlborough, show that they had it in *capacity* at all times; whereas we have no evidence that changelings have even a *capacity* of reasoning at any time, since they never do a rational action, nor ever utter a sentence to the purpose. That we have no *direct* and *positive* evidence of the minds of changelings being capable of reasoning, were they supplied with proper organs, must be granted; but the probabilities of their being so are many and great. We know by experience that the actual exercise of reason may be interrupted by an occasional and accidental pressure on the brain: and therefore we cannot doubt but that if this pressure were rendered permanent by any wrong configuration of the skull given to it in the womb, or in the act of being born into the world, an infant, with a mind capable of reasoning by means of proper organs, would by this accident be rendered, through the whole of life, an idiot or changeling. That idiotism is caused by such accidents, and is not the quality of an inferior mind occasionally given to a human body, will at least seem probable from the following considerations.

7 True doctrine.

It does not appear that an animal body can live and move but while it is actuated by some mind. Whence then does the unborn infant derive its mind? It must be either immediately from God, or *ex traduce* from its parents; but if the mind of man be immaterial, it cannot be *ex traduce*. Now, as idiots are very few in number when compared with the rational part of the human species, and as God in the government of this world acts not by partial but by general laws; we must conclude that the law which he has established respecting the union of mind and matter, is, that human bodies shall be animated with minds endowed with a capacity of reasoning, and that those who never exert this capacity are prevented by some such accident as we have assigned.

For a further account of qualities, why they are supposed to inhere in some subject, together with the usual distinction between the primary and secondary qualities of matter, see Metaphysics, Part II. chap. i.

Chemical Qualities, those qualities principally introduced by means of chemical experiments, as fumigation, amalgamation, cupellation, volatilization, precipitation, &c.

Quality, is also used for a kind of title given to certain persons, in regard of their territories, signiories, or other pretensions.

QUANGA. See Capra.

QUANG-ping-fou, a city in China, is situated in the northern part of the province of Pe-tcheli, between the provinces of Chang-tong and Ho-nan, and has nine cities of the third class dependent on it; all its plains are well watered by rivers. Among its temples, there is one dedicated to those men who, as these Chinese pretend, discovered the secret of rendering themselves immortal.

QUANGSI, a province of China, bounded on the north by Koe-Tcheau and Hu-Quang; on the east, by Yunan and Quantong; on the south, by the same and Tonquin; and on the west, by Yun-nan. It produces great plenty of rice, being watered by several large rivers; and contains 10,000,000 of inhabitants. The southern part is a flat country, and well cultivated; but the northern is full of mountains covered with trees. It contains mines of all sorts; and there is a gold mine lately opened. The capital town is Quie-ling.

A very singular tree, says Grosier, grows in this province; instead of pith, it contains a soft pulp, which yields a kind of flour: the bread made of it is said to be exceedingly good. Besides paroquets, hedgehogs, porcupines, and rhinoceroses, a prodigious number of wild animals, curious birds, and uncommon insects, are found here. This province contains 12 cities of the first class, and 80 of the second and third. See China, Supplement.

QUANG-tong, a province of China, bounded on the east by Kiang-si and Fokien; on the south, by the ocean; and on the west, by Tonquin. This province is diversified by valleys and mountains; and yields two crops of corn in a year. It abounds in gold, jewels, silk, pearls, tin, quicksilver, sugar, brass, iron, steel, saltpetre, ebony, and several sorts of odoriferous wood; besides fruits of all sorts proper to the climate. They have a prodigious number of ducks, whose eggs they hatch in ovens; and a tree, whose wood is remarkably hard and heavy, and thence called *iron-wood*. The mountains are covered with a sort of osiers which creep along the ground, and of which they make baskets, hurdles, matts, and ropes.

Although the climate of this province is warm, the air is pure, and the people are robust and healthy. They are very industrious; and it must be allowed that they possess in an eminent degree the talent of imitation: if they are only shown any of our European works, they execute others like them with the most surprising exactness. This province suffered much during the civil wars; but at present it is one of the most flourishing in the empire; and, as it is at a great distance from court, its government is one of the most important. This province is divided into ten districts, which contain ten cities of the first class, and 84 of the second and third. Canton is the capital town.

1 Quantity

QUANTITY, as explained by the great English lexicographer, is that property of any thing which may be increased or diminished. This interpretation of the *word* is certainly just, and for the purposes of common conversation it is sufficiently determinate; but the man of science may expect to find in a work like ours a definition of the *thing* signified. This, however, cannot be given him. A logical definition consists of the *genus* under which the thing defined is ranked, and the *specific* difference (see Logic, N° 20, &c.); but quantity is ranked under no genus. In that school where such definitions were most valued, it was considered as one of the ten *categories*, or general conceptions, under which all the objects of human apprehension were mustered, like soldiers in an army (see Category and Philosophy, N° 22.). On this account, even Aristotle himself,

Quantity.

2 characterized by Aristotle.

himself, who delighted in definitions, and was not easily deterred from a favourite pursuit, could not consistently with his own rules attempt to define *quantity*. He characterizes it, however, in several parts of his works: and particularly in the 15th chapter of the 4th book of his metaphysics, where he gives the following account of the three first *categories*: Ταυτα μεν γαρ, ων μια ἡ ουσια. ὁμοια δ' ων ἡ ποιοτης μια ισα δε, ων το ποσον εν. "Things are the *same* of which the SUBSTANCE is one; *similar*, of which the QUALITY is one; *equal*, of which the QUANTITY is one. Again, he tells us *, that the chief characteristic of quantity is, that it may be denominated *equal* and *unequal*.

* *Præd.* p. 34. edit. Sylb.

That any man can become wiser by reading such descriptions as these, none but an idolater of Aristotle will suppose. There is, indeed, no periphrasis by which we can explain what is meant by quantity to those who have not previously formed such a notion.—All that can be done by making the attempt is only to settle language, by stating exactly the cases in which we use this word in the greatest conformity to general custom; for there is a laxness or carelessness of expression in the language of most men, and our notions are frequently communicated by speech in a way by no means precise; so that it is often a great chance that the notions excited in the mind of the hearer are not exact counterparts of those in the mind of the speaker.

The understandings of men differ in nothing more remarkably than in their power of abstraction, and of rapidly forming conceptions so general and simple as not to be clogged with distinguishing circumstances, which may be different in different minds while uttering and hearing the same words: and it is of great consequence to a man of scientific habits, either to cultivate, if possible, this talent, or to supersede its use, by studiously forming to himself notions of the most important *universals* in his own course of contemplation, by careful abstraction of every thing extraneous. His language by this means becomes doubly instructive by its extreme precision; and he will even judge with greater certainty of notions intended to be communicated by the more slovenly language of another person.

We cannot say that there is much ambiguity in the general use of the term *quantity*: But here, as in all other cases, a love of refinement, of novelty, and frequently of vanity, and the wish of appearing ingenious and original, have made men take advantage of even the small latitude with which the careless use of the word will furnish them, to amuse themselves and the public by giving the appearance of science to empty sounds.

3 The subject of mathematical reasoning.

Mathematics is undoubtedly employed in discovering and stating many relations of quantity; and it is in this category alone that any thing is contemplated by the mathematician, whether in geometry, arithmetic, or algebra. Hence mathematics has been called the science of quantity. The simplicity of the object of the mathematician's contemplation, and the unparalleled distinctness with which he can perceive its modifications, have enabled him to erect a body of science, eminent not only for its certainty, but also for the great length to which he can carry his reasonings without danger of error; and the intimate connection which this science has with the arts of life, and the important services which it has performed, have procured it a most respectable place in the circle of the sciences. Ingenious men have availed themselves of this pre-eminence of mathematics, and have endeavoured to procure respect for their disquisitions on other subjects, by presenting them to the public as branches of mathematical science, and therefore susceptible of that accuracy and certainty which are its peculiar boast. Our moral affections, our sensations, our intellectual powers, are all susceptible of augmentation and diminution, are conceivable as greater and less when stated together, and are familiarly spoken of as admitting of degrees of comparison. We are perfectly well understood when we say that one pain, heat, grief, kindness, is greater than another; and as this is the distinguishing characteristic of quantity, and as quantity is the subject of mathematical discussion, we suppose that these subjects may be treated mathematically. Accordingly, a very celebrated and excellent philosopher * has said, among many things of the same kind, that the greatness of a favour is in the direct compound ratio of the service performed and the dignity of the performer, and in the inverse ratio of the merit and rank of the receiver; that the value of a character is in the compound ratio of the talents and virtue, &c.; and he has delivered a number of formal propositions on the most interesting questions in morals, couched in this mathematical language, and even expressed by algebraic formulæ. But this is merely play, and conveys no instruction. We understand the words; they contain no absurdity; and in as far as they have a sense, we believe the propositions to be true. But they give no greater precision to our sentiments than the more usual expressions would do. If we attend closely to the meaning of any one of such propositions, we shall find that it only expresses some vague and indistinct notions of degrees of those emotions, sentiments, or qualities, which would be just as well conceived by means of the expressions of ordinary language; and that it is only by a sort of analogy or resemblance that this mathematical language conveys any notions whatever of the subjects.

* *Dr Francis Hutchinson.*

4 Which is improperly introduced into other subjects.

5 The mathematician contemplates only quantities that are measurable.

The object of contemplation to the mathematician is not whatever is susceptible of greater and less, but what is measurable; and mathematics is not the science of magnitude, in its most abstracted and general acceptation, but of magnitude which can be measured. It is, indeed the SCIENCE of MEASURE, and whatever is treated in the way of mensuration is treated mathematically. Now, in the discourse of ordinary life and ordinary men, many things are called quantities which we cannot or *do not* measure. This is the case in the instances already given of the affections of the mind, pleasure, pain, beauty, wisdom, honour, &c. We do not say that they are incapable of measure; but we have not yet been able to measure them, nor do we think of measuring them when we speak rationally and usefully about them. We therefore do not consider them mathematically; nor can we introduce mathematical precision into our discussions of these subjects till we can, and actually do, measure them. Persons who are precise in their expression will even avoid such phrases on these subjects as suppose, or strictly express, such measurement. We should be much embarrassed how to answer the question, How much pain does the toothache give you just now; and how much is it easier since yesterday?

Quantity. yesterday? Yet the answer (if we had a measure) would be as easy as to the question, How many guineas did you win at cards? or how much land have you bought? Nay, though we say familiarly, "I know well how much such a misfortune would affect you," and are understood when we say it, it would be awkward language to say, "I know well the quantity of your grief." It is in vain, therefore, to expect mathematical precision in our discourse or conceptions of quantities in the most abstracted sense. Such precision is confined to quantity which may be and is measured (A). It is only trifling with the imagination when we employ mathematical language on subjects which have not this property.

It will therefore be of some service in science to discriminate quantities in this view; to point out what are susceptible of measure, and what are not.

6 Measuring explained.

What is measuring? It is one of these two things: It is either finding out some known magnitude of the thing measured, which we can demonstrate to be equal to it; or to find a known magnitude of it, which being taken so many times shall be equal to it. The geometer measures the contents of a parabolic space when he exhibits a parallelogram of known dimensions, and demonstrates that this parallelogram is equal to the parabolic space. In like manner, he measures the solid contents of an infinitely extended hyperbolic spindle, when he exhibits a cone of known dimensions, and demonstrates that three of these cones are equal to the spindle.

In this process it will be found that he actually subdivides the quantity to be measured into parts of which it consists, and states these parts as actually making up the quantity, specifying each, and assigning its boundaries. He goes on with it, piece by piece, demonstrating the respective equalities as he goes along, till he has exhausted the figure, or considered all its parts.—When he measures by means of a submultiple, as when he shows the surface of a sphere to be equal to four of its great circles, he stops, after having demonstrated the equality of one of these circles to one part of the surface: then he demonstrates that there are other three parts, each of which is precisely equal to the one he has minutely considered. In this part of the process he expressly assigns the whole surface into its distinct portions, of which he demonstrates the equality.

But there is another kind of geometrical measurement which proceeds on a very different principle. The geometer conceives a certain individual portion of his figure, whether line, angle, surface, or solid, as known in respect to its dimensions. He conceives this to be lifted from its place, and again laid down on the *adjoining* part of the figure, and that it is equal to the part which it now covers; and therefore that this part together with the first is double of the first: he lifts it again, and lays it down on the next adjoining part, and affirms that this, added to the two former, make up a quantity triple of the first. He goes on in this way, making similar inferences, till he can demonstrate that he has in this manner covered the whole figure by twenty applications, and that his moveable figure will cover no more; and he affirms that the figure is twenty times the part employed.

This mode is precisely similar to the manner of practical measurement in common life: we apply a foot-rule successively to two lines, and find that 30 applications exhaust the one, while it requires 35 to exhaust the other. We say therefore, that the one line is 30 and the other 35 feet long; and that these two lines are to each other in the ratio of 30 to 35. Having measured two shorter lines by a similar application of a stick of an inch long, 30 times to the one and 35 times to the other, we say that the ratio of the two first lines is the same with that of the two last. Euclid has taken this method of demonstrating the fourth proposition of the first book of his celebrated Elements.

7 Euclid's fourth proposition.

But all this process is a fiction of the mind, and it is the fiction of an impossibility. It is even *inconceivable*, that is, we cannot in imagination make this application of one figure to another; and we presume to say, that, if the elements of geometry cannot be demonstrated in some other way, the science has not that title to pure, abstract, and infallible knowledge, which is usually allowed it. We cannot *suppose* one of the triangles lifted and laid on the other, without supposing it something different from a triangle *in abstracto*. The *individuality* of such a triangle consists solely in its being in the precise place where it is, and in occupying *that* portion of space. If we could distinctly conceive otherwise, we should perceive that, when we have lifted the triangle from its place, and applied it to the other, it is gone from its former place, and that there is no longer a triangle *there*. This is inconceivable, and space has always been acknowledged to be immoveable. There is therefore some logical defect in Euclid's demonstration. We apprehend that he is labouring to demonstrate, or rather illustrate, a simple apprehension. This indeed is the utmost that can be done in any demonstration (see METAPHYSICS, N° 82.): but the mode by which he guides the mind to the apprehension of the truth of his fourth proposition is not consistent either with pure mathematics or with the laws of corporeal nature. The real process, as laid down by him, seems to be this. We suppose something different from the abstract triangle; some *thing* that, in conjunction with other properties, has the property of being triangular, with certain dimensions of two of its sides and the included angle. It has avowedly another property, not essential to, and not contained in, the abstract notion of a triangle, viz. mobility. We also suppose it permanent in shape and dimensions, or that although, *during* its motion, it does not occupy *the same space*, it continues, and all its parts, to occupy *an equal space*. In short, our conception is very mixed, and does not perceptibly differ from our conception of a triangular piece of matter, where the

(A) To talk intelligibly of the quantity of a pain, we should have some standard by which to measure it; some known degree of it so well ascertained, that all men, when talking of it, should mean the same thing.—And we should be able to compare other degrees of pain with this, so as to perceive distinctly, not only whether they exceed or fall short of it, but also how much, or in what proportion; whether by an half, or a fifth, or a tenth. *Reid.*

the triangle is not the subject, but an adjunct, a quality. And when we suppose the application made, we are not in fact supposing two abstract triangles to coincide. This we cannot do with any thing like distinctness; for our distinct conception now is, not that of two triangles coinciding, but of one triangle being now exactly occupied by that moveable thing which formerly occupied the other. In short, it is a vulgar measurement, restricted by suppositions which are inadmissible in all *actual* measurements in the present universe, in which no moveable material thing is *known* to be permanent, either in shape or magnitude.

This is an undeniable consequence of the principle of universal gravitation, and the compressibility of every kind of tangible matter with which we are acquainted. Remove the brass rule but one inch from its place; its gravitation to the earth and to the rest of the universe is immediately changed, and its dimensions change of consequence. A change of temperature will produce a similar effect; and this is attended to and considered in all nice mensurations. We do the best we can to assure ourselves that our rule always occupies a sensibly equal space; and we must be contented with chances of error which we can neither perceive nor remove.

We might (were this a proper place) take notice of some other logical defects in the reasoning of this celebrated proposition: but they are beside our present purpose of explaining the different modes of mathematical measurement, with the view of discovering that circumstance in which they all agree, and which (if the only one) must therefore be the characteristic of mensuration.

8
The characteristic notion of mensuration.

We think that the only circumstance in which all modes of mensuration agree, or the only notion that is found in them all, is, that the quantity is conceived as consisting of parts, distinguishable from each other, and separated by assignable boundaries; so that they are at once conceived separately and jointly. We venture to assert that no quantity is directly measured which we cannot conceive in this way, and that such quantities only are the immediate objects of mathematical contemplation, and should be distinguished by a generic name. Let them be called MATHEMATICAL QUANTITIES, EXTENSION, DURATION, NUMBER, and PROPORTION, have this characteristic, and they are the only quantities which have it. Any person will be convinced of the first assertion by attending to his own thoughts when contemplating these notions. He will find that he conceives every one of them as made up of its own parts, which are distinguishable from each other, and have assignable boundaries, and that it is only in consequence of involving this conception that they can be added to or subtracted from each other; that they can be multiplied, divided, and conceived in any proportion to each other.

He may perhaps find considerable difficulty in acquiring perfectly distinct notions of the mensurability, and the accuracy of the modes of mensuration. He will find that the way in which he measures duration is very similar to that in which he measures space or extension. He does not know, or does not attend to, any thing which hinders the brass foot-rule in his hand from continuing to occupy equal spaces during his use of it, in measuring the distance of two bodies. In like manner he selects an event which nature or art can repeat continually, and in which the circumstances which contribute to its accomplishment are invariably the same, or their variations and their effects are insensible. He concludes that it will always occupy an equal portion of time for its accomplishment, or always last an equal time. Then, observing that, during the event whose duration he wishes to measure, this standard event is accomplished $29\frac{1}{2}$ times, and that it is repeated $365\frac{1}{4}$ times during the accomplishment of another event, he affirms that the durations of these are in the ratio of $29\frac{1}{2}$ to $365\frac{1}{4}$. It is thus (and with the same logical defect as in the measuring a line by a brass rod) that the astronomer measures the celestial revolutions by means of the rotation of the earth round its axis, or by the vibrations of a pendulum.

We are indebted for most of the preceding observations to Dr Reid, the celebrated author of the Inquiry into the Human Mind on the Principles of Common Sense, and of the Essays on the Intellectual and Active Powers of Man. He has published a dissertation on this subject in the 45th volume of the Philosophical Transactions, N° 489, which we recommend to our philosophical readers as a performance eminent for precision and acuteness. If we presume to differ from him in any trivial circumstance, it is with that deference and respect which is due to his talents and his worth.

9
Characters of mathematical quantity.

Dr Reid justly observes, that as nothing has proportion which has not either extension, duration, or number, the characters of mathematical quantity may be restricted to these three. He calls them PROPER quantities, and all others he calls IMPROPER. We believe that, in the utmost precision of the English language, this denomination is very apposite, and that the word *quantity* derived from *quantum*, always supposes measurement: But the word is frequently used in cases where its original is not kept in view, and we use other words as synonymous with it, when all mensuration, whether possible or not, is out of our thoughts. According to practice, therefore, the *jus et norma loquendi*, there seems to be no impropriety in giving this name, in our language at least, to whatever can be conceived as great or little. There is no impropriety in saying that the pain occasioned by the stone is greater than that of the toothache; and when we search for the category to which the assertion may be referred, we cannot find any other than quantity. We may be allowed therefore to say, with almost all our scientific countrymen, that every thing is conceivable in respect of quantity which we can think or speak of as greater and less; and that this notion is the characteristic of quantity as a genus, while measureableness is the characteristic of mathematical quantity as a species.

10
Other quantities that cannot be considered mathematically.

But do we not measure many quantities, and consider them mathematically, which have not this characteristic of being made up of their own distinguishable parts? What else is the employment of the mechanician, when speaking of velocities, forces, attractions, repulsions, magnetic influence, chemical affinity, &c. &c.? Are not these mathematical sciences? And if the precision and certainty of mathematics arise from the nature of their specific object, are not all the claims of the mechanician and physical astronomer ill-founded pretensions? These questions require and deserve a serious answer.

It is most certain that we consider the notions which are expressed by these terms velocity, force, density, and the

Quantity.

the like, as susceptible of measure, and we consider them mathematically.

11 Velocity, force, density, how measured.

Some of these terms are nothing but names for relations of measurable quantity, and only require a little reflection to show themselves such. VELOCITY is one of these. It is only a name expressing a relation between the space described by a moving body and the time which elapses during its description. Certain moderate rates of motion are familiar to us. What greatly exceeds this, such as the flight of a bird when compared with our walking, excites our attention, and this excess gets a name. A motion not so rapid as we are familiar with, or as we wish, also gets a name; because in this the excess or defect may interest us. We wish for the flight of the hawk; we chide the tardy pace of our messenger: but it is scientific curiosity which first considers this relation as a *separate* object of contemplation, and the philosopher must have a name for it. He has not formed a new one, but makes use of a word of common language, whose natural meaning is the combination of a great space with a short time. Having once appropriated it, in his scientific vocabulary, to this very general use, it loses with him its true signification. Tardity would have done just as well, though its true meaning is diametrically opposite; and there is no greater impropriety in saying the tardity of a cannon bullet than in saying the velocity of the hour-hand of a watch. Velocity is a quality or affection of motion, the notion of which includes the notions of space and duration (two mathematical quantities), and no other. It does not therefore express a mathematical quantity itself, but a relation, a combination of two mathematical quantities of different kinds; and as it is measurable in the quantities so combined, its measure must be a unit of its own kind, that is, an unit of space *as combined* with an unit of time.

DENSITY is another word of the same kind, expressing a combination of space with number. *Densæ arbores* means trees standing at a small distance from each other; and the word is used in the same sense when we say that quicksilver is denser than water. The expression always suggests to the reflecting mind the notions of particles and their distances. We are indeed so habituated to complicated views of things, that we can see remote connections with astonishing rapidity; and a very few circumstances are sufficient for leading forward the mind in a train of investigation. Common discourse is a most wonderful instance of this. It is in this way that we say, that we found by weighing them that inflammable air had not the sixth part of the density of common air. Supposing all matter to consist of equal atoms equally heavy, and knowing that the weight of a bladder of air is the sum of the weights of all the atoms, and also knowing that the *vicinity* of the atoms is in a certain proportion of the *number* contained in a given bulk, we affirm that common air is more than six times denser than inflammable air; but this rapid decision is entirely the effect of habit, which makes us familiar with certain groupes of conceptions, and we instantaneously distinguish them from others, and thus think and discourse rationally. The Latin language employs the word *frequens* to express both the combination of space and number, and that of time and number.

There are perhaps a few more words which express combinations of mathematical quantities of different kinds; and the corresponding ideas or notions are therefore proper and immediate subjects of mathematical discussion: But there are many words which are expressive of things, or at least of notions, to which this way of considering them will not apply. All those affections or qualities of external bodies, by which they are conceived to act on each other, are of this kind: IMPULSIVE FORCE, WEIGHT, CENTRIPETAL AND CENTRIFUGAL FORCE, MAGNETICAL, ELECTRICAL, CHEMICAL ATTRACTIONS AND REPULSIONS; in short, all that we consider as the immediate causes of natural phenomena. These we familiarly measure, and consider mathematically.

12 Forces measured in the phenomena.

What was said on this subject in the article PHYSICS will give us clear conceptions of this process of the mind. These forces or causes are not immediate objects of contemplation, and are known only *by* and *in* the phenomena which we consider as their effects. The phenomenon is not only the indication of the agency of any cause, and the characteristic of its kind, but the measure of its degree. The necessary circumstances in this *train of human thought* are, 1st, The notion of the force as something susceptible of augmentation and diminution. 2d, The notion of an inseparable connection of the force with the effect produced, and of every degree of the one with a corresponding degree of the other. From these is formed the notion that the phenomenon or effect is the proper measure of the force or cause. All this is strictly logical.

But when we are considering these subjects mathematically, the immediate objects of our contemplation are not the forces which we are thus treating. It is not their relations which we perceive, and which we combine with such complication of circumstances and certainty of inference as are known in all other sciences: by no means; they are the phenomena only, which are subjects of purely mathematical discussion. They are motions, which involve only the notions of space and time; and when we have finished an accurate mathematical investigation, and make our affirmation concerning the forces, we are certain of its truth, because we *suppose* the forces to have the proportions and relations, and no other, which we observe in the phenomena. Thus, after having demonstrated, by the geometrical comparison of the lines and angles and surfaces of an ellipse, that the momentary deflection of the moon from the tangent of her orbit is the 3600th part of the simultaneous deflection of a stone from the tangent of its parabolic path; Newton affirms, that the force by which a particle of the moon is retained in her orbit is the 3600th part of the weight of a particle of the stone; and having farther shown, from fact and observation, that these momentary deflections are inversely as the squares of the distances from the centre of the earth, he affirms, that all this is produced by a force which varies its intensity in this manner.

Now all this investigation proceeds on the two suppositions mentioned above, and the measures of the forces are in fact the measures of the phenomena. The whole of physical astronomy, and indeed the whole of mechanical philosophy, might be taught and understood, without ever introducing the word force, or the notion which it is supposed to express: for our mathematical reasonings are really about the phenomena, which are subjects purely mathematical.

The precision, therefore, that we presume to affirm to attend these investigations, arises entirely from the measurable

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measurable nature of the quantities which are the real objects of our contemplation, and the suitableness and propriety of the measures which we adopt in our comparisons.

Since, then, the phenomena are the *immediate* subjects of our discussion, and the operating powers are only inferences from the phenomena considered as effects, the quantity ascribed to them must also be an inference from the quantity of the effect, or of some circumstance in the effect. The measure, therefore, of the cause, or natural power or force, cannot be one of its own parts; for the whole and the part are equally unperceived by us. Our measure, therefore, must be a measure of some interesting part, or of the only interesting part of the phenomenon. It is therefore in a manner arbitrary, and depends chiefly on the interest we take in the phenomenon. It must, however, be settled with precision, so that all men in using it may mean the same thing. It must be settled, therefore, by the description of that part or circumstance of the phenomenon which is characteristic of the natural power. This description is the *definition* of the measure.

13 Measures of centripetal force.

Thus Newton assumes as his measure of the centripetal force, the momentary deviation from uniform rectilineal motion. Others, and sometimes Newton himself, assumes the momentary change of velocity, which again is measured by *twice this deviation*. These measures, being thus selected, are always proper in a mathematical sense; and if strictly adhered to, can never lead us into any paralogism. They may, however, be physically wrong: there may not be that indissoluble connection between the phenomenon and the supposed cause. But this is no mathematical error, nor does it invalidate any of our mathematical inferences: it only makes them useless for explaining the phenomenon by the principle which we adopted; but it prepares a modification of the phenomenon for some more fortunate application of physical principles.

14 Requisites of such measures.

All that can be desired in the definitions or descriptions of these measures is, that they may not deviate from the ordinary use of the terms, because this would always create confusion, and occasion mistakes. Dr Reid has given an example of an impropriety of this kind, which has been the subject of much debate among the writers on natural philosophy. We mean the measure of the force inherent in a body in motion. Descartes, and all the writers of his time, assumed the velocity produced in a body as the measure of the force which produces it; and observing that a body, in consequence of its being in motion, produces changes in the state or motion of other bodies, and that these changes are in the proportion of the velocity of the changing body, they asserted that there is in a moving body a VIS INSITA, an INHERENT FORCE, and that this is proportional to its velocity; saying that its force is twice or thrice as great, when it moves twice or thrice as fast at one time as at another. But Leibnitz observed, that a body which moves twice as fast, rises four times as high, against the uniform action of gravity; that it penetrates four times as deep into a piece of uniform clay; that it bends four times as many springs, or a spring four times as strong, to the same degree; and produces a great many effects which are four times greater than those produced by a body which has half the initial velocity. If the velocity be triple, quadruple, &c. the effects are nine times, 16 times, &c. greater; and, in short, are proportional, not to the velocity, but to its square. This observation had been made before by Dr Hooke, who has enumerated a prodigious variety of important cases in which this proportion of effect is observed. Leibnitz, therefore, affirmed, that the force inherent in a moving body is proportional to the square of the velocity.

15 Controversy between the Cartesians and Leibnitzians on this subject.

It is evident that a body, moving with the same velocity, has the same inherent force, whether this be employed to move another body, to bend springs, to rise in opposition to gravity, or to penetrate a mass of soft matter. Therefore these measures, which are so widely different, while each is agreeable to a numerous class of facts, are not measures of this something inherent in the moving body which we call its force, but are the measures of its exertions when modified according to the circumstances of the case; or, to speak still more cautiously and securely, they are the measures of certain classes of phenomena consequent on the action of a moving body. It is in vain, therefore, to attempt to support either of them by a demonstration. The measure itself is nothing but a definition. The Cartesian calls that a double force which produces a double velocity in the body on which it acts. The Leibnitzian calls that a quadruple force which makes a quadruple penetration. The reasonings of both in the demonstration of a proposition in dynamics may be the same, as also the result, though expressed in different numbers.

But the two measures are far from being equally proper: for the Leibnitzian measure obliges us to do continual violence to the common use of words. When two bodies moving in opposite directions meet, strike each other, and stop, all men will say that their forces are equal, because they have the best test of equality which we can devise. Or when two bodies in motion strike the parts of a machine, such as the opposite arms of a lever, and are thus brought completely to rest, we and all men will pronounce their mutual energies by the intervention of the machine to be equal. Now, in all these cases, it is well known that a perfect equality is found in the products of the quantities of matter and velocity. Thus a ball of two pounds, moving with the velocity of four feet in a second, will stop a ball of eight pounds moving with the velocity of one foot per second. But the followers of Leibnitz say, that the force of the first ball is four times that of the second.

All parties are agreed in calling gravity a uniform or invariable accelerating force; and the definition which they give of such a force is, that it always produces the same acceleration, that is, equal accelerations in equal times, and *therefore* produces augmentations of velocity proportionable to the times in which they are produced. The only effect ascribed to this force, and consequently the only thing which indicates, characterises, and measures it, is the augmentation of velocity. What is this velocity, considered not merely as a mathematical term, but as a phenomenon, as an event, a production by the operation of a natural cause? It cannot be conceived any other way than as a *determination* to move on for ever at a certain rate, if nothing shall change it. We cannot conceive this very clearly. We feel ourselves forced to animate, as it were, the body, and give it not only a will and intention to move in this manner, but a real exertion of some faculty in

Quantity. consequence of this determination of mind. We are conscious of such a train of operations in ourselves; and the last step of this train is the exertion or energy of some natural *faculty*, which we, in the utmost propriety of language, call force. By such analogical conception, we suppose a something, an energy, inherent in the moving body; and its only office is the production and continuation of this motion, as in our own case. Scientific curiosity was among our latest wants, and language was formed long before its appearance: as we formed analogical conceptions, we contented ourselves with the words already familiar to us, and to this something we gave the name FORCE, which expressed that energy in ourselves which bears some resemblance (in office at least) to the determination of a body to move on at a certain rate. This sort of allegory pervades the whole of our conceptions of natural operations, and we can hardly think or speak of any operation without a language, which supposes the animation of matter. And, in the present case, there are so many points of resemblance between the effects of our exertions and the operations of nature, that the language is most expressive, and has the strongest appearance of propriety. By exerting our force, we not only move and keep in motion, but we move other bodies. Just so a ball not only moves, but puts other bodies in motion, or penetrates them, &c.—This is the origin of that conception which so forcibly obtrudes itself into our thoughts, that there is inherent in a moving body a force by which it produces changes in other bodies. No such thing appears in the same body if it be not in motion. We therefore conclude, that it is the production of the moving force, whatever that has been. If so, it must be conceived as proportional to its producing cause. Now this force, thus produced or exerted in the moving body, is only another way of conceiving that determination which we call velocity, when it is conceived as a natural event. We can form no other notion of it. The *vis insita*, the determination to move at a certain rate, and the velocity, are one and the same thing, considered in different relations.

16 Vis insita.

Therefore the *vis insita corpori moventi*, the determination to move at a certain rate, and the velocity, should have one and the same measure, or any one of them may be taken for the measure of the other. The velocity being an object of perception, is therefore a proper measure of the inherent force; and the propriety is more evident by the perfect agreement of this use of the words with common language. For we conceive and express the action of gravity as uniform, when we think and say that its effects are proportional to the times of its action. Now all agree, that the velocity produced by gravity is proportional to the time of its action. And thus the measure of force, in reference to its producing cause, perfectly agrees with its measure, independent of this consideration.

But this agreement is totally lost in the Leibnitzian doctrine; for the body which has fallen four times as far, and has sustained the action of gravity twice as long, is said to have four times the force.

The quaintness and continued paradox of expression which this measure of inherent force leads us into, would have quickly exploded it, had it not been that its chief abettors were leagued in a keen and acrimonious warfare with the British mathematicians who supported the claim of Sir Isaac Newton to the invention of fluxions. They rejoiced to find in the elegant writings of Huyghens a physical principle of great extent, such as this is, which could be set in comparison with some of the wonderful discoveries in Newton's Principia. The fact, that in the mutual action of bodies on each other the product of the masses and the squares of the velocities remain always the same (which they call the *conservatio virium vivarum*) is of almost universal extent; and the knowledge of it enabled them to give ready and elegant solutions of the most abstruse and intricate problems, by which they acquired a great and deserved celebrity. Dr Robert Hooke, whose observation hardly any thing escaped, was the first (long before Huyghens) who remarked *, that in all the cases of the gradual production and extinction of motion, the sensible phenomenon is proportional to the square of the produced or extinguished velocity.

17 Conservatio virium vivarum.

* Micographia, vis restitutiva, &c. in his Posthumous Works.

John Bernoulli brought all these facts together, and systematized them according to the principle advanced by Huyghens in his treatise on the centre of oscillation. He and Daniel Bernoulli gave most beautiful specimens of the prodigious use of this principle for the solution of difficult physical problems in their dissertations on the motion and impulse of fluids, and on the communication of motion. It was however very early objected to them (we think by Marquis Poleni), that in the collision of bodies perfectly hard there was no such *conservatio virium vivarum;* and that, in this case, the forces must be acknowledged to be proportional to the velocities. The objections were unanswerable.—But John Bernoulli evaded their force, by affirming that there were and could be no bodies perfectly hard. This was the origin of another celebrated doctrine, on which Leibnitz greatly plumed himself, THE LAW OF CONTINUITY, viz. that nothing is observed to change abruptly, or *per saltum*. But no one will pretend to say that a perfectly hard body is an inconceivable thing; on the contrary, all will allow that softness and compressibility are adjunct ideas, and not in the least necessary to the conception of a particle of matter, nay totally incompatible with our notion of an ultimate atom.

18 Law of continuity.

Sir Isaac Newton never could be provoked to engage in this dispute. He always considered it as a wilful abuse of words, and unworthy of his attention. He guarded against all possibility of cavil, by giving the most precise and perspicuous definitions of those measures of forces, and all other quantities which he had occasion to consider, and by carefully adhering to them. And in one proposition of about 20 lines, viz. the 39th of the 1st book of the Principia, he explained every phenomenon adduced in support of the Leibnitzian doctrine, showing them to be immediate consequences of the action of a force measured by the velocity which it produces or extinguishes. There it appears that the heights to which bodies will rise in opposition to the uniform action of gravity are as the squares of the initial velocities: So are the depths to which they will penetrate uniformly resisting matter: So is the number of equal springs which they will bend to the same degree, &c. &c. &c. We have had frequent occasion to mention this proposition as the most extensively useful of all Newton's discoveries. It is this which gives the immediate application of mechanical principles to the explanation of natural phenomena. It is incessantly employed in

19 Great superiority of Newton.

in every problem by the very persons who hold by the other measure of forces, although such conduct is virtually giving up that measure. They all adopt, in every investigation the two theorems $f\dot{t}=\dot{v}$, and $f\dot{s}=v\dot{v}$; both of which suppose an accelerating force f proportional to the velocity v which it produces by its uniform action during the time t, and the theorem $\int f\dot{s}=v^2$ is the 39th 1. Princip. and is the *conservatio virium vivarum*.

This famous dispute (the only one in the circle of mathematical science) has led us somewhat aside. But we have little more to remark with respect to measurable quantity. We cannot say what varieties of quantity are susceptible of strict measure, or that it is impossible to give accurate measures of every thing susceptible of augmentation and diminution. We affirm, however, with confidence, that pain, pleasure, joy, &c. are not made up of their own parts, which can be contemplated separately: but they may chance to be associated by nature with something that is measurable; and we may one day be able to assign their degrees with as much precision as we now ascertain the degrees of warmth by the expansion of the fluid in the thermometer. There is one sense in which they may all be measured, viz. numerically, as Newton measures density, *vis motrix*, &c. We can conceive the pain of each of a dozen of men to be the same. Then it is evident that the pain of eight of these men is to that of the remaining four as two to one; but from such mensuration we do not foresee any benefit likely to arise.

Quantity, in *Grammar*, an affection of a syllable, whereby its measure, or the time wherein it is pronounced, is ascertained: or that which determines the syllable to be long or short.

Quantity is also the object of prosody, and distinguishes verse from prose; and the economy and arrangement of quantities, that is, the distribution of long and short syllables, makes what we call the *number*. See Poetry, Part III.

The quantities are used to be distinguished, among grammarians, by the characters ˘, short, as pĕr; and ¯, long, as rōs. There is also a common, variable, or dubious quantity; that is, syllables that are at one time taken for short ones, and at another time for long ones; as the first syllable in *Atlas*, *patres*, &c.

QUARANTINE, is a trial which ships must undergo when suspected of a pestilential infection. It may be ordered by the king, with advice of the privy-council, at such times, and under such regulations, as he judges proper. Ships ordered on quarantine must repair to the place appointed, and must continue there during the time prescribed (generally six weeks); and must have no intercourse with the shore, except for necessary provisions, which are conveyed with every possible precaution. When the time is expired, and the goods opened and exposed to the air as directed, if there be no appearance of infection, they are admitted to port.

Ships infected with the pestilence must proceed to St Helen's Pool, in the Scilly islands, and give notice of their situation to the customhouse officers, and wait till the king's pleasure be known.

Persons giving false information to avoid performing quarantine, or refusing to go to the place appointed, or escaping, also officers appointed to see quarantine performed, deserting their office, neglecting their duty, or giving a false certificate, suffer death as felons.

Quarantine ‖ Quarries.

Goods from Turkey, or the Levant, may not be landed without license from the king, or certificate that they have been landed and aired at some foreign port. See Plague.

QUARLES, Francis, the son of James Quarles clerk to the board of green cloth, and purveyor to Queen Elizabeth, was born in 1592. He was educated at Cambridge; became a member of Lincoln's Inn; and was for some time cup-bearer to the queen of Bohemia, and chronologer to the city of London. It was probably on the ruin of her affairs that he went to Ireland as secretary to Archbishop Usher; but the troubles in that kingdom forcing him to return, and not finding affairs more at peace in England, some disquiets he met with were thought to have hastened his death, which happened in 1644. His works both in prose and verse are numerous, and were formerly in great esteem, particularly his Divine Emblems: but the obsolete quaintness of his style has caused them to fall into neglect, excepting among particular classes of readers. "The memory of Quarles, says a late author, has been branded with more than common abuse, and he seems to have been censured merely from the want of being read. If his poetry failed to gain him friends and readers, his piety should at least have secured him peace and good-will. He too often, no doubt, mistook the enthusiasm of devotion for the inspiration of fancy: to mix the waters of Jordan and Helicon in the same cup, was reserved for the hand of Milton; and for him, and him only, to find the bays of Mount Olivet equally verdant with those of Parnassus. Yet, as the effusions of a real poetical mind, however thwarted by untowardness of subject, will be seldom rendered totally abortive, we find in Quarles original imagery, striking sentiment, fertility of expression, and happy combinations; together with a compression of style that merits the observation of the writers of verse. Gross deficiencies of judgment, and the infelicity of his subjects, concurred in ruining him. Perhaps no circumstance whatever can give a more complete idea of Quarles's degradation than a late edition of his Emblems; the following passage is extracted from the preface: 'Mr Francis Quarles, the author of the Emblems that go under his name, was a man of the most exemplary piety, and had a deep insight into the mysteries of our holy religion. But, for all that, the book itself is written in so old a language, that many parts of it are scarcely intelligible in the present age; many of his phrases are so affected, that no person who has any taste for reading can peruse them with the least degree of pleasure; many of his expressions are harsh, and sometimes whole lines are included in a parenthesis, by which the mind of the reader is diverted from the principal object. His Latin mottos under each cut can be of no service to an ordinary reader, because he cannot understand them. In order, therefore, to accommodate the public with an edition of Quarles's Emblems properly modernised, this work was undertaken.' Such an exhibition of Quarles is chaining Columbus to an oar, or making John Duke of Marlborough a train-band corporal."

Headley's select Beauties of Ancient English Poetry.

QUARRIES, a name commonly given to an extraordinary cavern under the city of Paris, the existence

ence of which is known to few even of the inhabitants, and many of those who have heard of it consider the whole as an idle story. Mr White visited this cavern in 1784, having, with many others, obtained leave (which is very cautiously granted) to inspect it, accompanied by guides with torches. He gives the following account of it in the second volume of the Manchester Transactions. "At the entrance by the *Observatoire Royal*, the path is narrow for a considerable way; but soon we entered large and spacious streets, all marked with names, the same as in the city; different advertisements and bills were found, as we proceeded, pasted on the walls, so that it had every appearance of a large town swallowed up in the earth.

"The general height of the roof is about nine or ten feet; but in some parts not less than 30 and even 40. In many places there is a liquor continually dropping from it, which congeals immediately, and forms a species of transparent stone, but not so fine and clear as rock crystal. As we continued our peregrination, we thought ourselves in no small danger from the roof, which we found but indifferently propped in some places with wood much decayed. Under the houses, and many of the streets, however, it seemed to be tolerably secured by immense stones set in mortar; in other parts, where there are only fields or gardens above it, it was totally unsupported for a considerable space, the roof being perfectly level, or a plain piece of rock. After traversing about two miles, we again descended about 20 steps, and here found some workmen in a very cold and damp place, propping up a most dangerous part, which they were fearful would give way every moment. The path is here not more than three feet in width, and the roof so low, that we were obliged to stoop considerably.

"On walking some little distance farther, we entered into a kind of saloon cut out of the rock, and said to be exactly under the *Eglise de St Jacques*. This was illuminated with great taste, occasioned an agreeable surprise, and made us all ample amends for the danger and difficulty we had just before gone through. At one end was a representation in miniature of some of the principal forts in the Indies, with the fortifications, draw-bridges, &c. Cannons were planted with a couple of soldiers to each ready to fire. Centinels were placed in different parts of the garrison, particularly before the governor's house; and a regiment of armed men was drawn up in another place with their general in the front. The whole was made up of a kind of clay which the place affords, was ingeniously contrived, and the light that was thrown upon it gave it a very pretty effect.

"On the other side of this hall was a long table set out with cold tongues, bread, and butter, and some of the best Burgundy I ever drank. Now every thing was hilarity and mirth; our fears were entirely dispelled, and the danger we dreaded the moment before was now no longer thought of. In short, we were all in good spirits again, and proceeded on our journey about two miles farther, when our guides judged it prudent for us to ascend, as we were then got to the steps which lead up to the town. We here found ourselves safe at the *Val de Grace*, near to the English Benedictine convent, without the least accident having happened to any one of the party. We imagined we had walked about two French leagues, and were absent from the surface of the earth betwixt four and five hours.

"There were formerly several openings into the quarries, but the two I have mentioned, viz. the *Observatory* and the *Val de Grace*, are, I believe, the only ones left; and these the inspectors keep constantly locked, and rarely open them, except to strangers particularly introduced, and to workmen who are always employed in some part by the king. The police thought it a necessary precaution to secure all the entrances into this cavern, from its having been formerly inhabited by a famous gang of robbers, who infested the country for many miles round the city of Paris.

"As to the origin of this quarry, I could not, on the strictest inquiry, learn any thing satisfactory; and the only account I know published is the following contained in the *Tableaux de Paris, nouvelle edition, tome premier, chapitre 5me, page 12me.*

"For the first building of Paris it was necessary to get the stone in the environs; and the consumption of it was very considerable. As Paris was enlarged, the suburbs were insensibly built on the ancient quarries, so that all that you see without is essentially wanting in the earth for the foundation of the city: hence proceed the frightful cavities which are at this time found under the houses in several quarters. They stand upon abysses. It would not require a very violent shock to throw back the stones to the place from whence they have been raised with so much difficulty. Eight men being swallowed up in a gulf of 150 feet deep, and some other less known accidents, excited at length the vigilance of the police and the government, and, in fact, the buildings of several quarters have been privately propped up; and by this means a support given to these obscure subterraneous places which they before wanted.

"All the suburbs of St James's, Harp-street, and even the street of Tournon, stand upon the ancient quarries; and pillars have been erected to support the weight of the houses. What a subject for reflections, in considering this great city formed and supported by means absolutely contrary! These towers, these steeples, the arched roofs of these temples, are so many signs to tell the eye that what we now see in the air is wanting under our feet."

QUARRY, a place under ground, out of which are got marble, freestone, slate, limestone, or other matters proper for building. See SRATA.

Some limestone quarries in Fife are highly worthy the attention of the curious, on account of an amazing mixture of organized marine productions found in them. One of this kind was opened about the year 1759, at a farm called *Enderteel*, in the neighbourhood of Kirkaldy, belonging to General St Clair.

The flakes of the stone, which are of unequal thickness, most of them from eight to ten inches, lie horizontally, dipping towards the sea. Each of these flakes, when broken, presents to our view an amazing collection of petrified sea bodies, as the bones of fishes, stalks of sea-weed, vast quantities of shells, such as are commonly found on those coasts, besides several others of very uncommon figures. In some places the shells are so numerous, that little else is to be seen but prodigious clusters or concretions of them. In the uppermost stratum the shells are so entire, that the outer crust or plate may be scraped off with the finger; and the stalks of the sea-weed have a darkish colour, not that glossy whiteness which they have in the heart of of the quarry. The smallest rays or veins of the shells are deeply indented on the stone, like the impression of a seal upon wax. In short, no spot at the bottom of the ocean could exhibit a greater quantity of sea-bodies than are to be found in this solid rock; for we have the skeletons of several fishes, the *antennæ* or feelers of lobsters, the roots and stalks of sea-weeds, with the very *capsulæ* which contain the seed. The place where all these curiosities are found is on an eminence about an English mile from the sea; and as the ground is pretty steep the whole way, it may be 200 feet higher at least.

There are two or three things to be remarked here. 1. That among all the bodies we have mentioned, there are none but what are specifically heavier than water. This holds so constantly true, that the sea-weed, which floats in water when the plant is entire, has been stripped of the broad leaves, which make it buoyant, before it has been lodged here. 2. The shells have been all empty; for the double ones, as those of the flat kind, are always found single, or with one side only. 3. The rock seems to have been gradually deserted by the sea, and for a long time, washed with the tides; for the upper surface is all eaten, and hollowed in many places like an honey-comb, just as we observe in flat rocks exposed every tide to the access and recess of the waters. See the article SEA.

QUARRY, or *Quarrel*, among glaziers, a pane of glass cut in a diamond form.

Quarries are of two kinds, square and long; each of which are of different sizes, expressed by the number of the pieces that make a foot of glass, viz. eighths, tenths, eighteenths, and twentieths: but all the sizes are cut to the same angles, the acute angle in the square quarrels being $77^{\circ}\ 19'$, and $67^{\circ}\ 21'$ in the long ones.

QUARRY, among hunters, is sometimes used for a part of the entrails of the beast taken, given by way of reward to the hounds.

QUARRY, in falconry, is the game which the hawk is in pursuit of, or has killed.

QUART, a measure of capacity, being the fourth part of some other measure. The English quart is the fourth part of the gallon, and contains two pints. The quart of the Romans was the fourth part of their congius. The French have various quarts, besides their quart or pot consisting of two pints, and are distinguished by the whole of which they are quarters; as *quart de muid*, and *quart de boisseau*.

QUARTAN, a measure containing the fourth part of some other measure.

QUARTAN, a species of intermitting fever. See MEDICINE *Index*.

QUARTATION, is an operation by which the quantity of one thing is made equal to a fourth part of the quantity of another thing. Thus when gold alloyed with silver is to be parted, we are obliged to facilitate the action of the aquafortis, by reducing the quantity of the former of these metals to one fourth part of the whole mass; which is done by sufficiently increasing the quantity of the silver, if it be necessary. This operation is called *quartation*, and is preparatory to the parting; and even many authors extend this name to the operation of parting. See ORES, *Analysis of*.

QUARTER, the fourth part of any thing, the fractional expression for which is $\frac{1}{4}$.

QUARTER, in weights, is generally used for the fourth part of an hundred weight avoirdupois, or 28 lb.

Used as the name of a dry measure, *quarter* is the fourth part of a ton in weight, or eight bushels.

QUARTER, a term in the manege. To work from quarter to quarter, is to ride a horse three times in upon the first of the four lines of a square; then changing your hand, to ride him three times upon the second: and so to the third and fourth; always changing hands, and observing the same order.

QUARTERS, with respect to the parts of a horse, is used in various senses: thus the shoulders and fore-legs are called the *fore-quarters*, and the hips and hinder-legs the *hind-quarters*. The *quarters* of a horse's foot are the sides of the coffin, comprehending between the toe and the heel: the *inner* quarters are those opposite to one another, facing from one foot to the other; and these are always weaker than the *outside* quarters, which lie on the external sides of the coffin. *False-quarters*, are a cleft in the horn of a horse's hoof, extending from the coronet to the shoe. A horse is said to be a *quarter-cast* when for any disorder in the coffin we are obliged to cut one of the quarters of the hoof.

QUARTER, in *Astronomy*, the fourth part of the moon's period: thus, from the new moon to the quadrature is the first quarter; from this to full moon, the second quarter, &c.

QUARTER, in *Heraldry*, is applied to the parts or members of the first division of a coat that is quartered, or divided into four quarters.

Franc QUARTER, in *Heraldry*, is a quarter single or alone; which is to possess one fourth part of the field. It makes one of the honourable ordinaries of a coat.

QUARTER *of a Ship*, that part of a ship's side which lies towards the stern; or which is comprehended between the aftmost end of the main chains and the sides of the stern, where it is terminated by the quarter-pieces.

Although the lines by which the quarter and bow of a ship, with respect to her length, are only imaginary, yet experience appears sufficiently to have ascertained their limits: so that if we were to divide the ships's sides into five equal portions, the names of each space would be readily enough expressed. Thus the first, from the stern, would be the quarter; the second, abaft the midships; the third, the midships; the fourth, before the midships; and the fifth, the bow. Whether these divisions, which in reality are somewhat arbitrary, are altogether improper, may be readily discovered by referring to the mutual situation or approach of two adjacent vessels. The enemy boarded us on the larboard side! Whereabouts? Abaft the midships, before the midships, &c.

Fig. 1. represents a geometrical elevation of a quarter of a 74 gun ship. A the keel, with *a* the false keel beneath it. B the stern-post. DD the quarter-gallery with its ballustrades and windows. EE the quarter-pieces, which limit and form the outlines of the stern. F the taffarel, or upper pieces of the stern. FG the profile of the stern, with its galleries. H the gun-ports of

Plate CCCCLVIII. fig. 1.

Quarter. of the lower deck; *h* the gun-ports of the upper and quarter-deck. I the after-part of the mizzen channel. K the wing transom. KG the lower counter. LB the station of the deck transom. LQ the after-part of the main-wale. DR the after-part of the channel-wale, parallel to the main-wale. SU the sheer-rail, parallel to both wales. T *t* the rudder. A *t* F the rake of the stern. P *i i* the drift-rails. TU the after-part of the load *water-line; k k l* the curve of the several decks corresponding to those represented in the head. See the article HEAD.

Fig. 2. 3. 4. 5. 6. 7. As the marks, by which vessels of different constructions are distinguished from each other, are generally more conspicuous on the stern or quarter than any other part, we have represented some of the quarters, which assume the most different shapes, and form the greatest contrast with each other. Fig. 2. shows the stern and quarter of a Dutch flight. Fig. 3. the stern and quarter of a cat. Fig. 4. is the stern and quarter of a common galley. Fig. 5. exhibits the quarter of a first-rate galley, otherwise called a *galleasse*. Fig. 6. the quarter of a Dutch dogger, or galliot. Fig. 7. represents the stern and quarter of a sloop of war.

The quarters of all other ships have a near affinity to those above exhibited. Thus all ships of the line, and East-Indiamen, are formed with a quarter little differing from the principal figure in this plate. Xebecs have quarters nearly resembling those of galleasses, only somewhat higher. Hagboats and pinks approach the figure of *cats*, the former being a little broader in the stern, and the latter a little narrower; and the sterns and quarters of cats seem to be derived from those of fly-boats. The sterns of Dutch doggers and galliots are indeed singular, and like those of no other modern vessel: they have nevertheless a great resemblance to the ships of the ancient Grecians, as represented in medals and other monuments of antiquity.

On the QUARTER, may be defined an arch of the horizon, contained between the line prolonged from the ship's stern and any distant object, as land, ships, &c. Thus if the ship's keel lies on an east and west line, the stern being westward, any distant object perceived on the north-west or south-west, is said to be on the larboard or starboard quarter.

QUARTER-*Bill*, a roll, or list, containing the different stations, to which all the officers and crew of the ship are quartered in the time of battle, and the names of all the persons appointed to those stations. See QUARTERS.

QUARTER-*Master*, an officer, generally a lieutenant, whose principal business is to look after the quarters of the soldiers, their clothing, bread, ammunition, firing, &c. Every regiment of foot and artillery has a quarter-master, and every troop of horse one, who are only warrant-officers, except in the Blues.

QUARTER-*Master-General*, is a considerable officer in the army; and should be a man of great judgment and experience, and well skilled in geography. His duty is to mark the marches and encampments of an army: he should know the country perfectly well, with its rivers, plains, marshes, woods, mountains, defiles, passages, &c. even to the smallest brook. Prior to a march, he receives the order and route from the commanding general, and appoints a place for the quarter-masters of the army to meet him next morning, with whom he marches to the next camp; where being come, and having viewed the ground, he marks out to the regimental quarter-masters the ground allowed each regiment for their camp: he chooses the head-quarters, and appoints the villages for the generals of the army's quarters: he appoints a proper place for the encampment of the train of artillery: he conducts foraging parties, as likewise the troops to cover them against assaults, and has a share in regulating the winter-quarters and cantonments.

QUARTER-*Netting*, a sort of net-work, extended along the rails on the upper part of a ship's quarter. In a ship of war these are always double, being supported by iron cranes, placed at proper distances. The interval is sometimes filled with cork, or old sails; but chiefly with the hammocks of the sailors, so as to form a parapet to prevent the execution of the enemy's small arms in battle.

QUARTER-*Sessions*, a general court held quarterly by the justices of peace of each county. This court is appointed by stat. 2 Hen. V. c. 4. to be in the first week after Michaelmas-day; the first week after the Epiphany; the first week after the close of Easter; and in the week after the translation of Saint Thomas à Becket, or the 7th of July. The court is held before two or more justices of the peace, one of whom must be of the *quorum*. The jurisdiction of this court by 34 Ed. III. c. 1. extends to the trying and determining of all felonies and trespasses whatsoever, though they seldom, if ever, try any greater offence than small felonies within the benefit of clergy, their commission providing, that if any case of difficulty arises, they shall not proceed to judgment, but in the presence of one of the justices of the court of king's bench or common pleas, or one of the judges of assize. And therefore murderers and other capital felons are usually remitted for a more solemn trial to the assizes. They cannot also try any new created offence, without express power given them by the statute which creates it. But there are many offences, and particularly matters, which by particular statutes belong properly to this jurisdiction, and ought to be prosecuted in this court; as, the smaller misdemeanors against the public or commonwealth, not amounting to felony, and especially offences relating to the game, highways, alehouses, bastard children, the settlement and provision for the poor, vagrants, servants wages, apprentices, and popish recusants. Some of these are proceeded upon by indictment, and others in a summary way by motion and order thereupon; which order may, for the most part, unless guarded against by particular statutes, be removed into the court of king's bench, by writ of *certiorari facias*, and be there either quashed or confirmed. The records or rolls of the sessions are committed to the custody of a special officer, denominated the *custos rotulorum*. In most corporation towns there are quarter-sessions kept before justices of their own, within their respective limits, which have exactly the same authority as the general quarter-sessions of the county, except in very few instances: one of the most considerable of which is the matter of appeals from orders of removal of the poor, which, though they be from the orders of corporation justices, must be to the sessions of the county, by 8 and 9 Will. III. c. 30. In both corporations

Blackst. Comment. vol. iv. p. 271.

rations and countries at large, there is sometimes kept a special or petty session, by a few justices, for dispatching smaller business in the neighbourhood between the times of the general sessions, as for licensing alehouses, passing the accounts of parish-officers, and the like.

Quarter-Staff, a long staff borne by foresters, park-keepers, &c. as a badge of their office, and occasionally used as a weapon.

QUARTERS, a name given at sea to the several stations where the officers and crew of a ship of war are posted in action. See War, Part II.

The number of men appointed to manage the artillery is always in proportion to the nature of the guns, and the number and condition of the ship's crew. They are, in general, as follow, when the ship is well manned, so as to fight both sides at once occasionally:

Pounder.	No. of men.	Pounder.	No. of men.
To a 42	- 15	To a 9	- 6
32	- 13	6	- 5
24	- 11	4	- 4
18	- 9	3	- 3
12	- 7		

This number, to which is often added a boy to bring powder to every gun, may be occasionally reduced, and the guns nevertheless well managed. The number of men appointed to the small arms, on board his Majesty's ships and sloops of war, by order of the admiralty, are,

Rate of the ship.	No. of men to the small arms.
1st -	- 150
2d -	- 120
3d of 80 guns	- 100
— of 70 guns	- 80
4th of 60 guns	- 70
4th of 50 guns	- 60
5th -	- 50
6th -	- 40
Sloops of war	- 30

The lieutenants are usually stationed to command the different batteries, and direct their efforts against the enemy. The master superintends the movements of the ship, and whatever relates to the sails. The boatswain, and a sufficient number of men, are stationed to repair the damaged rigging; and the gunner and carpenter, wherever necessary, according to their respective offices.

The marines are generally quartered on the poop and forecastle, or gang-way, under the directions of their officers; although, on some occasions, they assist at the great guns, particularly in distant cannonading.

Quarters, at a siege, the encampment upon one of the principal passages round a place besieged, to prevent relief and convoys.

Head Quarters of an Army, the place where the commander in chief has his quarters. The quarters of generals of horse are, if possible, in villages behind the right and left wings, and the generals of foot are often in the same place: but the commander in chief should be near the centre of the army.

Quarters of Refreshment, the place or places where troops that have been much harassed are put to recover themselves during some part of the campaign.

Intrenched Quarters, a place fortified with a ditch and parapet to secure a body of troops.

Winter Quarters, sometimes means the space of time included between leaving the camp and taking the field; but more properly the places where the troops are quartered during the winter.

The first business, after the army is in winter-quarters, is to form the chain of troops to cover the quarters well: which is done either behind a river, under cover of a range of strong posts, or under the protection of fortified towns. Hussars are very useful on this service.

It should be observed, as an invariable maxim, in winter quarters, that your regiments be disposed in brigades, to be always under the eye of a general officer; and, if possible, let the regiments be so distributed, as to be each under the command of its own chief.

QUARTILE, an aspect of the planets when they are at the distance of 90° from each other, and it is denoted by the character □.

QUARTERING, in *Heraldry*, is dividing a coat into four or more quarters, or quarterings, by parting, couping, &c. that is, by perpendicular and horizontal lines, &c.

QUARTO-decimans, an ancient sect in the Christian church, who taught that Easter should always be celebrated according to the custom of the Jews, on the fourteenth day of the moon in the month of March, whensoever that day fell out. And hence they derived their name *quarto-decimani*, q. d. Fourteenthers. The Asiatics were mightily attached to this opinion, pretending that it was built on the authority of St John, who was their apostle; and Pope Victor could never bring them to obedience in this article, though he was upon the point of excommunicating them: but it is more probable he contented himself with menaces. See Easter.

QUARTZ, a mineral composed chiefly of siliceous earths. See Mineralogy *Index*.

QUASHING, in *Law*, the overthrowing and annulling a thing.

QUASI-contract, in the civil law, an act without the strict form of a contract, but yet having the force thereof. In a contract there must be the mutual consent of both parties, but in a *quasi-contract* one party may be bound or obligated to the other, without having given his consent to the act whereby he is obliged. For example: I have done your business, in your absence, without your procuration, and it has succeeded to your advantage. I have then an action against you for the recovery of what I have disbursed, and you an action against me to make me give an account of my administration, which amounts to a *quasi-contract*.

Quasi-Crime, or *Quasi-delict*, in the civil law, the action of a person who does damage, or evil, involuntarily. The reparation of *quasi-crimes* consists in making good the damages, with interest.

QUASS, a fermented liquor drunk in Russia. See Peasant.

QUASSIA, a genus of plants, belonging to the decandria class; and in the natural method ranking under the 14th order, *Gruinales*. See Botany *Index*.

QUATUORVIR, in antiquity, formerly written IIII. VIR, a Roman magistrate, who had three colleagues joined with him in the same administration, and had the care of conducting and settling the colonies sent into the provinces. There were also quatuorviri appointed to inspect and take care of repairs, &c.

QUAVER, in *Music*, a measure of time equal to half a crotchet, or an eighth part of a semibreve.

QUAY. See KEY.

QUEBEC, a handsome and large town of North America, and capital of Canada. The first place taken notice of when landing here is a square of an irregular figure, with well-built houses on each side; on the back of which is a rock; on the left it is bounded by a small church; and on the right are two rows of houses, parallel to each other. There is another between the church and the harbour; as also another long row on the side of the bay. This may be looked upon as a kind of suburb; and between this and the great street is a very steep ascent, in which they have made steps for the foot passengers to go up. This may be called the *Upper Town*, wherein is the bishop's palace; and between two large squares is a fort where the governor lodges. The Recolets have handsome houses over-against it, and on the right is the cathedral church: over-against this is the Jesuits college, and between them are well built houses; from the fort run two streets, which are crossed by a third, and between these are a church and a convent. In the second square are two descents to the river of St Charles. The Hotel Dieu is in the midway; and from thence are small houses, which reach to the house of the intendant. On the other side of the Jesuits college, where the church stands, is a pretty long street in which is a nunnery. Almost all the houses are built of stone, and there are about 15,000 inhabitants; the fort is a handsome building, but not quite finished. Quebec is not regularly fortified: but it cannot be easily taken; for the harbour is flanked with two bastions, which at high tides are almost level with the water. A little above one of the bastions is a demi-bastion, partly taken out of the rock; and above it, on the side of the gallery of the fort, is a battery of 25 pieces of cannon: still above this is a square fort called the *citadel*; and the ways from one fortification to another are difficult to pass. To the left of the harbour, on the side of the road, there are large batteries of cannon, and some mortars; besides these, there are several other fortifications not very easy to be described. In 1711 the British fitted out a fleet with a design to conquer Canada, which failed on account of the rashness of the admiral; who, contrary to the advice of his pilot, went too near the Seven isles, and so lost his largest ships, and 3000 of his best soldiers. It is about 300 miles north-west of Boston in New-England. On October, 18. 1759, it was taken by the British under the command of General Wolfe, who lost his life in the battle, after he had the satisfaction to know that our troops were victorious. Admiral Saunders commanded a squadron of men of war, and did immense service in reducing this place; there being not a man in the navy but what was active on this occasion, not excepting the sailors belonging to the transport vessels. After this valuable acquisition, all Canada came under the jurisdiction of the crown of Great Britain. W. Long. 69. 48. N. Lat. 46. 55.

QUEDA, a kingdom of Asia, in the peninsula beyond the Ganges, and near the straits of Malacca. The king is tributary to Siam. The principal town is of the same name, and said to contain about 8000 inhabitants. It has a harbour, and is 300 miles north of Malacca. E. Long. 100. 5. N. Lat. 7. 5.

QUEDLINGBURG, a town of Germany, in the circle of Upper Saxony, now belonging to Prussia. Here is a famous abbey, whose abbess was a princess of the empire, and sent deputies to the diets. Her contingent was one horseman and ten footmen. The inhabitants of the town live by brewing, husbandry, and feeding of cattle. It is 10 miles south-east of Halberstadt, and 32 west of Bernburg. E. Long. 11. 34. N. Lat. 52. 1.

QUEEN, a woman who holds a crown singly.

The title of *queen* is also given by way of courtesy to her that is married to a king, who is called by way of distinction *queen-consort*; the former being termed *queen-regent*. The widow of a king is also called *queen*, but with the addition of *dowager*. See ROYAL *Family*.

QUEEN *Charlotte's Sound* is situated at the northern extremity of the southern island of New Zealand, near Cook's Strait, lying in 41. 6. of south latitude, and 174. 19. of east longitude. The climate of this sound is much more mild than at Dusky Bay; and though there is not such plenty of wild fowl and fish, the defect is sufficiently compensated by the abundance of excellent vegetables. The hills about the sound consist mostly of an argillaceous stone of a greenish gray, or bluish or yellowish brown colour. A green talkous or nephritic (by the jewellers called *jade*) is likewise very common, together with horn-stone, shingle, several sorts of flinty stones and pebbles, some loose pieces of basaltes, strata of a compact mica or glimmer, with particles of quartz. Hence, Mr Forrester thinks, there is reason to believe that this part of New Zealand contains iron-ore, and perhaps several other metallic substances. The country is not so steep as at Dusky Bay, and the hills near the sea are generally inferior in height, but covered with forests equally intricate and impenetrable. Captain Cook sowed the seeds of many vegetables in this place, that have useful and nutritive roots. He sowed also corn of several sorts, beans, kidney-beans, and pease. The dogs here are of the long-haired sort, with pricked ears, and resemble the common shepherd's cur, but they are very stupid animals. They are fed with fish, and even dogs flesh, and perhaps human flesh, which the natives also eat. Captains Cook and Furneaux left on these islands a boar and two sows, with a pair of goats, male and female, with some geese, in order to benefit the natives and future generations of navigators. They left likewise among them a number of brass medals gilt, on one side of which was the head of his present Majesty, with the inscription "George III. King of Great Britain, France, and Ireland," &c. On the reverse, a representation of two men of war, with the names Resolution and Adventure over them; and on the exergue, "Sailed from England March MDCCLXXII."

QUEEN-*Gold*, is a royal duty or revenue belonging to to every queen of England during her marriage to the king, payable by persons in this kingdom and Ireland, on divers grants of the king by way of fine and oblation, &c. being one full tenth part above the entire fines, on pardons, contracts, or agreements, which becomes a real debt to the queen, by the name of *aurum reginæ*, upon the party's bare agreement with the king for his fine, and recording the same.

Queen's-County, a division of the province of Leinster in Ireland; so called from the popish Queen Mary, in whose reign it was first made a county by the earl of Sussex, then lord-deputy. It is bounded on the south by Kilkenny and Catherlogh: by King's county on the north and west; part of Kildare and Catherlogh on the east; and part of Tipperary on the west. Its greatest length from north to south is 35 miles, and its breadth near as much; but it is unequal both ways. This country was anciently full of bogs and woods, though now pretty well enclosed and cultivated. The number of inhabitants amounts to 82,000; and it sends two members to the imperial parliament.

Queen-Bee. See *Bee*, N° 3, &c.

QUEENBOROUGH, a town of the isle of Sheppey in Kent, which sends two members to parliament, though consisting only of about 100 low brick houses, and scarce 350 inhabitants. The chief employment of the people here is oyster-dredging; oysters being very plentiful, and of a fine flavour. E. Long. 0. 45 N. Lat. 51. 25.

QUEENSFERRY, which is sometimes denominated South Queensferry, is a royal borough in the shire of Linlithgow, on the coast of the frith of Forth, about 9 miles to the westward of Edinburgh. It obtained the name from Margaret, queen of Malcom Canmore, who was in the habit of frequenting the passage of the frith at this place, and was the principal patroness of the town. It is a small place, consisting of no more than one irregular street, the houses of which are small, and chiefly inhabited by people who lead a seafaring life. The principal manufacture is that of soap, begun in the year 1770, which from 1783 to 1789 was a trade of considerable extent, the works being then four in number, and paying about 10,000l. annually of excise duty.

The shipping of the port has considerably declined; and at present the chief consequence of the place may be regarded as arising from the ferry over the frith of Forth, which is very much frequented. The river here is about two miles broad, and on each side has convenient landing places. The passage is both safe and expeditious, and with the exception of a very few cases, may be had at all times. It is one of five boroughs that send a member to the British or Imperial parliament, the other four being Stirling, Dunfermline, Inverkeithing, and Culross. The parish is of very small extent, being confined to the borough. It is an erection in the parish of Dalmeny, which took place in the year 1636. The inhabitants were 558 in the year 1811.

Queensferry, North, a village in Fifeshire, situated on the Forth, directly opposite to the borough of Queensferry, between which there are regular passage boats. It lies in the parish of Dunfermline, but is annexed, *quoad sacra*, to the parish of Inverkeithing. The inhabitants in 1793 were 312.

QUEI-LING-FOU, the capital of the province of Quangsi in China, has its name from a flower called *quei*, which grows on a tree resembling a laurel; it exhales so sweet and agreeable an odour, that the whole country around is perfumed with it. It is situated on the banks of a river, which throws itself into the Taho; but it flows with such rapidity, and amidst so narrow valleys, that it is neither navigable nor of any utility to commerce. This city is large, and the whole of it is built almost after the model of our ancient fortresses; but it is much inferior to the greater part of the capitals of the other provinces. A great number of birds are found in the territories belonging to it, the colours of which are so bright and variegated, that the artists of this country, in order to add to the lustre of their silks, interweave with them some of their feathers, which have a splendour and beauty that cannot be imitated. Quei-ling has under its jurisdiction two cities of the second class and seven of the third.

Grosier's General Description of China.

Quei, in *Natural History*, is a name given by the Chinese to a peculiar earth found in many parts of the east. It is of the nature of an indurated clay, and in some degree approaches to the talks, as our steatites and the galactites do. It is very white and abstersive, used by the women of China to take off spots from the skin, and render it soft and smooth, as the Italian ladies use talk of Venice. They sometimes use the fine powder of this stone dry, rubbing it on the hands and face after washing; sometimes they mix it in pomatum.

QUELPAERT, an island in the mouth of the channel of Japan, subject to the king of Corea. Before the last voyage of the unfortunate La Perouse, this island was only known to the Europeans by the wreck of the Dutch ship Sparrow-hawk, in the year 1635. Some of the crew of this ship were kept prisoners for about 18 years, during which period they were often severely treated; but having found means to escape to Japan, and from thence to Batavia, they at last arrived in safety at Amsterdam. La Perouse discovered the island on the 21st of May 1787, the south point of which is in N. Lat. 33° 14′, and E. Long. 124° 15′ from Paris. The land has a gradual slope towards the sea, which makes the habitations assume the appearance of an amphitheatre. The soil appeared to be highly cultivated, and the divisions of fields were perceived by the assistance of glasses, which afforded a convincing proof of an extensive population. It is unfortunately inhabited by a people who are prohibited from all intercourse with strangers, and who make slaves of all those who have the misfortune to suffer shipwreck on their coasts.

QUERCI, a province of Guienne in France; bounded on the north by Limosin, on the east by Rouergue and Auvergne, on the south by Upper Languedoc, and on the west by Agenois and Perigord. It was divided into Upper and Lower; and corresponds nearly with the department of Lot. Cahors is the capital town.

QUERCUS, a genus of plants, belonging to the monœcia class; and in the natural method ranking under the 50th order, *Amentaceæ*. See Botany *Index*.

The robur, or common English oak, grows from about 60 or 70 to 100 feet high, with a prodigious large trunk, and monstrous spreading head; oblong leaves, broadest towards the top, the edges acutely sinuated, having the angles obtuse. There is a variety, having the leaves finely striped with white. This species grows

Quercus. in great abundance all over England, in woods, forests, and hedge-rows; is naturally of an amazing large growth, there being accounts of some above 100 feet stature, with wonderful large trunks and spreading heads; and is supposed to continue its growth many centuries.

The suber, or cork-tree, grows 30 or 40 feet high, having a thick, rough, fungous, cleft bark, and oblong-oval undivided serrated leaves, downy underneath. This species furnishes that useful material cork; it being the bark of the tree, which becoming of a thick fungous nature, under which, at the same time, is formed a new bark, and the old being detached for use, the tree still lives, and the succeeding young bark becomes also of the same thick spongy nature in six or seven years, fit for barking, having likewise another fresh bark forming under it, becoming cork like the others in the like period of time; and in this manner these trees wonderfully furnish the cork for our use, and of which is made the corks for bottles, bungs for barrels, and numerous other useful articles. The tree grows in great plenty in Spain and Portugal, and from these countries we receive the cork. The Spaniards burn it, to make that kind of light black we call Spanish black, used by painters. Cups made of cork are said to be good for hectical persons to drink out of. The Egyptians made coffins of cork; which being lined with a resinous composition, preserved dead bodies uncorrupted. The Spaniards line stone-walls with it, which not only renders them very warm, but corrects the moisture of the air.

Oak-trees, of all the above sorts, may be employed in gardening to diversify large ornamental plantations in out-grounds, and in forming clumps in spacious lawns, parks, and other extensive opens; the evergreen kinds in particular have great merit for all ornamental purposes in gardens. But all the larger growing kinds, both deciduous and evergreens, demand esteem principally as first-rate forest-trees for their timber. The English oak, however, claims precedence as a timber-tree, for its prodigious height and bulk, and superior worth of its wood. Every possessor of considerable estates ought therefore to be particularly assiduous in raising woods of them, which is effected by sowing the acorns either in a nursery and the plants transplanted where they are to remain, or sowed at once in the places where they are always to stand. All the sorts will prosper in any middling soil and open situation, though in a loamy soil they are generally more prosperous: however, there are but few soils in which oaks will not grow; they will even thrive tolerably in gravelly, sandy, and clayey land, as may be observed in many parts of this country of the common oak.

The oak is of the utmost importance to Britain, and its cultivation deserves the utmost attention. Much, therefore, to the honour of the members of the *London Society for encouraging Arts, Manufactures, and Commerce*, they have excited particular attention to it; and many excellent observations, drawn from practice, will be found in their Transactions.

The propagation of the striped-leaved varieties of the common oak, and any particular variety of the other species, must be effected by grafting, as they will not continue the same from seed: the grafting may be performed upon any kind of oakling-stocks raised from the acorns, and train them for standards like the others.

The oak is remarkable for its slowness of growth, bulk, and longevity. It has been remarked that the trunk has attained to the size only of 14 inches in diameter, and of some to 20, in the space of fourscore years. As to bulk, we have an account of an oak belonging to Lord Powis, growing in Broomfield wood, near Ludlow in Shropshire, in the year 1764, the trunk of which measured 68 feet in girth, 23 in length, and which, reckoning 90 feet for the larger branches, contained in the whole 1455 feet of timber, round measure, or 29 loads and five feet, at 50 feet to a load.

The Greendale oak, &c. we have already mentioned (see OAK). In the opinion of many, the Cowthorp oak near Wetherby in Yorkshire is the father of the forest. Dr Hunter, in his edition of Evelyn, has given an engraving of it. Within three feet of the surface he says it measures 16 yards, and close to the ground 26. In 1776, though in a ruinous condition, it was 85 feet high, and its principal limb extended 16 yards from the bole. The foliage was very thin. If this measurement were taken as the dimension of the *real stem*, the size of this tree would be enormous; but, like most very large trees, its stem is short, spreading wide at the base, the roots rising above the ground like buttresses to the trunk, which is similar not to a cylinder but to the frustum of a cone. Mr Marsham says, "I found it in 1768, at four feet, 40 feet six inches; at five feet, [illegible] feet six inches; and at six feet, 32 feet one inch." In the principal dimensions then, *the size of the stem*, it is exceeded by the Bentley oak; of which the same writer gives the following account: "In 1759 the oak in Holt-Forest, near Bentley, was at seven feet 34 feet. There is a large excrescence at five and six feet that would render the measure unfair. In 1778, this tree was increased half an inch in 19 years. It does not appear to be hollow, but by the trifling increase I conclude it not sound." These dimensions, however, are exceeded by those of the Boddington oak. It grows in a piece of rich grass land, called the *Old Orchard-Ground*, belonging to Boddington-Manor Farm, lying near the turnpike-road between Cheltenham and Tewksbury, in the Vale of Gloucester. The stem is remarkably collected at the root, the sides of its trunk being much more upright than those of large trees in general; and yet its circumference at the ground is about [illegible] paces: measuring with a two-foot rule, it is more than 18 yards. At three feet high it is 43 feet, and where smallest, i. e. from five to six feet high, it is 36 feet. At six feet it swells out larger, and forms an enormous head, which has been furnished with huge, and probably extensive, arms. But time and the fury of the winds have robbed it of much of its grandeur; and the greatest extent of arm in 1793 was eight yards from the stem.

In the Gentleman's Magazine for May 1794 we have an account of an oak tree growing in Penshurst park in Kent, together with an engraving. It is called the *Bear* or *Bare oak*, from being supposed to resemble that which Camden thought gave name to the county of Berkshire. The tradition at Penshurst is that it is the very tree planted on the day that the celebrated Sir Philip Sydney was born. "Some late writers (says Mr

Mr Rawlet) have questioned this, and think that to have been a different tree, which was cut down some years ago, and was indeed much larger than this. I remember being once in the hollow of the present oak with the late Sir John Cullum; and his opinion then was, that its antiquity was greater than the period assigned. But, I assure you, the tradition of this place is constant for this tree; and, in confirmation of it, an old lady of 94 years of age, now living, has told me, that all the tenants used to furnish themselves with boughs from this tree, to stick in their hats, whenever they went to meet the earls of Leicester, as was always the custom to do at the end of the park when they came to reside at their seat here. This fine old oak stands upon a plain about 500 yards from their venerable mansion, near a large piece of water called *Lancut-well.* Ben Jonson and Waller have particularly noticed it; and from the distinguished owners of this place, it may be truly said to stand on classic ground. Within the hollow of it there is a seat, and it is capable of containing five or six persons with ease. The bark round the entrance was so much grown up, that it has lately been cut away to facilitate the access. The dimensions of the tree are these:

	Feet.	Inches.
Girth close to the ground - -	35	6
Ditto one foot from ditto - -	27	6
Ditto five feet from ditto - -	24	0
Height taken by shadow - -	73	0
Girth of lowest, but not largest, limb	6	9

With respect to longevity, Linnæus gives account of an oak 260 years old: but we have had traditions of some in England (how far to be depended upon we knew not) that have attained to more than double that age. Mr Marsham, in a letter to Thomas Beevor, Esq. Bath Papers, vol. i. p. 79, makes some very ingenious calculations on the age of trees, and concludes from the increase of the Bentley oak, &c. that the Fortworth chesnut is 1100 years old.

Besides the grand purposes to which the timber is applied in navigation and architecture, and the bark in tanning of leather, there are other uses of less consequence, to which the different parts of this tree have been referred. The Highlanders use the bark to dye their yarn of a brown colour, or, mixed with copperas, of a black colour. They call the oak *the king of all the trees in the forest;* and the herdsman would think himself and his flock unfortunate if he had not a staff of it. The acorns are a good food to fatten swine and turkeys; and, after the severe winter of the year 1709, the poor people in France were miserably constrained to eat them themselves. They are, however, acorns produced from another species of oak, which are eaten to this day in Spain and Greece, with as much pleasure as chesnuts, without the dreadful compulsion of hunger.

Quercus Marina, the *Sea Oak*, in *Botany*, the name of a broad-leaved dichotomous sea-fucus. It is not agreed, among the late botanists, what was the sea-oak of Theophrastus; and the most ancient botanists, Clusius and Cæsalpinus, suppose it to have been a species of the shrubby coralline; but that seems by no means to have been the case, since Theophrastus says his sea-oak had a long, thick, and fleshy leaf; whence we may much more naturally conclude it to have been of the fucus class.

QUERIA, a genus of plants, belonging to the triandria class; and in the natural method ranking under the 22d order, *Caryophyllei.* See Botany *Index*.

QUESNE, Abraham du, marquis of Quesne, admiral of the naval forces of France, and one of the greatest men of the 17th century, was born in Normandy in 1610. He contributed to the defeating of the naval power of Spain before Gattari; was dangerously wounded before Barcelona in 1642, and on other occasions: he went into the service of the Swedes, and became vice-admiral; gave the Danes an entire defeat, killed their admiral, and took his ship. He was recalled into France in 1647, and commanded the squadron sent to Naples. The sea-affairs of France being much fallen, he fitted out divers ships for the relief of the royal army that blocked up Bourdeaux; which was the principal cause of the surrender of the town. He was very fortunate in the last wars of Sicily, where he beat the Dutch thrice, and De Ruyter was killed. He also obliged the Algerines to sue in a very humble manner for peace from France. In short, Asia, Africa, and Europe, felt the effects of his valour. He was a Protestant; yet the king bestowed on him the land of Bouchet, and to immortalize his memory gave it the name of that great man. He died in 1688.

QUESTION, in *Logic*, a proposition stated by way of interrogation.

Question, or *Torture*. See Rack.

QUESTOR, or Quæstor, in Roman antiquity, an officer who had the management of the public treasure.

The questorship was the first office any person could bear in the commonwealth, and have a right to sit in the senate.

At first there were only two; but afterwards two others were created, to take care of the payment of the armies abroad, of selling the plunder, booty, &c. for which purpose they generally accompanied the consuls in their expeditions; on which account they were called *peregrini*, as the first and principal two were called *urbani*.

The number of questors was afterwards greatly increased. They had the keeping of the decrees of the senate: and hence came the two offices of *questor principis*, or *augusti*, sometimes called *candidatus principis*, whose office resembled in most respects that of our secretaries of state, and the *questor palatii*, answering in a great measure to our lord-chancellor.

QUEUE, in *Heraldry*, signifies the tail of a beast; thus, if a lion be borne with a forked tail, he is blazoned double-queued.

Queue *d'Aronde*, or *Swallow's Tail*, in *Fortification*, a detached or outwork, the sides of which open towards the champaign, or draw closer towards the gorge. Single or double tenailles are of this kind, and some hornworks, the sides of which are not parallel, but narrow at the gorge, and open at the head, resembling a swallow's tail. When the sides are less than the gorge, the work is called *centre queue d'aronde*.

Queue *d'Aronde*, in carpentry, a method of jointing, also called *dovetailing*.

QUEVEDO de Villegas, Francisco, a celebrated Spanish poet, born at Madrid in 1570. He was

descended

Quevedo, Quick.

descended from a noble family, and was made a knight of St James; but was thrown into prison by order of Count Olivarez, whose administration he satirized in his verses, and was not set at liberty till after that minister's disgrace. Quevedo wrote some heroic, lyric, and facetious poems. He also composed several treatises on religious subjects, and has translated some authors into Spanish. He died in 1644. The most known of his works are, 1. The Spanish Parnassus. 2. The Adventurer Buscon. 3. Visions of Hell Reformed, &c. Quevedo was one of the greatest scholars and most eminent poets of his time. His youth was spent in the service of his country in Italy, where he distinguished himself with the utmost sagacity and prudence. His moral discourses prove his sound doctrine and religious sentiments, while his literary pieces display his infinite judgment and refined taste. His great knowledge of Hebrew is apparent from the report of the historian Mariana to the king, requesting that Quevedo might revise the new edition of the Bible of Arias Montanus. His translations of Epictetus and Phocylides, with his imitations of Anacreon, and other Greek authors, show how well he was versed in that language: that he was a Latin scholar, his constant correspondence, from the age of twenty, with Lipsius, Chifflet, and Scioppius, will sufficiently illustrate. As a poet, he excelled both in the serious and burlesque style, and was singularly happy in that particular turn we have since admired in Butler and Swift. His library, which consisted of about five thousand volumes, was reduced at his death to about two thousand, and is preserved in the convent of St Martin at Madrid.

QUICK, or *Quickset Hedge*, among gardeners, denotes all live hedges, of whatever sort of plants they are composed, to distinguish them from dead hedges; but in a more strict sense of the word, it is restrained to those planted with the hawthorn, under which name those young plants or sets are sold by the nursery-gardeners who raise them for sale.

The following method of propagating the common white thorn for hedges is recommended by Mr Taylor of Moston near Manchester, in a letter addressed to the Society for the Encouragement of Arts, &c. After premising that we have successfully repeated the experiment, we shall give the account of the process in his own words.

"Every one of you, I think, will allow that fences are material objects to be attended to in agriculture; you must also be convinced that there is no plant in this kingdom of which they can so properly be made as the *cratægus oxyacantha Linnæi*, or common white thorn. In consequence of my being convinced of this, I have been induced to make a few experiments to effect the better propagation of that valuable plant; the result of which, along with specimens of my success, I beg leave to submit to your inspection.

"In the year 1801, I had occasion to purchase a quantity of thorns, and finding them very dear, I was determined to try some experiments, in order if possible to raise them at a less expence. I tried to propagate them from cuttings of the branches, but with little or no success. I likewise tried if pieces of the root would grow; and I cut from the thorns which I had purchased about a dozen of such roots as pleased me, and planted them in a border along with those I had bought. To my great astonishment, not one of them died; and in two years they became as good thorns as the average of those I had purchased. The thorns I purchased were three years old when I got them. In April 1802, I had occasion to move a fence, from which I procured as many roots of thorns as made me upwards of two thousand cuttings, of which I did not lose five in the hundred.

"In the spring of 1803, I likewise planted as many cuttings of thorn roots as I could get. In 1804, I did the same; and this year I shall plant many thousands.

"I have sent for your inspection specimens of the produce of 1802, 1803, and 1804, raised after my method, with the best I could get of these raised from haws in the common way, which generally lie one year in the ground before they vegetate. They are exactly one, two, and three years old, from the day they were planted.—I was so pleased with my success in raising so valuable an article to the farming interest of this kingdom, at so trifling an expence (for it is merely that of cutting the roots into lengths and planting them), that I was determined to make it known to the world, and could think of no better method than communicating it to your society; and should you so far approve of this method of raising thorns, as to think me entitled to any honorary reward, I shall receive it with gratitude, but shall feel myself amply repaid for any trouble I have been at, should you think it worthy a place in the next volume of your Transactions.

"The method of raising the thorns from roots of the plant, is as follows.

"I would advise every farmer to purchase a hundred or a thousand thorns, according to the size of his farm, and plant them in his orchard or garden, and when they have attained the thickness of my three-year-old specimens, which is the size I always prefer for planting in fences, let him take them and prune the roots in the manner I have pruned the specimen sent you, from which he will upon an average get ten or twelve cuttings from each plant, which is as good as thorns of the same thickness; so that you will easily perceive that in three years he will have a succession of plants fit for use, which he may if he pleases increase tenfold every time he takes them up.

"The spring (say in all April) is the best time to plant the cuttings, which must be done in rows half a yard asunder, and about four inches from each other in the row; they ought to be about four inches long, and planted with the top one-fourth of an inch out of the ground, and well fastened; otherwise they will not succeed so well.

"The reason why I prefer spring to autumn for planting the roots, is, that were they to be planted in autumn, they would not have got sufficient hold of the ground before the frost set in, which would raise them all from the ground: and, if not entirely destroy the plants, would oblige the farmer to plant them afresh.

"I have attached the produce of my three-year-old specimen to the plants it came from, cut in the way I always practise; on the thick end of the root I make two, and on the other end one cut, by which means the proper end to be planted uppermost, which is the thick one, may easily be known.

"Although I recommend the roots to be planted in April,

April, yet the farmer may, where he pleases, take up the thorns he may want, and put the roots he has pruned off into sand or mould, where they will keep until he has leisure to cut them into proper lengths for planting; he will likewise keep them in the same way until planted.

"The great advantage of my plan is: first, that in case any one has raised from haws a thorn with remarkably large prickles, of vigorous growth, or possessing any other qualification requisite to make a good fence, he may propagate it far better and sooner, from roots, than any other way. Secondly, in three years he may raise from roots a better plant than can in six years be raised from haws, and with double the quantity of roots; my three-year-old specimen would have been half as big again, had I not been obliged to move all my cuttings the second year after they were planted.

"It would not be a bad way, in order to get roots, to plant a hedge in any convenient place, and on each side trench the ground two yards wide, and two grafts deep; from which, every two or three years, a large quantity of roots might be obtained, by trenching the ground over again, and cutting away what roots were found, which would all be young and of a proper thickness."

QUICKLIME, a general name for all calcareous substances when deprived of their fixed air; such as chalk, limestone, oyster-shells, &c. calcined. See LIME, CHEMISTRY, for an account of the properties and combinations of lime.

QUICKSILVER, or MERCURY, one of the metals, and so fusible that it cannot be reduced to a solid state but at a degree of cold, equal to 40 below 0 of Fahrenheit's thermometer. For the method of extracting quicksilver from its ore, &c. see *ORES, Reduction of*. For the various preparations, &c. see CHEMISTRY and MATERIA MEDICA *Index*; and for the natural history of the ores of quicksilver or mercury, see MINERALOGY *Index*.

Mines of quicksilver are very rare, insomuch that, according to the calculations of Hoffman, there is 50 times more gold got every year out of the mines than mercury and its ores. But Dr Lewis, in his notes upon Newmann, says, that Cramer suspects that Hoffman only meant five times instead of 50; but neither the Latin nor the English edition of this author expresses any such thought; on the contrary, he adopts the same opinion; and only adds, that mercury is much more frequently met with than is commonly believed; but being so volatile in the fire, it often flies off in the roasting of ores, and escapes the attention of metallurgists.

According to Newmann, the mines of Idria have produced at the rate of 231,778 pounds weight of mercury per annum; but those of Almaden in Spain produce much more. The chemists of Dijon inform us, that their annual produce is five or six thousand quintals, or between five and six hundred thousand pounds weight. In the year 1717 there were upwards of 2,500,000 pounds of quicksilver sent from them to Mexico, for the amalgamation of the gold and silver ores of that country.

At Guançavelica in Brasil the annual produce of the mines, according to Bomare, amounts to one million of pounds, which are carried overland to Lima, thence to Arica, and lastly to Potosi for the same purpose.

Besides these mines there are others in Brasil near Villa Rica, where such a quantity of cinnabar, and native running mercury, are found near the surface of the earth, that the black slaves often collect it in good quantities, and sell it for a trifling price to the apothecaries; but none of these mines have ever been worked or taken notice of by the owners. Gold naturally amalgamated with mercury is likewise met with in the neighbourhood of that place; and it is said that almost all the gold mines of that country are worked out by simply washing them out with running water, after reducing into powder the hard ores, which are sometimes imbedded in quartzose and rocky matrices.

In the duchy of Deux Ponts and in the Lower Austria the quicksilver flows from a schistose or stony matrice, and is probably, says Mr Kirwan, mixed with some other metal, as its globules are not perfectly spherical. The mines of Friuli are all in similar beds or strata. The metal is likewise found visibly diffused through masses of clay or very heavy stone, of a white, red, or blue colour; of which last kind are the mines of Spain, some of Idria, and of Sicily. Mascagni found fluid quicksilver, as well as native cinnabar and mineral ethiops, near the lake of Travale in the duchy of Sienna; but the quantity was so small as not to be worth the expence of working. On the other hand, the following mines afford profits to the owners after clearing all expences, viz. those at Kremnitz in Hungary; at Horowitz in Bohemia; Zorge in Saxony; Wolfstein, Stahlberg, and Moeschfeld in the Palatinate. Mercury is also brought from Japan in the East Indies; but the greatest part of what is sold in Europe as Japan cinnabar is said to be manufactured in Holland.

Lemery, Pomet, and others, lay down some external marks by which those places are distinguished where there are mines of quicksilver, viz. thick vapours like clouds arising in the months of April and May; the plants being much larger and greener than in other places: the trees seldom bearing flowers or fruit, and putting forth their leaves more slowly than in other places; but, according to Newmann, these marks are far from being certain. They are not met with in all places where there is quicksilver, and are observed in places where there is none. Abundance of these cloudy exhalations are met with in the Hartz forest in Germany, though no mercury has ever been found there; to which we may add, that though vast quantities of mercurial ores are found at Almaden in Spain, none of the above-mentioned indications are there to be met with.

Native mercury was formerly sought from the mines of Idria with great avidity by the alchemists for the purpose of making gold; and others have showed as ridiculous an attachment to the Hungarian cinnabar, supposing it to be impregnated with gold; nay, we are informed by Newmann, that not only the cinnabar, antimony, and copper of Hungary, but even the vine trees of that country, were thought to be impregnated with the precious metal. Not many years ago a French chemist advertised that he had obtained a considerable quantity of gold from the ashes of vine twigs and stems, as well as of the garden soil where they grew: but the falsehood of these assertions was demonstrated by the count de Lauragais to the satisfaction of the Royal Academy of Sciences.

The reduction of mercury into a solid state, so tha

it

it might be employed like silver, was another favourite alchemical pursuit. But all processes and operations of this kind, says Newmann, if they have mercury in them, are no other than hard amalgams. When melted lead or tin are just becoming consistent after fusion, if a stick be thrust into the metal, and the hole filled with quicksilver, as soon as the whole is cold, the mercury is found solid. Macquer informs us, that mercury becomes equally solid by being exposed to the fumes of lead. Maurice Hoffman, as quoted by Newmann, even gives a process for reducing mercury, thus coagulated, to a state of malleability, viz. by repeatedly melting and quenching it in linseed oil. Thus, he tells us, we obtain a metal which can be formed into rings and other utensils. But here the mercury is entirely dissipated by the repeated fusions, and nothing but the original lead is left. Wallerius, after mentioning strong soap-leys, or caustic lixivium, and some other liquors proper for fixing quicksilver, tells us, that by means of a certain gradatory water, the composition of which he learned from Creuling *de Aureo Vellere*, he could make a coagulum of mercury whenever he pleased, of such consistency that great part of it would resist cupellation; but what this gradatory water was, he has not thought proper to lay before the public.

QUICK-MATCH, among artillery men, a kind of combustible preparation formed of three cotton strands drawn into length, and dipped in a boiling composition of white-wine vinegar, saltpetre, and mealed powder. After this immersion it is taken out hot, and laid in a trough where some mealed powder, moistened with spirits of wine, is thoroughly incorporated into the twists of the cotton, by rolling it about therein. Thus prepared, they are taken out separately, and drawn through mealed powder; then hung upon a line and dried, by which they are fit for immediate service.

QUID PRO QUO, in *Law*, q. d. "what for what," denotes the giving one thing of value for another: or the mutual consideration and performance of both parties to a contract.

QUID *pro quo*, or QUI *pro quo*, is also used in physic to express a mistake in the physician's bill, where *quid* is wrote for *quo*, i. e. one thing for another; or of the apothecary in reading *quid* for *quo*, and giving the patient the wrong medicine. Hence the term is in the general extended to all blunders or mistakes committed in medicine, either in the prescription, the preparation, or application of remedies.

QUIDDITY, QUIDDITAS, a barbarous term used in the schools for *essence*. The name is derived hence that it is by the essence of a thing that it is a *tale quid*, such a *quid*, or thing, and not another. Hence what is essential to a thing is said to be *quiddative*.

QUIETISTS, a religious sect, famous towards the close of the last century. They were so called from a kind of absolute rest and inaction, which they supposed the soul to be in when arrived at that state of perfection which they called the *unitive life;* in which state they imagined the soul wholly employed in contemplating its God, to whose influence it was entirely submissive; so that he could turn and drive it where and how he would. In this state, the soul no longer needs prayers, hymns, &c. being laid, as it were, in the bosom and between the arms of its God, in whom it is in a manner swallowed up.

Molinos, a Spanish priest, is the reputed author of Quietism; though the Illuminati in Spain had certainly taught something like it before. The sentiments of Molinos were contained in a book which he published at Rome in the year 1681, under the title of the *Spiritual Guide;* for which he was cast into prison in 1685, and where he publicly renounced the errors of which he was accused. This solemn recantation, however, was followed by a sentence of perpetual imprisonment, and he died in prison in the year 1696. Molinos had numerous disciples in Italy, Spain, France, and the Netherlands. One of the principal patrons and propagators of Quietism in France was Marie Bouvieres de la Mothe Guyon, a woman of fashion, remarkable for goodness of heart and regularity of manners; but of an unsettled temper, and subject to be drawn away by the seduction of a warm and unbridled fancy. She derived all ideas of religion from the feelings of her own heart, and described its nature to others as she felt it herself. Accordingly her religious sentiments made a great noise in the year 1687; and they were declared unsound, after accurate investigation, by several men of eminent piety and learning, and professedly confuted, in the year 1697, by the celebrated Bossuet. Hence arose a controversy of greater moment between the prelate last mentioned and Fenelon archbishop of Cambray, who seemed disposed to favour the system of Guyon, and who in 1697 published a book containing several of her tenets. Fenelon's book, by means of Bossuet, was condemned in the year 1699, by Innocent XII. and the sentence of condemnation was read by Fenelon himself at Cambray, who exhorted the people to respect and obey the papal decree. Notwithstanding this seeming acquiescence, the archbishop persisted to the end of his days in the sentiments, which, in obedience to the order of the pope, he retracted and condemned in a public manner.

A sect similar to this had appeared at Mount Athos in Thessaly, near the end of the 14th century, called *Hesychasts*, meaning the same with Quietists. They were a branch of the mystics, or those more perfect monks, who, by long and intense contemplation, endeavoured to arrive at a tranquillity of mind free from every degree of tumult and perturbation. In conformity to an ancient opinion of their principal doctors (who thought there was a celestial light concealed in the deepest retirements of the mind), they used to sit every day, during a certain space of time, in a solitary corner, with their eyes eagerly and immoveably fixed upon the middle regions of the belly, or navel; and boasted, that while they remained in this posture, they found, in effect, a divine light beaming forth from their soul, which diffused through their hearts inexpressible sensations of pleasure and delight. To such as inquired what kind of light this was, they replied, by way of illustration, that it was the glory of God, the same celestial radiance that surrounded Christ during his transfiguration on the Mount. Barlaam, a monk of Calabria, from whom the Barlaamites derived their denomination, styled the monks who adhered to this institution *Massalians* and *Euchites;* and he gave them also the new name of *Umbilicani*. Gregory Palamas, archbishop of Thessalonica, defended their cause against Barlaam, who was condemned in a council held at Constantinople in the year 1341.—See *Fenelon's Max. des Saints*.

The Mahometans seem to be no strangers to quietism. They expound a passage in the 17th chapter of the Koran, viz. "O thou soul which art at rest, return unto the Lord, &c." of a soul which, having, by pursuing the concatenation of natural causes, raised itself to the knowledge of that being which produced them and exists of necessity, rests fully contented, and acquiesces in the knowledge, &c. of him, and in the contemplation of his perfection.

QUILLET, Claude, an eminent Latin poet of the 17th century, was born at Chinon, in Touraine, and practised physic there with reputation: but having declared against the pretended possession of the nuns of Loudun, in a manuscript treatise, the original of which was deposited in the library of the Sorbonne, he was obliged to retire into Italy, where he became secretary to the marshal d'Estrees, the French ambassador at Rome. In 1655, Quillet having published in Holland a Latin poem, entitled *Callipædia*, under the name of *Galvidius Lætus*, he there inserted some verses against the cardinal Mazarine and his family; but that cardinal making him some gentle reproaches, he retrenched what related to the cardinal in another edition, and dedicated it to him, Mazarine having, before it was printed, given him an abbey. He died in 1661, aged 59, after having given Menage all his writings, and 500 crowns to pay the expence of printing them; but the abbé took the money and papers, and published none of them. His *Callipædia*, or the art of getting beautiful children, has been translated into English verse.

QUILLS, the large feathers taken out of the end of the wing of a goose, crow, &c. They are denominated from the order in which they are fixed in the wing; the second and third quills being the best for writing, as they have the largest and roundest barrels. Crow-quills are chiefly used for drawing. In order to harden a quill that is soft, thrust the barrel into hot ashes, stirring it till it is soft, and then taking it out, press it almost flat upon your knee with the back of a penknife, and afterwards reduce it to a roundness with your fingers. If you have a number to harden, set water and alum over the fire, and while it is boiling, put in a handful of quills, the barrels only, for a minute, and then lay them by.

QUIN, James, a celebrated performer on the English stage, was born at London in 1693. He was intended for the bar; but preferring Shakespeare to the statutes at large, he on the death of his father, when it was necessary for him to do something for himself, appeared on the stage at Drury-lane. In 1720, he first displayed his comic powers in the character of Falstaff, and soon after appeared to as great advantage in Sir John Brute; but it was upon Booth's quitting the stage that Quin appeared to full advantage, in the part of Cato. He continued a favourite performer until the year 1748, when, on some disgust between him and Mr Rich the manager, he retired to Bath, and only came up annually to act for the benefit of his friend Ryan; until the loss of two front teeth spoiled his utterance for the stage. While Mr Quin continued upon the stage, he constantly kept company with the greatest geniuses of the age. He was well known to Pope and Swift; and the earl of Chesterfield frequently invited him to his table: but there was none for whom he entertained a higher esteem than for the poet Thomson, the author of the Seasons, to whom he made himself known by an act of generosity that does the greatest honour to his character; and for an account of which see our life of Thomson. Mr Quin's judgment in the English language recommended him to his royal highness Frederick prince of Wales, who appointed him to instruct his children in speaking and reading with a graceful propriety; and Quin being informed of the elegant manner in which his present Majesty delivered his first gracious speech from the throne, he cried out in a kind of ecstasy, "Ay—I taught the boy to speak!" Nor did his majesty forget his old tutor; for, soon after his accession to the throne, he gave orders, without any application being made to him, that a genteel pension should be paid to Mr Quin during his life. Mr Quin indeed, was not in absolute need of this royal benefaction; for, as he was never married, and had none but distant relations, he sunk 2000l. which was half his fortune, in an annuity, for which he obtained 200l. a-year; and with about 2000l. more in the funds, lived in a decent manner during the latter part of his life at Bath, from whence he carried on a regular correspondence with Mr Garrick, and generally paid a visit to his friends in the metropolis once a-year, when he constantly passed a week or two at Mr Garrick's villa at Hampton. He died of a fever in 1766.

QUINARIUS, was a small Roman coin equal to half the denarius, and consequently worth about threepence three farthings of our money. See Money. It was called *quinarius*, because it contained the value of five asses, in the same manner as the denarius was named from its containing ten.

QUINAUT, Philip, a celebrated French poet, born of a good family at Paris in 1635. He cultivated poetry from his infancy, and 16 dramatic pieces of his were acted between the years 1653 and 1666. In the mean time, Quinaut was not so much devoted to poetry but that he applied himself to the study of the law; and made his fortune by marrying the widow of a rich merchant to whom he had been useful in his profession. Quinaut afterwards turned his attention to the composing of operas, which were set to music by the famous Lully; and Lully was charmed with a poet whose verses were not too nervous to yield to the capricious airs of music. He died in 1688, after having for many years enjoyed a handsome pension from Louis XIV.: and we are told he was extremely penitent in his last illness for all those of his compositions which tended to inspire love and pleasure.

QUINCE, in *Botany*. See Cydonia.

QUINCUNX, in Roman antiquity, denotes any thing that consists of five-twelfths of another; but particularly of the *as*.

Quincunx *Order*, in *Gardening*, is a plantation of trees, disposed originally in a square consisting of five trees, one at each corner, and a fifth in the middle; which disposition, repeated again and again, forms a regular grove, wood, or wilderness.

QUINDECAGON, in *Geometry*, a plain figure with 15 sides and 15 angles.

QUINDECEMVIRI, in Roman antiquity, a college of 14 magistrates, whose business it was to preside over

over the sacrifices. They were also the interpreters of the Sybil's books; which, however, they never consulted but by an express order of the senate.

QUINQUAGENARIUS, in Roman antiquity, an officer who had the command of 50 men.

QUINQUAGESIMA SUNDAY, Shrove Sunday, so called as being about the 50th day before Easter.

QUINQUATRIA, or QUINQUATRUS, was a festival kept at Rome in honour of Minerva, which began on the 18th of March, or, as others will have it, on the 19th, and lasted five days. On the first day they offered sacrifices and oblations without the effusion of blood; the second, third, and fourth, were spent in shows of gladiators; and on the fifth day they went in procession through the city. Scholars had a vacation during the solemnity, and presented their masters at this time with a gift or fee, called *Minerval*. Boys and girls used now to pray to the goddess Minerva for wisdom and learning, of which she had the patronage. Plays were acted, and disputations held, at this feast, on subjects of polite literature. The quinquatria were so called, because they lasted for five days. There seems to be a strong resemblance betwixt this festival and the panathenæa of the Greeks.

QUINQUENNALIS, in Roman antiquity, a magistrate in the colonies and municipal cities of that empire, who had much the same office as the ædile at Rome.

QUINQUEREMIS, in the naval architecture of the ancients, is a name given to a galley which had five rows of oars. They divided their vessels in general into *monocrota* and *polycrota* *. The former had only one tire of rowers: the latter had several tires of them, from two or three up to 20, 30, or even 40; for such a vessel we have an account of in the time of Philopater, which required no less than 4000 men to row it.

* See *Polycrota*.

Meibom has taken off from the imaginary improbability of there ever having been such a vessel, by reducing the enormous height supposed necessary for such a number of rows of oars and men to work them, by finding a better way of placing the men than others had thought of. The quinqueremes of the ancients had 420 men in each; 300 of which were rowers, and the rest soldiers. The Roman fleet at Messina consisted of 330 of these ships; and the Carthaginian, at Lilybœum, of 350 of the same size. Each vessel was 150 feet long. Thus 130,000 men were contained in the one, and 150,000 in the other, with the apparatus and provisions necessary for such expeditions as they were intended for. This gives so grand an idea of the ancient naval armaments, that some have questioned the truth of the history: but we find it related by Polybius, an historian too authentic to be questioned, and who expresses his wonder at it while he relates it.

QUINQUEVIRI, in Roman antiquity, an order of five priests, peculiarly appointed for the sacrifices to the dead, or celebrating the rites of Erebus.

QUINQUINA. See CINCHONA, BOTANY and MATERIA MEDICA *Index*.

QUINSY, or QUINZY. See MEDICINE, N° 177—183.

QUINTEN, a town of France, in the department of Côtes de Nord, with a handsome castle. It is seated in a valley near the river Guy, and near a large forest of the same name, eight miles south of St Brieux, and 200 west of Paris. It had formerly the title of a duchy. W. Long. 2. 40. N. Lat. 48. 26.

QUINTESSENCE, in *Chemistry*, a preparation consisting of the essential oil of some vegetable substance, mixed and incorporated with spirit of wine.

QUINTESSENCE, in *Alchemy*, is a mysterious term, signifying the fifth or last and highest essence of power in a natural body.—Or when divested of its alchemistical signification, and employed to express something that is intelligible, the word denotes merely the highest state of purification in which any body can be exhibited.

QUINTAL, the weight of 100 lbs. in most countries, but in England it is the cwt. or 112 lbs. Quintal was formerly used for a weight of lead, iron, or other common metal, usually equal to 100 lbs. at six scores to the hundred.

QUINTILE, in *Astronomy*, an aspect of the planets when they are 72 degrees distant from one another, or a fifth part of a zodiac.

QUINTILIANUS, MARCUS FABIUS, a celebrated Latin orator, and the most judicious critic of his time, was a native of Calagurris, or Calahorra, in Spain; and was the disciple of Domitius Afer, who died in the year 59. He taught rhetoric at Rome for 20 years with great applause: and not only laid down rules for speaking, but exhibited his eloquence at the bar. Some authors imagine, but with little foundation, that he arrived at the consulship; but it is more certain that he was preceptor to the grandsons of the emperor Domitian's sister. There is still extant his excellent work, intitled, *Institutiones Oratoriæ*, which is a treatise of rhetoric in 12 books; where his precepts, judgment, and taste, are justly admired. These institutions were found entire by Poggius, in an old tower of the abbey of St Gal, and not in a grocer's shop in Germany as some authors have asserted. There is also attributed to Quintilian a dialogue *De causis corruptæ eloquentiæ*; but it is more commonly ascribed to Tacitus. The best editions of Quintilian's works are those of Mr Obreight, published at Strasburg in 2 vols 4to, in 1698, and of M. Capperonier, in folio. There is an English translation by Mr Guthrie.

Quintilian had a son of the same name, on whom he bestows great praises. This son ought not to be confounded with Quintilian the father, or rather the grandfather, of him who is the subject of this article, and who wrote 145 declamations. Ugolin of Parma published the first 136 in the 15th century; the nine others were published in 1563 by Peter Ayrault, and afterwards by Peter Pithou in 1580. There have also been 19 other declamations printed under the name of Quintilian the Orator; but, in the opinion of Vossius, they were written neither by that orator nor his grandfather.

QUINTILIANS, a sect of ancient heretics, thus called from their prophetess Quintilia. In this sect the women were admitted to perform the sacerdotal and episcopal functions. They attributed extraordinary gifts to Eve for having first eaten of the tree of knowledge; told great things of Mary the sister of Moses, as having been a prophetess, &c. They added, that Philip the deacon had four daughters, who were all prophetesses, and were of their sect. In these assemblies it was usual to see the virgins entering in white robes, personating prophetesses.

QUINTIN MATSYS, also called the *Farrier of Antwerp*, famous for being transformed, by the force of love, from a blacksmith to a painter. He had followed the trade of a blacksmith and farrier for near twenty years; when falling in love with a painter's daughter who was very handsome, and disliked nothing but his trade, he quitted it, and betook himself to painting, in which he made very great progress. He was a diligent and careful imitator of ordinary life, and succeeded better in representing the defects than the beauties of nature. Some historical performances of this master deserve commendation, particularly a Descent from the Cross, in the cathedral at Antwerp: but his best known picture is that of the two Misers in the gallery at Windsor. He died in 1529.

QUINTINIE, JOHN DE LA, a celebrated French gardener, born at Poictiers in 1626. He was brought up to the law; and acquitted himself so well at the bar as to acquire the esteem of the chief magistrate. M. Tamboneau, president of the chamber of accounts, engaged him to undertake the preceptorship of his only son, which Quintinie executed entirely to his satisfaction; applying his leisure hours to the study of writers on agriculture, ancient and modern, to which he had a strong inclination. He gained new lights by attending his pupil at Italy; for all the gardens about Rome being open to him, he failed not to add practice to his theory. On his return to Paris, M. Tamboneau gave up the management of his garden entirely to him; and Quintinie applied so closely to it, that he became famous all over France. Louis XIV. erected a new office purposely for him, that of director of the royal fruit and kitchen gardens; and these gardens, while he lived, were the admiration of the curious. He lived to a good old age; we have not learned the time of his death; his Directions for the management of Fruit and Kitchen Gardens have been much esteemed.

QUINTUS CALABER, a Greek poet, who wrote a large Supplement to Homer's Iliad, in 14 books, in which a relation is given of the Trojan war from the death of Hector to the destruction of Troy. It is conjectured, from his style and manner, that he lived in the fifth century. Nothing certain can be collected either concerning his person or country. His poem was first made known by Cardinal Bessarion, who discovered it in St Nicolas's church, near Otranto in Calabria; from whence the author was named *Quintus Calaber*. It was first published at Venice by Aldus, but it is not said in what year.

QUINTUS CURTIUS. See CURTIUS.

QUINZY, QUINSEY, or *Angina Pectoris*. See MEDICINE, N° 403.

QUIRE OF PAPER, the quantity of 24 sheets.

QUIRINALIA, in antiquity, a feast celebrated among the Romans in honour of Romulus.

QUIRITES, in Roman antiquity. In consequence of the agreement entered into by Romulus and Tatius king of the Sabines, Rome was to retain its name, taken from Romulus, and the people were to be called *Quirites*, from Cures, the principal town of the Sabines, a name used in all public addresses to the Roman people. ——Dion. Hal. says, that each particular citizen was to be called *Romanus*, and the collective body of them *Quirites;* yet it appears by this ancient form of words used at funerals, *Ollus Quiris letho datus est*, that each private citizen was also called *Quiris*.

The origin of the word *Quirites*, which was at first peculiar to the Sabines, and became, in Romulus's time, the general name of the inhabitants of Rome, has been much sought for; and the most probable account antiquity gives us of it, is this: The word *Quiris*, according to Plutarch and some others, signified in the Sabine language, both "a dart," and "a warlike deity armed with a dart." It is uncertain whether the god gave name to the dart, or the dart to the god. But be that as it will, this *Quiris*, or *Quirinus*, was either Mars or some other god of war; and the worship of *Quiris* continued in Rome all Romulus's reign: but after his death he was honoured with the name *Quirinus*, and took the place of the god *Quiris*.

QUIRK, in a general sense, denotes a subtilty or artful distinction.

QUIRK, in building, a piece of ground taken out of any regular ground-plot, or floor: thus, if the ground-plot were oblong or square, a piece taken out of a corner to make a court or yard, &c. is called a *quirk*.

QUISQUALIS, a genus of plants belonging to the decandria class, and in the natural method ranking under the 31st order, *Vepreculæ*. See BOTANY *Index*.

QUITO, a town of South America, in Peru (see PERU), seated between two chains of high mountains called *Cordillera de los Andes*, on much higher ground than the rest of habitable Peru. It is 300 yards higher than the level of the sea according to the exactest observations. The town is 1600 yards long and 1200 broad, and is the seat of a bishop. It contains about 50,000 inhabitants, one-third of whom are originally Spaniards. Among the inhabitants are some persons of high rank and distinction, descended either from the original conquerors, or persons who at different times came from Spain invested with some lucrative post. The number of these, however, is but small. The commonalty, besides Spaniards, consist of Mestizos, Indians, and Negroes; but the last are not proportionally numerous. Merchandises and commodities of all sorts are extremely dear, partly on account of the difficulty of bringing them.

There are several religious communities at Quito, and two colleges or universities governed by Jesuits and Dominicans.

The principal courts held at Quito are that of the royal audience, which consists of the president, who is governor of the province with regard to law affairs; four auditors, who are at the same time civil and criminal judges; a royal fiscal, who, besides the causes brought before the audience, takes cognizance of every thing relating to the revenue; and an officer styled the *protector of the Indians*, who solicits for them, and when they are injured pleads in their defence. The next is the treasury, the chief officers of which are an accountant, a treasurer, and a royal fiscal. The tribunal of the Croisade, which has a commissary, who is generally some dignitary of the church, and a treasurer. There is also a treasury for the effects of persons deceased: an institution established all over the Indies, for receiving the goods of those whose lawful heirs are in Spain, in order to secure them from those accidents to which they might be liable in private hands. There is likewise

wise a commissary of the inquisition, with an alguazil-major and familiars, appointed by the inquisition of Lima. The corporation consists of a corregidor, two ordinary alcaldes, chosen annually, and regidores. The latter superintend the election of the alcaldes, which is attended with no small disturbance, the people being divided into two parties, the Creoles and Europeans.

QUITTER-BONE. See FARRIERY, N° 347.

QUIT-RENT (*quietus redditus*, i. e. "quiet rent,") is a certain small rent payable by the tenants of manors, in token of subjection, and by which the tenant goes quiet and free. In ancient records it is called *white rent*, because paid in silver money, to distinguish it from rent-corn, &c.

QUOAD HOC, is a term used in the pleadings and arguments of lawyers; being as much as to say, As to this thing the law is so and so.

QUOIN, or COIN, on board a ship, a wedge fastened on the deck close to the breech of the carriage of a gun, to keep it firm up to the ship's side. Cantic quoins are short three-legged quoins put between casks to keep them steady.

QUOINS, in *Architecture*, denote the corners of brick or stone walls. The word is particularly used for the stones in the corners of brick buildings. When these stand out beyond the brick-work, their edges being chamfred off, they are called *rustic quoins*.

QUOTIDIAN, any thing which happens every day. Hence, when the paroxysms of an ague recur every day, it is called a *quotidian ague*. See MEDICINE, N° 161—164.

QUOTIDIANA DECEPTIVA. See MEDICINE, N° 150.

QUORUM, a word frequently mentioned in our statutes, and in commissions both of justices of the peace and others. It is thus called from the words of the commission, *quorum* A. B. *unum esse volumus*. For an example, where a commission is directed to seven persons, or to any three of them, whereof A. B. and C. D. are to be two; in this case, they are said to be of the quorum, because the rest cannot proceed without them: so a justice of the peace and quorum is one without whom the rest of the justices in some cases cannot proceed.

QUOTIENT, in *Arithmetic*, the number resulting from the division of a greater number by a smaller, and which shows how often the smaller is contained in the greater, or how often the divisor is contained in the dividend. The word is formed from the Latin *quoties*; *q. d.* How often is such a number contained in such another.

In division, as the divisor is to be dividend, so is unity to the quotient.—Thus the quotient of 12 divided by 3 is 4; which is thus disposed, 3) 12 (4 quotient. See ARITHMETIC.

R.

R, or *r*, a liquid consonant, being the 17th letter of our alphabet. Its sound is formed by a guttural extrusion of the breath vibrated through the mouth, with a sort of quivering motion of the tongue drawn from the teeth, and canulated with the tip a little elevated towards the palate. In Greek words it is frequently aspirated with an *h* after it, as in *rhapsody*, *rhetoric*, &c. otherwise it is always followed by a vowel at the beginning of words and syllables.

In the notes of the ancients, R. or RO. signifies *Roma*, R. C. *Romana civitas*; R. G. C. *rei gerendæ causa*; R. F. E. D, *recte factum et dictum*; R. G. F. *regis filius*; R. P. *res publica*, or *Romani principes*, and R. R. R. F. F. F. *res Romana ruet ferro, fame, flamma*.

Used as a numeral, R anciently stood for 80; and with a dash over it thus R̄, for 80,000; but the Greek *r*, ρ́, with a small mark over it, signified 100; with the same mark under it, it denoted 1000 × 10; thus ρ͵ signifies 100,000. In the Hebrew numeration ר denoted 200: and with two horizontal points over it 1000 × 200; thus ר̈ = 200,000.

In the prescriptions of physicians, R or ℞ stands for *recipe*, i. e. "take."

RAAB, a town of Lower Hungary, capital of Javern, with a castle and a bishop's see. It is a strong frontier bulwark against the Turks, and has two bridges, one over a double ditch, and another that leads towards Alba Regalis. The surrounding country is plain, and there is nothing that seems to command it but a small hill at some distance, which is undermined and may be blown up. It was taken by Amurath III. with the loss of 20,000 men; but was surprised soon after by Count Palfi, who killed all the Turks that were found therein. It is seated at the confluence of the rivers Rab and Rabnitz, not far from the Danube, 32 miles west of Gran, and 55 south-east of Vienna. E. Long. 17. 25. N. Lat. 47. 48.

RABAC, a small port on the Arabian coast of the Red sea, in N. Lat. 22° 35′ 40″, by Mr Bruce's account. The entry to the harbour is from the E. N. E. and is about a quarter of a mile broad. The port extends about two miles in length to the eastward. The mountains are about three leagues to the north, and the town about four miles north by east from the entrance to the harbour. The water is good, and all ships may be supplied here from the wells which are in the neighbourhood of the town. The country is bare and uncultivated; but from the appearance of it, and the freshness of the water, Mr Bruce supposes that it sometimes rains among the mountains here, which is the more probable as it is considerably within the tropic.

RABAT, a large and handsome sea-port town of Africa,

Africa, in the kingdom of Fez and province of Tremesen. It has fine mosques and handsome palaces, and is seated at the mouth of the river Burrigrig, almost in the mid-way between Fez and Tangier. W. Long. 5. 28. N. Lat. 34. 40.

Rabat, together with Sallee, which is opposite to it, was formerly famous for fitting out piratical vessels; but the late emperor Sidi Mahomet subdued them both, and annexed them to the empire; since which time the harbour of Rabat has been so filled with the sand washed in by the sea as to render it unfit to carry on such piracies in future.

The town of Rabat, whose walls inclose a large space of ground, is defended on the sea-side by three forts tolerably well finished, which were erected some little time ago by an English renegado, and furnished with guns from Gibraltar. The houses in general are good, and many of the inhabitants are wealthy. The Jews, who are very numerous in this place, are generally in better circumstances than those of Larache or Tangier, and their women are extremely beautiful.

The castle, which is very extensive, contains a strong building, formerly used by the late emperor as his principal treasury, and a noble terrace, which commands an extensive prospect of the town of Sallee, the ocean, and all the neighbouring country. There are also the ruins of another castle, which is said to have been built by Jacob Almanzor, one of their former emperors, and of which at present very little remains but its walls, containing within them some very strong magazines for powder and naval stores. On the outside of these walls is a very high and square tower, handsomely built of cut stone, and called the tower of *Hassen*. From the workmanship of this tower, contrasted with the other buildings, a very accurate idea may be formed how greatly the Moors have degenerated from their former splendour and taste for architecture.

RABBETTING, in *Carpentry*, the planing or cutting of channels or grooves in boards, &c.

In ship-carpentry, it signifies the letting in of the planks of the ship into the keel; which, in the rake and run of a ship, is hollowed away, that the planks may join the closer.

RABBI, or RABBINS, a title which the Pharisees and doctors of the law among the Jews assumed, and literally signifies *masters* or *excellents*.

There were several gradations before they arrived at the dignity of a rabbi; which was not conferred till they had acquired the profoundest knowledge of the law and the traditions. It does not, however, appear that there was any fixed age or previous examination necessary; but when a man had distinguished himself by his skill in the written and oral law, and passed through the subordinate degrees, he was saluted a rabbin by the public voice.

Among the modern Jews, for near 700 years past, the learned men retain no other title than that of *rabbi*, or *rabbins*; they have great respect paid them, have the first places or seats in their synagogues, determine all matters of controversy, and frequently pronounce upon civil affairs; they have even power to excommunicate the disobedient.

RABBINISTS, among the modern Jews, an appellation given to the doctrine of the rabbins concerning traditions, in opposition to the Caraites; who reject all traditions. See CARAITE.

RABELAIS, FRANCIS, a French writer famous for his facetiousness, was born at Chinon in Touraine about the year 1483. He was first a Franciscan friar; but quitting his religious habit, studied physic at Montpelier, where he took his doctor's degree. It is said, that the chancellor du Pratt having abolished the privileges of the faculty of physic at Montpelier by a decree of the parliament, Rabelais had the address to make him revoke what he had done; and that those who were made doctors of that university wore Rabelais's robe, which is there held in great veneration. Some time after, he came to Rome, in quality of physician in ordinary to Cardinal John du Bellay archbishop of Paris. Rabelais is said to have used the freedom to jeer Pope Paul III. to his face. He had quitted his religious connections for the sake of leading a life more agreeable to his taste; but renewed them on a second journey to Rome, when he obtained, in 1536, a brief to qualify him for holding ecclesiastical benefices; and, by the interest of his friend Cardinal John du Bellay, he was received as a secular canon in the abbey of St Maur near Paris. His profound knowledge in physic rendered him doubly useful; he being as ready, and at least as well qualified, to prescribe for the body as for the soul: but as he was a man of wit and humour, many ridiculous things are laid to his charge, of which he was quite innocent. He published several things; but his chief performance is a strange incoherent romance, called the *History of Gargantua and Pantagruel*, being a satire upon priests, popes, fools, and knaves of all kinds. This work contains a wild, irregular profusion of wit, learning, obscenity, low concits, and arrant nonsense; hence the shrewdness of his satire, in some places where he is to be understood, gains him credit for those where no meaning is discoverable. Some allusions may undoubtedly have been so temporary and local as to be now quite lost: but it is too much to conclude thus in favour of every unintelligible rhapsody; for we are not without English writers of great talents, whose sportive geniuses have betrayed them into puerilities, no less incoherent at the times of writing than those of Rabelais appear above two centuries after. He died about 1553.

RABBIT, in *Zoology*. See LEPUS, MAMMALIA *Index*.

The buck rabbits, like our boar cats, will kill the young ones if they can get at them; and the does in the warrens prevent this, by covering their stocks, or nests, with gravel or earth, which they close so artificially up with the hinder part of their bodies, that it is hard to find them out. They never suckle their young ones at any other time than early in the morning and late at night; and always, for eight or ten days, close up the hole at the mouth of the nest, in this careful manner, when they go out. After this they begin to leave a small opening, which they increase by degrees; till at length, when they are about three weeks old, the mouth of the hole is left wholly open that they may go out; for they are at that time grown big enough to take care of themselves, and to feed on grass.

People who keep rabbits tame for profit, breed them in hutches; but these must be kept very neat and clean, else they will be always subject to diseases. Care must be taken also to keep the bucks and does apart till the latter

Rabbit. latter have just kindled; then they are to be turned to the bucks again, and to remain with them till they shun and run from them.

The general direction for the choosing of tame rabbits is, to pick the largest and fairest; but the breeder should remember that the skins of the silver-haired ones sell better than any other. The food of the tame rabbits may be colewort and cabbage-leaves, carrots, parsneps, apple-rinds, green corn, and vetches, in the time of the year; also vine-leaves, grass, fruits, oats, and oatmeal, milk-thistles, sow-thistles, and the like: but with these moist foods they must always have a proportionable quantity of the dry foods, as hay, bread, oats, bran, and the like, otherwise they will grow pot-bellied, and die. Bran and grains mixed together have been also found to be very good food. In winter they will eat hay, oats, and chaff, and these may be given them three times a-day; but when they eat green things, it must be observed that they are not to drink at all, for it would throw them into a dropsy. At all other times a very little drink serves their turn, but that must always be fresh. When any green herbs or grass are cut for their food, care must be taken that there be no hemlock among it; for though they will eat this greedily among other things when offered to them, yet it is sudden poison to them.

Rabbits are subject to two principal infirmities. First, the rot, which is caused by giving them too large a quantity of greens, or from giving them fresh gathered with the dew or rain hanging in drops upon them. Excess of moisture always causes this disease. The greens therefore are always to be given dry; and a sufficient quantity of hay, or other dry food, intermixed with them, to take up the abundant moisture of their juices. On this account the very best food that can be given them, is the shortest and sweetest hay that can be got, of which one load will serve 200 couples a year; and out of this stock of 200, 200 may be eaten in the family, 200 sold in the markets, and a sufficient number kept in case of accidents.

The other general disease of these creatures is a sort of madness: this may be known by their wallowing and tumbling about with their heels upwards, and hopping in an odd manner into their boxes. This distemper is supposed to be owing to the rankness of their feeding; and the general cure is the keeping them low, and giving them the prickly herb called *tare thistle* to eat.

The general computation of males and females is, that one buck-rabbit will serve for nine does: some allow 10 to one buck; but those who go beyond this always suffer for it in their breed.

Wild rabbits are either to be taken by small cur dogs, or by spaniels bred up to the sport; and the places of hunting those who straggle from their burrows, is under close hedges or bushes, or among corn fields and fresh pastures. The owners use to course them with small greyhounds; and though they are seldom killed this way, yet they are driven back to their burrows, and prevented from being a prey to others. The common method is by nets called *purse-nets*, and ferrets. The ferret is sent into the hole to fetch them out; and the purse-net being spread over the hole, takes them as they come out. The ferrets mouths must be muffled, and then the rabbit gets no harm. For the more certain taking of them, it may not be improper to pitch up a hay-net or two, at a small distance from the burrows that are intended to be hunted: thus very few of the number that are attempted will escape.

Some who have no ferrets smoke the rabbits out of their holes with burning brimstone and orpiment. This certainly brings them out into the nets; but then it is a very troublesome and offensive method, and is very detrimental to the place, as no rabbit will for a long time afterwards come near the burrows which have been fumed with such ingredients.

The following observations on the breeding and management of rabbits and some other animals appear to us to be of such importance, that we shall give them a place in the words of the author.

"In my travels through America," says the author, "I have often been surprised that no attempt has been made to introduce, for the purpose of propagation, that useful little animal, the warren rabbit, of such vast importance to the hat manufactory of England. It is chiefly owing to the fur of this animal that the English hats are so much esteemed abroad. It is a fact well known amongst the hatters, that a hat composed of one half of coney wool, one-sixth old coat beaver, one-sixth pelt beaver, and one-sixth Vigonia wool, will wear far preferable to one made all of beaver, as it will keep its shape better, feel more firm, and wear bright and black much longer.

"The value of the coney wool, the produce of the united kingdom only, is not less, I will venture to say, than 250,000l. per annum; but the quantity is much diminished, owing to the banishment and persecution they meet with on every side, and so many small warrens taken in for grain land; in consequence of which it is time that some protection should be afforded, if possible, to that important branch of British manufactory (in which coney wool is used) from suffering any inconvenience in the want of so essential an article, and the accomplishment of this grand object I conceive perfectly easy.

"*General Observations.*—When I speak of the warren rabbit, I have to observe, that there are in England, as well as in most parts of Europe, three other kinds, viz. the tame rabbit, of various colours, the fur of which is of little value, except the white; the shock rabbit, which has a long shaggy fur of little value; the bush rabbit, like those of America, which commonly sits as a hare, and the fur of which is of a rotten inferior quality.

"To return to the warren rabbit.—There are two sorts in respect to colour, that is, the common gray, and the silver gray, but little or no difference in respect to the strength and felting qualities of the fur. The nature of this animal is to burrow deep in sandy ground, and there live in families, nor will they suffer one from a neighbouring family to come amongst them without a severe contest, in which the intruders are generally glad to retire with the loss of part of their coat, unless when pursued by an enemy, when they find protection.

"It is scarcely worth while for me to mention a thing so generally known, viz. that rabbits, particularly those of the warren, are the most prolific of all other four-footed animals in the world; nor do I apprehend any difficulty would attend the exporting this little quadruped with safety to any distance, provided it

was

was kept dry, and regularly supplied with clean sweet food, and a due regard to the cleanliness of the boxes or places of confinement.

"Twelve or fifteen pair of these valuable animals taken to Upper Canada, and there enclosed within a small space of ground suitable to their nature, but furnished with a few artificial burrows at the first by way of a nursery, spread over those now useless plains, islands, and peninsulas, so well calculated to their nature, would, I will make bold to say, the eighth year after their introduction, furnish the British market with a valuable raw material, amounting to a large sum, increasing every year with astonishing rapidity, so as to become, in a few years, one amongst the first of national objects.

"It may be supposed by some, that the above project is magnified beyond possibility, or even probability; but the serious attention I have paid to the subject, these many years past, as to all points for and against, leaves no room to accuse myself of being too sanguine; for, if properly managed a few years at the first, I cannot find a single thing likely to interrupt their progress.

"Some idea of the astonishing increase of the rabbit may be had from the following facts:

"An old doe rabbit will bring forth young nine times in one year, and from four to ten each time; but to allow for casualties, state the number at five each litter.

In nine months - - - -	45
The females of the first litter will bring forth five times, the proportion of which is $2\frac{1}{2}$ females produce - - - - -	62
Those of the second litter four times produce	50
Ditto of ditto third ditto three ditto ditto	37
Ditto of ditto second ditto two ditto ditto	25
Total in one year from one pair	219

"The third female race of the old dam, and the second of the first litter, seldom breed the first year, but are early breeders in the spring following, when we might expect an increase of the whole in proportion to the first pair, if properly attended to and protected.

"It is generally allowed that hares are not more than one-fourth as prolific as rabbits, notwithstanding, agreeable to an experiment tried by Lord Ribblesdale, who enclosed a pair of hares for one year, the offspring was (as I have been credibly informed) 68: these animals, could they be exported to Upper Canada with safety, and there protected within enclosures for a few years, would soon after spread over a large extent of country: the fur is nearly as valuable as that of the rabbit.

"In that part of Upper Canada within the 45 degrees of north latitude, and the southern and western boundaries, the climate is nearly the same as that of England, a little hotter a few days in summer, and a little colder a few days in winter, agreeable to Fahrenheit's thermometer, which I have paid great attention to for some years, comparing the same with the observations of the English.

"The increase of most animals appears much greater in proportion in America than in England, mankind not excepted: that of sheep is very apparent to those that pay attention to their breeding stock, which gives me hopes, that in a few years we shall be able to pay for our woollen cloths in wool. Finding the effect of soil and climate so salutary to sheep, &c. it may be reasonably supposed, that rabbits will answer the most sanguine expectations, as I understand the wool of the sheep retains all its nature the same as in England, particularly its strength, and felting qualities among the hatters, which assures me that rabbit wool from those bred in Upper Canada will do the same; and there are some millions of acres within the latitude and boundaries which I have before described, suited to the nature of the warren rabbit; nor do I apprehend that the wolves, foxes, &c. of Upper Canada will be half so destructive as the poachers in England.

"The *guanaco*, or camel sheep of South America, no doubt will be a national object at some future period. This is a tame, domestic animal, very hardy, and used with much cruelty by the natives in travelling over the mountains with their burdens; it shears a fleece of wool of from 2lb. to 3lb. which is of dusky red on the back; on the sides inclined to white, and under the belly quite white; its texture is very fine, yet strong; its felting qualities very powerful, and is worth, when ready for use, from five to fifteen shillings per pound. This animal would no doubt thrive, and do well in England, Upper Canada, and in particular I should suppose in New Holland.

"The *beaver* might be propagated to great advantage in Scotland, Ireland, and northern parts of England. It is an animal, when tamed, very familiar, and will eat bread and milk, willow-sticks, elm bark, &c. and no doubt might be imported with safety; but as these two last-mentioned animals are not likely to be attended to immediately, I shall say no more respecting them for the present *."

* *Trans. of Soc for encouragement of Arts*, &c. for 1807.

RABIRIUS, C. a Roman knight, who lent an immense sum of money to Ptolemy Auletes king of Egypt. The monarch afterwards not only refused to repay him, but even confined him, and endangered his life. Rabirius escaped from Egypt with difficulty; but at his return to Rome he was accused by the senate of having lent money to an African prince for unlawful purposes. He was ably defended by Cicero, and acquitted with difficulty.—There was a Latin poet of the same name in the age of Augustus. He wrote a poem on the victory which the emperor had gained over Antony at Actium. Seneca has compared him to Virgil for elegance and majesty; but Quintilian is not so favourable to his poetry.—And there was an architect in the reign of Domitian called *Rabirius*. He built a celebrated palace for the emperor, of which the ruins are still seen at Rome.

RACCOON. See Ursus, Mammalia *Index*.

RACE, in general, signifies running with others in order to obtain a prize, either on foot, or by riding on horseback, in chariots, &c.

The race was one of the exercises among the ancient Grecian games, which was performed in a course containing 125 paces; and those who contended in these foot-races were frequently clothed in armour. Chariot and horse races also made a part of the ancient games.

Races were known in England in very early times. Fitz-Stephen, who wrote in the days of Henry II. mentions the great delight that the citizens of London took

took in the diversion. But by his words, it appears not to have been designed for the purposes of gaming, but merely to have sprung from a generous emulation of showing a superior skill in horsemanship.

Races appears to have been in vogue in the reign of Queen Elizabeth, and to have been carried to such excess as to injure the fortunes of the nobility. The famous George earl of Cumberland is recorded to have wasted more of his estate than any of his ancestors, and chiefly by his extreme love to horse-races, tiltings, and other expensive diversions. It is probable that the parsimonious queen did not approve of it; for races are not among the diversions exhibited at Kennelworth by her favourite Leicester. In the following reign, places were allotted for the sport. Croyden in the south, and Garterly in Yorkshire, were celebrated courses. Camden also says, that in 1607 there were races near York, and the prize was a little golden bell. See RACING.

RACE, in genealogy, a lineage or extraction continued from father to son. See DESCENT.

RACINE, JOHN, a celebrated French poet, member of the French academy, treasurer of France in the generality of Moulins, and a secretary to his majesty, was born at Ferre Milon in 1639. He had a fine genius for the *belles lettres*, and became one of the first poets of the age. He produced his *Thebaide* when but very young, and afterward other pieces, which met with great success, though they appeared when Corneille was in his highest reputation. In his career, however, he did not fail to meet with all that opposition which envy and cabal are ever ready to set up against a superior genius. It was partly owing to chagrin from this circumstance that he took a resolution to quit the theatre for ever; although his genius was still in full vigour, being not more than 38 years of age. But he had also imbibed in his infancy a deep sense of religion; and this, though it had been smothered for a while by his connections with the theatre, and particularly with the famous actress Champmelle, whom he greatly loved, and by whom he had a son, now at length broke out, and bore down all before it. In the first place, he resolved not only to write no more plays, but to do a rigorous penance for those he had written; and he actually formed a design of becoming a Carthusian friar. His religious director, however, a good deal wiser than he, advised him to think more moderately, and to take measures more suitably to his character. He put him upon marrying, and settling in the world: with which proposal this humble and tractible penitent complied; and immediately took to wife the daughter of a treasurer of France for Amiens, by whom he had seven children.

He had been admitted a member of the French academy in 1673, in the room of La Mothe le Vayer deceased; but spoiled the speech he made upon that occasion by pronouncing it with too much timidity. In 1677, he was nominated with Boileau, with whom he was ever in strict friendship, to write the history of Louis XIV.; and the public expected great things from two writers of their distinction, but were disappointed. Boileau and Racine, after having for some time laboured at this work, perceived that it was entirely opposite to their genius.

He spent the latter years of his life in composing a history of the house of Port-Royal, the place of his education, which, however, though finely drawn up, as many have asserted, has not been published. Too great sensibility, say his friends, but more properly an impotence of spirit, shortened the days of this poet.—Though he had conversed much with the court, he had not learned the wisdom, which is usually learned there, of disguising his real sentiments. Having drawn up a well-reasoned and well-written memorial upon the miseries of the people, and the means of relieving them, he one day lent it to Madame de Maintenon to read; when the king coming in, and demanding what and whose it was, commended the zeal of Racine, but disapproved of his meddling with things that did not concern him, and said with an angry tone, "Because he knows how to make good verses, does he think he knows every thing? And would he be a minister of state, because he is a great poet?" These words hurt Racine greatly: he conceived dreadful ideas of the king's displeasure; and his chagrin and fears brought on a fever, of which he died the 22d of April 1699.

The king, who was sensible of his great merit, and always loved him, sent often to him in his illness; and finding after his death that he had more glory than riches, settled a handsome pension upon his family.—There is nothing in the French language written with more wit and elegance than his pieces in prose. Besides his plays, several of his letters have been published; he also wrote spiritual songs, epigrams, &c. Racine's works were printed at Amsterdam in 1722, in 2 vols 12mo, and the next year a pompous edition was printed in 2 vols quarto.

RACING, the riding heats for a plate, or other premium. See PLATE. The amusement of horse-racing, which is now so common, was not unknown among the great nations of antiquity, nor wholly unpractised by our ancestors in Britain, as we have already mentioned in the article RACE. In 1599, private matches between gentlemen, who were their own jockies and riders, were very common; and in the reign of James I. public races were established at various places, when the discipline, and mode of preparing the horses for running, &c. were much the same as they are now. The most celebrated races of that time were called bell-courses, the prize of the conqueror being a bell: hence, perhaps, the phrase *bearing the bell*, when applied to excellence, is derived. In the latter end of Charles I.'s reign, races were performed in Hyde-Park. Newmarket was also a place for the same purpose, though it was first used for hunting. Racing was revived soon after the Restoration, and much encouraged by Charles II. who appointed races for his own amusement at Dachet Mead, when he resided at Windsor. Newmarket, however, now became the principal place. The king attended in person, established a house for his own accommodation, and kept and entered horses in his own name. Instead of bells, he gave a silver bowl or cup value 100 guineas; on which prize the exploits and pedigree of the successful horse were generally engraved. Instead of the cup or bowl, the royal gift is now a hundred guineas. William III. not only added to the plates, but even founded an academy for riding; and Queen Anne continued the bounty of her ancestors, adding several plates herself. George I. towards the end of his reign, discontinued the plates, and gave in their room a hundred guineas. An act was passed in the 13th year of the reign of George II. for suppressing races by poneys and other small and weak horses,

horses, &c. by which all matches for any prize under the value of 50l. are prohibited, under a penalty of 200l. to be paid by the owner of each horse running, and 100l. by such as advertise the plate; and by which each horse entered to run, if five years old, is obliged to carry ten stones; if six, eleven; and if seven, twelve. It is also ordained, that no person shall run any horse at a course unless it be his own, nor enter more than one horse for the same plate, upon pain of forfeiting the horses; and also every horse-race must be begun and ended in the same day. Horses may run for the value of 50l. with any weight, and at any place, 13 Geo. II. cap. 19. 18 Geo. II. cap. 34. Pennant's British Zoology, vol. i. p. 6. &c. Berrenger's History and art of Horsemanship, vol. i. p. 185, &c. At Newmarket there are two courses, the long and the round: the first is exactly four miles and about 380 yards, i. e. 7420 yards. The second is 6640 yards. Childers, the swiftest horse ever known, has run the first course in seven minutes and a half, and the second in six minutes forty seconds; which is at the rate of more than forty-nine feet in a second. But all other horses take up at least seven minutes and fifty seconds in completing the first and longest course, and seven minutes only in the shortest, which is at the rate of more than forty-seven feet in a second. And it is commonly supposed that these coursers cover, at every bound, a space of ground in length about twenty-four English feet. Race-horses have for some time been an object of taxation.

RACHITIS, the RICKETS. See MEDICINE *Index*.

RACK, EDMUND, a person well known in the literary world by his attachment to, and promotion of, agricultural knowledge: he was a native of Norfolk, a Quaker. His education was common, and he was apprenticed originally to a shopkeeper: his society was select in this situation, and by improving himself in learning, his conversation was enjoyed by a respectable acquaintance. He wrote many essays, poems, and letters, and some few controversial tracts. At length he settled, about his 40th year, at Bath in 1775, and was soon introduced to the most eminent literati of that place, among whom Dr Wilson and Mrs Macaulay highly esteemed him for his integrity and abilities. In 1777 he published Mentor's Letters, a moral work, which has run through many editions. But this year he gained great celebrity by his plan of an agricultural society, which was soon adopted by four counties. He still further advanced his fame by his papers in the Farmer's Magazine, and his communications in the Bath Society's papers; a work remarkable for its ingenuity and spirit. His last engagement was in the History of Somersetshire, where the topographical parochial surveys were his. This work, in 3 vols 4to, was published in 1791, by his colleague the Reverend Mr Collinson.—Mr Rack died of an asthma in February 1787, aged 52.

RACK, an engine of torture, furnished with pulleys, cords, &c. for extorting confession from criminals.—The trial by rack is utterly unknown to the law of England: though once, when the dukes of Exeter and Suffolk, and other ministers of Henry VI. had laid a design to introduce the civil law into this kingdom as the rule of government; for a beginning thereof they erected a rack for torture, which was called in derision the duke of Exeter's daughter, and still remains in the Tower of London, where it was occasionally used as an engine of state, not of law, more than once in the reign of Queen Elizabeth. But when, upon the assassination of Villiers duke of Buckingham, by Felton, it was proposed in the privy council to put the assassin to the rack in order to discover his accomplices; the judges, being consulted, declared unanimously, to their own honour and the honour of the English law, that no such proceeding was allowable by the laws of England. It seems astonishing that this usage of administering the torture should be said to arise from a tenderness to the lives of men; and yet this is the reason given for its introduction in the civil law, and its subsequent adoption by the French and other foreign nations, viz. because the laws cannot endure that any man should die upon the evidence of a false or even a single witness, and therefore contrived this method that innocence should manifest itself by a stout denial, or guilt by a plain confession; thus rating a man's virtue by the hardiness of his constitution, and his guilt by the sensibility of his nerves. The marquis Beccaria, in an exquisite piece of raillery, has proposed this problem, with a gravity and precision that are truly mathematical: "The force of the muscles and the sensibility of the nerves of an innocent person being given; it is required to find the degree of pain necessary to make him confess himself guilty of a given crime." See *Act of Faith*, INQUISITION, and TORTURE.

RACK, a spirituous liquor made by the Tartars of Tongusla. This kind of rack is made of mare's milk, which is left to be sour, and afterwards distilled twice or thrice between two earthen pots closely stopped; whence the liquor runs through a small wooden pipe. This liquor is more intoxicating than brandy distilled from wine.

RACK, or *Arack*. See ARACK.

To RACK Wines, &c. To draw them off from their lees, after having stood long enough to ebb and settle. Hence rack-vintage is frequently used for the second voyage our wine-merchants used to make into France for racked wines.

RACKOON, a species of ursus. See URSUS, MAMMALIA *Index*.

RACONI, a populous town of Italy, in Piedmont, seated in a pleasant plain, on the road from Savillan to Turin, on the rivers Grana and Macra. It belongs to the prince of Carignan, who has a handsome castle here. It is six miles from Savillan, and six from Carignan. E. Long. 7. 46. N. Lat. 44. 39.

RADCLIFFE, DR JOHN, an English physician of great eminence in his time, born at Wakefield in Yorkshire in 1650. He was educated at Oxford, and enrolled himself upon the physical line; but it was remarkable that he recommended himself more by his ready wit and vivacity, than by any extraordinary acquisitions in learning. He began to practise at Oxford in 1675; but never paid any regard to established rules, which he censured whenever he thought fit, with great freedom and acrimony; and as this drew all the old practitioners upon him, he lived in a continual state of hostility with them. Nevertheless, his reputation increased with his experience; so that, before he had been two years in business, his practice was very extensive among persons of high rank. In 1684 he removed to London,

London, and settled in Bow-street, Covent Garden, where in less than a year he got into great employment. In 1687 the princess Anne of Denmark made him her physician; yet when her husband and she joined the prince of Orange, Radcliffe, either not choosing to declare himself, or unwilling to favour the measures then in agitation, excused himself from attending them, on the plea of the multitude of his patients. Nevertheless, he was often sent for to King William and other great personages, though he did not incline to be a courtier. He incurred some censure for his treatment of Queen Mary, who died of the smallpox; and soon after lost his place about the princess Anne, by his attachment to his bottle. He also totally lost the favour of King William by his uncourtly freedom; for, in 1699, when the king showed him his swollen ankles, while the rest of his body was emaciated, and asked him what he thought of them? "Why truly I would not have your majesty's two legs for your three kingdoms," replied Radcliffe. He continued increasing in business and insolence as long as he lived, continually at war with his brethren the physicians; who considered him in no other light than that of an active ingenious empiric, whom constant practice had at length brought to some degree of skill in his profession. He died in 1714; and if he never attempted to write any thing himself, has perpetuated his memory by founding a fine library at Oxford, to preserve the writings of other men.

RADIALIS, the name of two muscles in the arm. See ANATOMY, *Table of the Muscles*.

RADIANT, in *Optics*, is any point of a visible object from whence rays proceed.

RADIATED FLOWERS, in *Botany*, are such as have several semifloscules set round a disk, in form of a radiant star; those which have no such rays are called *discous flowers*.

RADIATION, the act of a body emitting or diffusing rays of light all round as from a centre.

RADICAL, in general, something that serves as a basis or foundation. Hence physicians talk much of a radical moisture. In grammar, we give the appellation *radical* to primitives, in contradistinction to compounds and derivatives. Algebraists also speak of the radical sign of quantities, which is the character expressing their roots.

RADICLE, that part of the seeds of all plants which upon vegetating becomes their root, and is discoverable by the microscope. See PLANT.

RADISH. See RAPHANUS, BOTANY *Index*; and for the mode of culture, see GARDENING *Index*.

RADIUS, in *Geometry*, the semidiameter of a circle, or a right line drawn from the centre to the circumference.

In *Trigonometry*, the radius is termed the whole sine, or sine of 90°. See SINE.

RADIUS, in *Anatomy*, the exterior bone of the arm, descending along with the ulna from the elbow to the wrist.

RADNOR, the county town of Radnorshire, in South Wales, distant from London about 150 miles. It is situated near the springhead of the river Somergil, in a fruitful valley at the bottom of a hill, where there are sheep grazing in abundance. It is a very ancient borough-town, whose jurisdiction extends near 12 miles round: the government of it is vested in a bailiff and 25 burgesses; and the population in 1801 was nearly 2000. Though it is the county town, the assizes are held at Presteign: it has one privilege, however, that is very extraordinary, besides that of sending one member to parliament; and that is, it keeps a court of pleas for all actions, without being limited to any particular sum. It was formerly fenced with a wall and strong castle; but both were in a great measure demolished by Owen Glendower, when he assumed the title of Prince of Wales, upon the deposition of King Richard II. W. Long. 2. 45. N. Lat. 52. 10.

RADNORSHIRE, a county of South Wales, is bounded on the north by Montgomeryshire; on the east by Shropshire and Herefordshire; on the south and south-west by Brecknockshire; and on the west by Cardiganshire; extending 30 miles in length and 25 in breadth. This county is divided into six hundreds, in which are contained three market-towns, 52 parishes, and in 1811 there were 4165 houses, and 20,900 inhabitants. It is seated in the diocese of Hereford, and sends two members to parliament, one for the county and one for the town of Radnor. The soil in general is but indifferent; yet some places produce corn, particularly the eastern and southern parts; but in the northern and western, which are mountainous, the land is chiefly stocked with horned cattle, sheep, and goats. See RADNORSHIRE, SUPPLEMENT.

RADIX. See ROOT.

RAFT, a sort of float, formed by an assemblage of various planks or pieces of timber, fastened together side by side, so as to be conveyed more commodiously to any short distance in a harbour or road than if they were separate. The timber and plank with which merchant-ships are laden, in the different parts of the Baltic sea, are attached together in this manner, in order to float them off to the shipping.

RAFTERS, in building, are pieces of timber which, standing by pairs on the reason or railing piece, meet in an angle at the top, and form the roof of a building. See ARCHITECTURE.

ROWLEY RAGG, a variety of whinstone or greenstone of a dusky or dark gray colour, with many small shining crystals, having a granular texture, and acquiring an ochry crust by exposure to the air.

RAGMAN'S ROLL, Rectius Ragimund's roll, so called from one Ragimund a legate in Scotland, who calling before him all the beneficed clergymen in that kingdom, caused them on oath to give in *the true value* of their benefices; according to which they were afterwards taxed by the court of Rome; and this roll, among other records, being taken from the Scots by Edward I. was redelivered to them in the beginning of the reign of Edward III.

RAGOUT, or RAGOO, a sauce, or seasoning, intended to rouse the appetite when lost or languishing.

This term is also used for any high-seasoned dish prepared of flesh, fish, greens, or the like: by stewing them with bacon, salt, pepper, cloves, and the like ingredients. We have ragouts of celery, of endive, asparagus, cock's-combs, giblets, craw fish, &c.

The ancients had a ragout called *garum*, made of the putrified guts of a certain fish kept till it dissolved into a mere sanies, which was thought such a dainty, that, according to Pliny, its price equalled that of the richest perfumes.

RAGSTONE,

RAGSTONE, a coarse kind of sandstone which is used as a whetstone for coarse cutting tools. It is found in the hills about Newcastle, and many other parts of England, where there are large rocks of it.

RAGULED, or RAGGED, in *Heraldry*, jagged or knotted. This term is applied to a cross formed of the trunks of two trees without their branches, of which they show only the stumps. *Raguled* differs from *indented*, in that the latter is regular, the former not.

RAGUSA, an ancient town of Sicily, in the Val di Noto, near the river Maulo, 12 miles north of Modica. E. Long. 14. 59. N. Lat. 37. 0.

RAGUSA, a city of Dalmatia, and capital of Ragusen. It is about two miles in circumference, is pretty well built, and strong by situation, having an inaccessible mountain on the land-side, and on the side of the sea a strong fort. It is an archbishop's see, and was formerly a republic, with a doge like that of Venice, who continued a month only in his office. It carries on a considerable trade with the Turks. E. Long. 18. 10. N. Lat. 42. 50.

RAGUSEN, a territory of Europe in Dalmatia, lying along the coast of the gulf of Venice, about 55 miles in length, and 20 in breadth. It was formerly a republic under the protection of the Turks and Venetians, but fell under the dominion of the French, and was since transferred to the Austrians, in whose possession it remains.

RAJA, or RAJAH, the title of the Indian black princes, the remains of those who ruled there before the Moguls. Some of the rajas are said to preserve their independency, especially in the mountainous parts; but most of them pay an annual tribute to the Mogul. The Indians call them *rai;* the Persians, *raian*, in the plural; and our travellers *rajas*, or *ragias*.

RAJA, the *Ray-Fish*, in *Ichthyology*, a genus of fishes belonging to the cartilaginous order.

RAIANIA, a genus of plants belonging to the diœcia class; and in the natural method ranking under the 11th order, *Sarmentaceæ*. See BOTANY *Index*.

RAIETEA, one of the South sea islands, named also ULIETEA.

RAIL. See RALLUS, ORNITHOLOGY *Index*.

RAILLERY, according to Dr Johnson, means slight satire, or satirical merriment; and a beautiful writer of the last century compares it to a light which dazzles, and which does not burn. It is sometimes innocent and pleasant, and it should always be so, but it is most frequently offensive. Raillery is of various kinds; there is a serious, severe, and good-humoured raillery; and there is a kind which perplexes, a kind which offends, and a kind which pleases.

To rally well, it is absolutely necessary that kindness run through all you say; and you must ever preserve the character of a friend to support your pretensions to be free with a man. Allusions to past follies, hints to revive what a man has a mind to forget for ever, should never be introduced as the subjects of raillery. This is not to thrust with the skill of fencers, but to cut with the barbarity of butchers. But it is below the character of men of humanity and good-breeding to be capable of mirth, while there is any in the company in pain and disorder.

RAIN, the descent of water from the atmosphere in the form of drops of a considerable size. By this circumstance it is distinguished from dew and fog: in the former of which the drops are so small that they are quite invisible; and in the latter, though their size be larger, they seem to have very little more specific gravity than the atmosphere itself, and may therefore be reckoned hollow spherules rather than drops. Some of the more general facts relative to the phenomena of rain have been already given under METEOROLOGY. We shall here add some account of the speculations of philosophers on the same subject, in attempting to account for those phenomena.

It is universally agreed, that rain is produced by the water previously absorbed by the heat of the sun, or otherwise, from the terraqueous globe, into the atmosphere; but very great difficulties occur when we begin to explain why the water, once so closely united with the atmosphere, begins to separate from it. We cannot ascribe this separation to cold, since rain often takes place in very warm weather; and though we should suppose the condensation owing to the superior cold of the higher regions, yet there is a remarkable fact which will not allow us to have recourse to this supposition. It is certain that the drops of rain increase in size considerably as they descend. On the top of a hill, for instance, they will be small and inconsiderable, forming only a drizzling shower; but at the bottom of the same hill the drops will be excessively large, descending in an impetuous rain; which shows that the atmosphere is disposed to condense the vapours, and actually does so, as well where it is warm as where it is cold.

For some time the suppositions concerning the cause of rain were exceedingly insufficient and unsatisfactory. It was imagined, that when various congeries of clouds were driven together by the agitation of the winds, they mixed, and run into one body, by which means they were condensed into water. The coldness of the upper parts of the air also was thought to be a great means of collecting and condensing the clouds into water; which, being heavier than the air, must necessarily fall down through it in the form of rain. The reason why it falls in drops, and not in large quantities, was said to be the resistance of the air; whereby being broken, and divided into smaller and smaller parts, it at last arrives to us in small drops. But this hypothesis is entirely contrary to almost all the phenomena: for the weather, when coldest, that is, in the time of severe frost, is generally the most serene; the most violent rains also happen where there is little or no cold to condense the clouds; and the drops of rain, instead of being divided into smaller and smaller ones, as they approach the earth, are plainly increased in size as they descend.

Dr Derham accounted for the precipitation of the drops of rain from the vesiculæ being full of air, and meeting with an air colder than they contained, the air they contained was of consequence contracted into a smaller space; and consequently the watery shell rendered thicker, and thus specifically heavier, than the common atmosphere. But it has been shown, that the vesiculæ, if such they are, of vapour, are not filled with air, but with fire, or heat; and consequently, till they part with this latent heat, the vapour cannot be condensed. Now, cold is not always sufficient to effect this, since in the most severe frosts the air is very often serene, and parts with little or none of its vapour for

for a very considerable time. Neither can we admit the winds to have any considerable agency in this matter, since we find that blowing upon vapour is so far from condensing it, that it unites it more closely with the air, and wind is found to be a great promoter of evaporation.

According] to Rohault, the great cause of rain is the heat of the air; which, after continuing for some time near the earth, is raised on high by a wind, and there thawing the snowy villi or flocks of half-frozen vesiculæ, reduces them to drops; which, coalescing, descend. Here, however, we ought to be informed by what means these vesiculæ are suspended in their half-frozen state; since the thawing of them can make but little difference in their specific gravity, and it is certain that they ascended through the air not in a frozen but in an aqueous state.

Dr Clarke and others ascribe this descent of the rain rather to an alteration of the atmosphere than of the vesiculæ; and suppose it to arise from a diminution of the elastic force of the air. This elasticity, which, they say, depends chiefly or wholly upon terrene exhalations, being weakened, the atmosphere sinks under its burden, and the clouds fall. Now, the little vesicles being once upon the descent, will continue therein, notwithstanding the increase of resistance they every moment meet with. For, as they all tend to the centre of the earth, the farther they fall, the more coalitions they will make; and the more coalitions, the more matter will there be under the same surface; the surface increasing only as the squares, but the solidity as the cubes; and the more matter under the same surface, the less resistance will there be to the same matter. Thus, if the cold, wind, &c. act early enough to precipitate the ascending vesicles before they are arrived at any considerable height, the coalitions being but few, the drops will be proportionably small; and thus is formed a dew. If the vapours be more copious, and rise a little higher, we have a mist or fog. A little higher still, and they produce a small rain; if they neither meet with cold nor wind, they form a heavy thick dark sky. This hypothesis is equally unsatisfactory with the others; for, granting that the descent and condensation of the vapours are owing to a diminution of the atmosphere's elasticity, by what is this diminution occasioned? To say that it is owing to terrene exhalations, is only solving one difficulty by another; since we are totally unacquainted both with the nature and operation of these exhalations. Besides, let us suppose the cause to be what it will, if it acts equally and at once upon all the vapour in the air, then all that vapour must be precipitated at once; and thus, instead of gentle showers continuing for a considerable length of time, we should have the most violent water-spouts, continuing only for a few minutes, or perhaps seconds, which, instead of refreshing the earth, would drown and lay waste every thing before them.

Since philosophers have admitted the electric fluid to such a large share in the operations of nature, almost all the natural phenomena have been accounted for by the action of that fluid; and rain, among others, has been reckoned an effect of electricity. But this word, unless it be explained, makes us no wiser than we were before; the phenomena of artificial electricity having been explained on principles which could scarce apply in any degree to the electricity of nature: and therefore all the solution we can obtain of the natural appearances of which we speak, comes to this, that rain is occasioned by a moderate electrification, hail and snow by one more violent, and thunder by the most violent of all; but in what manner this electrification is occasioned, has not yet been explained. The principles of electricity necessary to be attended to in the solution of the phenomena under consideration are the following:

1. The electric fluid and solar light are the same substances in two different modifications.

2. Electricity is the motion of the fluid when running, or attempting to run, in a continued stream from one place to another: heat is when the fluid has no tendency but to vibrate outwards and inwards to and from a centre; or at least when its streams converge to a point or focus.

3. The fluid acting as electricity, like water, or any other fluid, always tends to the place where there is least resistance.

On these three principles may the phenomena of atmospherical electricity, and the descent of rain by its means, be explained as follows:

1. The light or heat of the sun, acting in that peculiar manner which we call *heat*, unites itself with the moisture of the earth, and forms it into vapour, which thus becomes specifically lighter than air, and of consequence ascends in the atmosphere to a certain height.

2. Besides the quantity of light which is thus united to the water, and forms it into vapour, a very considerable quantity enters the earth, where it assumes the nature of electric fluid.

3. As the earth is always full of that fluid, every quantity which enters must displace an equal quantity which is already there.

4. This quantity which is displaced must escape either at a distance from the place where the other enters, or very near it.

5. At whatever place a quantity of electric matter escapes, it must electrify the air above that place where it has escaped; and as a considerable quantity of light must always be reflected from the earth into the atmosphere, where it does not combine with the aqueous vapour, we have thence another source of electricity to the air: as this quantity must undoubtedly assume the action of electric fluid, especially after the action of the sun has ceased. Hence the reason why in serene weather the atmospherical electricity is always strongest, and rather more so in the night than in the day.

6. From these considerations, we see an evident reason why there must commonly be a difference between the electricity of the earth and that of the atmosphere, excepting when an earthquake is about to ensue. The consequence of this must be, that as the action of the solar light continues to bring down the electric matter, and the earth continues to discharge an equal quantity of it into the atmosphere, some part of the atmosphere must at last become overloaded with it, and attempt to throw it back into the earth. This attempt will be vain, until a vent is found for the electricity at some other place; and as soon as this happens, the electrified atmosphere begins to throw off its superfluous electricity, and the earth to receive it. As the atmosphere itself

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is a bad conductor, and the more so the drier it is, the electric matter attacks the small aqueous particles which are detained in it by means of the latent heat. These being unable to bear the impetus of the fluid, throw out their latent heat, which easily escapes, and thus makes a kind of vacuum in the electrified part of the atmosphere. The consequences of this are, that the aqueous particles being driven together in large quantity, at last become visible, and the sky is covered with clouds; at the same time a wind blows against these clouds, and, if there is no resistance in the atmosphere, will drive them away.

7. But if the atmosphere all round the cloud is exceedingly electrified, and the earth is in no condition to receive the superfluous fluid excepting in that place which is directly under the cloud, then the whole electricity of the atmosphere for a vast way round will tend to that part only, and the cloud will be electrified to an extreme degree. A wind will now blow against the cloud from all quarters, more and more of the vapour will be extricated from the air by the electric matter, and the cloud will become darker and thicker, at the same time that it is in a manner stationary, as being acted upon by opposite winds; though its size is enlarged with great rapidity by the continual supplies of vapour brought by the winds.

8. The vapours which were formerly suspended invisibly by means of the latent heat are now suspended visibly by the electric fluid, which will not let them fall to the earth, until it is in a condition to receive the electric matter descending with the rain.—It is easy to see, however, that thus every thing is prepared for a violent storm of thunder and lightning as well as rain. The surface of the earth becomes electrified from the atmosphere: but when this has continued for some time, a zone of earth considerably below the surface acquires an electricity opposite to that of the clouds and atmosphere; of consequence the electricity in the cloud being violently pressed on all sides, will at last burst out towards that zone where the resistance is least, as explained under the article LIGHTNING.—The vapours now having lost that which supported them, will fall down in rain, if there is not a sufficient quantity of electric matter to keep them in the same state in which they were before: but if this happens to be the case, the cloud will instantly be charged again, while little or no rain will fall; and hence very violent thunder sometimes takes place without any rain at all, or such as is quite inconsiderable in quantity.

9. When the electricity is less violent, the rain will descend in vast quantity, especially after every flash of lightning; and great quantities of electric matter will thus be conveyed to the earth, insomuch that sometimes the drops have been observed to shine as if they were on fire, which has given occasion to the reports of fiery rain having fallen on certain occasions. If the quantity of electric matter is smaller, so that the rain can convey it all gradually to the ground, there will be rain without any thunder; and the greater the quantity of electricity the more violent will be the rain.

From this account of the causes of rain, we may see the reason why in warm climates the rains are excessive, and for the most part accompanied with thunder; for there the electricity of the atmosphere is immensely greater than it is with us. We may also see why in certain places, according to the situation of mountains, seas, &c. the rains will be greater than in others, and likewise why some parts of the world are exempted from rain altogether; but as a particular discussion of these would necessarily include an explanation of the causes and phenomena of THUNDER, we shall for this reason refer the whole to be treated of under that article.

Whether this theory be just, however, it would be too assuming in us to say. It may admit of dispute; for we must grant that in the very best systems, though an occurrence so frequent, the theory of rain is but very imperfectly understood. Dr Hutton, whose speculations are always ingenious, though generally extraordinary, and much out of the common way, has given a new theory of rain in the first volume of the Transactions of the Royal Society of Edinburgh. It is well known that atmospheric air is capable of dissolving, with a certain degree of heat, a given quantity of water. The Doctor ascertains the ratio of the dissolving power of air, in relation to water, in different degrees of heat; and shews, that by mixing a portion of transparent humid warm air with a portion of cold air, the mixture becomes opaque, and part of the water will be precipitated; or, in other words, the vapour will be condensed into rain. The ratio which he states, however, does not appear to us to be supported by experience. Whether the electricity of the air changes in consequence of its depositing the water dissolved in it, or the change is a cause of this deposition, must remain uncertain; but, in either view, there must be an agent different from heat and cold, since the changes in these respects do not in other operations change the state of electricity. Dr Hutton supposes that heat and solution do not increase by equal increments; but that, in reality, if heat be supposed to increase by equal increments along a straight line, solution will be expressed by ordinates to a curve whose convex side is turned towards that line. That the power of solution is not increased in the same ratio with heat, is, however, hypothetical, except when we rise pretty high in the scale, when its proportional increase is a little doubtful; and it is not, in this paper, supported by experiment. The condensation of the breath in air is not an observation in point, except in air already saturated with vapour. It can amount, in any view, to no more than this, that to render it visible, the heat must be diminished in a greater proportion than can be compensated by the power of solution in the body of air, in which the portion expired is at first immersed. To explain rain from this cause, we must always suppose a constant diminution of heat to take place at the moment of the condensation of the vapour; but we actually find that the change from a state of vapour to the fluid state is attended with heat; so that rain must at once oppose its own cause, and continued rains would be impossible, without calling in the aid of other causes. From his own system, Dr Hutton endeavours to explain the regular and irregular seasons of rain, either respecting the generality of its appearance, or the regularity of its return. And to obviate the apparent exceptions of the theory, from the generality of rain, he explains the proportional quantities of rain, and adds a comparative estimate of climates, in relation to rain, with the meteorological observations made in our own climate.

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climate. As his principle is at least insufficient, and we think erroneous, it would be useless, even were this a proper place for it, to pursue these various branches, which must partake of the errors of the system. In these branches we ought to observe, that there are several just observations, mixed with errors, because evaporation and condensation must at last be the great basis of every theory: the mistakes arise from not being aware of all the causes, and misrepresenting the operation of those which do exist.

In a work entitled Thoughts on Meteorology, vol. ii. M. de Luc considers very particularly the grand phenomenon of rain, and the numerous circumstances connected with it. He examines the several hypotheses with considerable care; but thinks them, even if admissible, utterly insufficient to account for the formation of rain. The grand question in this inquiry is, what becomes of the water that rises in vapour into the atmosphere; or what state it subsists in there, between the time of its evaporation and its falling down again in rain. If it continues in the state of watery vapour, or such as is the immediate product of evaporation, it must possess the distinctive characters essential to that fluid: it must make the hygrometer move towards humidity, in proportion as the vapour is more or less abundant in the air: on a diminution of heat, the humidity, as shown by the hygrometer, must increase; and on an increase of the heat the humidity must diminish; and the introduction of other hygroscopic substances, drier than the air, must have the same effect as an augmentation of heat. These are the properties of watery vapour, on every hypothesis of evaporation; and therefore all the water that exists in the atmosphere without possessing these properties, is no longer vapour, but must have changed its nature. M. de Luc shows, that the water which forms rain, though it has ever been considered and reasoned upon as producing humidity, does not possess these properties, and must therefore have passed into another state. As he thinks that the vapour passes into an invisible state in the interval between evaporation and its falling again in rain, and that in that state it is not sensible to the hygrometer, he considers the laws of hygrology as insufficient for explaining the formation of rain; but he does not pretend to have discovered the immediate cause of the formation of clouds and rain. If it is not in the immediate product of evaporation that rain has its source; if the vapours change their nature in the atmosphere, so as no longer to be sensible to the hygrometer, or to the eye; if they do not become vapour again till clouds appear; and if, when the clouds are formed, no alteration is perceived in the quality of the air—we must acknowledge it to be very probable, that the intermediate state of vapour is no other than air—and that the clouds do not proceed from any distinct fluid contained in the atmosphere, but from a decomposition of a part of the air itself, perfectly similar to the rest.

It appears, to us at least, that M. de Luc's mode of reasoning on this subject agrees better with the phenomena than Dr Hutton's. The Doctor, however, thinks differently, and published answers to the objections of M. de Luc with regard to his theory of rain; to which M. de Luc replied in a letter which was printed in the Appendix to the 81st volume of the Monthly Review: but it would extend our article beyond its due bounds, to give a view of this controversy.

As to the general quantity of rain that falls, and its proportion in several places at the same time, and in the same place at several times, we have many observations, journals, &c. in the Memoirs of the French Academy, the Philosophical Transactions, &c. Upon measuring, then, the rain falling yearly, its depth, at a medium, and its proportion in several places, is found as in the following table:

	Inches.
At Townley, in Lancashire, observed by Mr Townley - - -	$42\frac{1}{4}$
Upminster, in Essex, by Mr Derham -	$19\frac{1}{4}$
Zurich, in Swisserland, by Dr Scheuchzer	$32\frac{1}{4}$
Pisa, in Italy, by Dr Mich. Ang. Tilli -	$43\frac{1}{4}$
Paris, in France, by M. de la Hire -	19
Lisle, in Flanders, by M. de Vauban -	24

At Upminster.			At Paris.	
1700	19 Inch.	.03	21 Inch.	.37
1701	18	.69	27	.77
1702	20	.38	17	.45
1703	23	.99	18	.51
1704	15	.80	21	.20
1705	16	.93	14	.82

From the Meteorological Journal of the Royal Society, kept by order of the president and council, it appears that the whole quantity of rain at London, in each of the years specified below, was as follows, viz.

			Inches.	
1774	-	-	26	.328
1775	-	-	24	.083
1776	-	-	20	.354
1777	-	-	25	.371
1778	-	-	20	.772
1779	-	-	26	.785
1780	-	-	17	.313

The quantity of rain in the four following years at London was

			Inches.	
In 1789	-	-	21	.976
1790	-	-	16	.052
1791	-	-	15	.310
1792	-	-	19	.489

Proportion of the Rain of the several Seasons to one another.

1708	Depth at Pisa. Inch.	Dep. at Upmin. Inch.	Dep. at Zurich. Inch.	1708	Dep. at Pisa. Inch.	Dep. at Upmin. Inch.	Dep. at Zurich. Inch.
Jan.	6 .41	2 .88	1 .64	July	0 .20	1 .11	3 .50
Feb.	3 .28	0 .46	1 .65	Aug.	2 .27	2 .94	3 .15
Mar.	2 .65	2 .03	1 .51	Sep.	7 .21	1 .46	3 .02
April	1 .25	0 .96	4 .69	Oct.	5 .33	0 .23	2 .44
May	3 .33	2 .02	1 .91	Nov.	0 .13	0 .86	0 .62
June	4 .90	2 .32	5 .91	Dec.	0 .00	1 .97	2 .62
Half Year	21 .82	10 .67	17 .31	Half Year	14 .94	8 .57	15 .35

See Philosophical Transactions abridged, vol. iv. part ii. p. 81, &c. and also Meteorological Journal of the Royal Society, published annually in the Philosophical Transactions.

As to the use of rain, we may observe, that it moistens

stens and softens the earth, and thus fits it for affording nourishment to plants; by falling on high mountains, it carries down with it many particles of loose earth, which serve to fertilize the surrounding valleys, and purifies the air from noxious exhalations, which tend in their return to the earth to meliorate the soil; it moderates the heat of the air; and is one means of supplying fountains and rivers. However, vehement rains in many countries are found to be attended with barrenness and poorness of the lands, and miscarriage of the crops in the succeeding year: and the reason is plain; for these excessive storms wash away the fine mould into the rivers, which carry it into the sea, and it is a long time before the land recovers itself again. The remedy to the famine, which some countries are subject to from this sort of mischief, is the planting large orchards and groves of such trees as bear esculent fruit; for it is an old observation, that in years, when grain succeeds worst, these trees produce most fruit of all. It may partly be owing to the thorough moistening of the earth, as deep as their roots go by these rains, and partly to their trunks stopping part of the light mould carried down by the rains, and by this means furnishing themselves with a coat of new earth.

Preternatural RAINS. We have numerous accounts, in the historians of our own as well as other countries, of preternatural rains; such as the raining of stones, of dust, of blood, nay, and of living animals, as young frogs, and the like. We are not to doubt the truth of what those who are authors of veracity and credit relate to us of this kind, so far as to suppose that the falling of stones and dust never happened; the whole mistake is, the supposing them to have fallen from the clouds: but as to the blood and frogs, it is very certain that they never fell at all, but the opinion has been a mere deception of the eyes. Men are extremely fond of the marvellous in their relations; but the judicious reader is to examine strictly whatever is reported of this kind, and is not to suffer himself to be deceived.

There are two natural methods by which quantities of stones and dust may fall in certain places, without their having been generated in the clouds or fallen as rain. The one is by means of hurricanes: the wind which we frequently see tearing off the tiles of houses, and carrying them to considerable distances, being equally able to take up a quantity of stones, and drop them again at some other place. But the other, which is much the most powerful, and probably the most usual way, is for the eruptions of volcanoes and burning mountains to toss up, as they frequently do, a vast quantity of stones, ashes, and cinders, to an immense height in the air: and these, being hurried away by the hurricanes and impetuous winds which usually accompany those eruptions, and being in themselves much lighter than common stones, as being half calcined, may easily be thus carried to vast distances; and there falling in places where the inhabitants know nothing of the occasion, they cannot but be supposed by the vulgar to fall on them from the clouds. It is well known, that, in the great eruptions of Ætna and Vesuvius, showers of ashes, dust, and small cinders, have been seen to obscure the air, and overspread the surface of the sea for a great way, and cover the decks of ships; and this at such a distance, as it should appear scarce conceivable that they should have been carried to: and probably, if the accounts of all the showers of these substances mentioned by authors be collected, they will all be found to have fallen within such distances of volcanoes; and if compared as to the time of their falling, will be found to correspond in that also with the eruptions of those mountains. We have known instances of the ashes from Vesuvius having been carried thirty, nay, forty leagues, and peculiar accidents may have carried them yet farther. It is not to be supposed that these showers of stones and dust fall for a continuance in the manner of showers of rain, or that the fragments or pieces are as frequent as drops of water; it is sufficient that a number of stones, or a quantity of dust, fall at once on a place, where the inhabitants can have no knowledge of the part from whence they came, and the vulgar will not doubt their dropping from the clouds. Nay, in the canton of Berne in Swisserland, the inhabitants accounted it a miracle that it rained earth and sulphur uppon them at a time that a small volcano terrified them; and even while the wind was so boisterous, and hurricanes so frequent, that they saw almost every moment the dust, sand, and little stones torn up from the surface of the earth in whirlwinds, and carried to a considerable height in the air, they never considered that both the sulphur thrown up by the volcano, and the dust, &c. carried from their feet must fall soon after somewhere. It is very certain that in some of the terrible storms of large hail, where the hailstones have been of many inches round, on breaking them there have been found what people have called *stones in their middle;* but these observers needed only to have waited the dissolving of one of these hailstones, to have seen the stone in its centre disunite also, it being only formed of the particles of loose earthy matter, which the water exhaled, by the sun's heat, had taken up in extremely small moleculæ with it; and this only having served to give an opaque hue to the inner part of the congelation, to which the freezing of the water alone gave the apparent hardness of stone.

The raining of *blood* has been ever accounted a more terrible sight and more fatal omen than the other preternatural rains already mentioned. It is very certain that nature forms blood nowhere but in the vessels of animals; and therefore showers of it from the clouds are by no means to be credited. Those who suppose that what has been taken for blood has been actually seen falling through the air, have had recourse to flying insects for its origin, and suppose it the eggs or dung of certain butterflies discharged from them as they were high up in the air. But it seems a very wild conjecture, as we know of no butterfly whose excrements or eggs are of such a colour, or whose abode is so high, or their flocks so numerous, as to be the occasion of this.

It is most probable that these bloody waters were never seen falling; but that people seeing the standing waters blood-coloured, were assured, from their not knowing how it should else happen, that it had rained blood into them. A very memorable instance of this took place at the Hague in the year 1670. Swammerdam, who relates it, tells us, that one morning the whole town was in an uproar on finding their lakes and ditches full of blood, as they thought: and having been certainly full of water the night before, they agreed it must have rained blood in the night: but a certain physician

sician went down to one of the canals, and taking home a quantity of this blood-coloured water, he examined it by the microscope, and found that the water was water still, and had not at all changed its colour; but that it was full of prodigious swarms of small red animals, all alive, and very nimble in their motions, whose colour and prodigious number gave a red tinge to the whole body of the water they lived in, on a less accurate inspection. The certainty that this was the case, did not however persuade the Hollanders to part with the miracle: they prudently concluded, that the sudden appearance of such a number of animals was as great a prodigy as the raining of blood would have been; and are assured to this day, that this portent foretold the scene of war and destruction which Louis XIV. afterwards brought into that country, which had before enjoyed 40 years of uninterrupted peace.

The animals which thus colour the water of lakes and ponds are the *pulices arborescentes* of Swammerdam, or the water-fleas with branched horns. These creatures are of a reddish-yellow or flame colour: they live about the sides of ditches, under weeds, and among the mud; and are therefore the less visible, except at a certain time, which is in the end or beginning of June: it is at this time that these little animals leave their recesses to float loose about the water, to meet for the propagation of their species, and by that means become visible in the colour they give the water. This is visible, more or less, in one part or other of almost all standing waters at this season; and it is always at this season that the bloody waters have alarmed the ignorant.

The raining of *frogs* is a thing not less wonderful in the accounts of authors who love the marvellous, than those of blood or stones; and this is supposed to happen so often, that there are multitudes who pretend to have been eye-witnesses of it. These rains of frogs always happen after very dry seasons, and are much more frequent in the hotter countries than in the cold ones. In Italy they are very frequent; and it is not uncommon to see the streets of Rome swarming both with young frogs and toads in an instant in a shower of rain; they hopping everywhere between the people's legs as they walk, though there was not the least appearance of them before. Nay, they have been seen to fall through the air down upon the pavements. This seems a strong circumstance in favour of their being rained down from the clouds; but, when strictly examined, it comes to nothing: for these frogs that are seen to fall, are always found dead, lamed, or bruised by the fall, and never hop about as the rest; and they are never seen to fall, except close under the walls of houses, from the roofs and gutters of which they have accidentally slipped down. Some people, who love to add to strange things yet stranger, affirm that they have had the young frogs fall into their hats in the midst of an open field; but this is idle, and wholly false.

Others, who cannot agree to their falling from the clouds, have tried to solve the difficulty of their sudden appearance, by supposing them hatched out of the egg, or spawn, by these rains. Nay, some have supposed them made immediately out of the dust: but there are unanswerable arguments against all these suppositions. Equivocal generation, or the spontaneous production of animals out of dust, is now wholly exploded. The fall from the clouds must destroy and kill these tender and soft-bodied animals: and they cannot be at this time hatched immediately out of eggs; because the young frog does not make its appearance from the egg in form, but has its hinder legs enveloped in a skin, and is what we call a *tadpole;* and the young frogs are at least 100 times larger at the time of their appearance, than the egg from which they should be hatched.

It is beyond a doubt, that the frogs which make their appearance at this time, were hatched and in being long before: but that the dry seasons had injured them, and kept them sluggishly in holes or coverts; and that all the rain does, is the enlivening them, giving them new spirits, and calling them forth to seek new habitations, and enjoy the element they were destined in great part to live in. Theophrastus, the greatest of all the naturalists of antiquity, has affirmed the same thing. We find that the error of supposing these creatures to fall from the clouds was as early as that author's time; and also that the truth, in regard to their appearance, was as early known; though, in the ages since, authors have taken care to conceal the truth, and to hand down to us the error. We find this venerable sage, in a fragment of his on the generation of animals which appear on a sudden, bantering the opinion, and asserting that they were hatched and living long before. The world owes, however, to the accurate Signior Redi the great proof of this truth, which Theophrastus only has affirmed: for this gentleman, dissecting some of these new-appearing frogs, found in their stomachs herbs and other half-digested food; and, openly showing this to his credulous countrymen, asked them whether they thought that nature, which engendered, according to their opinion, these animals in the clouds, had also been so provident as to engender grass there for their food and nourishment?

To the raining of frogs we ought to add the raining of *grasshoppers* and *locusts*, which have sometimes appeared in prodigious numbers, and devoured the fruits of the earth. There has not been the least pretence for the supposing that these animals descended from the clouds, but that they appeared on a sudden in prodigious numbers. The naturalist, who knows the many accidents attending the eggs of these and other the like animals, cannot but know that some seasons will prove particularly favourable to the hatching them, and the prodigious number of eggs that many insects lay could not but every year bring us such abundance of the young, were they not liable to many accidents, and had not provident nature taken care, as in many plants, to continue the species by a very numerous stock of seeds, of which perhaps not one in 500 need take root in order to continue an equal number of plants. As it is thus also in regard to insects, it cannot but happen, that if a favourable season encourage the hatching of all those eggs, a very small number of which alone was necessary to continue the species, we must, in such seasons, have a proportionate abundance of them. There appeared about 50 years ago, in London, such a prodigious swarm of the little beetle called the *lady-cow*, that the very posts in the streets were everywhere covered with them. But thanks to the progress of philosophy among us, we had nobody to assert that it rained cow-ladies, but contented ourselves with saying that it had been a favourable season for their eggs. The prodigious number of a sort of grub which did vast mischief about the same

period

period among the corn and grass by eating off their roots, might also have been supposed to proceed from its having rained grubs by people fond of making every thing a prodigy; but our knowledge in natural history assured us, that these were only the hexapode worms of the common hedge-beetle called the *cockchafer*.

The raining of *fishes* has been a prodigy also much talked of in France, where the streets of a town at some distance from Paris, after a terrible hurricane in the night, which tore up trees, blew down houses, &c. were found in a manner covered with fishes of various sizes. Nobody here made any doubt of these having fallen from the clouds; nor did the absurdity of fish, of five or six inches long, being generated in the air, at all startle the people, or shake their belief in the miracle, till they found, upon inquiry, that a very well stocked fish-pond, which stood on an eminence in the neighbourhood, had been blown dry by the hurricane, and only the great fish left at the bottom of it, all the smaller fry having been tossed into their streets.

Upon the whole, all the supposed marvellous rains have been owing to substances naturally produced on the earth, and either never having been in the air at all, or only carried thither by accident.

In Silesia, after a great dearth of wheat in that country, there happened a violent storm of wind and rain, and the earth was afterwards covered, in many places, with small round seeds. The vulgar cried out that Providence had sent them food, and that it had rained *millet*: but these were, in reality, only the seeds of a species of veronica, or speedwell, very common in that country; and whose seeds being just ripe at that time, the wind had dislodged them from their capsules, and scattered them about. In our own country, we have histories of rains of this marvellous kind, but all fabulous. It was once said to rain *wheat* in Wiltshire; and the people were all alarmed at it as a miracle, till Mr Cole showed them, that what they took for wheat was only the seeds or kernels of the berries of ivy, which being then fully ripe, the wind had dislodged from the sides of houses, and trunks of trees, on which the ivy that produced them crept.

And we even once had a raining of fishes near the coast of Kent in a terrible hurricane, with thunder and lightning. The people who saw small sprats strewed all about afterwards, would have it that they had fallen from the clouds; but those who considered how far the high winds have been known to carry the sea-water, did not wonder that they should be able to carry small fish with it so small a part of the way.

In the Philosophical Transactions for 1782, we have the following account of a preternatural kind of rain by Count de Gioeni: "The morning of the 24th instant there appeared here a most singular phenomenon. Every place exposed to the air was found wet with a coloured cretaceous gray water, which, after evaporating and filtrating away, left every place covered with it to the height of two or three lines; and all the iron-work that was touched by it became rusty.

"The public, inclined to the marvellous, fancied various causes of this rain, and began to fear for the animals and vegetables.

"In places where rain-water was used, they abstained from it: some suspecting vitriolic principles to be mixed with it, and others predicting some epidemical disorder.

"Those who had observed the explosions of Etna 20 days and more before, were inclined to believe it originated from one of them.

"The shower extended from N. ¼ N. E. to S. ¼ S. W. over the fields, about 70 miles in a right line from the vertex of Etna.

"There is nothing new in volcanoes having thrown up sand, and also stones, by the violent expansive force generated within them, which sand has been carried by the wind to distant regions.

"But the colour and subtility of the matter occasioned doubts concerning its origin; which increased from the remarkable circumstance of the water in which it came incorporated; for which reasons some other principle or origin was suspected.

"It became, therefore, necessary by all means to ascertain the nature of this matter, in order to be convinced of its origin, and of the effects it might produce. This could not be done without the help of a chemical analysis. To do this then with certainty, I endeavoured to collect this rain from places where it was most probable no heterogeneous matter would be mixed with it. I therefore chose the plant called *brassica capitata*, which having large and turned up leaves, they contained enough of this coloured water: many of these I emptied into a vessel, and left the contents to settle till the water became clear.

"This being separated into another vessel, I tried it with vegetable alkaline liquors and mineral acids; but could observe no decomposition by either. I then evaporated the water in order to reunite the substances that might be in solution; and touching it again with the aforesaid liquors, it showed a slight effervesence with the acids. When tried with the syrup of violets, this became a pale green; so that I was persuaded it contained a calcareous salt. With the decoction of galls no precipitation was produced.

"The matter being afterwards dried in the shade, it appeared a very subtile fine earth, of a cretaceous colour, but inert, from having been diluted by the rain.

"I next thought of calcining it with a slow fire, and it assumed the colour of a brick. A portion of this being put into a crucible, I applied to it a stronger heat; by which it lost almost all its acquired colour. Again, I exposed a portion of this for a longer time to a very violent heat (from which a vitrification might be expected); it remained, however, quite soft, and was easily bruised, but returned to its original dusky colour.

"From the most accurate observations of the smoke from the three calcinations, I could not discover either colour or smell that indicated any arsenical or sulphureous mixture.

"Having therefore calcined this matter in three portions, with three different degrees of fire, I presented a good magnet to each: it did not act either on the first or second; a slight attraction was visible in many places on the third: this persuaded me, that this earth contains a martial principle in a metallic form, and not in a vitriolic substance.

"The nature of these substances then being discovered, their volcanic origin appears; for iron, the more it is

Rain, Rainbow.

is exposed to violent calcination, the more it is divided by the loss of its phlogistic principle; which cannot naturally happen but in the great chimney of a volcano. Calcareous salt, being a marine salt combined with a calcareous substance by means of violent heat, cannot be otherwise composed than in a volcano.

"As to their dreaded effects on animals and vegetables, every one knows the advantageous use, in medicine, both of the one and the other, and this in the same form as they are thus prepared in the great laboratory of nature.

"Vegetables, even in flower, do not appear in the least macerated, which has formerly happened from only showers of sand.

"How this volcanic production came to be mixed with water may be conceived in various ways.

"Ætna, about its middle regions, is generally surrounded with clouds that do not always rise above its summit, which is 2900 paces above the level of the sea. This matter being thrown out, and descending upon the clouds below it, may happen to mix and fall in rain with them in the usual way. It may also be conjectured, that the thick smoke which the volcanic matter contained might, by its rarefaction, be carried by the wind over that tract of country; and then cooling so as to condense and become specifically heavier than the air, might descend in that coloured rain.

"I must, however, leave to philosophers (to whom the knowledge of natural agents belongs) the examination and explanation of such phenomena, confining myself to observation and chemical experiments." See METEOROLOGY, SUPPLEMENT.

RAIN, a well built and fortified town of Bavaria, one of the keys of this electorate, on the Lech, 20 miles west of Ingolstadt. N. Lat. 48. 51. E. Long. 11. 12.

RAIN-Bird. See CUCULUS, ORNITHOLOGY *Index*.

RAINBOW. See OPTICS.

In the Philosophical Transactions for 1793, we have the following account of two rainbows seen by the Rev. Mr Sturges.

"On the evening of the 9th of July 1792, between seven and eight o'clock, at Alverstroke, near Gosport, on the sea-coast of Hampshire, there came up, in the south-east, a cloud with a thunder-shower; while the sun shone bright, low in the horizon, to the north-west.

Plate CCCCLVIII. fig. 2.

"In this shower two primary rainbows appeared, AB and AC, not concentric, but touching each other at A, in the south part of the horizon; with a secondary bow to each, DE and DF (the last very faint, but discernible), which touched likewise at D. Both the primary were very vivid for a considerable time, and at different times nearly equally so; but the bow AB was most permanent, was a larger segment of a circle, and at last, after the other had vanished, became almost a semicircle; the sun being near setting. It was a perfect calm, and the sea was as smooth as glass.

"If I might venture to offer a solution of this appearance, it would be as follows. I consider the bow AB as the true one, produced by the sun itself; and the other, AC, as produced by the reflection of the sun from the sea, which, in its perfectly smooth state, acted as a speculum. The direction of the sea, between the Isle of Wight and the land, was to the north-west in a line with the sun, as it was then situated. The image reflected from the water, having its rays issuing from a point lower than the real sun, and in a line coming from beneath the horizon, would consequently form a bow higher than the true one AB. And the shores, by which that narrow part of the sea is bounded, would before the sun's actual setting intercept its rays from the surface of the water, and cause the bow AC, which I suppose to be produced by the reflection, to disappear before the other."

The marine or sea bow is a phenomenon which may be frequently observed in a much agitated sea, and is occasioned by the wind sweeping part of the waves, and carrying them aloft; which when they fall down are refracted by the sun's rays, which paint the colours of the bow just as in a common shower. These bows are often seen when a vessel is sailing with considerable force, and dashing the waves around her, which are raised partly by the action of the ship and partly by the force of the wind, and, falling down, they form a rainbow; and they are also often occasioned by the dashing of the waves against the rocks on shore.

In the Philosophical Transactions, it is observed by F. Bourzes, that the colours of the marine rainbow are less lively, less distinct, and of shorter continuance, than those of the common bow; and there are scarcely above two colours distinguishable, a dark yellow on the side next the sun, and a pale green on the opposite side. But they are more numerous, there being sometimes 20 or 30 seen together.

To this class of bows may be referred a kind of white or colourless rainbows, which Mentzelius and others affirm to have seen at noon-day. M. Marlotte, in his fourth *Essai de Physique*, says, these bows are formed in mists, as the others are in showers; and adds, that he has seen several both after sunrising and in the night. The want of colours he attributes to the smallness of the vapours which compose the mist; but perhaps it is rather from the exceeding tenuity of the little vesiculæ of the vapour, which being only little watery pellicles bloated with air, the rays of light undergo but little refraction in passing out of air into them; too little to separate the differently coloured rays, &c. Hence the rays are reflected from them, compounded as they came, that is, white. Rohault mentions * coloured rainbows on the grass; formed by the refractions of the sun's rays in the morning dew. Rainbows have been also produced by the reflection of the sun from a river; and in the Philosophical Transactions, vol. l. p. 294. we have an account of a rainbow, which must have been formed by the exhalations from the city of London, when the sun had been set 20 minutes, and consequently the centre of the bow was above the horizon. The colours were the same as in the common rainbow, but fainter.

* Traité Physique.

It has often been made a subject of inquiry among the curious how there came to be no rainbow before the flood, which is thought by some to have been the case, from its being made a sign of the covenant which the Deity was pleased to make with man after that event. Mr Whitehurst, in his *Inquiry into the Original State and Formation of the Earth*, p. 173, &c. endeavours to establish it as a matter of great probability at least, that the antediluvian atmosphere was so uniformly temperate as never to be subject to storms, tempests, or rain, and of course it could never exhibit a rainbow. For our own part, we cannot see how the earth at that period could do do without rain any more than at present; and it appears to us from Scripture equally probable that the rainbow was seen before the flood as after it. It was then, however, made a token of a certain covenant; and it would unquestionably do equally well for that purpose if it had existed before as if it had not.

Lunar Rainbow. The moon sometimes also exhibits the phenomenon of an iris or rainbow by the refraction of her rays in drops of rain in the night time. This phenomenon is very rare. In the Philosophical Transactions for 1783, however, we have an account of three seen in one year, and all in the same place, communicated in two letters by Marmaduke Tunstall, Esq. The first was seen 27th February 1782, at Greta Bridge, Yorkshire, between seven and eight at night, and appeared "in tolerably distinct colours, similar to a solar one, but more faint: the orange colour seemed to predominate. It happened at full moon; at which time alone they are said to have been always seen. Though Aristotle is said to have observed two, and some others have been seen by Snellius, &c. I can only find two described with any accuracy; viz. one by Plot, in his History of Oxfordshire, seen by him in 1675, though without colours; the other seen by a Derbyshire gentleman at Glapwell, near Chesterfield, described by Thoresby, and inserted in N° 331. of the Philosophical Transactions: this was about Christmas, 1710, and said to have had all the colours of the iris solaris. The night was windy; and though there was then a drizzling rain and dark cloud, in which the rainbow was reflected, it proved afterwards a light frost."

Two others were afterwards seen by Mr Tunstall; one on July the 30th, about 11 o'clock, which lasted about a quarter of an hour, without colours. The other, which appeared on Friday October 18, was "perhaps the most extraordinary one of the kind ever seen. It was first visible about nine o'clock, and continued, though with very different degrees of brilliancy, till past two. At first, though a strongly marked bow, it was without colours; but afterwards they were very conspicuous and vivid in the same form as in the solar, though fainter; the red, green, and purple, were most distinguishable. About twelve it was the most splendid in appearance; its arc was considerably a smaller segment of a circle than a solar; its south-east limb first began to fail, and a considerable time before its final extinction: the wind was very high, nearly due west, most part of the time, accompanied with a drizzling rain. It is a singular circumstance, that three of these phenomena should have been seen in so short a time in one place, as they have been esteemed ever since the time of Aristotle, who is said to have been the first observer of them, and saw only two in 50 years, and since by Plot and Thoresby, almost the only two English authors who have spoke of them, to be exceeding rare. They seem evidently to be occasioned by a refraction in a cloud or turbid atmosphere, and in general are indications of stormy and rainy weather: so bad a season as the late summer having, I believe, seldom occurred in England. Thoresby, indeed, says, the one he observed was succeeded by several days of fine serene weather. One particular, rather singular, in the second, viz. of July the 30th, was its being six days after the full of the moon; and the last, though of so long a duration, was three days before the full: that of the 27th of February was exactly at the full, which used to be judged the only time they could be seen, though in the Encyclopedia there is an account that Weidler observed one in 1719, in the first quarter of the moon, with faint colours, and in very calm weather. No lunar iris, I ever heard or read of, lasted near so long as that on the 18th instant, either with or without colours."

In the Gentleman's Magazine for August 1788 we have an account of a lunar rainbow by a correspondent who saw it. "On Sunday evening the 17th of August (says he), after two days, on both of which, particularly the former, there had been a great deal of rain, together with lightning and thunder, just as the clocks were striking nine, 23 hours after full moon, looking through my window, I was struck with the appearance of something in the sky, which seemed like a rainbow. Having never seen a rainbow by night, I thought it a very extraordinary phenomenon, and hastened to a place where there were no buildings to obstruct my view of the hemisphere: here I found that the phenomenon was no other than a lunar rainbow; the moon was truly 'walking in brightness,' brilliant as she could be; not a cloud was to be seen near her; and over against her, toward the north-west, or perhaps rather more to the north, was a rainbow, a vast arch, perfect in all its parts, not interrupted or broken as rainbows frequently are, but unremittedly visible from one horizon to the other. In order to give some idea of its extent, it is necessary to say, that as I stood toward the western extremity of the parish of Stoke Newington, it seemed to take its rise from the west of Hampstead, and to end, perhaps, in the river Lea, the eastern boundary of Tottenham; its colour was white, cloudy, or grayish, but a part of its western leg seemed to exhibit tints of a faint sickly green. I continued viewing it for some time, till it began to rain; and at length the rain increasing and the sky growing more hazy, I returned home about a quarter or 20 minutes past nine, and in ten minutes came out again; but by that time all was over, the moon was darkened by clouds, and the rainbow of course vanished."

Marine Rainbow, or *Sea-bow*. See the article Rainbow.

Rainbow Stone. See *Moon-Stone*.

RAISINS, grapes prepared by suffering them to remain on the vine till they are perfectly ripe, and then drying them in the sun, or by the heat of an oven. The difference between raisins dried in the sun and those dried in ovens, is very obvious: the former are sweet and pleasant, but the latter have a latent acidity with the sweetness that renders them much less agreeable.

The common way of drying grapes for raisins, is to tie two or three bunches of them together while yet on the vine, and dip them into a hot lixivium of wood-ashes, with a little of the oil of olives in it. This disposes them to shrink and wrinkle; and after this they are left on the vine three or four days separated on sticks in an horizontal situation, and then dried in the sun at leisure, after being cut from the tree. The finest and best raisins are those called in some places *Damascus* and *Jube raisins;* which are distinguished from the others by their size and figure: they are flat and wrinkled on the surface, soft and juicy within, and near an inch ong; and, when fresh and growing on the bunch, are of the size and shape of a large olive.

The raisins of the sun, and jar-raisins, are all dried by the heat of the sun; and these are the sorts used in medicine. However, all the kinds have much the same virtues: they are all nutritive and balsamic; they are allowed to be attenuant, are said to be good in nephritic complaints, and are an ingredient in pectoral decoctions: in which cases, as also in all others where astringency is not required of them, they should have the stones carefully taken out.

Raisin-Wine. See Wine.

RAKKATH, in *Ancient Geography*, a town of Upper Galilee, thought to be Tiberias, (Talmud): but this is denied by Reland, who says that Rakkath was a town of the tribe of Naphthali.

RAKE is a well known instrument with teeth, by which the ground is divided. See Agriculture, *Instruments*.

Rake also means a loose, disorderly, vicious, and thoughtless fellow.

Rake of a Ship, is all that part of her hull which hangs over both ends of her keel. That which is before is called the *fore rake* or *rake forward*, and that part which is at the setting on of the stern-post is called the *rake-aft* or *afterward*.

RALEIGH, Sir Walter, fourth son of Walter Raleigh, Esq. of Fardel, in the parish of Cornwood in Devonshire, was born in 1552 at Hayes, in the parish of Budley, a farm belonging to his father. About the year 1568, he was sent to Oriel college in Oxford, where he continued but a short time; for in the following year he embarked for France, being one of the hundred volunteers, commanded by Henry Champernon, who, with other English troops, were sent by Queen Elizabeth to assist the queen of Navarre in defending the Protestants. In this service he continued for five or six years; after which he returned to London, and probably resided in the Middle Temple. But his enterprising genius would not suffer him to remain long in a state of inactivity. In 1577 or 1578, he embarked for the Low Countries with the troops sent by the queen to assist the Dutch against the Spaniards, and probably shared the glory of the decisive victory over Don John of Austria in 1578. On his return to England, a new enterprise engaged his attention. His half brother, Sir Humphrey Gilbert, having obtained a patent to plant and inhabit some parts of North America, Mr Raleigh embarked in this adventure; but meeting with a Spanish fleet, after a smart engagement they returned, without success in 1579.

The following year, the king of Spain, in conjunction with the pope, having projected a total conquest of the English dominions, sent troops to Ireland to assist the Desmonds in the Munster rebellion Raleigh obtained a captain's commission under Lord Grey of Wilton, then deputy of Ireland, and embarked for that kingdom; where, by his conduct and resolution, he was principally instrumental in putting an end to the rebellious attempt. He returned to England; and attracted the notice of Queen Elizabeth, owing, as we are told in Naunton's *Fragmenta Regalia*, to the following accidental piece of gallantry. The queen, as she was one day taking a walk, being stopped by a *splashy* place in the road, our gallant young soldier took off his new plush mantle, and spread it on the ground. Her majesty trod gently over the fair foot-cloth, surprised and pleased with the adventure. He was a handsome man, and remarkable for his gentility of address.

The queen admitted him to her court, and employed him first as an attendant on the French ambassador Simier on his return home, and afterwards to escort the duke of Anjou to Antwerp. During this excursion he became personally known to the prince of Orange; from whom, at his return, he brought special acknowledgments to the queen, who now frequently conversed with him. But the inactive life of a courtier did not suit the enterprising spirit of Mr Raleigh. In the year 1583, he embarked with his brother, Sir Humphrey Gilbert, on a second expedition to Newfoundland, in a ship called the *Raleigh*, which he built at his own expence; but was obliged to return on account of an infectious distemper on board. He was, however, so little affected by this disappointment, that he now laid before the queen and council a proposal for exploring the continent of North America; and in 1584 obtained a patent empowering him to possess such countries as he should discover in that part of the globe. Accordingly Mr Raleigh fitted out two ships at his own expence, which sailed in the month of April, and returned to England about the middle of September, reporting that they had discovered and taken possession of a fine country called *Windangocoa*, to which the queen gave the name of *Virginia*. About this time he was elected knight of the shire for the county of Devon, and soon after received the honour of knighthood; and to enable him to carry on his designs abroad, the queen granted him a patent for licensing the venders of wine throughout the kingdom. In 1585 he sent a fleet of seven ships to Virginia, commanded by his relation Sir Richard Greenville, who left a colony at Roanah of 107 persons, under the government of Mr Lane; and by the establishment of this colony he first imported tobacco into England. See Nicotiana. In the same year Sir Walter Raleigh obtained a grant of 12,000 acres of the forfeited lands in the county of Cork in Ireland.—About the same time he was made seneschal of the duchy of Cornwall, and warden of the stanneries; and grew into such favour with the queen, that even Leicester was jealous of his influence.

In 1587, he sent another colony of 150 men to Virginia, with a governor, Mr John White, and 12 assistants. About this time we find our knight distinguished by the titles of *Captain of the queen's guards*, and *Lieutenant-general of Cornwall.* From this period to the year 1594, he was continually engaged in projecting new expeditions, sending succours to the colonies abroad, defending the kingdom from the insults of the Spaniards, and transacting parliamentary business, with equal ability and resolution. Whilst thus employed, he was publicly charged, in a libel written by the infamous Jesuit Parsons, with being an Atheist; a groundless and ridiculous imputation. In 1594, he obtained from the queen a grant of the manor of Sherborne in Dorsetshire, where he built a magnificent house: but Sir Walter fell under the queen's displeasure on account of an intrigue with the daughter of Sir Nicholas Throgmorton, one of the maids of honour; however, he married the lady, and lived with her in great conjugal harmony.

mony. During his disgrace at court, he projected the conquest of Guiana in South America, and in 1595 sailed for that country; of which having taken possession, after defeating the Spaniards who were settled there, he returned to England the same year, and soon after published an account of his expedition. In the following year he was one of the admirals in the successful expedition against Cadiz, under the command of Howard and the earl of Essex; and in 1597 he sailed with the same commanders against the Azores. Soon after these expeditions, we find him assiduously engaged in parliamentary business, and a distinguished personage in jousts and tournaments. In 1600 he was sent on a joint embassy with Lord Cobham to Flanders, and at his return made governor of Jersey.

Queen Elizabeth died in the beginning of the year 1603; and with her Raleigh's glory and felicity sunk, never to rise again. Upon the accession of James, Sir Walter lost his interest at court, was stripped of his preferments, and accused of a plot against the king. He was arraigned at Winchester, and, on his trial, insulted with the most shocking brutality by the famous Coke, attorney general, whose sophistical vociferation influenced the jury to convict him without the least proof of guilt. After a month's imprisonment, however, in daily expectation of his execution, he was reprieved, and sent to the Tower: and his estates were given to Car, earl of Somerset, the king's favourite. During this confinement, he wrote many of his most valuable pieces, particularly his History of the World. In March, 1615, after 16 years imprisonment, he obtained his liberty, and immediately began to prepare for another voyage to Guiana. In August 1616, the king granted him a very ample commission for that purpose; and in July the year following, he sailed from Plymouth. but, strange as it may appear, it is most certain that the whole scheme was revealed to the Spaniards by the king himself, and thus necessarily rendered abortive.

He returned to England in 1618, where he was soon after seized, imprisoned, and beheaded; not for any pretended misdemeanor on the late expedition, but in consequence of his former attainder. The truth of the matter is, he was sacrificed by the pusillanimous monarch to appease the Spaniards; who, whilst Raleigh lived, thought every part of their dominions in danger. He was executed in Old Palace Yard, and buried in St Margaret's adjoining, in the 66th year of his age. His behaviour on the scaffold was manly, unaffected, cheerful, and easy. Being asked by the executioner which way he would lay his head, he answered, "So the heart be right, it is no matter which way the head lies." He was a man of admirable parts, extensive knowledge, undaunted resolution, and strict honour and honesty. He was the author of a great many works, some of which have not been printed.

RALLUS, the RAIL, a genus of birds belonging to the order of grallæ. See ORNITHOLOGY *Index*.

RALPH, JAMES, an ingenious historical and political writer, of whose birth and country nothing is exactly known. He was first known as a schoolmaster in Philadelphia in North America. He came to England about the beginning of the reign of George I. and wrote some things in the dramatic way, which were not received with great applause; but though he did not succeed as a poet, he was a very ingenious prose-writer,

He wrote A History of England, commencing with the Stuarts, which is much esteemed; as were his political essays and pamphlets, some of which were looked upon as master-pieces. His last publication, The Case of Authors by Profession, is an excellent and entertaining performance. He died in 1762.

RAM. See OVIS, MAMMALIA *Index*.

Battering RAM, in antiquity, a military engine used to batter down the walls of besieged places. See BATTERING *Ram*.

RAM'*s Head*, in a ship, is a great block belonging to the fore and main haulyards. It has three shivers in it, in which the haulyards are put; and in a hole at the end are reeved the ties.

RAMADAN, a solemn season of fasting among the Mahometans. See MAHOMETANISM.

RAMAH, in *Ancient Geography*, a town of Benjamin, near Gibea, (Judges); called *Rama of Saul* (1 Sam. xxii.), six miles from Jerusalem to the north; memorable for the story of the Levite and his concubine: Taken and fortified by Baasa king of Israel, in order to annoy the kingdom of Judah. This Rama is mentioned Isa. x. Jer. xxxi. and Math. ii. and is to be distinguished from *Rama of Samuel*, 1. Sam. xix. called also *Ramatha*, 1 Sam. i. 19. and *Ramathaim Zophim*, ibid. i. 1. which lay a great way to the west, towards Joppa, near Lydda, 1 Maccab. ii. the birth-place of Samuel; adjoining to the mountains of Ephraim, and the place of his residence, 1 Sam. xv. &c. (Joseph.). Called *Ramula* in the lower age, (Gul. Tyrius). There is here a convent of the fathers of the Holy Land, inhabited only by Portuguese, Spaniards, and Italians.

RAMATH-MIZPE, (Joshua xiii.); *Ramoth-Masphe*, (Septuagint, Vulgate); *Ramoth in Gilead*, or *Remmoth Galaad*, (Seventy); a town in that tract of Gilead called *Maspha*, or *Mizpe*, one of the cities of refuge.

RAMAZZINI, BERNARDIN, an Italian physician, born at Carpi near Modena in 1633. He was professor of physic in the university of Modena for 18 years; and in 1700 accepted an invitation from Padua, where he was made rector of the college; and died in 1714. His works were collected and published in London, 1716; of which, his treatise *De Morbis Artificum*, "Of the peculiar maladies of artificers," will always be esteemed useful and curious.

RAMEKINS, a fortress of the United Netherlands, on the south coast of the island of Walcherin in the province of Zealand. One of the cautionary towns given to Queen Elizabeth for the repayment of the charges she had been at for the defence of this republic in its infancy. Four miles east of Flushing; in N. Lat. 51. 34. E. Long. 4. 24.

RAMESES, in *Ancient Geography*, a town built by the Israelites during their bondage in Egypt, and from which the Exodus took place, and which must have been towards and not far from the Arabian gulf, seeing in the third station the Israelites arrived on its shore.

RAMESES, king of the Lower Egypt when Jacob went thither with his family, in the 1706th year before the Christian era. Ancient authors mention several other kings of Egypt of the same name; and it is thought that one of those princes erected in the temple of the sun at Thebes, the magnificent obelisk which the emperor Constantine caused to be removed to Alexandria

dria in the year 334; and that prince dying, his son Constantius had the obelisk transported from Alexandria to Rome in 352, where it was erected in the grand Circus. Its height was 132 feet. When the Goths sacked the city of Rome in 409, they overthrew this obelisk, which continued buried in the sand till the time of Sixtus V. in 1587, when it was found broken in three pieces; which being joined together, it was set up in the square of St John de Lateran. On the four sides of this wonderful obelisk are a number of figures and hieroglyphical characters, which, according to the explication of Ammianus Marcellinus, contain the praises of Rameses.

RAMIFICATION, the production of boughs or branches, or of figures resembling branches.

RAMILLIES, a small village of Brabant, in the Netherlands, 12 miles north of Namur, and 22 south-east of Brussels. Lat. 50. 51. Long. 4. 48. Famous for the battle fought by the allies commanded by the duke of Marlborough and M. d'Auverquirque, against that of the two crowns, commanded by the duke of Bavaria and Marshal Villeroy, the 22d of May 1706. See BRITAIN, N° 357.

The troops destined to compose the army of the allies being joined at the camp of Borchloon the 20th of May, halted the 21st. On the 22d the army marched from Borchloon in four columns, and posted itself the same day, with the right towards the mill of Quorem, extending with the left towards Blehen: from this camp was discovered the army of the two crowns, which was encamped with the left at Over-Espen, and the right towards the wood of Chapiaraux, Heylissem in their front, and Tirlemont in the rear. It was resolved the same day to march the next morning towards the plain of Meerdorp or Mierdau, to view the posture of the enemies, and determine what would be the most proper means of attacking them according to the movement they should make. To this end, an advanced guard of 600 horse and all the quarter-masters of the army were sent forward on the 23d at break of day.

The same morning about four, the army marched in eight columns toward the aforesaid plain. The advanced guard and the quarter masters arrived about eight at the height of Meerdorp or Mierdau; from whence the army of the enemy was seen in motion: a little after it was perceived that the enemy was marching through the plain of Mount St Andrew in four columns, of which information was given to the duke of Malborough and M. d'Auverquirque, who immediately repaired to the said height; and by the time these generals were arrived there, the head of the enemy's army already appeared at the tomb of Ottomont upon the causeway, near the Mehaigne; whereupon the duke of Marlborough and M. d'Auverquirque made the army advance with all expedition.

The enemy, as fast as they advanced, ranged in order of battle, with their right towards the tomb of Ottomont upon the Mehaigne, extending with their left to Autr'Eglise: having Tranquiers in front of the right, into which they had thrown several battalions of infantry and 14 squadrons of dragoons, who had dismounted their horses to support them. They had placed many of their infantry and a considerable part of their artillery in the village of Ramillies, which fronted the right of their main body, as well as into the village of Offuz, which fronted the left of their infantry, and into the village of Autr'Eglise, quite on their left. The front between the village of Ramillies and Autr'Eglise was covered by a small stream of water, which rendered the meadows in some places marshes, and also by several roads covered with hedges; which difficulties prevented our cavalry of the right wing from coming to action. As fast as the army of the allies arrived it was ranged in order of battle; with the left towards Bonnef, and the right towards Folz, and every thing was disposed in order to attack. To this end, four battalions were detached to attack the village of Franquenies, and 12 battalions to attack the village of Ramillies, which were to be supported by the whole infantry.

Our artillery began to cannonade the enemy at one; at about two, the attack began with the post of Franquenies, where our infantry had the good fortune to drive the enemy from the hedges, where they were advantageously posted, and at the same time all the cavalry of our left wing advanced to attack that of our enemy's right; soon after all was in action. Whilst the cavalry were engaged, the village of Ramillies was likewise attacked, and forced after a vigorous resistance.

The battle lasted about two hours, and was pretty obstinate; but so soon as our cavalry had gained ground enough to attack the enemy in flank, they began to give way; at the same time all their infantry were put in disorder, so that the whole retreated, in great confusion. The cavalry of their left wing formed a little upon the high ground, between Offuz and Mount St Andrew, to favour their retreat; but after the infantry and cavalry of our right wing had filed off between the bottom of the village of Ramillies and Offuz, the whole army marched in several columns to attack the enemy anew; but they gave way before we could come up with them, and retired in great confusion, some towards the defile of the abbey De la Ramée and towards Dongelberge, others towards Judogne, and others again towards Hougarde. They were pursued all night so closely that they were obliged to abandon all their artillery and baggage, part of which was found at Judogne and at Hougarde, with their chests of ammunition.

The enemy lost above 30,000 men, 60 cannon, eight mortars, standards, colours, baggage, &c.; we about 3000. The rest of the campaign was spent in the sieges of Ostend, Menin, and Aeth. In fourteen days the duke defeated and dispersed the best appointed army the French ever had, and recovered all Spanish Brabant, the marquisite of the holy Roman empire. The army of the enemy consisted of 76 battalions and 142 squadrons, including the king's houshold troops (*La Maison du Roi*); and the army of the allies was 74 battalions and 123 squadrons. Considering the importance of the victory, the loss of the allies was very small, not above 1100 being killed, and 2600 wounded.

RAMISSERAM, a small island about 20 miles from that of Manaar, and the nearest channel of communication between Ceylon and the continent of India. When Mr Cordiner and his companions landed here in 1804, they entered the nearest *choultry*, or place erected for the accommodation of strangers, half a mile beyond which is the grand pagoda, or temple of Shivven, having nothing remarkable in its external appearance, when seen from a distance; but on a nearer inspection it is almost impossible to describe the ornaments and laboured workmanship

workmanship that strike the eye. Yet these are far outdone by the magnificence of the interior parts of the pagoda. Upon this island there are great numbers of small horses, constantly employed in conveying travellers and in transporting goods.

After dinner a number of brahmins with five well dressed dancing girls waited upon Mr Cordiner and his companions at the choultry, who very agreeably amused and entertained them for upwards of an hour, and would have continued much longer, had they not been informed that they were at liberty to depart.

The men of this island are stout, and the females have something in their appearance very engaging; they are remarkably clean, and dress with great neatness. They are seen only by accident, for they keep out of the way of travellers with as much caution as possible. The ordinary dress of the brahmins consists only of a piece of muslin folded about the middle, and a string composed of nine threads is used as an ornament for the neck. They shave their heads quite bare, and in general wear them uncovered; but turbans and jackets are occasionally worn by some of them.

So abundant are black cattle on this small island, that it is no uncommon thing to see numbers of them lying in the streets, none of which are ever killed, the food of the inhabitants being entirely composed of milk and vegetable productions. The island being almost wholly covered with shrubs, is verdant and beautiful, yet no vestige of a corn field is to be met with, nor any other appearance of cultivation, if we except the large trees by which the roads are shaded, and a few groves of cocoa-nut trees. The nature of the soil in general is sandy, like that of Manaar, and the circumference of the whole island does not appear to exceed 20 miles. The houses on it are far superior to the ordinary dwellings of India; but the buildings sacred to divine worship, and the choultries for the accommodation of strangers, are truly magnificent, and must have been very expensive.

In a word, when Ramisseram is contrasted with the indigent and barren island of Manaar, only 20 miles distant, it must be pronounced rich, fruitful, and luxuriant, exhibiting so much liberty and plenty as warm the heart and kindle in the bosom of every beholder a lively flame of pleasure.

RAMLA, the modern name of Arimathea. See Arimathea.

RAMMER, an instrument used for driving down stones or piles into the ground; or for beating the earth, in order to render it more solid for a foundation.

Rammer of a Gun, the *Gun-stick;* a rod used in charging of a gun, to drive home the powder, as also the shot, and the wad which keeps the shot from falling out.

RAMPANT, in *Heraldry*, a term applied to a lion, leopard, or other beast that stands on its hind legs, and rears up his fore-feet in the posture of climbing, showing only half his face, as one eye, &c. It is different from saliant, in which the beast seems springing forward as if making a sally.

RAMPART, in *Fortification*, is an elevation of the earth round a place capable of resisting the cannon of an enemy; and formed into bastions, curtains, &c.

RAMPHASTOS, the Toucan. See Rhamphastos, Ornithology *Index*.

RAMSAY, Allan, a Scottish poet, was born at Leadhills in Lanarkshire, in October 1686. His father was employed in the management of Lord Hopeton's mines at that place; but died while the poet was yet in his infancy, in consequence of which and the marriage of his mother soon after his father's death, it seems probable that during the earlier part of his life he continued in rather a destitute situation. He remained at Leadhills till he reached his fifteenth year, and as we have been assured by the relations of some very old persons who were the contemporaries of Ramsay, and who died not many years ago, he was employed in washing, preparing the lead ore for smelting, and other operations about the works in which the children of miners and young persons are usually occupied. The period of his residence on his native spot is fixed by himself in the following descriptive verses, which are part of a petition addressed to a Club in Edinburgh to be admitted a member.

> Of Crawford Moor, born in Leadhill,
> Where mineral springs Glengoner fill,
> Which joins sweet-flowing Clyde.——
> Native of Clydesdale's upper ward,
> Bred fifteen summers there.

The extent of Ramsay's education, it may well be presumed, did not exceed what he could derive from the parish schoolmaster; and even the acquisition of what little could thus be obtained, from the circumstances that attended his early life, must have been often and greatly interrupted.

In 1701, when he was in his 15th year he was bound apprentice to a wigmaker in Edinburgh, and it appears from the record of his children's birth in the parish register that he continued in the same humble profession till the year 1716: for in that register his designation is wigmaker. One of the earliest of Ramsay's productions now known, an address to the most happy members of the Easy Club, appeared in 1712, when he was 26 years of age, and three years after he was humorously appointed their poet laureat. Many of his poems about this time were published in the form of separate pamphlets. When he had followed the occupation of a wigmaker for a considerable time, he at last abandoned it for that of a bookseller, as being more congenial to the literary turn of his mind. His detached pamphlets were afterwards published by him in the year 1721, in one volume 4to, which was encouraged by a very liberal subscription. It was advertised as follows in the Edinburgh Evening Courant. "The Poems of Allan Ramsay, in a large quarto volume; fairly printed, with notes, and a complete glossary (as promised to the subscribers), being now finished; all who have generously contributed to carrying on of the design, may call for their copies as soon as they please, from the author, at the Mercury, opposite to Niddry's wynd, Edinburgh." The first volume of his well known collection, "The Tea-table Miscellany," was published in 1724, after which a second volume soon made its appearance; a third in 1727, and a fourth after another interval of time. He soon after published what is called the Evergreen, being a collection of Scots poems written by the ingenious prior to the year 1600. In 1725 appeared his Gentle Shepherd, part of which, called Patie and Roger, was printed in 1721, and Jenny and Meggy in 1723, the great success of

Ramsay. of which induced him to form them afterwards into a regular drama.

In the year 1728, he published a second volume of his poems, which was afterwards reprinted in 8vo. These performances so rapidly enlarged the circle of his fame and reputation, that in 1731, an edition of his poetical works was published by the booksellers of London, and two years after they appeared at Dublin. He held an extensive correspondence with cotemporary poets, among whom we find the facetious Hamilton of Gilbertfield, and the celebrated author of the Chace sent him two epistles. From his shop opposite to Niddry street, he removed to one at the east end of the Luckenbooths. In this shop he continued to sell and lend out books till he was far advanced in years; and we are informed that he was the first person who established a circulating library in Scotland. His collection of Fables appeared in 1730, after which period he may be said to have almost discontinued the occupation of an author.

Such, however, was his enterprising spirit, that he built, at his own expence, the first theatre for dramatical performances ever known in Edinburgh, which took place in what is called Carubber's close, in the year 1736; but he did not long enjoy his character of manager, for the magistrates of Edinburgh required him to shut it up, as an act of parliament prohibited all such amusements without a special licence and his majesty's letters patent. It is generally understood that he relinquished the trade of a bookseller about the year 1755, being then 69 years of age, and lived the remainder of his days in a small house erected by himself on the north side of the Castle-hill. A scorbutic complaint, attended with excruciating pain, deprived him of his teeth, and after corroding one of his jaw bones, put a period to his existence on the 7th of June 1758, in the 71st year of his age.

Ramsay possessed a considerable share of poetical genius: Of this his Gentle Shepherd, which will continue to be admired as long as the language in which it is written shall be understood, and especially by the natives of North Britain, to whom only the peculiarities of dialect by which it is distinguished can be familiar, affords the best proof. Some of his songs may contain farfetched allusions and childish conceits; but many of them are equal, if not superior for their pastoral simplicity, to productions of a similar nature in any other language. Some of the imitations of the ancients by this poet are extremely happy, in particular Horace's Ode, *Vides ut alta stet nive*, &c.; and some of his tales have all the excellencies of that species of composition. But of a great proportion of his other productions, it may be pronounced with truth that they are mere prosaic compositions, filled with the most common-place observations, and destitute even of the ornament of smooth versification and correct rhymes.

Ramsay, *Andrew Michael*, generally known by the name of the *Chevalier Ramsay*, was a polite Scots writer, born of a good family at Ayr in 1686. His good parts and learning recommended him to be tutor to the son of the earl of Wemyss; after which, conceiving a disgust at the religion in which he had been educated, he in the same ill humour reviewed other Christian churches; and, finding none to his liking, rested for a while in Deism. While he was in this uncertain state of mind, he went to Leyden; where, falling into the company of one Poiret a mystic divine, he received the infection of mysticism: which prompted him to consult M. Fenelon, the celebrated archbishop of Cambray, who had imbibed principles of the same nature; and who gained him over to the Catholic religion in 1709. The subsequent course of his life received its direction from his friendship and connections with this prelate; and being appointed governor to the duke de Chateau Thierry, and the prince de Turenne, he was made a knight of the order of St Lazarus. He was sent for to Rome by the chevalier de St George, to undertake the education of his children; but he found so many intrigues and dissensions on his arrival there in 1724, that he obtained the chevalier's leave to return to Paris. He died in 1743, in the office of intendant to the duke of Bouillon, prince de Turenne. The most capital work of his writing is the *Travels of Cyrus*, which has been several times printed in English.

Ramsay, *The Rev. James*, so justly celebrated for his philanthropy, was born on the 25th of July 1733, at Frasersburgh, a small town in the county of Aberdeen, North Britain. His descent was honourable, being, through his father, from the Ramsays of Melrose in Banffshire, and through his mother, from the Ogilvies of Purie in Angus. His parents were of characters the most respectable, but in circumstances by no means affluent. From his earliest years he discovered a serious disposition, and a strong thirst for knowledge; and after passing through the course of a Scotch grammar school education, he was inclined to pursue the studies requisite to fit him for the profession of a clergyman; an inclination with which the wishes of his mother, a woman of eminent piety, powerfully concurred. Several circumstances, however, conspired to divert him for a time from his favourite pursuit.

He was educated in the episcopal persuasion; and having been unhappy enough to lose his father while yet very young, he found, upon his advancing towards the state of manhood, that the joint fortunes of himself and his mother could not bear the expence of a regular education in either of the universities of Oxford or Cambridge, which he doubtless thought absolutely necessary to one who aspired to respectability in the church of England. Yielding therefore to necessity, he resolved to study surgery and pharmacy; and was with this view bound apprentice to Dr Findlay, a physician (A) in Frasersburgh. But though obliged to relinquish for a time his favourite studies, he did not think ignorance excusable in a surgeon more than in a clergyman, or conceive that he could ever become eminent in the profession in which circumstances had placed him, merely by skill in setting a bone or compounding a medicine. He determined therefore, with the full approbation of his master, who

(A) In the remote towns of Scotland the same man generally acts in the triple capacity of physician, surgeon, and apothecary.

Ramsay.

who very soon discovered his talents for literature, to make himself acquainted with at least the outlines of the liberal arts and sciences; and with this view he repaired in 1750 to the King's College and university of Aberdeen, where he obtained one of the *bursaries* or *exhibitions* which are there annually bestowed upon such candidates for them as display the most accurate knowledge of the Latin language. The small sum of five pounds, however (which none of these bursaries exceed), was still inadequate to the expence of residence in college; but our young student was soon to obtain a more valuable exhibition, and to obtain it likewise by his own merit.

During the long vacation he returned to his master Dr Findlay, and was by him intrusted with a very desperate case in surgery, of which his management may be said to have laid the foundation of his future fortunes. A female servant of one of the judges of the Court of Session, who, when the court was not sitting, resided in the neighbourhood of Frasersburgh, had been so dreadfully gored by a bull, that hardly any hopes were entertained of her recovery; but Mr Ramsay, to whose care she was entirely left, treated the wound with such skilful attention, that, contrary to general expectation, his patient recovered. This attracted the judge's notice, who having informed himself of the young man's circumstances and character, recommended him so effectually to Sir Alexander Ramsay of Balmain, that he presented him with a bursary of 15 pounds a-year, which commenced at the next *session* or *term*, in the same college.

He now prosecuted his studies with comfort: and though he was detained in college a year longer than is usual, being obliged, upon his acceptance of a second bursary, to begin his course anew, he always considered this as a fortunate circumstance, because it gave him the celebrated Dr Reid three years for his preceptor. To that great and amiable philosopher he so recommended himself by his talents, his industry, and his virtues, that he was honoured with his friendship to the day of his death. Nor was it only to his masters that his conduct recommended him; Sir Alexander Ramsay, whom he visited during some of the vacations, was so well pleased with his conversation, that he promised him another bursary, in his gift, of 25l. a-year, to commence immediately on the expiration of that which he enjoyed. This promise he performed in the beginning of the year 1755; and at the solicitation of Dr Findlay, even paid the money per advance to enable the exhibitioner to travel for the purpose of improving himself in his profession.

Thus provided, Mr Ramsay went to London, and studied surgery and pharmacy under the auspices of Dr Macaulay; in whose family he lived for two years, caressed and esteemed both by him and by his lady. Afterwards, having passed the usual examination at Surgeons-hall, he served in his medical capacity for several years in the royal navy; but how long he was continued in the station of a mate, or when and by whom he was first appointed surgeon, we have not been able to learn. We can say, however, upon the best authority, that by his humane and diligent discharge of his duty in either station, he endeared himself to the seamen, and acquired the esteem of his officers.

Of his humanity there is indeed one memorable instance, which must not be omitted. Whilst he acted as surgeon of the Arundel, then commanded by Captain (now Vice-admiral Sir Charles) Middleton, a slave-ship on her passage from Africa to the West Indies fell in with the fleet to which the Arundel belonged. An epidemical distemper, too common in such vessels, had swept away not only a great number of the unfortunate negroes, but also many of the ship's crew, and among others the surgeon. In this distressed situation the commander of the Guinea ship applied to the English commodore for medical assistance; but not a surgeon or surgeon's mate in the whole fleet, except Mr Ramsay, would expose himself to the contagion of so dangerous a distemper. Prompted, however, by his own innate benevolence, and fully authorised by his no less benevolent commander, the surgeon of the Arundel, regardless of personal danger, and trusting in that God to whom mercy is more acceptable than sacrifice, went on board the infected ship, visited all the patients, and remained long enough to leave behind him written directions for their future treatment. If a cup of cold water given in charity be entitled to a reward, how much more such an action as this? But the rewards of Christianity are not immediate. Mr Ramsay indeed escaped the contagion; but on his return to his own ship, just as he had got on the deck, he fell and broke his thigh-bone; by which he was confined to his apartment for ten months, and rendered in a small degree lame through the remainder of his life.

The fearless humanity which he displayed on this occasion gained him the friendship and esteem of Sir Charles Middleton, which no future action of his life had the smallest tendency to impair; but the fracture of his thigh-bone and his subsequent lameness determined him to quit the navy, and once more turn his thoughts towards the church. Accordingly, while the Arundel lay at St Christopher's, he opened his views to some of the principal inhabitants of that island, by whom he was so strongly recommended to the bishop of London, that on his coming home with Sir Charles Middleton, who warmly joined in the recommendation, he was admitted into orders; after which he immediately returned to St Christopher's, where he was presented by the governer to two rectories, valued at 700l. a-year.

As soon as he took possession of his livings, in 1763, he married Miss Rebecca Akers, the daughter of a planter of the best family-connections in the island, and began to regulate his household on the pious plan inculcated in his *Essay on the Treatment and Conversion of the African Slaves in the British Sugar Colonies*. He summoned all his own slaves daily to the prayers of the family, when he took an opportunity of pointing out to them their duty in the plainest terms, reproving those that had done amiss, and commending such as had shown any thing like virtue; but he confessed that his occasions for reproof were more frequent than for commendation. As became his office and character, he inculcated upon others what he practised himself, and knew to be equally the duty of all. "On his first settlement as a minister in the West Indies, he made some public attempts to instruct slaves. He began to draw up some easy plain discourses for their instruction. He invited them to attend, on Sunday, at particular hours. He appointed hours at home to instruct such sensible slaves as

Ramsay. as would of themselves attend. He repeatedly exhorted their masters to encourage such in their attendance. He recommended the French custom, of beginning and ending work by prayer. But inconceivable is the listlessness with which he was heard, and bitter was the censure heaped on him in return. It was quickly suggested, and generally believed, that he wanted to interrupt the work of slaves, to give them time, forsooth, to say their prayers; that he aimed at the making of them Christians, to render them incapable of being good slaves. In one word, he stood, in opinion, a rebel convict against the interest and majesty of plantership. And as the Jews say, that in every punishment, with which they have been proved, since the bondage of Egypt, there has been an ounce of the golden calf of Horeb; so might he say, that in every instance of prejudice (and they were not a few) with which, till within a year or two of his departure from the country, he was exercised, there was an ounce of his fruitless attempts to improve the minds of slaves. In the bidding prayer, he had inserted a petition for the conversion of those persons. But it was deemed so disagreeable a momento, that several white people, on account of it, left off attending divine service. He was obliged to omit the prayer entirely, to try and bring them back. In short, neither were the slaves at that time desirous of being taught, nor were their masters inclined to encourage them."

That he was hurt by this neglect cannot be questioned, for he had a mind benevolent, warm, and irritable; but he still retained many friends amongst the most worthy members of the community; and as he was conscious of having done nothing more than his duty, he consoled himself with reflecting, that those are "blessed whom men revile, and persecute, and speak all manner of evil against falsely, for the sake of the gospel."

Although his serious studies were now theological, he considered himself as answerable to God, his country, and his own family, for a proper use of every branch of knowledge which he possessed. He therefore took the charge of several plantations around him in the capacity of a medical practitioner; and attended them with unremitting diligence, and with great success. Thus he lived till the year 1777, when relinquishing the practice of physic entirely, he paid a visit to the place of his nativity, which he had not seen since 1755. His mother, whose latter days he had made comfortable by a handsome annuity, had been dead for some years; but he rewarded all who had been attentive to her, or in early life serviceable to himself; and he continued the pension to a sister who had a numerous family, for which her husband was unable to provide.

After remaining three weeks in Scotland, and near a year in England, during which time he was admitted into the confidence of Lord George Germaine, secretary of state for the American department, Mr Ramsay was appointed chaplain to Admiral Barrington, then going out to take a command in the West Indies. Under this gallant officer, and afterwards under Lord Rodney, he was present at several engagements, where he displayed a fortitude and zeal for the honour of his country which would not have disgraced the oldest admiral. To the navy, indeed, he seems to have been strongly attached; and he wrote, at an early period of his life, an *Essay on the Duty and Qualifications of a Sea-officer*, with such a knowledge of the service as would have done honour to the pen of the most experienced commander. Of the first edition of this essay the profits were by its benevolent author appropriated to the Magdalen and British lying-in hospitals, as those of the second and third (which last was published about the period of which we now write) were to the maritime school, or, in the event of its failure, to the maritime society.

Although caressed by both the admirals under whom he served, and having such influence with the latter as to be able to render essential services to the Jews and other persons whom he thought harshly treated at the capture of St Eustatius, Mr Ramsay once more quitted the sea-service, and retired to his pastoral charge in the island of St Christopher's. There, however, though the former animosities against him had entirely subsided, and though his friendship was now solicited by every person of consequence in the island, he remained but a little while. Sick of the life of a planter and of the prospect of slavery around him, he resigned his livings, bade adieu to the island, and returned to England with his wife and family in the end of the year 1781. Immediately on his arrival, he was, through the interest of his steady friend Sir Charles Middleton, presented to the livings of Teston and Nettlestead in the county of Kent.

Here he was soon determined, by the advice of those whom he most respected, to publish an *Essay*, which had been written many years before, *on the Treatment and Conversion of African Slaves in the British Sugar Colonies*. The controversy in which this publication involved him, and the acrimony with which it was carried on, are so fresh in the memory of all our readers, that no man who thinks of the narrow limits within which our biographical articles must be confined, will blame us for not entering into a detail of the particulars.— Torrents of obloquy were poured upon the benevolent author by writers who were unfair enough to conceal their names; and it must be confessed, that his replies abounded with sarcasms, which the most rational friends to the cause which he supported would not have been sorry to see blotted from his pages. The provocation, however, which he received was great; and Mr Ramsay, though an amiable, virtuous, and pious man, had a warmth of temper, which, though not deserving of praise, will be censured by none who reflect on the frailties of our common nature. That the particular calumnies propagated against him on this occasion were wholly groundless, it is impossible to doubt, if we admit him to have been possessed of common understanding. When some years ago a story was circulated, of Swift's having, when prebendary of Kilroot, been convicted before a magistrate of an attempt to commit a rape on the body of one of his parishioners, it was thought a sufficient confutation of the calumny to put the retailer of it in mind, that the dean of St Patrick's, though detested by the most powerful faction in the kingdom, lampooned without dread, and with great severity, the dean of Ferns for the very crime, of which, had this anecdote been true, he must have been conscious that all Ireland knew himself to be guilty! Such conduct cannot be reconciled to common sense. Had Swift been a ravisher, though he might have been penitent, and reasoned in general terms against giving way to such licentious passions, he would never have satirised a

Ramsay, Ramsden's Machine.

a *particular person* for the crime of which he himself stood convicted. In like manner, had Mr Ramsay been a tyrant to his own slaves, though he might have argued against slavery in the abstract, on the broad basis of virtue and religion, he never could have arraigned for similar cruelty a number of individuals in the very island which witnessed his own enormities.

But the melancholy part of the narrative is behind. The agitation given to his mind by these calumnies, and the fatigues he underwent in his endeavours to rescue from misery the most helpless portion of the human race, contributed to shorten a life in no common degree useful. He had been for some time afflicted with a pain in his stomach, for which he was prevailed upon, though with great reluctance, to try the effects of air and exercise, by attempting a journey of 100 miles. But in London, being seized with a violent vomiting of blood, he was unable either to proceed or to be removed home; and in the house of Sir Charles Middleton he ended his days, on the 20th of July 1789, amidst the groans of his family, and the tears of many friends.—Thus died a man, of whom it is not too much to say, that "the blessing of many that were ready to perish came upon him;" for whatever be the fate of the slave-trade (see SLAVERY), it is certain that his writings have contributed much to meliorate the treatment of slaves. He left behind him a widow and three daughters: and his works, besides those to which we have alluded, consist of a volume of *Sea-sermons*, preached on board his majesty's ship the Prince of Wales, which show him to have been a master of true pulpit eloquence; and a *Treatise on Signals*, which was certainly written, and we think printed, though we know not whether it was ever published.

RAMSDEN's MACHINE *for Dividing* MATHEMATICAL INSTRUMENTS, is an invention by which these divisions can be performed with exceeding great accuracy, such as would formerly have been deemed incredible. On discovering the method of constructing this machine, its inventor, Mr Ramsden of Piccadilly, received 615l. from the commissioners of longitude; engaging himself to instruct a certain number of persons, not exceeding ten, in the method of making and using this machine from the 28th October 1775 to 28th October 1777: also binding himself to divide all octants and sextants by the same engine, at the rate of three shillings for each octant, and six shillings for each brass sextant, with Nonius's divisions to half minutes, for as long time as the commissioners should think proper to let the engine remain in his possession. Of this sum of 615l. paid to Mr Ramsden, 300l. was given him as a reward for the improvement made by him in discovering the engine, and the remaining 315l. for his giving up the property of it to the commissioners. The following description of the engine, is that given upon oath by Mr Ramsden himself.

"This engine consists of a large wheel of bell-metal, supported on a mahogany stand, having three legs which are strongly connected together by braces, so as to make it perfectly steady. On each leg of the stand is placed a conical friction pulley, whereon the dividing wheel rests: to prevent the wheel from sliding off the friction-pulleys, the bell-metal centre under it turns in a socket on the top of the stand.

"The circumference of the wheel is ratched or cut (by a method which will be described hereafter) into 2160 teeth, in which an endless screw acts. Six revolutions of the screw will move the wheel a space equal to one degree.

Ramsden's Machine.

Now a circle of brass being fixed on the screw arbor, having its circumference divided into 60 parts, each division will consequently answer to a motion of the wheel of 10 seconds, six of them will be equal to a minute, &c.

"Several different arbors of tempered steel are truly ground into the socket in the centre of the wheel. The upper parts of the arbors that stand above the plane are turned of various sizes, to suit the centres of different pieces of work to be divided.

"When any instrument is to be divided, the centre of it is very exactly fitted on one of these arbors; and the instrument is fixed down to the plane of the dividing wheel, by means of screws, which fit into holes made in the radii of the wheel for that purpose.

"The instrument being thus fitted on the plane of the wheel, the frame which carries the dividing-point is connected at one end by finger-screws with the frame which carries the endless screw; while the other end embraces that part of the steel arbor, which stands above the instrument to be divided, by an angular notch in a piece of hardened steel; by this means both ends of the frame are kept perfectly steady and free from any shake.

"The frame carrying the dividing-point, or tracer, is made to slide on the frame which carries the endless screw to any distance from the centre of the wheel, as the radius of the instrument to be divided may require, and may be there fastened by tightening two clamps; and the dividing-point or tracer being connected with the clamps by the double-jointed frame, admits a free and easy motion towards or from the centre for cutting the divisions, without any lateral shake.

"From what has been said, it appears, that an instrument thus fitted on the dividing-wheel may be moved to any angle by the screw and divided circle on its arbor, and that this angle may be marked on the limb of the instrument with the greatest exactness by the dividing-point or tracer, which can only move in a direct line tending to the centre, and is altogether freed from those inconveniencies that attend cutting by means of a straight edge. This method of drawing lines will also prevent any error that might arise from an expansion or contraction of the metal during the time of dividing.

"The screw-frame is fixed on the top of a conical pillar, which turns freely round its axis, and also moves freely towards or from the centre of the wheel, so that the screw-frame may be entirely guided by the frame which connects it with the centre: by this means any excentricity of the wheel and arbor would not produce any error in the dividing; and, by a particular contrivance (which will be described hereafter), the screw when pressed against the teeth of the wheel always moves parallel to itself; so that a line joining the centre of the arbor and the tracer continued, will always make equal angles with the screw. Plate CCCCLIX.

"Figure 1. represents a perspective view of the engine. Plate CCCCLX.

"Fig. 2. is a plan, of which fig. 3. represents a section on the line ΠA. Fig. 1.

"The large wheel A is 45 inches in diameter, and has

Ramsden's Machine. has ten radii, each being supported by edge-bars, as represented in fig. 3. These bars and radii are connected by the circular ring B, 24 inches in diameter and three deep; and for greater strength, the whole is cast in one piece in bell-metal.

"As the whole weight of the wheel A rests on its ring B, the edge-bars are deepest where they join it; and from thence their depth diminishes, both towards the centre and the circumference, as represented in fig. 3.

"The surface of the wheel A was worked very even and flat, and its circumference turned true. The ring C, of fine brass, was fitted very exactly on the circumference of the wheel; and was fastened thereon with screws, which, after being screwed as tight as possible, were well rivetted. (Fig. 3.) The face of a large chuck being turned very true and flat in the lathe, the flattened surface A of the wheel was fastened against it with holdfasts; and the two surfaces and circumferences of the ring C, a hole through the centre and the plane part round (*b*) it, and the lower edge of the ring B, were turned at the same time.

"D is a piece of hard bell-metal, having the hole, which receives the steel arbor *d*, made very straight and true. This bell-metal was turned very true on an arbor; and the face, which rests on the wheel at *b*, was turned very flat, so that the steel arbor *d* might stand perpendicular to the plane of the wheel: this bell metal was fastened to the wheel by six steel screws *l*.

"A brass socket Z is fastened on the centre of the mahogany stand, and receives the lower part of the bell-metal piece D, being made to touch the bell-metal in a narrow part near the mouth, to prevent any obliquity of the wheel from bending the arbor: good fitting is by no means necessary here; since any shake in this socket will produce no bad effect, as will appear hereafter when we describe the cutting frame.

Fig. 1, 2, and 3. "The wheel was then put on its stand, the lower edge of the ring B resting on the circumference of three conical friction-pulleys W, to facilitate its motion round its centre. The axis of one of these pulleys is in a line joining the centre of the wheel and the middle of the endless screw, and the other two placed so as to be at equal distances from each other.

Fig. 1. "F is a block of wood strongly fastened to one of the legs of the stand; the piece *g* is screwed to the upper side of the block, and has half holes, in which the (Fig. 4.) transverse axis *h* turns: the half holes are kept together by the screws *i*.

Fig. 1. & 4 "The lower extremity of the conical pillar P terminates in a cylindrical steel-pin *k*, which passes through (Fig. 4.) and turns in the transverse axis *h*, and is confined by a check and screw.

"To the upper end of the conical pillar is fastened (Fig. 4.) the frame G, in which the endless screw turns: the pivots of the screw are formed in the manner of two frustums of cones joined by a cylinder, as represented at X. These pivots are confined between half poles, (Fig. 5.) which press only on the conical parts, and do not touch the cylindric parts: the half holes are kept together by screws *a*, which may be tightened at any time, to prevent the screw from shaking in the frame.

Fig. 1, 2, 4, 5. "On the screw-arbor is a small wheel of brass K, having its outside edge divided into 60 parts, and numbered at every 6th division with 1, 2, &c. to 10. The motion of this wheel is shown by the index *y* on the screw-frame G.

"H represents a part of the stand, having a parallel (Fig. 4. & 5. Fig. 1.) slit in the direction towards the centre of the wheel, large enough to receive the upper part of the conical brass pillar P, which carries the screw and its frame: and as the resistance, when the wheel is moved by the endless screw, is against that side of the slit H which is towards the left hand, that side of the slit is faced with brass, and the pillar is pressed against it by a steel spring on the opposite side: by this means the pillar is strongly supported laterally, and yet the screw may be easily pressed from or against the circumference of the wheel, and the pillar will turn freely on its axis to take any direction given it by the frame L.

"At each corner of the piece I are screws *n* of (Fig. 4.) tempered steel, having polished conical points: two of them turn in conical holes in the screw frame near *o*, and the points of the other two screws turn in holes in the piece Q; the screws *p* are of steel, which being tightened, prevent the conical pointed screws from unturning when the frame is moved,

"L is a brass frame, which serves to connect the end- (Fig. 1, 2, 4.) less screw, its frame, &c. with the centre of the wheel: each arm of this frame is terminated by a steel screw, that may be passed through any of the holes *q* in the (Fig. 4.) piece Q, as the thickness of work to be divided on the wheel may require, and are fastened by the finger-nuts *r*. (Fig. 1. & 2.)

"At the other end of this frame is a flat piece of tempered steel *b*, wherein is an angular notch: when (Fig. 6.) the endless screw is pressed against the teeth on the circumference of the wheel, which may be done by turning the finger-screw S, to press against the spring *t*, (Fig. 1. & 2.) this notch embraces and presses against the steel arbor *d*. (Fig. 2.) This end of the frame may be raised or depressed by moving the prismatic slide *u*, which may be fixed at any height by the four steel screws *v*. (Fig. 1, 2, 6.)

"The bottom of this slide has a notch *k*, whose (Fig. 1. & 6.) plane is parallel to the endless screw; and by the point of the arbor *d* resting in this notch, this end of the (Fig. 3.) frame is prevented from tilting. The screw S is prevented from unturning, by tightening the finger-nut *w*. (Fig. 1, 2.)

"The teeth on the circumference of the wheel were cut by the following method:

"Having considered what number of teeth on the circumference would be most convenient, which in this engine is 2160, or 360 multiplied by 6, I made two screws of the same dimensions, of tempered steel, in the manner hereafter described, the interval between the threads being such as I knew by calculation would come within the limits of what might be turned off the circumference of the wheel: one of the screws, which was intended for ratching or cutting the teeth, was notched across the threads, so that the screw, when pressed against the edge of the wheel and turned round, cut in the manner of a saw. Then having a segment of a circle a little greater than 60 degrees, of about the same radius with the wheel, and the circumference made true, from a very fine centre, I described an arch near the edge, and set off the chord of 60 degrees on this arch. This segment was put in the place of the wheel, the edge of it was ratched, and the number of revolutions

Ramsden's Machine. revolutions and parts of the screw contained between the interval of the 60 degrees were counted. The radius was corrected in the proportion of 360 revolutions, which ought to have been in 60 degrees, to the number actually found; and the radius, so corrected, was taken in a pair of beam-compasses: while the wheel was on the lathe, one foot of the compasses was put in the centre, and with the other a circle was described on the ring; then half the depth of the threads of the screw being taken in dividers, was set from this circle outwards, and another circle was described cutting this point; a hollow was then turned on the edge of the wheel of the same curvature as that of the screw at the bottom of the threads: the bottom of this hollow was turned to the same radius or distance from the centre of the wheel, as the outward of the two circles before mentioned.

Fig. 3. "The wheel was now taken off the lathe; and the bell-metal piece D was screwed on as before directed, which after this ought not to be removed.

"From a very exact centre a circle was described Fig. 1, 2, 3. on the ring C, about four-tenths of an inch within where the bottom of the teeth would come. This circle was divided with the greatest exactness I was capable of, first into five parts, and each of these into three. These parts were then bisected four times: (that is to say) supposing the whole circumference of the wheel to contain 2160 teeth, this being divided into five parts, each would contain 432 teeth; which being divided into three parts, each of them would contain 144; and this space bisected four times would give 72, 36, 18, and 9: therefore each of the last divisions would contain nine teeth. But, as I was apprehensive some error might arise from quinquesection and trisection; in order to examine the accuracy of the divisions, I described another circle on Fig. 7. the ring C, one tenth of an inch within the former, and divided it by continual bisections, as 2160, 1080, 540 270, 135, $67\frac{1}{2}$, and $33\frac{1}{4}$; and as the fixed wire (to be described presently) crossed both the circles, I could examine their agreement at every 135 revolutions; (after ratching, could examine it at every $33\frac{1}{4}$): but, not finding any sensible difference between the two sets of divisions, I, for ratching, made choice of the former; and, as the coincidence of the fixed wire with an intersection could be more exactly determined than with a dot or division, I therefore made use of intersection in both circles before described.

Fig. 7. "The arms of the frame L were connected by a thin piece of brass of three-fourths of an inch broad, having a hole in the middle of four-tenths of an inch in diameter; across this hole a silver wire was fixed exactly in a line to the centre of the wheel; the coincidence of this wire with the intersections was examined by a lens seven-tenths of an inch focus, fixed in a tube which was attached to one of the arms L (A). Now a handle or winch being fixed on the end of the screw, the division marked on the end of the screw, the division marked 10 on the circle K was set to its index, and, by means of a clamp and adjusting screw for that purpose, the intersection marked 1 on the circle C was set exactly to coincide with the fixed wire; the screw was then carefully pressed against the circumference of the wheel, by turning the finger-screw S; then, removing the clamp, I turned the screw by its handle nine revolutions, till the intersection marked 240 came nearly to the wire; then, unturning the finger-screw S, I released the screw from the wheel, and turned the wheel back till the intersection marked 2 exactly coincided with the wire, and, by means of the clamp before mentioned, the division 10 on the circle being set to its index, the screw was pressed against the edge of the wheel by the finger-screw S; the clamps were removed, and the screw turned nine revolutions till the intersection marked 1 nearly coincided with the fixed wire; the screw was released from the wheel by unturning the finger-screw S, as before, the wheel was turned back till the intersection 3 coincided with the fixed wire; the division 10 on the circle being set to its index, the screw was pressed against the wheel as before, and the screw was turned nine revolutions, till the intersection 2 nearly coincided with the fixed wire, and the screw was released; and I proceeded in this manner till the teeth were marked round the whole circumference of the wheel. This was repeated three times round, to make the impression of the screw deeper. I then ratched the wheel round continually in the same direction without ever disengaging the screw; and, in ratching the wheel about 300 times round, the teeth were finished.

"Now it is evident, if the circumference of the wheel was even one tooth or ten minutes greater than the screw would require, this error would in the first instance be reduced to $\frac{1}{240}$ part of a revolution, or two seconds and a half; and these errors or inequalities of the teeth were equally distributed round the wheel at the distance of nine teeth from each other. Now, as the screw in ratching had continually hold of several teeth at the same time, and, these constantly changing, the above-mentioned inequalities soon corrected themselves, and the teeth were reduced to a perfect equality. The piece of brass which carries the wire was now taken away, and the cutting screw was also removed, and a plain one (hereafter described) put in its place: on one end of the screw is a small brass circle, having its edge divided into 60 equal parts, and numbered at every sixth division, as before mentioned. On the other end of the screw is a ratchet-wheel C, having 60 teeth, covered by the hollowed circle *d*, which carries two Fig. 5. clicks that catch upon the opposite sides of the ratchet when the screw is to be moved forwards. The cylinder S turns on a strong steel arbor F, which passes through and is firmly screwed to the piece Y: this piece, for greater firmness, is attached to the screw-frame G by the braces *v*; a spiral groove or thread Fig. 4. is cut on the outside of the cylinder S, which serves both for holding the string, and also giving motion to the lever J on its centre by means of a steel tooth *n*, that works between the threads of the spiral. To the lever is attached a strong steel pin *m*, on which a brass socket *r* turns: this socket passes through a slit in

(A) The intersections are marked for the sake of illustration, though properly invisible, because they lie under the brass plate.

Ramsden's Machine. in the piece p, and may be tightened in any part of the slit by the finger-nut f: this piece serves to regulate the number of revolutions of the screw for each tread of the treadle R.

Fig. 1. "T is a brass box containing a spiral string; a strong gut is fastened and turned three or four times round the circumference of this box, the gut then passes several times round the cylinder S, and from thence down to the treadle R. Now, when the treadle is pressed down, the string pulls the cylinder S round its axis, and the clicks catching hold of the teeth on the ratchet carry the screw round with it, till, by the tooth n working in Fig. 4. the spiral groove, the lever J is brought near the wheel d, and the cylinder stopped by the screw-head x striking on the top of the lever J; at the same time the spring is wound up by the other end of the gut passing round the box T. Now, when the foot is taken off the treadle, the spring unbending itself pulls back the cylinder, the Fig. 1. clicks leaving the ratchet and screw at rest till the piece t strikes on the end of the piece p: the number of revolutions of the screw at each tread is limited by the number of revolutions the cylinder is allowed to turn back before the stop strikes on the piece p.

"When the endless screw was moved round its axis with a considerable velocity, it would continue that mo- Fig. 1. & 4. tion a little after the cylinder S was stopped: to prevent this, the angular lever κ was made; that when the lever J comes near to stop the screw x, it, by a small chamfer, presses down the piece x of the angular lever; this brings the other end κ of the same lever forwards, and stops the endless screw by the steel pin μ striking upon the top of it; the foot of the lever is raised again by a small spring pressing on the brace v.

Fig. 1, 2, 6. "D, two clamps, connected by the piece α, slide one on each arm of the frame L, and may be fixed at pleasure by the four finger-screws ι, which press against steel springs to avoid spoiling the arms: the piece q is made to turn without shake between two conical pointed screws f, which are prevented from unturning by tightening the finger-nuts N.

Fig. 6. "The piece M is made to turn on the piece q by the conical pointed screws f resting in the hollow centers e.

"As there is frequent occasion to cut divisions on inclined planes, for that purpose the piece γ, in which the tracer is fixed, has a conical axis at each end, which turns in half holes: when the tracer is set to any inclination, it may be fixed there by tightening the steel screws β.

Description of the Engine by which the endless screw of the Dividing Engine was cut.

"Fig. 9. represents this engine of its full dimensions seen from one side.

"Fig. 8. the upper side of the same as seen from above.

"A represents a triangular bar of steel, to which the triangular holes in the pieces B and C are accurately fitted, and may be fixed on any part of the bar by the screws D.

"E is a piece of steel whereon the screw is intended to be cut; which, after being hardened and tempered, has its pivots turned in the form of two frustums of cones, as represented in the drawing of the dividing engine (fig. 5.). These pivots were exactly fitted to the half holes F and T, which were kept together by the screw Z. Ramsden's Machine, Ramsey.

"H represents a screw of untempered steel, having a pivot I, which turns in the hole K. At the other end of the screw is a hollow centre, which receives the hardened conical point of the steel pin M. When this point is sufficiently pressed against the screw, to prevent its shaking, the steel pin may be fixed by tightening the screws Y.

"N is a cylindric nut, moveable on the screw H; which, to prevent any shake, may be tightened by the screws O. This nut is connected with the saddle-piece P by means of the intermediate universal joint W, through which the arbor of the screw H passes. A front view of this piece, with the section across the screw arbor, is represented at X. This joint is connected with the nut by means of two steel slips S, which turn on pins between the cheeks T on the nut N. The other ends of these slips S turn in like manner on pins a. One axis of this joint turns in a hole in the cock b, which is fixed to the saddle-piece; and the other turns in a hole d, made for that purpose in the same piece on which the cock b is fixed. By this means, when the screw is turned round, the saddle-piece will slide uniformly along the triangular bar A.

"K is a small triangular bar of well-tempered steel, which slides in a groove on the saddle-piece P. The point of this bar or cutter is formed to the shape of the thread intended to be cut on the endless screw. When the cutter is set to take proper hold of the intended screw, it may be fixed by tightening the screw e, which presses the two pieces of brass G upon it.

"Having measured the circumference of the dividing-wheel, I found it would require a screw about one thread in a hundred coarser than the guide-screw H. The wheels on the guide-screw arbor H, and that on the steel E, on which the screw was to be cut, were proportioned to each other to produce that effect, by giving the wheel L 198 teeth, and the wheel Q 200. These wheels communicated with each other by means of the intermediate wheel R, which also served to give the threads on the two screws the same direction.

"The saddle-piece P is confined on the bar A by means of the pieces g, and may be made to slide with a proper degree of tightness by the screws n." See DIVIDING INSTRUMENTS, SUPPLEMENT.

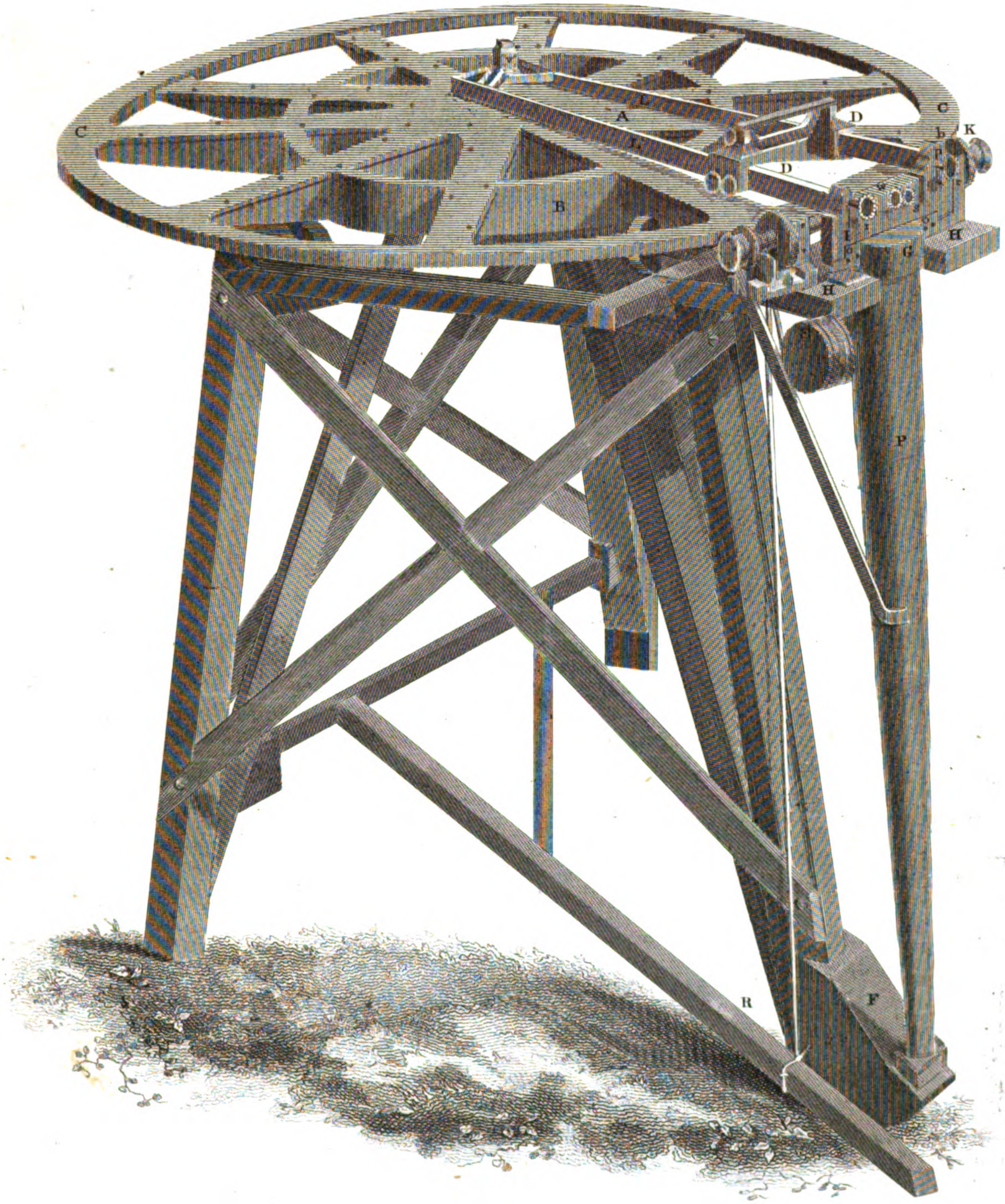
For Ramsden's equatorial or portable observatory, see OPTICS, N° 89. and ASTRONOMY, N° 364. See also a long account of an equatorial instrument made by Mr Ramsden by the direction of Sir George Shuckburgh in the Philosophical Transactions for 1793, art. x. p. 67. In this instrument the circle of declinations is four feet in diameter, and may be observed nearly to a second. The glass is placed between six pillars, which form the axis of the machine, and turn round by two pivots placed on two blocks of stone. See also BAROMETER.

RAMSEY, a town of Huntingdonshire, 68 miles north of London, and 12 north-east of Huntingdon. It is situated as it were in an island, being everywhere encompassed with fens, except on the west, where it is separated from the *terra firma* by a causeway for two miles. The neighbouring meers of Ramsey and Whitlesey, which are formed by the river Nyne, abound with fish, especially eel and large pikes. It was once famous for

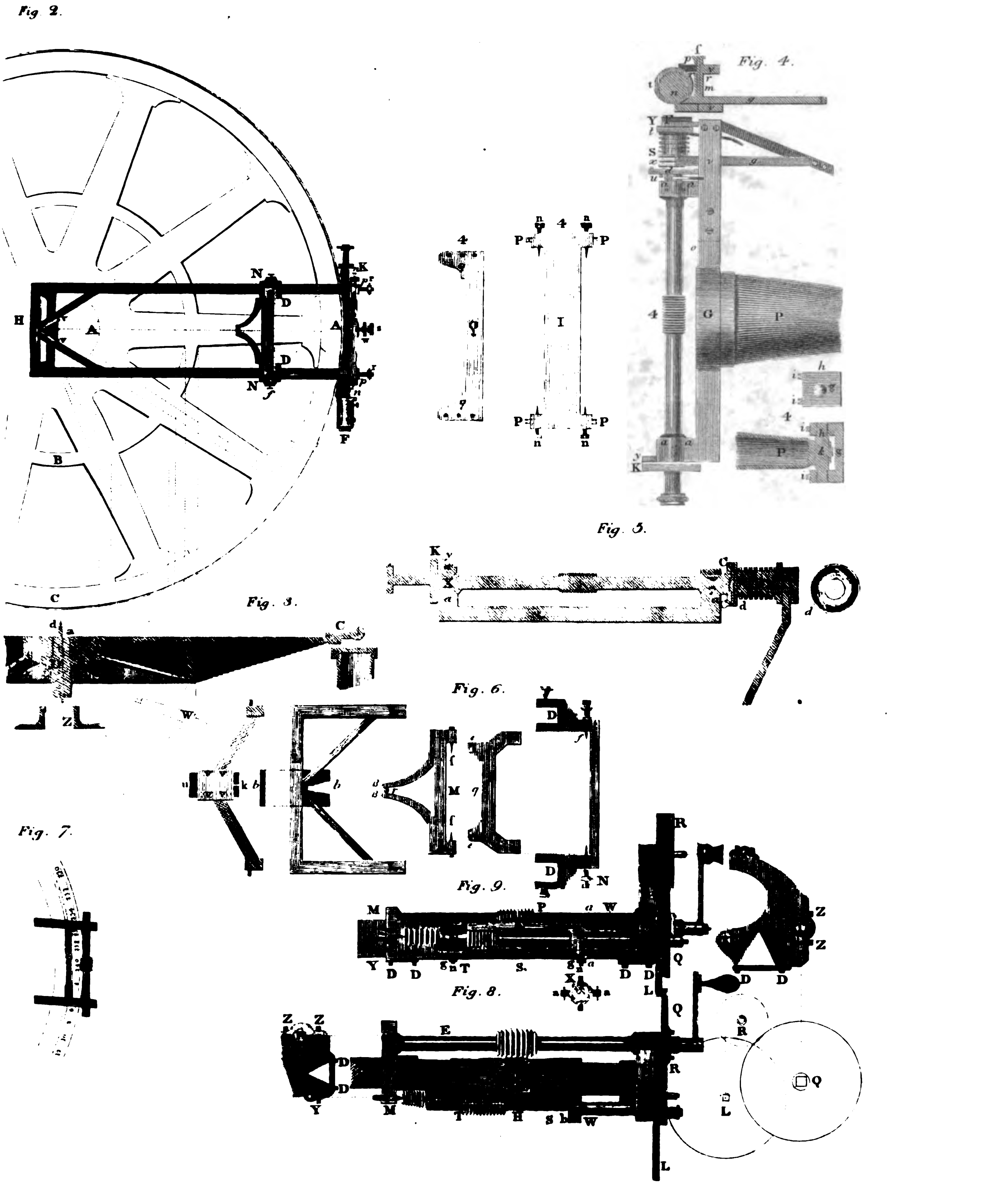
RAMSDEN'S MACHINE. PLATE CCCCLIX.

For dividing Mathematical Instruments.

Fig. 1.



F. Mitchell, sculp.t



E. Mitchell Sculp.

a very rich abbey, part of the gatehouse of which is still standing, and a neglected statue of Ailwin; the epitaph on whose tomb, which is reckoned one of the oldest pieces of English sculpture extant, styles him "kinsman of the famous King Edward, alderman of all England, and miraculous founder of this abbey." It was dedicated to St Dunstan, and its abbots were mitred and sat in parliament; and so many kings of England were benefactors to it, that its yearly rents, says Camden, were 7000l. The town was then called *Ramsey the Rich*; but by the dissolution of the abbey it soon became poor; and even lost its market for many years, till about 200 years ago it recovered it. It is held on Saturday, and is reckoned one of the most plentiful in England. In the year 1721 a great number of Roman coins was found here, supposed to have been hid by the monks on some incursion of the Danes. There is a charity school in the town for poor girls. In 1811 the number of inhabitants was 2390. W. Long. 0. 19. N. Lat. 52. 26.

Ramsey, an island of South Wales, on the coast of Pembrokeshire, about two miles in length, and a mile and a half broad. Near it are several small ones, known by the name of the *bishop and his clerks*. It is four miles west of St David's, and 17 north-east of Milfordhaven. It belongs to the bishopric of St David's, and was in the last age, says Camden, famous for the death of one Justinian, a most holy man, who retiring hither from Brittanny, in that age rich in saints, and devoting himself entirely to God, lived a long while in solitude, and being at last murdered by his servant was enrolled among the martyrs. W. Long. 5. 20. N. Lat. 51. 55.

Ramsey, in the Isle of Man, to the north, a most noted and spacious haven, in which the greatest fleet may ride at anchor with safety enough from all winds but the north-east, and in that case they need not be embayed. This town standing upon a beach of loose sand, or shingle, is in danger, if not timely prevented, of being washed away by the sea.

RAMSGATE, a sea-port town of Kent, in the isle of Thanet, five miles from Margate, where a very fine pier has been lately built for the security of ships that come into the harbour, being seated near the Downs between the north and south Foreland, 10 miles north-east of Canterbury. The town is situated in the cove of a chalky cliff. It was formerly but an obscure fishing village, but since the year 1688 has been improved and enlarged by a successful trade to Russia and the east country. But what renders it most worthy of notice, is the new harbour, which is one of the most capacious in England, if not in Europe. It was begun in the year 1750, but delayed by various interruptions. It consists of two piers; that to the east is built wholly of Purbeck stone, and extends itself into the ocean near 800 feet before it forms an angle; its breadth on the top is 26 feet, including a strong parapet wall, which runs along the outside of it. The other to the west is constructed of wood as far as the low water mark, but the rest is of stone. The angles, of which there are five in each pier, consist of 160 feet each, with octagons at the end of 60 feet diameter, leaving an entrance of 200 feet into the harbour, the depth of which admits of a gradual increase of 18 to 36 feet. In 1811 the population was 4221. E. Long. 1. 30. N. Lat. 51. 22.

RAMTRUT, a deity worshipped by the Ranazins of Hindostan, where he has a celebrated temple at Onor.

He is represented as more resembling a monkey than a man.

RAMUS, in general, denotes a branch of any thing, as of a tree, an artery, &c. In the anatomy of plants it means the first or lateral branches, which go off from the petiolum, or middle rib of a leaf. The subdivisions of these are called *surculi*; and the final divisions into the most minute of all, are by some called *capillamenta*; but both kinds are generally denominated *surculus*.

Ramus, *Peter*, was one of the most famous professors of the 16th century. He was born in Picardy in 1515. A thirst for learning prompted him to go to Paris when very young, and he was admitted a servant in the college of Navarre. Spending the day in waiting on his masters, and the greatest part of the night in study, he made such surprising progress, that, when he took his master of arts degree, he offered to maintain a quite opposite doctrine to that of Aristotle. This raised him many enemies; and the two first books he published, *Institutiones Dialecticæ*, and *Aristotelicæ Animadversiones*, occasioned great disturbances in the university of Paris: and the opposition against him was not a little heightened by his deserting the Romish religion, and professing that of the Reformed. Being thus forced to retire from Paris, he visited the universities of Germany, and received great honours wherever he came. He returned to France in 1571, and lost his life miserably in the horrid massacre of St Bartholemew's day. He was a great orator, a man of universal learning, and endowed with very fine moral qualities. He published many books, which Teissier enumerates. Ramus's merit in his opposition to Aristotle, and his firmness in undermining his authority, is unquestionably great. But it has been doubted, and with much reason, whether he was equally successful in his attempts after a new logical institute. We have the following general outline of his plan in Dr Enfield's History of Philosophy. "Considering dialectics as the art of deducing conclusions from premises, he endeavours to improve this art, by uniting it with that of rhetoric. Of the several branches of rhetoric, he considers invention and disposition as belonging equally to logic. Making Cicero his chief guide, he divides his treatise on dialectics into two parts, the first of which treats of the invention of arguments, the second of judgments. Arguments he derives not only from what the Aristotelians call middle terms, but from any kind of proposition, which, connected with another, may serve to prove any assertion. Of these he enumerates various kinds. Judgments he divides into axioms, or self-evident propositions, *dianoëa*, or deductions by means of a series of arguments. Both these he divides into various classes; and illustrates the whole by examples from the ancient orators and poets.

"In the logic of Ramus, many things are borrowed from Aristotle, and only appear under new names; and many others are derived from other Grecian sources, particularly from the dialogues of Plato, and the logic of the Stoics. The author has the merit of turning the art of reasoning from the futile speculations of the schools to forensic and common use; but his plan is defective in confining the whole dialectic art to the single object of disputation, and in omitting many things, which respect the general culture of the understanding and the investigation of truth. Notwithstanding the defects of his system, we cannot, however, subscribe to the severe censure which has been passed upon Ramus by Lord Bacon and others; for much is, we think, due to him for having with so much firmness and perseverance asserted the natural freedom of the human understanding. The logic of Ramus obtained great authority in the schools of Germany, Great Britain, Holland, and France; and long and violent contests arose between his followers and those of the Stagyrite, till his fame vanished before that of Descartes."

RAN, in the old English writers, means open or public robbery, so manifest as not to be denied. Ran *dicitur aperta rapina quæ negari non potest*. Lamb. 125. Leg. Canut. cap. 58. Hence it is now commonly said of one who takes the goods of another injuriously and violently, that he has taken or snatched all he could *rap* and *ran*.

RANA, or RANULA. See RANULA.

RANA, the frog; a genus of reptiles belonging to the order of amphibia. See ERPETOLOGY *Index*.

RANAI, one of the Sandwich islands discovered by Captain Cook, is about nine miles distant from MOWEE and MOROTOI, and is situated to the south-west of the passage between these two isles. The country towards the south is elevated and craggy; but the other parts of the island had a better appearance, and seemed to be well inhabited. It abounds in roots, such as sweet potatoes, *taro*, and yams; but produces very few plantains and bread-fruit trees. The south point of Ranai is in the latitude of 20° 46′ north, and in the longitude of 203° 8′ east.

RANCID, denotes a fatty substance, that is become rank or musty, or that has contracted an ill smell by being kept close.

RANDIA, a genus of plants belonging to the pentandria class; and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

RANDOLPH, THOMAS, an eminent English poet in the 17th century, was born in Northamptonshire 1605. He was educated at Westminster and Cambridge, and very early distinguished for his excellent genius; for at about nine or ten years of age he wrote the History of the Incarnation of our Saviour in verse. His subsequent writings established his character, and gained him the esteem and friendship of some of the greatest men of that age, particularly of Ben Johnson, who adopted him one of his sons in the muses. He died in 1634, and was honourably interred. He wrote, 1. The Muses Looking-glass, a comedy. 2. Amyntas, or the Impossible Dowry, a pastoral, acted before the king and queen. 3. Aristippus, or the Jovial Philosopher. 4. The Conceited Pedlar. 5. The Jealous Lovers, a comedy. 6. Hey for Honesty, down with Knavery, a comedy; and several poems.

RANDOM SHOT, in *Gunnery*, is a shot made when the muzzle of a gun is raised above the horizontal line, and is not designed to shoot directly or point blank.

The utmost random of any piece is about ten times as far as the bullet will go point-blank The bullet will go farthest when the piece is mounted to about 45° above the level range. See GUNNERY and PROJECTILES.

RANGE, in *Gunnery*, the path of a bullet, or the line it describes from the mouth of the piece to the point where it lodges. If the piece lie in a line parallel to the horizon, it is called the *right* or *level range:* if it be mounted to 45°, it is said to have the *utmost range:* all others between 00 and 45° are called the *intermediate ranges*.

RANGER, a sworn officer of a forest, appointed by the king's letters patent; whose business is to walk through his charge, to drive back the deer out of the purlieus, &c. and to present all trespasses within his jurisdiction at the next forest court.

RANK, the order or place assigned a person suitable to his quality or merit.

RANK, is a straight line made by the soldiers of a battalion or squadron, drawn up side by side: this order was established for the marches, and for regulating the different bodies of troops and officers which compose an army.

RANK and Precedence, in the army and navy, are as follow:

Engineers RANK. Chief, as colonel; director, as lieutenant-colonel; sub-director, as major; engineer in ordinary, as captain; engineer extraordinary, as captain-lieutenant; sub-engineer, as lieutenant; practitioner engineer, as ensign.

Navy RANK. Admiral, or commander in chief of his majesty's fleet, has the rank of a field-marshal; admirals, with their flags on the main-top-mast-head, rank with generals of horse and foot; vice-admirals, with lieutenant-generals; rear-admirals, as major-generals; commodores, with broad pendants, as brigadier-generals; captains of post-ships, after three years from the date of their first commission, as colonels; other captains, as commanding post-ships, as lieutenant-colonels; captains, not taking post, as majors; lieutenants, as captains.

RANK between the Army, Navy, and Governors.

ARMY.	NAVY.	GOVERNORS.
General in Chief	Admiral in chief	Commander in chief of the forces in America
Generals of horse	Admiral with a flag at the main-top-mast	Captain-generals of provinces
Lieutenant-generals	Vice-admirals	Lieutenant-generals of provinces
Major-generals	Rear-admirals	Lieutenant-governors and presidents
Colonels	Post-captains of 3 years	Lieutenant-governors not commanding
Lieutenant-colonels	Post-captains	Governors of charter colonies
Majors	Captains	Deputy-governors
Captains	Lieutenants	Established by the king, 1760.

Doubling of the RANKS, is the placing two ranks in one, frequently used in the manœuvres of a regiment.

RANKS *and Files*, are the horizontal and vertical lines of soldiers when drawn up for service.

RANSOM, a sum of money paid for the redemption of a slave, or the liberty of a prisoner of war. In our law books, ransom is also used for a sum paid for the pardon of some great offence, and to obtain the offender's liberty.

RANULA, a tumor under a child's tongue, which, like a ligature, binders it from speaking or sucking.

RANUNCULUS, CROWFOOT; a genus of plants of the polygamia order, belonging to the polyandria class; and in the natural method ranking under the 26th order, *Multisiliquæ*. See BOTANY *Index*.

RAPACIOUS ANIMALS, are such as live upon prey.

RAPE, in *Law*, the carnal knowledge of a woman forcibly and against her will. This, by the Jewish law, was punished with death, in case the damsel was betrothed to another man: and, in case she was not betrothed, then a heavy fine of fifty shekels was to be paid to the damsel's father, and she was to be the wife of the ravisher all the days of his life; without that power of divorce, which was in general permitted by the Mosaic law.

The civil law punishes the crime of ravishment with death and confiscation of goods: under which it includes both the offence of forcible abduction, or taking away a woman from her friends; and also the present offence of forcibly dishonouring her; either of which, without the other, is in that law sufficient to constitute a capital crime. Also the stealing away a woman from her parents or guardians, and debauching her, is equally penal by the emperor's edict, whether she consent or is forced. And this, in order to take away from women every opportunity of offending in this way; whom the Roman law suppose never to go astray without the seduction and arts of the other sex; and therefore, by restraining and making so highly penal the solicitations of the men, they meant to secure effectually the honour of the women. But our English law does not entertain quite such sublime ideas of the honour of either sex, as to lay the blame of a mutual fault upon one of the transgressors only; and therefore makes it a necessary ingredient in the crime of rape, that it must be against the woman's will.

Rape was punished by the Saxon laws, particularly those of King Athelstan, with death; which was also agreeable to the old Gothic or Scandinavian constitution. But this was afterwards thought too hard: and in its stead another severe, but not capital, punishment was inflicted by William the Conqueror, viz. castration and loss of eyes; which continued till after Bracton wrote, in the reign of Henry III. But in order to prevent malicious accusations, it was then the law, (and, it seems, still continues to be so in appeals of rape), that the woman should, immediately after, go to the next town, and there make discovery to some credible persons of the injury she has suffered; and afterwards should acquaint the high constable of the hundred, the coroners, and the sheriff with the outrage. This seems to correspond in some degree with the laws of Scotland and Arragon, which require that complaint must be made within 24 hours: though afterwards by statute Westm. 1. c. 13. the time of limitation in England was extended to 40 days. At present there is no time of limitation fixed: for, as it is usually now punished by indictment at the suit of the king, the maxim of law takes place, that "nullum tempus occurrit regi:" but the jury will rarely give credit to a stale complaint. During the former period also it was held for law, that the woman (by consent of the judge and her parents) might redeem the offender from the execution of his sentence, by accepting him for her husband; if he also was willing to agree to the exchange, but not otherwise.

In the 3 Edw. I. by the statute Westm. 1. c. 13. the punishment of rape was much mitigated: the offence itself, of ravishing a damsel within age (that is, twelve years old), either with her consent or without, or of any other woman against her will, being reduced to a trespass, if not prosecuted by appeal within 40 days, and subjecting the offender only to two years imprisonment, Rape.

ment, and a fine at the king's will. But this lenity being productive of the most terrible consequences, it was, in ten years afterwards, 13 Edw. I. found necessary to make the offence of forcible rape felony by statute Westm. 2. c. 34. And by statute 18 Eliz. c. 7. it is made felony without benefit of clergy: as is also the abominable wickedness of carnally knowing or abusing any woman-child under the age of ten years; in which case the consent or non-consent is immaterial, as by reason of her tender years she is incapable of judgment and discretion. Sir Matthew Hale is indeed of opinion, that such profligate actions committed on an infant under the age of twelve years, the age of female discretion by the common law, either with or without consent, amount to rape and felony; as well since as before the statute of Queen Elizabeth: but that law has in general been held only to extend to infants under ten; though it should seem that damsels between ten and twelve are still under the protection of the statute Westm. 1. the law with respect to their seduction not having been altered by either of the subsequent statutes.

A male infant, under the age of fourteen years, is presumed by law incapable to commit a rape, and therefore it seems cannot be found guilty of it. For though in other felonies "malitia supplet ætatem;" yet, as to this particular species of felony, the law supposes an imbecility of body as well as mind.

The civil law seems to suppose a prostitute or common harlot incapable of any injuries of this kind: not allowing any punishment for violating the chastity of her, who hath indeed no chastity at all, or at least hath no regard to it. But the law of England does not judge so hardly of offenders, as to cut off all opportunity of retreat even from common strumpets, and to treat them as never capable of amendment. It therefore holds it to be felony to force even a concubine or harlot; because the woman may have forsaken that unlawful course of life: for, as Bracton well observes, "licet meretrix fuerit antea, certe tunc temporis non fuit, cum reclamando nequitiæ ejus consentire noluit."

As to the material facts requisite to be given in evidence and proved upon an indictment of rape, they are of such a nature, that though necessary to be known and settled, for the conviction of the guilty and preservation of the innocent, and therefore are to be found in such criminal treatises as discourse of these matters in detail, yet they are highly improper to be publicly discussed, except only in a court of justice. We shall therefore merely add upon this head a few remarks from Sir Matthew Hale, with regard to the competency and credibility of witnesses; which may, *salvo pudore*, be considered.

And, first, the party ravished may give evidence upon oath, and is in law a competent witness: but the credibility of her testimony, and how far forth she is to be believed, must be left to the jury upon the circumstances of fact that concur in that testimony. For instance: if the witness be of good fame; if she presently discovered the offence, and made search for the offender; if the party accused fled for it; these and the like are concurring circumstances, which give greater probability to her evidence. But, on the other side, if she be of evil fame, and stand unsupported by others; if she concealed the injury for any considerable time after she had opportunity to complain; if the place, where the fact was alleged to be committed, was where it was possible she might have been heard, and she made no outcry: these and the like circumstances carry a strong, but not conclusive, presumption that her testimony is false or feigned.

Rape, Raphael.

Moreover, if the rape be charged to be committed on an infant under 12 years of age, she may still be a competent witness, if she hath sense and understanding to know the nature and obligations of an oath, and, even if she hath not, it is thought by Sir Matthew Hale, that she ought to be heard without oath, to give the court information; though that alone will not be sufficient to convict the offender. And he is of this opinion, first, Because the nature of the offence being secret, there may be no other possible proof of the actual fact; though afterwards there may be concurrent circumstances to corroborate it, proved by other witnesses: and, secondly, Because the law allows what the child told her mother, or other relations, to be given in evidence, since the nature of the case admits frequently of no better proof; and there is much more reason for the court to hear the narration of the child herself, than to receive it at second-hand from those who swear they heard her say so. And indeed it seems now to be settled, that in these cases infants of any age are to be heard; and, if they have any idea of an oath, to be also sworn: it being found by experience, that infants of very tender years often give the clearest and truest testimony. But in any of these cases, whether the child be sworn or not, it is to be wished, in order to render her evidence credible, that there should be some concurrent testimony of time, place, and circumstances, in order to make out the fact; and that the conviction should not be grounded singly on the unsupported accusation of an infant under years of discretion. There may be therefore, in many cases of this nature, witnesses who are competent, that is, who may be admitted to be heard; and yet, after being heard, may prove not to be credible, or such as the jury is bound to believe. For one excellence of the trial by jury is, that the jury are triers of the credit of the witnesses, as well as of the truth of the fact.

"It is true (says this learned judge), that rape is a most detestable crime, and therefore ought severely and impartially to be punished with death; but it must be remembered, that it is an accusation easy to be made, hard to be proved, but harder to be defended by the party accused, though innocent." He then relates two very extraordinary cases of malicious prosecution for this crime, that had happened within his own observation; and concludes thus: "I mention these instances, that we may be the more cautious upon trials of offences of this nature, wherein the court and jury may with so much ease be imposed upon, without great care and vigilance; the heinousness of the offence many times transporting the judge and jury with so much indignation, that they are over-hastily carried to the conviction of the persons accused thereof, by the confident testimony of sometimes false and malicious witnesses."

RAPHAEL D'URBINO, the greatest, most sublime, and most excellent painter that has appeared, since the revival of the fine arts, was the son of an indifferent painter named *Sanzio*, and was born at Urbino on Good Friday

Friday 1482. The popes Julius II. and Leo X. who employed him, loaded him with wealth and honour; and it is said that Cardinal de St Bibiana had such a value for him, that he offered him his niece in marriage. His genius is admired in all his pictures; his contours are free, his ordonnances magnificent, his designs correct, his figures elegant, his expressions lively, his attitudes natural, his heads graceful; in fine, every thing is beautiful, grand, sublime, just, and adorned with graces. These various perfections he derived not only from his excellent abilities, but from his study of antiquity and anatomy; and from the friendship he contracted with Ariosto, who contributed not a little to the improvement of his taste. His pictures are principally to be found in Italy and Paris. That of the Transfiguration, preserved at Rome in the church of St Peter Monterio, passes for his masterpiece. He had a handsome person, was well proportioned, and had great sweetness of temper; was polite, affable, and modest. He, however, lived in the utmost splendour; most of the eminent masters of his time were ambitious of working under him; and he never went out without a crowd of artists and others, who followed him purely through respect. He was not only the best painter in the world, but perhaps the best architect too; on which account Leo X. charged him with building St Peter's church at Rome: but he was too much addicted to pleasure, which occasioned his death at 37 years of age. He left a great number of disciples; among whom were Julio Romano and John Francis Penni, who were his heirs. Many able engravers, as Raimondi, George Mantuan, and Bloemart, engraved after Raphael. See PAINTING.

RAPHAIM, or REPHAIM, (Moses), a name signifying *Giants*, as they really were, and an actual people too, situated in Basan or Batanea, beyond Jordan, separated from the Zanzummim by the river Jabbok. Also a valley near Jerusalem; Joshua x.

RAPHANUS, RADISH; a genus of plants belonging to the tetradynamia class; and in the natural method ranking under the 39th order, *Siliquosæ*. See BOTANY *Index;* and for the method of culture, see GARDENING.

RAPHANIDOSIS, a punishment inflicted at Athens upon adulterers. The manner of it was this: The hair was plucked off from the privities of the offenders, hot ashes laid upon the place, and a radish or mullet thrust up his fundament, as has been mentioned under ADULTERY. To this Juvenal alludes, Sat. x. ver. 317. *Quosdam mœchos et mugilis intrat.* Persons who had been thus punished were called ευπρωκτοι. The word *ruphanidosis* is derived from ραφανις, "a radish."

RAPHIDIA, a genus of insects, of the neuroptera order. See ENTOMOLOGY *Index*.

RAPIER, formerly signified a long old-fashioned sword, such as those worn by the common soldiers: but it now denotes a small sword, as contradistinguished from a back-sword.

RAPIN, RENE, a Jesuit and eminent French writer, was born at Tours in 1621. He taught polite literature in the society of the Jesuits with great applause, and was justly esteemed one of the best Latin poets and greatest wits of his time. He died at Paris in 1687. He wrote, 1. A great number of Latin poems, which have rendered him famous throughout all Europe; among which are his *Hortorum libri quatuor*, which is reckoned his masterpiece. 2. Reflections on Eloquence, Poetry, History, and Philosophy. 3. Comparisons between Virgil and Homer, Demosthenes and Cicero, Plato and Aristotle, Thucydides and Titus Livius. 4. The History of Jansenism. 5. Several works on religious subjects. The best edition of his Latin poems is that of Paris in 1723, in 3 vols. 12mo.

RAPIN *de Thoyras*, *Paul de*, a celebrated historian, was the son of James de Rapin lord of Thoyras, and was born at Castres in 1661. He was educated at first under a tutor in his father's house; and afterwards sent to Puylaurens, and thence to Samur. In 1679 he returned to his father, with a design to apply himself to the study of the law, and was admitted an advocate: but some time after, reflecting that his being a Protestant would prevent his advancement at the bar, he resolved to quit the profession of the law, and apply himself to that of the sword; but his father would not consent to it. The revocation of the edict of Nantes in 1685, and the death of his father, which happened two months after, made him resolve to come to England; but as he had no hopes of any settlement here, his stay was but short. He therefore soon after went to Holland, and listed himself in the company of French volunteers at Utrecht, commanded by M. Rapin his cousin-german. He attended the prince of Orange into England in 1688: and the following year the lord Kingston made him an ensign in his regiment, with which he went into Ireland, where he gained the esteem of his officers at the siege of Carrickfergus, and had soon a lieutenant's commission. He was present at the battle of the Boyne, and was shot through the shoulder at the siege of Limerick. He was soon after captain of the company in which he had been ensign; but, in 1693, resigned his company to one of his brothers, in order to be tutor to the earl of Portland's son. In 1699, he married Marianne Testard; but this marriage neither abated his care of his pupil, nor prevented his accompanying him in his travels. Having finished this employment, he returned to his family, which he had settled at the Hague; and here he continued some years. But as he found his family increase, he resolved to retire to some cheap country; and accordingly removed, in 1707, to Wesel, where he wrote his History of England, and some other pieces. Though he was of a strong constitution, yet 17 years application (for so long was he in composing the history just mentioned) entirely ruined his health. He died in 1725. He wrote in French, 1. A Dissertation on the Whigs and Tories. 2. His History of England, printed at the Hague in 1726 and 1727, in 9 vols 4to, and reprinted at Trevoux in 1728, in 10 vols 4to. This last edition is more complete than that of the Hague. It has been translated into English, and improved with Notes, by the reverend Mr Tindal, in 2 vols folio. This performance, though the work of a foreigner, is deservedly esteemed as the fullest and most impartial collection of English political transactions extant. The readers of wit and vivacity, however, may be apt to complain of him for being sometimes rather tedious and dull.

RAPINE, in *Law*, the taking away another's goods, &c. by violence.

RAPPERSWIL, a town of Swisserland, on the confines of the canton of Zurich, and of the territory of Gaster, with an old castle. It is strong by situation, being seated on a neck of land, which advances into the lake of Zurich, and over which there is a bridge 850 paces long. It is subject to the cantons of Zurich and Berne. E. Long. 8. 57. N. Lat. 47. 20.

RAPPOLSTEIN, a town of France in the department of Upper Rhine, which, before the revolution, had the title of a barony. All the musicians of Alsace likewise depended upon this baron, and were obliged to him a certain tribute, without which they could not play upon their instruments. E. Long. 7. 28. N. Lat. 48. 15.

RAPTURE, an ecstasy or transport of mind. See EXTASY.

RARE, in *Physics*, stands opposed to dense; and denotes a body that is very porous, whose parts are at a great distance from one another, and which is supposed to contain but little matter under a large bulk. See the following article.

RAREFACTION, in *Physics*, the act whereby a body is rendered rare; that is, brought to possess more room, or appear under a larger bulk, without accession of any new matter.—This is very frequently the effect of fire, as has long been universally allowed. In many cases, however, philosophers have attributed it to the action of a repulsive principle. However, from the many discoveries concerning the nature and properties of the electric fluid and fire, there is the greatest reason to believe, that this repulsive principle is no other than elementary fire. See REPULSION.

RAS-EL-FEEL, one of the frontier provinces of Abyssinia, of which the late celebrated traveller Mr Bruce was made governor while in that country. It is but of small extent, and in its most prosperous state contained only 39 villages. The climate is extremely hot, in Mr Bruce's opinion one of the hottest in the world. He informs us, that on the first day of March, at three o'clock in the afternoon, the thermometer stood at 114° in the shade, and in the evening at 82°; though at sunrise it had been no higher than 61. Notwithstanding this appearance of extreme heat, however, the sensation was by no means intolerable; they could hunt at midday, and felt the evenings rather cold. The soil is a fat, loose, black earth, which our author says is the same from 13° to 16° of north latitude; at least till we come to the deserts of Atbara, where the tropical rains cease. This country divides that of the Shangalla into two parts, nearly equal. These people inhabit a belt of land about 60 miles broad, all along the northern frontier of Abyssinia, excepting two large gaps or spaces which have been left open for the sake of commerce, and which are inhabited by strangers, to keep the Shangalla in awe. The latter trade in gold, which they pick up in the streams as it is washed down from the mountains; for there are no mines in their country, neither is there any gold in Abyssinia, excepting what is imported from this or some other country. The Shangalla are the natural enemies of the inhabitants of Ras-el-Feel, and much blood has been shed in the various incursions they have made upon one another; though of late those of Ras-el-Feel, by the assistance of the emperors, have been enabled to keep the Shangalla at bay.

RAS-SEM, a city of Tripoli in Barbary, concerning which a number of fables were told by the Tripoline ambassador, all of which were believed in England and other parts of Europe in the beginning of this century. (See *PETRIFIED City*). Mr Bruce informs us, that it is situated about five days journey south from Bengazi; but has no water excepting one fountain, which has a disagreeable taste and seems to be impregnated with alum. Hence it has obtained the name of *Ras-Sem*, or the fountain of poison. The only remains of antiquity in this place consist of the ruins of a tower or fortification, which, in the opinion of Mr Bruce, is as late as the time of the Vandals; but he says he cannot imagine what use they made of the water; and they had no other within two days journey of the place.—Here our traveller saw many of the animals called *jerboa*, a kind of mice; which, he says, seem to partake as much of the nature of a bird as of a quadruped.

RASAY, one of the Hebrides islands, is about 13 miles long and two broad. It contains 700 inhabitants, has plenty of limestone and freestone; feeds great numbers of black cattle; but has neither deers, hares, nor rabbits. The only appearance of a harbour in Rasay is at Clachan bay, where Mr Macleod the proprietor of the island resides. Rasay presents a bold shore, which rises to the height of mountains; and here the natives have, with incredible labour, formed many little corn fields and potato grounds. These heights decrease at the south end, where there are some farms and a good-looking country. Mr Macleod is sole proprietor of this island and of Rona and Fladda at the north end of it, which are only proper for grazing.

The house of Rasay is pleasantly situated near the south-west end of the island, which is the most level part of it. It has an extensive and excellent garden, and is surrounded with forest trees of considerable magnitude; another proof that trees will grow upon the edge of the sea, though it must be allowed that the channel here is narrow. Immediately behind the house of Rasay are the ruins of an ancient chapel, now used as the family burying-place.

RASCIANS, a poor oppressed people who dwelt on both sides of the Danube, and who, about the year 1594, being weary of the Turkish thraldom, first took 13 of their vessels upon that river; and then drawing together a body of 15,000 men between Bude and Belgrade, twice defeated the pâshâ of Temeswar with a body of 14,000 Turks. They afterwards took Baczkerek, four miles from Belgrade, and the castle of Ottadt; then laying siege to that of Beche, on the Theyssa, the old pâshâ of Temeswar marched to relieve it with 11,000 men; but the Rascians encountering them, slew near 10,000, and took 18 pieces of cannon. The consequence of this victory was the reduction of Wersetza and Lutz. Then, sending to the archduke for aid and gunners, they offered to put themselves and their country under the emperor's protection.

RASOR-BILL, a species of alca. See ALCA, ORNITHOLOGY *Index*.

RASOR-Fish, a genus of shell-fish. See SOLEN, CONCHOLOGY *Index*.

RASTALL, John, a printer and miscellaneous writer, was born in London, probably about the end of the 15th century, and educated at Oxford. Returning from the university, he settled in the metropolis, and commenced printer, "then esteemed (says Wood) a profession fit for any scholar or ingenious man." He married the

the sister of Sir Thomas More, with whom, we are told, he was very intimate, and whose writings he strenuously defended. From the title-page of one of his books, he appears to have lived in Cheapside, at the sign of the Mermaid. He died in the year 1536; and left two sons, William and John: the first of whom became a judge in Queen Mary's reign, and the latter a justice of peace. This John Rastall, the subject of the present article, was a zealous Papist; but Bale says that he changed his religion before his death. He wrote, 1. *Natura naturata.* Pits calls it a copious *(prolixa)* and ingenious comedy, describing Europe, Asia, and Africa; with cuts. What sort of a comedy this was, is not easy to conceive. Probably it is a cosmographical description, written in dialogue, and therefore styled a *comedy.* 2. The pastyme of the people; the cronycles of diverse realmys, and most especially of the realm of England, brevely compiled and emprinted in Cheapesyde, at the sign of the mearmaid, next Pollysgate, *cum privilegio*, fol. 3. *Ecclesia Johannis Rastall*, 1542, was one of the prohibited books in the reign of Henry VIII. 4. *Legum Anglicanarum vocabula explicata.* French and Latin. Lond. 1567, 8vo. And some other works.

RASTADT, a town of Germany, in the circle of Suabia and duchy of Baden, with a handsome castle. It is remarkable for a treaty concluded here between the French and imperialists in 1714; and near this place the French defeated the imperial troops in July 1796; in 1798 a congress was held here for the conclusion of a peace between France and Germany; but it broke up in 1799, when, not far from Rastadt, the French plenipotentiaries, on their return, were murdered by a party of Austrian hussars. See FRANCE, N° 501. Rastadt is seated on the river Merg, near the Rhine. E. Long. 8. 14. N. Lat. 48. 54.

RASTENBURG, a fine city in Prussia, on the Guber, surrounded with a wall, and since 1629 also with a rampart. It is 46 miles south-east of Koningsberg. E. Long. 21. 30. N. Lat. 54. 20.

RAT. See MUS, MAMMALIA *Index;* and for an account of the methods of destroying rats, see VERMIN, *Destruction of.*

RAT-Island, a small detached part of the island of Lundy, off the north coast of Devon. Though noted in Donn's map of the country, it is not worth mention here, but as giving opportunity to subjoin a farther notice of Lundy, which island was purchased a few years since by Mr Cleveland, M. P. for about 1200 guineas, who has a small villa on it: not more than 400 acres are cultivated: it is let altogether for 70l. a-year. The soil is good, though no trees will grow on the island. It has fine springs of water: the houses are seven: the inhabitants, men, women, and children, do not exceed 24. The bird called *murr*, whose eggs are very large and fine, the Lundy parrot, and rabbits, are the chief produce; these abound, and are taken for the feathers, eggs, and skins, principally. They have now (1794) 70 bullocks and 400 sheep, but the latter do not thrive. They pay no taxes: fishing skiffs often call with necessaries: the situation is very pleasant, and the rocks around, which are large, and partly granite, are wild and romantic. It had probably more inhabitants once, as human bones have been ploughed up. It has no place of worship, and no public-house; but strangers are always welcome. Eight cannon lie on the battlements on the top of a very steep precipice, under which is a curious cavern. Lord Gower, Mr Benson, and Sir J. B. Warren, K. B. have been former proprietors. See LUNDY.

RAT-Tails, or *Arrests.* See FARRIERY *Index.*

RATAFIA, a fine spirituous liquor, prepared from the kernels, &c. of several kinds of fruits, particularly of cherries and apricots.

Ratafia of cherries is prepared by bruising the cherries, and putting them into a vessel wherein brandy has been long kept; then adding to them the kernels of cherries, with strawberries, sugar, cinnamon, white pepper, nutmeg, cloves; and to 20 pounds of cherries 10 quarts of brandy. The vessel is left open 10 or 12 days, and then stopped close for two months before it be tapped. Ratafia of apricots is prepared two ways, viz. either by boiling the apricots in white wine, adding to the liquor an equal quantity of brandy, with sugar, cinnamon, mace, and the kernels of apricots; infusing the whole for eight or ten days; then straining the liquor, and putting it up for use: or else, by infusing the apricots, cut in pieces, in brandy, for a day or two, passing it through a straining bag, and then putting in the usual ingredients.

RATCH, or RASH, in clock-work, a sort of wheel having twelve fangs, which serve to lift up the detents every hour, and make the clock strike. See CLOCK.

RATCHETS, in a watch, are the small teeth at the bottom of the fusy or barrel, which stops it in winding up.

RATE, a standard or proportion, by which either the quantity or value of a thing is adjusted.

RATES, in the navy, the orders or classes into which the ships of war are divided, according to their force and magnitude.

The regulation which limits the rates of men of war to the smallest number possible, seems to have been dictated by considerations of political economy, or of that of the simplicity of the service in the royal dock-yards. The British fleet is accordingly distributed into six rates, exclusive of the inferior vessels that usually attend on naval armaments; as sloops of war, armed ships, bomb-ketches, fire-ships and cutters, or schooners, commanded by lieutenants.

Ships of the first rate mount 100 cannon, having 42-pounders on the lower deck, 24-pounders on the middle deck, 12-pounders on the upper deck, and 6-pounders on the quarter-deck and fore-castle. They are manned with 850 men, including their officers, seamen, marines, and servants.

In general, the ships of every rate, besides the captain, have the master, the boatswain, the gunner, the chaplain, the purser, the surgeon, and the carpenter; all of whom, except the chaplain, have their mates or assistants, in which are comprehended the sail-maker, the master at arms, the armourer, the captain's clerk, the gunsmith, &c.

The number of other officers is always in proportion to the rate of the ship. Thus a first-rate has six lieutenants, six master's mates, twenty-four midshipmen, and five surgeon's mates, who are considered as gentlemen: besides the following petty officers; quarter-masters and their mates, fourteen; boatswain's mates and yeomen, eight; gunner's mates and assistants, six; quarter-gunners, twenty-five; carpenter's mates, two, besides fourteen

Rates. fourteen assistants; with one steward and steward's mate to the purser.

If the dimensions of all ships of the same rate were equal, it would be the simplest and most perspicuous method to collect them into one point of view in a table: but as there is no invariable rule for the general dimensions, we must content ourselves with but a few remarks on ships of each rate, so as to give a general idea of the difference between them.

The Victory, one of the last built of our first rates, is 222 feet 6 inches in length, from the head to the stern; the length of her keel, 151 feet 3 inches; that of her gun-deck, or lower deck, 186 feet; her extreme breadth is 51 feet 10 inches; her depth in the hold, 21 feet 6 inches; her burden, 2162 tons; and her poop reaches 6 feet before the mizen-mast.

Ships of the second rate carry 90 guns upon three decks, of which those on the lower battery are 32-pounders; those on the middle, 18-pounders; on the upper-deck, 12-pounders; and those on the quarter-deck, 6-pounders, which usually amount to four or six. Their complement of men is 750, in which there are six lieutenants, four master's mates, 24 midshipmen, and four surgeon's mates, 14 quarter masters and their mates, eight boatswain's mates and yeomen, six gunner's mates and yeomen, with 22 quarter-gunners, two carpenter's mates, with 10 assistants, and one steward and steward's mate.

Ships of the third rate carry from 64 to 80 cannon, which are 32, 18, and 9 pounders. The 80-gun ships, however, begin to grow out of repute, and to give way to those of 74, 70, &c. which have only two whole batteries; whereas the former have three, with 28 guns planted on each, the cannon of their upper deck being the same as those on the quarter-deck and fore-castle of the latter, which are 9-pounders. The complement in a 74 is 650, and in a 64, 500 men; having, in peace, four lieutenants, but in war, five; and when an admiral is aboard six. They have three master's mates, 16 midshipmen, three surgeon's mates, 10 quarter-masters, and their mates, six boatswain's mates and yeomen, four gunner's mates and yeomen, with 18 quarter-gunners, one carpenter's mate, with eight assistants, and one steward and steward's mate under the purser.

Ships of the fourth rate mount from 60 to 50 guns, upon two decks, and the quarter-deck. The lower tier is composed of 24-pounders, the upper tier of 12-pounders, and the cannon on the quarter-deck and fore-castle are 6-pounders. The complement of a 50 gun ship is 350 men, in which there are three lieutenants, two master's mates, 10 midshipmen, two surgeon's mates, eight quarter-masters and their mates, four boatswain's mates and yeomen, one gunner's mate and one yeoman, with 12 quarter-gunners, one carpenter's mate and six assistants, and a steward and steward's mate.

All vessels of war, under the fourth rate, are usually comprehended under the general name of *frigates*, and never appear in the line of battle. They are divided into the 5th and 6th rates; the former mounting from 40 to 32 guns, and the latter from 28 to 20. The largest of the fifth rate have two decks of cannon, the lower battery being of 18-pounders, and that of the upper-deck of 9-pounders: but those of 36 and 32 guns have one complete deck of guns, mounting 12-pounders, besides the quarter-deck and fore-castle, which carry 6-pounders. The complement of a ship of 44 guns is 280 men; and that of a frigate of 36 guns, 240 men. The first has three, and the second two lieutenants; and both have two master's mates, six midshipmen, two surgeon's mates, six quarter-masters and their mates, two boatswain's mates, and one yeoman, one gunner's mate and one yeoman, with 10 or 11 quarter-gunners, and one purser's steward.

Frigates of the 6th rate carry 9-pounders, those of 28 guns having 3-pounders on their quarter-deck, with 200 men for their complement; and those of 24, 160 men: the former has two lieutenants, the latter, one; and both have two master's mates, four midshipmen, one surgeon's mate, four quarter-masters and their mates, one boatswain's mate and one yeoman, one gunner's mate and one yeoman, with six or seven quarter-gunners, and one purser's steward.

The sloops of war carry from 18 to 8 cannon, the largest of which have six-pounders; and the smallest, viz. those of 8 or 10 guns, four-pounders. Their officers are generally the same as in the 6th rates, with little variation; and their complements of men are from 120 to 60, in proportion to their force or magnitude. N. B. Bomb-vessels are on the same establishment as sloops; but fire-ships and hospital ships are on that of fifth-rates.

Nothing more evidently manifests the great improvement of the marine art, and the degree of perfection to which it has arrived in Britain, than the facility of managing our first rates; which were formerly esteemed incapable of government, unless in the most favourable weather of the summer.

Ships of the second rate, and those of the third, which have three decks, carry their sails remarkably well, and labour very little at sea. They are excellent in a general action, or in cannonading a fortress. Those of the third rate, which have two tiers, are fit for the line of battle, to lead the convoys and squadrons of ships of war in action, and in general to suit the different exigencies of the naval service.

The fourth-rates may be employed on the same occasions as the third-rates, and may be also destined amongst the foreign colonies, or on expeditions of great distance; since these vessels are usually excellent for keeping and sustaining the sea.

Vessels of the fifth rate are too weak to suffer the shock of a line of battle; but they may be destined to lead the convoys of merchant ships, to protect the commerce in the colonies, to cruize in different stations, to accompany squadrons, or be sent express with necessary intelligence and orders. The same may be observed of the sixth rates.

The frigates, which mount from 28 to 38 guns upon one deck, with the quarter-deck, are extremely proper for cruizing against privateers, or for short expeditions, being light, long, and usually excellent sailers.

RATEEN, or RATTEN, in commerce, a thick woollen stuff, quilled, woven on a loom with four treddles, like serges and other stuffs that have the whale or quilling. There are some rateens dressed and prepared like cloths; others left simply in the hair, and others where the hair or knap is frized. Rateens are chiefly manufactured in France, Holland, and Italy, and are

are mostly used in linings. The frize is a sort of coarse rateen, and the drugget is a rateen half linen half woollen.

RATIFICATION, an act of approving and confirming something done by another in our name.

RATIO, in *Arithmetic* and *Geometry*, is that relation of homogeneous things which determines the quantity of one from the quantity of another, without the intervention of a third.

The numbers, lines, or quantities, A and B, being proposed, their relation one to another may be considered under one of these two heads: 1. How much A exceeds B, or B exceeds A? And this is found by taking A from B, or B from A, and is called *arithmetic reason* or *ratio*. 2. Or how many times, or parts of a time, A contains B, or B contains A? and this is called *geometric reason* or *ratio*; (or, as Euclid defines it, it is the *mutual habitude*, or *respect*, of two magnitudes of the same kind, according to quantity; that is, as to how often the one contains, or is contained in, the other); and is found by dividing A by B, or B by A. And here note, that that quantity which is referred to another quantity is called the *antecedent of the ratio*: and that to which the other is referred is called the *consequent of the ratio*; as in the ratio of A to B, A is the antecedent, and B the consequent. Therefore any quantity, as antecedent, divided by any quantity as a consequent, gives the ratio of that antecedent to the consequent.

Thus the ratio of A to B is $\frac{A}{B}$, but the ratio of B to A is $\frac{B}{A}$; and, in numbers, the ratio of 12 to 4 is $\frac{12}{4}=3$, or triple; but the ratio of 4 to 12 is $\frac{4}{12}=\frac{1}{3}$, or subtriple.

And here note, that the quantities thus compared must be of the same kind; that is, such as by multiplication may be made to exceed one the other, or as these quantities are said to have a ratio between them, which, being multiplied, may be made to exceed one another. Thus a line, how short soever, may be multiplied, that is, produced so long as to exceed any given right line; and consequently these may be compared together, and the ratio expressed: but as a line can never, by any multiplication whatever, be made to have breadth, that is, to be made equal to a superficies, how small soever; these can therefore never be compared together, and consequently have no ratio or respect to one another, according to quantity; that is, as to how often the one contains, or is contained in, the other. See QUANTITY.

RATIOCINATION, the act of reasoning. See REASONING.

RATION, or RATIAN, in the army, a portion of ammunition, bread, drink, and forage, distributed to each soldier in the army, for his daily subsistence, &c. The horse have rations of hay and oats when they cannot go out to forage. The rations of bread are regulated by weight. The ordinary ration of a foot soldier is a pound and a half of bread per day. The officers have several rations according to their quality and the number of attendants they are obliged to keep.—When the ration is augmented on occasions of rejoicing, it is called a *double ration*. The ships crews have also their rations or allowances of biscuit, pulse, and water, proportioned according to their stock.

RATIONALE, a solution or account of the principles of some opinion, action, hypothesis, phenomenon or the like.

RATIBOR, a town of Prussian Silesia, and capital of a duchy of the same name, with a castle. It has been twice taken by the Swedes, and is seated on the river Oder, in a country fertile in corn and fruits, 15 miles north-east of Troppaw and 142 east of Prague. E. Long. 18. 10. N. Lat. 50. 14.

RATISBON, an ancient, large, handsome, and strong city of Germany, in Bavaria, with a bishop's see, whose bishop was a prince of the empire. It is called by the Germans Regensburg, from the river Regens, which runs under a fine stone bridge, and throws itself into the Danube below the city; and the rivers Luber and Nab mix with it above the city. The French call it Ratisbon, in imitation of the Latins; it was formerly subject to the kings of Bavaria, who made it the place of their residence; but it was declared free by the emperor Frederick I. and continued a free and imperial city till 1806, when it was united to the kingdom of Bavaria. It was the first city of the bench of Suabia, and contained within its walls five different free states of the empire; namely, the bishop, the abbot of St Emmeran, the abbesses of the Low and High Munster, and the city. The inhabitants of Ratisbon had the privilege not to be cited before other tribunals, unless for actions above 400 florins. The senate was composed of 17 members, and there was a council of 10, charged with the government of the state The Catholics have the exercise of their religion in the cathedral church and others, and the Lutherans in three churches which they have built. The magistrates and officers of the city are all Protestants; and it is to be remarked, that although there are about 22 Catholic churches, yet there are very few Catholic citizens, the magistracy not allowing the freedom of the town to be given to Catholics living there. As this city is large, elegant, and full of magnificent houses, it was chosen many years for the place of holding the diet, upon account of the conveniency, to many neighbouring princes and states, of sending their provisions by land and water, without great expence. The town-house, in the midst of which the diet met, is extremely magnificent. In the year 1740, however, when there was a war in Germany, the diet met at Frankfort on the Main, till after the death of the emperor Charles VII; and since the new constitution of Germany was established, the meetings of the diet have again been transferred to Frankfort. Provisions are very plentiful at Ratisbon in time of peace. The inhabitants have a good deal of trade, the river on which it stands being navigable, and communicating with a great part of Germany. It is 55 miles south-east of Nuremberg, 62 north of Munich, and 195 west of Vienna, and contains about 22,000 inhabitants. E. Long 12. 5. N. Lat. 48. 59.

RATLINES, or, as the sailors call them, *ratlins*, those lines which make the ladder steps to go up the shrouds and pattocks, hence called the *ratlins of the shrouds*.

RATOLFZEL,

RATOLFZEL, a strong town of Germany, in Suabia, near the west end of the lake Constance. It is seated on that part of it called *Bodensee*, and belongs to the house of Austria, who took it from the duke of Wirtemburg, after the battle of Nordlingen. It is 12 miles west of the city of Constance. It is defended by the impregnable castle of Hohen Dwel, on an inaccessible hill in the middle of a plain, the rock of which is flint, so that a few men may hold it out against an army.

RATTLESNAKE. See CROTALUS, OPHIOLOGY *Index*.

RATTLESNAKE Root. See POLYGALA, BOTANY *Index*.

RATZEBURG, or RATZEMBURG, an ancient town of Germany, in the circle of Lower Saxony, and in the duchy of Lawenburg, with a bishop's see and a castle. The town depends on the duchy of Lawenburg, and the cathedral church on that of Ratzeburg. It is seated on an eminence, and almost surrounded with a lake 25 miles in length and three in breadth. The duke of Lawenburg seized and fortified it in 1689, and the king of Denmark took it in 1693; but it was dismantled, and restored in 1700 to the duke, who refortified it. This town has been frequently pillaged, particularly in 1552, by Francis duke of Saxe Lawenburg, because the canons refused to elect his son Magnus their bishop. It is nine miles south of Lubec. This place is noted for its excellent beer. E. Long. 10. 58. N. Lat. 53. 47.

RAVA, a town of Poland, and capital of a palatinate of the same name, with a fortified castle, where they keep state prisoners. The houses are built of wood, and there is a Jesuit's college. It is seated in a morass covered with water, which proceeds from the river Rava, with which it is surrounded. It is 45 miles south of Blosko, and 50 south-west of Warsaw. The palatinate is bounded on the north by that of Blosko, on the east by that of Mazovia, on the south by that of Sandomer, and on the west by that of Lencieza.

RAVELIN, in *Fortification*, was anciently a flat bastion placed in the middle of a curtain; but now a detached work composed only of two faces, which make a salient angle without any flanks, and raised before the counterscarp of the place. See FORTIFICATION.

RAVEN. See CORVUS, ORNITHOLOGY *Index*.

Sea RAVEN, or *corvo marino* of Kongo in Africa, in *Ichthyology*, is about six feet long; but the most singular circumstance appertaining to this creature is the stone found in its head, to which the natives ascribe some medicinal virtues, and the delicate taste of its hard roe, which is still much admired, when dried in the sun, and becomes as hard as a stone.

RAVENGLAS, a town of Cumberland in England, situated between the rivers Irt and Esk, which, with the sea, encompass three parts of it. It is a well built place, and has a good road for shipping, which brings it some trade. E. Long. 0. 5. N. Lat. 54. 20.

RAVENNA, in *Ancient Geography*, a noble city of Gallia Cispadana; a colony of Thessalians, on the Adriatic, in washes or a boggy situation, which proved a natural security to it. The houses were all of wood, the communication by bridges and boats, and the town kept sweet and clean by the tides carrying away the mud and soil, (Strabo). Anciently it had a port at the mouth of the Bedesis; Augustus added a new port, capacious to hold a fleet, for the security of the Adriatic, between which and the city lay the Via Cæsaris. In the lower age it was the seat of the Ostrogoths for 72 years; but being recovered by Narses, Justinian's general, it became the residence of the exarchs, magistrates sent by the emperor from Constantinople, for 175 years, when it was taken by the Longobards. It is still called *Ravenna*, and is the capital of the province of Romagna in the states of the Church. It contains about 14,000 souls. The seat of the western or Roman empire was by Honorius translated to Ravenna about the year 404, and hence the country in which it stood was called *Romania*. It had a very flourishing trade till the sea withdrew two miles from it, which has been a great detriment. The fortifications are of little importance, and the citadel is gone to ruin. It is now most remarkable for the excellent wine produced in its neighbourhood. The mausoleum of Theodoric is still to be seen, remarkable for being covered by a single stone 28 feet in diameter and 15 thick. It was at Ravenna that the duke of Nemours fell, after having gained a most decisive victory over the confederate army, in 1511.

RAVENSBURG, a county of Germany, in Westphalia, bounded on the north by the bishoprics of Osnaburg and Minden, on the east by Lemgow, on the south by the bishopric of Paderborn, and on the west by that of Munster. It belongs to the king of Prussia, and has its name from the castle of Ravensburg. The population amounts to about 81,812.

RAVENSBURG, a town of Germany, formerly free and imperial, but now subject to Wirtemberg. It is well built, and the public structures are handsome. The inhabitants are partly Protestants and partly Papists. It is seated on the river Chenss, in E. Long. 9. 46. N. Lat. 47. 44.

RAVET, an insect shaped like a may-bug, or cockchafer, (see SCARABÆUS), with which the island of Guadaloupe is much pestered. It has a stinking smell, preys upon paper, books, and furniture, and whatever they do not gnaw is discoloured by their ordure. These nasty insects, which are very numerous, and appear chiefly by night, would be intolerable, were it not for a large spider, some of them as long as man's fist, which intangles them in its web, and otherwise surprises them. On which account the inhabitants of the island are very careful of these spiders.

RAVILLIAC, FRANCIS, the infamous assassin of Henry IV. of France, was a native of Angoulesme, and at the time of his execution was about one or two and thirty years of age. See FRANCE, N° 150, and HENRY IV. of France. Ravilliac was the son of parents who lived upon alms. His father was that sort of inferior retainer to the law, to which the vulgar give the name of a *pettifogger*, and his son had been bred up in the same way. Ravilliac had set up a claim to an estate, but the cause went against him; this disappointment affected his mind deeply: he afterwards taught a school, and, as himself said, received charitable gifts, though but of a very small value, from the parents of those whom he taught; and yet his distress was so great, that he had much ado to live. When he was seized for the king's murder, he was very loosely guarded; all were permitted to speak with him who pleased; and it was thought

Mod. Univ. Hist. vol xxi. p. 14. note A. &c.

thought very remarkable that a Jesuit should say to him, "Friend, take care, whatever you do, that you don't charge honest people." He was removed next day from the house of Espernon to the Conciergerie, the proper prison of the parliament of Paris. When he was first interrogated, he answered with great boldness, "That he had done it, and would do it if it were to do again." When he was told that the king, though dangerously wounded, was living, and might recover, he said that he had struck him home, and that he was sure he was dead. In his subsequent examinations he owned that he had long had an intention to kill the king, because he suffered two religions in his kingdom; and that he endeavoured to obtain an audience of him, that he might admonish him. He also said that he understood the king's great armament to be against the pope, and that, in his opinion, to make war against the pope, was to make war against God. We have no distinct account of the three last examinations; but he is said to have persisted in the most solemn asservations, that he had no accomplices, and that nobody had persuaded him to the fact. He appeared surprised at nothing so much as at the universal abhorrence of the people, which, it seems, he did not expect. They were forced to guard him strictly from his fellow-prisoners, who would otherwise have murdered him. The butchers of Paris desired to have him put into their hands, affirming that they would flay him alive, and that he should still live 12 days. When he was put to the torture, he broke out into horrid execrations, and always insisted that he did the fact from his own motive, and that he could accuse nobody. On the day of his execution, after he had made the *amende honourable* before the church of Notre Dame, he was carried to the Greve; and, being brought upon a scaffold, was tied to a wooden engine in the shape of a St Andrew's cross. The knife with which he did the murder being fastened in his right hand, it was first burnt in a slow fire; then the fleshy parts of his body were torn with red-hot pincers, and melted lead, oil, pitch, and rosin, poured into the wounds, and through a clay funnel into his bowels by the navel. The people refused to pray for him; and when, according to the sentence pronounced upon him, he came to be dragged to pieces by four horses, one of those that were brought appearing to be but weak, one of the spectators offered his own, with which the criminal was much moved: he is said to have then made a confession, which was so written by the greffier Voisin, that not so much as one word of it could ever be read. He was very earnest for absolution, which his confessor refused, unless he would reveal his accomplices; "Give it me conditionally (said he), upon condition that I have told the truth," which they did. His body was so robust, that it resisted the force of the horses; and the executioner was at length obliged to cut him into quarters, which the people dragged through the streets. The house in which he was born was demolished, and a column of infamy erected; his father and mother were banished from Angoulesme, and ordered to quit the kingdom upon pain of being hanged, if they returned, without any form of process; his brothers, sisters, uncles, and other relations, were commanded to lay aside the name of Ravilliac, and to assume some other. Such was the fate of this execrable monster, who, according to his own account, suffered himself to be impelled to such a fact by the seditious sermons and books of the Jesuits, whom Henry, rather out of fear than love, had recalled and caressed, and to whom he had bequeathed his heart.

Neither the dying words of Ravilliac, nor so much of his process as was published, were credited by his cotemporaries. Regalt the historian says, that there were two different opinions concerning this assassination; one, that it was conducted by some grandees, who sacrificed that monarch to their old resentments; the other, that it was done by the emissaries of the Spaniards. Letters from Brussels, Antwerp, Mechlin, and other places, were received before the 15th of May, with a report of the king's death. Though nothing occurs in the examinations of Ravilliac that were first published, in reference to his journeys to Naples and other places; yet as these are set down as certain truths by good authors, so there are probable grounds to believe that they were not fictitious. It appears from Sir Ralph Winwood's Memorials, that Ravilliac had been not long before at Brussels. Amongst other circumstances that created a very great doubt, whether the assassin spoke truth, were the things found in his pocket at the time he was seized; amongst which was a chaplet, the figure of a heart made in cotton, in the centre of which he said there was a bit of the true cross, but when cut there was none, which he affirmed was given him by a canon at Angoulesme, a piece of paper with the arms of France painted upon it, another full of characters, and a third containing verses for the meditation of a criminal going to execution. The provost of Pluviers, or Petiviers, in Beauce, about six miles from Paris, had said openly on the day that Henry IV. was murdered, "This day the king is either slain or dangerously wounded." After the king's death was known, he was seized and sent prisoner to Paris; but, before he was examined, he was found hanged in the strings of his drawers. His body was, notwithstanding, hung up by the heels on the common gibbet on the 19th of June. What increased the suspicions grounded on this man's end, was his having two sons Jesuits, and his being a dependant on the family of Monsieur d'Entragues.

RAUN, a town of some strength upon the river Miza, remarkable for a bloody skirmish between the Prussians and Austrians, in August 1744. The king of Prussia, intending to get possession of Beraun, sent thither six battalions, with eight cannon, and 800 hussars; but General Festititz being there with a great party of his corps, and M. Luchesi with 1000 horse, they not only repulsed the Prussians, but attacked them in their turn, and, after a warm dispute, obliged them to retire with considerable loss.

RAURICUM, in *Ancient Geography*, a town of the Raurici, situated over against Abnoba, a mountain from which the Danube takes its rise. A Roman colony led by L. Manutius Plancus the scholar and friend of Cicero: called *Colonia Rauriaca* (Pliny), *Raurica* (Inscription), *Augusta Rauricorum*. The town was destroyed in Julian's time. It is now commonly called *Augst*, a village greatly decayed from what it formerly was. It is situated on the Rhine, distant about two hours to the east of Basil. The country is now the canton of Basil.

RAY, JOHN, a celebrated naturalist, was the son of Mr Roger Ray a blacksmith, and was born at Black

Ray. Notly in Essex in 1628. He received the first rudiments of learning at the grammar-school at Braintree; and in 1644 was admitted into Catharine-Hall in Cambridge, from whence he afterwards removed to Trinity college in that university. He took the degree of master of arts, and became at length a senior fellow of the college; but his intense application to his studies having injured his health, he was obliged at his leisure hours to exercise himself by riding or walking in the fields, which led him to the study of plants. He noted from Johnson, Parkinson, and the *Phytologia Britannica*, the places where curious plants grew; and in 1658 rode from Cambridge to the city of Chester, from whence he went into North Wales, visiting many places, and among others the famous hill of Snowdon; returning by Shrewsbury and Gloucester. In 1660 he published his *Catalogus Plantarum circa Cantabrigiam nascentium*, and the same year was ordained deacon and priest. In 1661 he accompanied Francis Willoughby, Esq. and others in search of plants and other natural curiosities in the north of England and Scotand; and the next year made a western tour from Chester, and through Wales, to Cornwall, Devonshire, Dorsetshire, Hampshire, Wiltshire, and other counties. He afterwards travelled with Mr Willoughby and other gentlemen through Holland, Germany, Italy, France, &c. took several tours in England, and was admitted fellow of the Royal Society. In 1672 his intimate and beloved friend Mr Willoughby died in the 37th year of his age, at Middleton Hall, his seat at Yorkshire; "to the infinite and unspeakable loss and grief (says Mr Ray) of myself, his friends, and all good men." There having been the closest and sincerest friendship between Mr Willoughby and Mr Ray, who were men of similar natures and tastes, from the time of their being fellow collegians, Mr Willoughby not only confided in Mr Ray, in his lifetime, but also at his death: for he made him one of the executors of his will, and charged him with the education of his sons Francis and Thomas, leaving him also for life 60l. per annum. The eldest of these young gentlemen, not being four years of age, Mr Ray, as a faithful trustee, betook himself to the instruction of them; and for their use composed his *Nomenclator Classicus*, which was published this very year, 1672. Francis the eldest dying before he was of age, the younger became Lord Middleton. Not many months after the death of Mr Willoughby, Mr Ray lost another of his best friends, Bishop Wilkins; whom he visited in London the 18th of November 1672, and found near expiring by a total suppression of urine for eight days. As it is natural for the mind, when it is hurt in one part, to seek relief from another; so Mr Ray, having lost some of his best friends, and being in a manner left destitute, conceived thoughts of marriage; and accordingly, in June 1673, did actually marry a gentlewoman of about 20 years of age, the daughter of Mr Oakley of Launton in Oxfordshire. Towards the end of this year, came forth his "Observations Topographical, Moral, &c." made in foreign countries; to which was added his *Catalogus Stirpium in exteris regionibus observatarum*: and about the same time, his *Collection of unusual or local English words*, which he had gathered up in his travels through the counties of England. After having published many books on subjects foreign to his profession, he at length resolved to publish in the character of a divine, as well as in that of a natural philosopher: in which view he published his excellent demonstration of the being and attributes of God, entitled *The Wisdom of God manifested in the Works of the Creation*, 8vo, 1697. The rudiments of this work were read in some college lectures; and another collection of the same kind he enlarged and published under the title of *Three Physico-theological discourses, concerning the Chaos, Deluge, and Dissolution of the World*, 8vo, 1692. He died in 1705. He was modest, affable, and communicative; and was distinguished by his probity, charity, sobriety, and piety. He wrote a great number of works; the principal of which, besides those already mentioned, are, 1. *Catalogus Plantarum Angliæ*. 2. *Dictionariolum Trilingue secundum locos communes*. 3. *Historia Plantarum, Species hactenus editas, aliasque insuper multas noviter inventas et descriptas complectens*, three vols. 4. *Methodus Plantarum nova, cum Tabulis*, 8vo, and several other works on plants. 5. *Synopsis Methodica Animalium Quadrupedum et Serpentini generis*, 8vo. 6. *Synopsis Methodica Avium et Piscium*. 7. *Historia Insectorum, opus posthumum*. 8. *Methodus Insectarum*. 9. Philosophical Letters, &c.

RAYNAL, William Thomas, or the Abbé Raynal, was born about the year 1712, and received his education among the celebrated order of the Jesuits, and became one of their number. Their value and excellence chiefly consisted in assigning to each member his proper employment. Among them it was that Raynal acquired a taste for literature and science, and by them he was afterwards expelled, but for what reason is not certainly known, although the abbé Barruel ascribes it to impiety. Soon after this event he associated with Voltaire, D'Alembert, and Diderot, by whom it is said, he was employed to furnish the articles in theology for the *Encyclopedie*; but he employed the abbé Yvon to furnish them for him, whom Barruel allows to have been an inoffensive and upright man.

His first work, which is justly regarded as an eminent performance, is entitled "Political and Philosophical History of the European Settlements in the East and West Indies." The style of this work is animated; it contains many just reflections both of a political and philosophical nature, and has been translated into every European language. We believe this performance was followed by a small tract in the year 1780, entitled "The Revolution of America," in which he pleads the cause of the colonists with much zeal, censures the conduct of the British government, and discovers an acquaintance with the principles of the different factions, which has induced a belief that he had been furnished with materials by those who knew the merits of the dispute much better than any foreigner could reasonably be supposed to do.

The French government instituted a prosecution against him on account of his history of the East and West Indies; but with so little severity was it conducted, that sufficient time was allowed him to retire to the dominions of his Prussian majesty, by whom he was protected, notwithstanding he had treated the character of that sovereign with very little ceremony. Even the most despotic princes shewed him much kindness, although he always animadverted on their conduct without reserve; and he lived in the good graces of the empress of Russia. At one period the British house of commons shewed him a very singular mark of respect. The speaker having been informed that Raynal was a spectator in the gallery, public business was instantly suspended, and the stranger was conducted to a more honourable situation. But when a friend of Dr Johnson's asked him respecting the same personage, "Will you give me leave, doctor, to introduce to you the abbé Raynal?" he turned on his heel, and said, "No, sir."

A love of liberty was the principal trait in Raynal's character, of which he gave no proper or accurate definition in his earlier writings; but when he beheld the abuse of liberty in the progress of the French Revolution, he nobly attempted to retrieve his errors. In the month of May 1791, he addressed to the Constituent Assembly, a letter the most eloquent, argumentative, and impressive, that perhaps was ever composed upon any subject whatever. He observes among other things; "I have long dared to speak to kings of their duty; suffer me now to speak to the people of their errors, and to their representatives of the dangers which threaten us. I am, I own to you, deeply afflicted at the crimes which plunge this empire into mourning. It is true that I am to look back with horror at myself for being one of those who, by feeling a noble indignation against arbitrary power, may perhaps have furnished arms to licentiousness. Do then religion, the laws, the royal authority, and public order, demand back from philosophy and reason the ties which united them to the grand society of the French nation, as if, by exposing abuses, and teaching the rights of the people and the duties of princes, our criminal efforts had broken these ties? But, no!——never have the bold conceptions of philosophy been represented by us as the strict rule for acts of legislation."

He afterwards completely proves, that it was not the business of the assembly to abolish every ancient institution; that the genius of the French people is such, that they never can be happy or prosperous but under a well regulated monarchical government; and that, if they wished not the nation to fall under the worst kind of despotism, they must increase the power of the king.

Besides the works already mentioned, he was the author of "A History of the Parliament of England," &c. "History of the Stadtholderate;" "The History of the Divorce of Catharine of Arragon by Henry VIII." and a "History of the Revocation of the Edict of Nantz," in four volumes; but he committed many of his papers to the flames during the sanguinary reign of Robespierre. He was deprived of all his property during the revolution, and died in poverty in the month of March 1796, in the 84th year of his age.

Ray, in *Optics*, a beam of light emitted from a radiant or luminous body. See Light and Optics.

Inflected Rays, those rays of light which, on their near approach to the edges of bodies, in passing by them, are bent out of their course, being turned either from the body or towards it. This property of the rays of light is generally termed *diffraction* by foreigners, and Dr Hooke sometimes called it *deflection*.

Reflected Rays, those rays of light which, after falling upon the body, do not go beyond the surface of it, but are thrown back again.

Refracted Rays, those rays of light which, after falling upon any medium, enter its surface, being bent either towards or from a perpendicular to the point on which they fell.

Pencil of Rays, a number of rays issuing from a point of an object, and diverging in the form of a cone.

RAZOR, a well-known instrument, used by surgeons, barbers, &c. for shaving off the hair from various parts of the body.—As shaving to many people is a most painful operation, cutlers in different countries have long applied their skill to remove that inconvenience. Some have invented soaps of a peculiar kind to make the operation more easy, and some have invented straps. With respect to razors, some artists have succeeded rather by accident than from any fixed principle; and therefore we have found great inequality in the goodness of razors made by the same artist.

A correspondent assures us, that he has for 40 years past been at much pains to find out razors made by the best makers both in England and Scotland, and was fortunate enough, at last, to discover a kind made by a Scotchman of the name of *Logan*, which he called magnetical razors, because they were directed to be touched with an artificial magnet before using. These, our friend assures us, are most excellent razors, and he has used them for upwards of 20 years. He says likewise that they continue in good order, without requiring to be ground; but that the great draw-back on their being generally used, is the price, which is higher than most people are able or disposed to give for that instrument. Our correspondent, who resides in the vicinity of London, also informs us, that lately the famous surgeon's instrument-maker, Mr Savigny in Pall Mall, after numberless experiments, in the course of above 20 years, has at length brought razors to a degree of perfection never yet equalled; and with such certainty, that the purchaser is in no danger of a disappointment, though the price is very moderate. By these, we are told, the operation of shaving is performed with greater ease, more perfectly, and more expeditiously than with any other.

RE, in *Grammar*, an inseparable particle added to the beginning of words to double or otherwise modify their meaning; as in re-action, re-move, re-export, &c.

RE-ACTION, in *Physiology*, the resistance made by all bodies to the action or impulse of others that endeavour to change its state whether of motion or rest, &c.

READING, the art of delivering written language with propriety, force, and elegance.

"We must not judge so unfavourably of eloquence or good reading (says the illustrious Fenelon), as to reckon it only a frivolous art, that a declaimer uses to impose upon the weak imagination of the multitude, and to serve his own ends. It is a very serious art, designed to instruct people; to suppress their passions and reform their manners; to support the laws, direct public councils, and to make men good and happy."

1
Reason and experience demonstrate, that *delivery in reading ought to be less animated than in interested speaking*. In every exercise of the faculty of speech, and those expressions of countenance and gesture with which it is generally attended, we may be considered to be always in one of the two following situations: First, delivering our *bosom sentiments* on circumstances which relate to ourselves or others; or, secondly, *repeating* something that was spoken on a certain occasion for the amusement

Delivery in reading should be less animated than in interested speaking.

Reading.

amusement or information of an auditor. Now, if we observe the deliveries natural to these two situations, we shall find, that the first may be accompanied with every degree of expression which can manifest itself in us, from the lowest of sympathy to the most violent and energetic of the superior passions; while the latter, from the speaker's chief business being to repeat what he heard *with accuracy*, discovers only a faint imitation of those signs of the emotions which we suppose agitated him from whom the words were first borrowed.—The use and necessity of this difference of manner is evident; and if we are attentive to these natural signs of expression, we shall find them conforming with the greatest nicety to the slightest and most minute movements of the breast.

This repetition of another's words might be supposed to pass through the mouth of a second or third person; and in these cases, since they were not ear and eye witnesses of him who first spoke them, their manner of delivery would want the advantage necessarily arising from an immediate idea of the original one; hence, on this account, this would be a still less lively representation than that of the first *repeater*. But as, from a daily observation of every variety of speech and its associated signs of emotion, mankind soon become pretty well acquainted with them, and this in different degrees, according to their discernment, sensibility, &c. experience shows us that these latter *repeaters* (as we call them) might conceive and use a manner of delivery which, though less *characteristic* perhaps, would on the whole be no way inferior to the first, as to the *common* natural expression proper for their situation. It appears, therefore, that repeaters *of every degree* may be esteemed upon a level as to animation, and that our twofold distinction above contains accurately enough the whole variety of ordinary delivery;—we say *ordinary*, because

There is another very peculiar kind of delivery sometimes used in the person of a *repeater*, of which it will in this place be necessary to take some notice. What we mean here is *mimicry;* an accomplishment which, when perfectly and properly displayed, never fails of yielding a high degree of pleasure. But since this pleasure chiefly results from the principle of *imitation* respecting *manner*, and not from the purport of the *matter* communicated; since, comparatively speaking, it is only attainable by few persons, and practised only on particular occasions;—on these accounts it must be refused a place among the modes of useful delivery taught us by *general* nature, and esteemed a qualification purely anomalous.

These distinctions with regard to a speaker's situation of mind premised, let us see to which of them an *author* and his *reader* may most properly be referred, and how they are circumstanced with regard to one another.

The matter of all books is, either what the author says in his *own* person, or an acknowledged recital of the words of *others:* hence an author may be esteemed both an *original* speaker and a *repeater*, according as what he writes is of the first or second kind. Now a reader must be supposed either actually to personate the author, or one whose office is barely to communicate what he has said to an auditor. But in the first of these suppositions he would, in the delivery of what is the author's own, evidently commence *mimic;* which being, as above observed, a character not acknowledged by general nature in this department, ought to be rejected as generally improper. The other supposition therefore must be accounted right; and then, as to the whole matter of the book, the reader is found to be exactly in the situation of a *repeater*, save that he takes what he delivers from the page before him instead of his memory. It follows then, in proof of our initial proposition, that, if we are directed by nature and propriety, the manner of our delivery in reading ought to be inferior in warmth and energy to what we should use, were the language before us the spontaneous effusions of our own hearts in the circumstances of those out of whose mouths it is supposed to proceed.

Evident as the purport of this reasoning is, it has not so much as been glanced at by the writers on the subject we are now entered upon, or any of its kindred ones; which has occasioned a manifest want of accuracy in several of their rules and observations. Among the rest, this precept has been long reverberated from author to author as a perfect standard for propriety in reading. "Deliver yourselves in the same manner you would do, were the matter your own original sentiments uttered directly from the heart." As all kinds of delivery must have many things in common, the rule will in many articles be undoubtedly right; but, from what has been said above, it must be as certainly faulty in respect to several others; as it is certain nature never confounds by like signs two things so very different, as a *copy* and an *original*, an emanation darted immediately from the sun, and its weaker appearance in the lunar reflection.

The precepts we have to offer for improving the above-mentioned rule, shall be delivered under the heads of *accent*, *emphasis*, *modulation*, *expression*, *pauses*, &c.

I. *Accent.*—In attending to the affections of the voice when we speak, it is easy to observes, that, independent of any other consideration, one part of it differs from another, in *stress*, *energy*, or *force* of utterance. In words we find one syllable differing from another with respect to this mode; and in sentences one or more words as frequently vary from the rest in a similar manner. This stress with regard to *syllables* is called *accent*, and contributes greatly to the variety and harmony of language. Respecting *words*, it is termed *emphasis;* and its chief office is to assist the sense, force, or perspicuity of the sentence—of which more under the next head.

"Accent (as described in the Lectures on Elocution) is made by us two ways; either by dwelling longer upon one syllable than the rest, or by giving it a smarter percussion of the voice in utterance. Of the first of these we have instances in the words *glōry*, *fāther*, *hōly*; of the last in *bat'tle*, *hab'it*, *bor'row*. So that accent with us is not referred to tune, but to time; to quantity, not quality; to the more equable or precipitate motion of the voice, not to the variation of the notes or inflexions."

In *theatric declamation*, in order to give it more pomp and solemnity, it is usual to dwell longer than common upon the unaccented syllables; and the author now quoted has endeavoured to prove (p. 51. 54.) the practice faulty, and to show (p. 55.) that "though it (i. e. true solemnity) may demand a slower utterance than usual, yet (it) requires that the same proportion in point of

Reading. of quantity be observed in the syllables, as there is in musical notes when the same tune is played in quicker or slower time." But that this deviation from ordinary speech is not a fault, as our author asserts; nay, that on the contrary it is a real beauty when kept under proper regulation, the following observations it is hoped will sufficiently prove.

(I.) It is a truth of the most obvious nature, that those things which on their application to their proper senses have a power of raising in us certain ideas and emotions, are ever *differently* modified in their constituent parts when different effects are produced in the mind: and also (II.) that, within proper bounds, were we to suppose these constituent parts to be proportionally increased or diminished as to *quantity*, this effect would still be the same as to *quality*.—For instance: The different ideas of strength, swiftness, &c. which are raised in us by the same species of animals, is owing to the different form of their corresponding parts; the different effects of music on the passions, to the different airs and movements of the melody; and the different expressions of human speech to a difference in tone, speed, &c. of the voice. And these peculiar effects would still remain the same, were we to suppose the animals above alluded to, to be *greater* or *lesser*, within their proper bounds; the movement of the music *quicker* or *slower*, provided it did not palpably interfere with that of some other species; and the pitch of the voice *higher* or *lower*, if not carried out of the limits in which it is observed on similar occasions naturally to move. Farther (III.) since, respecting the emotions more especially, there are no rules to determine *à priori* what effect any particular attribute or modification of an object will have upon a percipient, our knowledge of this kind must evidently be gained from experience. Lastly, (IV.) In every art imitating nature we are pleased to see the characteristic members of the pattern *heightened* a little farther than perhaps it ever was carried in any real example, provided it be not bordering upon some ludicrous and disagreeable provinces of excess.

Now for the application of these premisses.—To keep pace and be consistent with the *dignity* of the tragic muse, the delivery of her language should necessarily be dignified; and this it is plain from observation (I.) cannot be accomplished otherwise than by something different in the manner of it from that of ordinary speech; since *dignity* is essentially different from *familiarity*. But how must we discover this different manner? By attending to nature: and in this case she tells us, that besides using a *slower* delivery, and greater *distinctness* of the words (which every thing merely *grave* requires, and gravity is a *concomitant* of dignity, though not its *essence*), we must dwell a little *longer* upon the *unaccented* syllables than we do in common. As to what our author observes in the above quotation, of *dignity's* only requiring a *slower* utterance than ordinary, while the proportion of the syllables as to quantity continues the same; it is apprehended the remark (II.) respecting *quickness* and *slowness* of movement will show it to be not altogether true. For since the delivery is not altered in *form*, its expression must be still of the same kind, and perhaps what may be rightly suggested by the term *gravely familiar*.

But something farther may be yet said in defence of this *artificial* delivery, as our author calls it. Is not the movement of any thing, of whatever species, when dignified or solemn, in general of an *equable* and *deliberate* nature (as in the minuet, the military step, &c.)? And in theatrical declamation, is not the propensity to introduce this *equableness* so strong, that it is almost *impossible* to avoid it wholly, were we ever so determined to do it? If these two queries be answered in the affirmative (as we are persuaded they will), while the first supports our argument for the *propriety* of the manner of delivery in question, the second discovers a kind of *necessity* for it. And that this manner may be carried a little *farther* in quantity on the *stage* than is usual in *real life*, the principle (IV.) of heightening nature will justify, provided fashion (which has ever something to do in these articles) give it a sanction; for the *precise* quantity of several heightenings may be varied by this great legislator almost at will.

3 Emphasis.

II. *Emphasis*.—As *emphasis* is not a thing annexed to particular words, as *accent* is to syllables, but owes its rise chiefly to the *meaning* of a passage, and must therefore vary its seat according as that meaning varies, it will be necessary to explain a little farther the general idea given of it above.

> Of man's first disobedience, and the fruit
> Of that forbidden tree, whose mortal taste
> Brought death into the world, and all our woe, &c.
> Sing heav'nly muse, &c.

Supposing, in reference to the above well-known lines, that originally other beings, besides men, had disobeyed the commands of the Almighty, and that the circumstance were well known to us, there would fall an *emphasis* upon the word *man's* in the first line, and hence it would be read thus:

> Of *man's* first disobedience, and the fruit, &c.

But if it were a notorious truth, that mankind had transgressed in a peculiar manner more than once, the *emphasis* would fall on *first*, and the line be read,

> Of man's *first* disobedience, &c.

Again, admitting death (as was really the case) to have been an unheard of and dreadful punishment brought upon man in consequence of his transgression; on that supposition the third line would be read,

> Brought *death* into the world, &c.

But if we were to suppose mankind knew there was such an evil as death in other regions, though the place they inhabited had been free from it till their transgression; the line would run thus,

> Brought death into the *world*, &c.

Now from a proper delivery of the above lines, with regard to any one of the suppositions we have chosen, out of several others that might in the same manner have been imagined, it will appear that the *emphasis* they illustrate is effected by a manifest *delay* in the pronunciation, and a tone something *fuller* and *louder* than is used in ordinary; and that its office is solely to determine the meaning of a sentence with reference to something said before, presupposed by the author as general knowledge, or in order to remove an ambiguity where a passage is capable of having more senses given it than one.

But,

Reading.

But, supposing in the above example, that none of the senses there pointed out were precisely the true one, and that the meaning of the lines were no other than what is obviously suggested by their simple construction; in that case it may be asked, if in reading them there should be no word dignified with the emphatical accompanyments above described?—The answer is, Not one with an emphasis of the *same* kind as that we have just been illustrating; yet, it is nevertheless true, that on hearing these lines well read, we shall find some words distinguished from the rest by a manner of delivery bordering a little upon it (A). And these words will in general be such as seem the most important in the sentence, or on other accounts to merit this distinction. But as at best it only *enforces*, *graces*, or *enlivens*, and not *fixes* the meaning of any passage, and even caprice and fashion (B) have often a hand in determining its place and magnitude, it cannot properly be reckoned an *essential* of delivery. However, it is of too much moment to be neglected by those who would wish to be good readers; and, for the sake of distinction, we may not unaptly denominate both the kinds of energies in question, by the terms *emphasis of sense*, and *emphasis of force* (C).

Now from the above account of these two species of emphasis it will appear, "that in reading, as in speaking, the first of them must be determined entirely by the *sense* of the passage, and always made *alike*: But as to the other, *taste* alone seems to have a right of fixing its situation and quantity."—Farther: Since the more essential of these to energies is solely the work of *nature* (as appears by its being *constantly* found in the common conversation of people of all kinds of capacities and degrees of knowledge), and the most ignorant person never fails of using it *rightly* in the effusions of his own heart, it happens very luckily, and ought always to be remembered, that provided we understand what we read, and give way to the dictates of our own feeling, the *emphasis of sense* can scarce ever avoid falling spontaneously upon its proper place.

Here it will be necessary to say something by way of reply to a question which will naturally occur to the mind of every one. As the rule for the *emphasis of sense* requires we should understand what we read before it can be properly used, it is incumbent upon us never to attempt to read what we have not previously studied for that purpose? In answer to this, it must be observed, that though such a step will not be without its advantages; yet, as from the fairness of printed types, the well-known pauses of punctuation, and a long acquaintance with the phraseology and construction of our language, &c. experience tells us it is *possible* to comprehend the sense at the first reading, a previous perusal of what is to be read does not seem *necessary* to *all*, though, if they would wish to appear to advantage, it may be *expedient* to *many*; and it is this circumstance which makes us venture upon extemporary reading, and give it a place among our amusements.—Similar remarks might be made with regard to *modulation*, *expression*, &c. did not what is here observed naturally anticipate them.

Modulation.

III. *Modulation* (D). Every person must have observed,

(A) The following lines will illustrate both these kinds of stresses: For, to convey their right meaning, the word ANY is evidently to be pronounced louder and fuller than those with the accent over them.

> Get wéalth and pláce, if possible with gráce;
> If not, by ANY meáns get weálth and pláce.—POPE.

This couplet is accented in the manner we find it in the *Essay on Elocution* by *Mason*. And if, according to the judgment of this author, the words thus distinguished are to have an emphatical stress, it must be of the inferior kind above mentioned, and which a little farther on we call *emphasis of force;* while the word ANY in a different type alone possesses the other sort of energy, and which is there contradistinguished by the term *emphasis of sense*.

(B) Among a number of people who have had proper opportunities of learning to read in the best manner it is now taught, it would be difficult to find two, who, in a given instance, would use the *emphasis of force* alike, either as to place or quantity. Nay some scarcely use any at all: and others will not scruple to carry it *much* beyond any thing we have a precedent for in common discourse; and even now and then throw it upon words so very trifling in themselves, that it is evident they do it with no other view, than for the sake of the *variety* it gives to the modulation.—This practice, like the introduction of discords into music, may without doubt be indulged now and then; but were it too frequent, the capital intent of these energies would manifestly either be destroyed or rendered dubious.

(C) The first of these terms answers to the *simple emphasis* described in the *Lectures on Elocution*, and the second *nearly* to what is there called *complex*. The difference lies in this. Under *complex emphasis* the author seems (for he is far from being clear in this article) to include the *tones* simply considered of all the emotions of the mind; as well the *tender* and *languid*, as the *forcible* and *exulting*. Our term is intended to be confined to such modes of expression alone as are marked with an apparent *stress* or *increase* of the voice.

(D) The author of the *Introduction to the Art of Reading*, not allowing that there is any variation of tone, as to *high* and *low*, in the delivery of a complete period or sentence, places modulation solely in the diversification of the key-note and the variety of syllables, as to *long* or *short*, *swift* or *slow*, *strong* or *weak*, and *loud* or *soft*. As we are of a different opinion, our idea of modulation is confined purely to *harmonious inflexions of voice*. These qualities of words, it is true, add greatly both to the force and beauty of delivery; yet, since some of them are fixed and not arbitrary (as *long* and *short*), and the others (of *swift* and *slow*, *strong* and *weak*, *loud* and *soft*) may be considered as modes of expression which do not affect the modulation as to *tone*, it will agree best with our plan to esteem ved, that, in speaking, the voice is subject to an alteration of sound, which in some measure resembles the movement of a tune. These sounds, however, are evidently nothing like so much varied as those that are strictly musical; and we have attempted to show in the preceding chapter, that, besides this, they have an essential difference in themselves. Nevertheless, from the general similitude of these two articles, they possess several terms in common; and the particular we have now to examine is in both of them called *modulation*. This affection of the voice, being totally *arbitrary*, is differently characterized in different parts of the world; and, through the power of custom, every place is inclined to think their own the only one natural and agreeable, and the rest affected with some barbarous twang or ungainly variation (E). It may be observed, however, that though there is a general uniform cast or fashion of modulation peculiar to every country, yet it by no means follows that there is or can be any thing fixed in its application to particular passages; and therefore we find different people will in any given instance, use modulations something different, and nevertheless be each of them equally agreeable.

But, quitting these general remarks, we shall (as our purpose requires it) consider the properties of modulation a little more minutely.

First, then, we may observe, that, in speaking, there is a particular sound (or *key-note*, as it is often called) in which the modulation for the most part runs, and to which its occasional inflexions, either above or below, may in some respects be conceived to have a reference, like that which common music has to its key-note. Yet there is this difference between the two kinds of modulation, that whereas the first always concludes in the key-note, the other frequently concludes a little below it (F). This key-note, in speaking, is generally the sound given at the outset of every complete sentence or period; and it may be observed on some occasions to vary its pitch through the limits of a musical interval of a considerable magnitude. The tones, that fall a little lower than the key at the close of a sentence or period, are called *cadences*. These cadences, if we are accurate in our distinctions, will, with respect to their offices, be found of two kinds; though they meet so frequently together, that it may be best to conceive them only as answering a double purpose. One of these offices is to assist the sense, and the other to decorate the modulation. An account of the first may be seen in the section on *Pauses;* and the latter will be found to show itself pretty frequently in every thing grave and plaintive, or in poetic description and other highly ornamented language, where the mind is by its influence brought to feel a placid kind of dignity and satisfaction. These two cadences, therefore, may be conveniently distinguished by applying to them respectively the epithets *significant* and *ornamental*.

We have already observed, that reading should in some things differ from speaking; and the particular under consideration seems to be one which ought to vary a little in these arts. For,

Modulation in reading serves a twofold purpose. At the same time that it gives pleasure to the ear on the principles of harmony, it contributes through that medium to preserve the attention. And since written language (when not purely dramatical) is in general more elegant in its construction, and musical in its periods, than the oral one; and since many interesting particulars are wanting in reading, which are present in speaking, that contribute greatly to fix the regard of the hearer; it seems reasonable, in order to do justice to the language, and in part to supply the incitements of attention just alluded to, that in the former of these two articles a modulation should be used something more harmonious and artificial than in the latter. Agreeably to this reasoning, it is believed, we shall find every reader, on a narrow examination, adopt more or less a modulation thus ornamented: though, after all, it must be acknowledged there are better grounds to believe, that the

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esteem these properties as respectively belonging to the established laws of *pronunciation* and the *imitative* branch of expression mentioned in the end of the ensuing head.

(E) From what accounts we have remaining of the modulation of the ancients, it appears to have been highly ornamented, and apparently something not unlike our modern *recitative;* particularly that of their theatric declamation was music in its strictest sense, and accompanied with instruments. In the course of time and the progress of refinement, this modulation became gradually more and more simple, till it has now lost the genius of music, and is entirely regulated by taste. At home here, every one has heard the *sing-song* cant, as it is called, of

Ti ti dum dum, ti ti dum ti dum de,
Ti dum ti dum, ti dum ti dum dum de;

which, though disgustful now to all but to mere rustics on account of its being out of fashion, was very probably the favourite modulation in which heroic verses were recited by our ancestors. So fluctuating are the taste and practices of mankind! But whether the power of language over the passions has received any advantage from the change just mentioned, will appear at least very doubtful, when we recollect the stories of its former triumphs, and the inherent charms of musical sounds.

(F) As musical sounds have always an harmonical reference to a key or fundamental note, and to which the mind is still secretly attending, no piece of music would appear perfect, that did not close in it, and so naturally put an end to expectation. But as the tones used in speech are not musical, and therefore cannot refer harmonically to any other sound, there can be no necessity that this terminating sound (and which we immediately below term the *cadence*) should either be used at all, or follow any particular law as to form, &c. farther than what is imposed by taste and custom.

Reading

the practice has been hitherto directed intuitively by nature, than that it was discovered by the inductions of reason. We shall conclude this head with a rule for modulation in reading. "In every thing dramatic, colloquial, or of simple narrative, let your modulation be the same as in speaking; but when the subject is flowery, solemn, or dignified, add something to its harmony, diversify the key-note, and increase the frequency of cadences in proportion to the merit of the composition."

It will readily be seen, that the precepts here drawn from a comparison between speaking and reading, would be very inadequate, were they left destitute of the assistance of *taste*, and the opportunity of *frequently hearing and imitating masterly readers*. And indeed, to these two great auxiliaries we might very properly have referred the whole matter at once, as capable of giving sufficient directions, had we not remembered that our plan required us to found several of our rules as much on the principles of a philosophical analysis, as on those more familiar ones which will be found of greater efficacy in real practice.

5 Expression as to the tones of the voice.

IV. *Expression*. 1. There is no composition in music, however perfect as to key and melody, but, in order to do justice to the subject and ideas of the author, will require, in the performing, something more than an exact adherence to *tune* and *time*. This something is of a nature, too, which perhaps can never be adequately pointed out by any thing graphic, and results entirely from the taste and feeling of the performer. It is that which chiefly gives music its power over the passions, and characterises its notes with what we mean by the words *sweet*, *harsh*, *dull*, *lively*, *plaintive*, *joyous*, &c. for it is evident every sound, considered abstractedly, without any regard to the movement, or high and low, may be thus modified. In practical music, this commanding particular is called *Expression*; and as we find certain tones analogous to it frequently coalescing with the modulation of the voice, which indicate our passions and affections (thereby more particularly pointing out the meaning of what we say) the term is usually applied in the same sense to speaking and reading.

These tones are not altogether peculiar to man.— Every animal, that is not dumb, has a power of making several of them. And from their being able, unassisted by words, to manifest and raise their kindred emotions, they constitute a kind of language of themselves. In this language of the heart man is eminently conversant; for we not only understand it in one another, but also in many of the inferior creatures subjected by providence to our service.

The expression here illustrated is one of the most essential articles in good reading, since it not only gives a finishing to the sense, but, on the principles of sympathy and antipathy, has also a peculiar efficacy in interesting the heart. It is likewise an article of most difficult attainment; as it appears from what follows, that a masterly reader ought not only to be able to incorporate it with the modulation properly as to *quality*, but in any degree as to *quantity*.

Every thing written being a proper imitation of speech, expressive reading must occasionally partake of all its tones. But from what was said above, of the difference between reading and speaking, it follows, that these signs of the emotions should be less strongly characterised in the former article than in the latter. Again, as several of these tones of expression are in themselves agreeable to the mind, and raise in us agreeable emotions (as those of *pity*, *benevolence*, or whatever indicates *happiness* and *goodness* of heart), and others disagreeable (as those of a *boisterous*, *malevolent*, and *depraved* nature, &c.) it farther appears, since reading is an art *improving* and not *imitating* nature, that, in whatever degree we abate the expressions of the tones above alluded to in the first case, it would be eligible to make a greater abatement in the latter. But as to the quantities and proportional magnitudes of these abatements, they, like many other particulars of the same nature, must be left solely to the taste and judgment of the reader.

To add one more remark, which may be of service on more accounts than in suggesting another reason for the doctrine above. Let it be remembered, that though in order to acquit himself agreeably in this article of expression, it will be necessary every reader should *feel* his subject as well as *understand* it; yet, that he may preserve a proper ease and masterliness of delivery, it is also necessary he should guard against discovering too much emotion and perturbation.

From this reasoning we deduce the following rule, for the tones which indicate the passions and emotions.

"In reading, let all your tones of expression be borrowed from those of common speech, but something more faintly characterised. Let those tones which signify any disagreeable passion of the mind, be still more faint than those which indicate their contrary; and preserve yourself so far from being affected with the subject, as to be able to proceed through it with that peculiar kind of ease and masterliness, which has its charms in this as well as every other art."

We shall conclude this section with the following observation, which relates to speaking as well as reading. When words fall in our way, whose "sounds seem an echo to the sense," as *squirr*, *buzz*, *hum*, *rattle*, *hiss*, *jar*, &c. we ought not to pronounce them in such a manner as to heighten the imitation, except in light and ludicrous subjects. For instance, they should not in any other case be sounded *squir.r.r—buzz.z.z—hum.m.m—r.r.rattle*, &c. On the contrary, when the imitation lies in the *movement*, or *flow and structure of a whole passage* (which frequently happens in poetry), the delivery may always be allowed to give a heightening to it with the greatest propriety; as in the following instances, out of a number more which every experienced reader will quickly recollect.

In these deep solitudes and awful cells,
Where heav'nly pensive Contemplation dwells,
And ever-musing Melancholy reigns—
POPE'S *Eloisa to Abelard*.

With easy course
The vessels glide unless their speed be stopp'd
By dead calms, that oft lie on these smooth seas.
DYER'S *Fleece*.

Softly sweet in Lydian measure,
Soon he sooth'd his soul to pleasure.
DRYDEN'S *Ode on St Cecilia's day*.

Still

Still gathering force it smokes, and, urg'd amain,
Whirls, leaps, and *thunders down impetuous to the plain.*
POPE's *Iliad*, b. 13.

For who to dumb forgetfulness a prey,
This pleasing anxious being ere resign'd,
Left the warm precincts of the cheerful day,
Nor cast *one longing ling'ring look behind*?
GRAY's *Elegy*.

6
Expression.

2. Besides the particular tones and modifications of voice above described, which always accompany and express our inward agitations, nature has in these cases endowed us with another language, which, instead of the ear, addresses itself to the eye, thereby giving the communications of the heart a double advantage over those of the understanding, and *us* a double chance to preserve so inestimable a blessing. This language is what arises from the different, almost involuntary, movements and configurations of the face and body in our emotions and passions, and which, like that of tones, every one is formed to understand by a kind of intuition.

When men are in any violent agitation of mind, this co-operating *expression* (as it is called) of face and gesture is very strongly marked, and totally free from the mixture of any thing which has a regard to gracefulness, or what appearance they may make in the eyes of others. But in ordinary conversation, and where the emotions are not so warm, fashionable people are perpetually insinuating, into their countenance and action, whatever they imagine will add to the ease and elegance of their deportment, or impress on the spectator an idea of their amiableness and breeding. Now, though the above-mentioned natural organical signs of the emotions should accompany every thing spoken, yet from what was observed in the introductory part of this article (like the tones we have just treated upon), they should in reading be much less strongly expressed, and those suffer the greatest diminution that are in themselves the most ungainly. And as it was in the last section recommended to the reader to preserve himself as far from being affected in all passionate subjects as to be able to keep a temperate command over the various affections of the voice, &c. so under the sanction of this subordinate feeling he may accompany his delivery more frequently with any easy action or change of face, which will contribute to set off his manner, and make it agreeable on the principles of art.

As these calm decorations of action (as we may call them) are not altogether natural, but have their rise from a kind of institution, they must be modelled by the practices of the polite. And though mankind differ from one another scarce more in any particular than in that of talents for adopting the graceful actions of the body, and hence nothing determinate can be said of their nature and frequency; yet even those, most happily calculated to acquit themselves well in their use, might profit by considering that it is better greatly to abridge the display, than to over-do it ever so little. For the peculiar modesty of deportment with which the inhabitants of this kingdom are endowed, makes us in common endeavour to suppress many signs of an agitated mind; and in such cases the bodily ones in particular are very sparingly used. We have also a natural and rooted dislike to any kind of affectation; and to no species, that we can recollect, a greater, than to that which is seen in a person who pretends to mimicry and courtly gesture, without possessing the advantages and talents they require; and of which not many people, comparatively speaking, have any remarkable share.

The inference of this is too obvious to need drawing out, and we would particularly recommend it to the consideration of those readers who think the common occurrences of a newspaper, &c. cannot be properly delivered without a good deal of elbow room.

Although it is impossible to come to particulars in any directions of this kind, yet there is one article of our present subject on which a serviceable remark may be made. In ordinary discourse, when we are particularly pressing and earnest in what we say, the eye is naturally thrown upon those to whom we address ourselves: And in reading, a turn of this organ now and then upon the hearers, when any thing very remarkable or interesting falls in the way, has a good effect in gaining it a proper attention, &c. But this should not be too frequently used; for if so, besides its having a tendency to confound the natural importance of different passages, it may not be altogether agreeable to some to have their own reflexions broken in upon by a signal, which might be interpreted to hint at their wanting regulation.

One observation more, and then we shall attempt to recapitulate the substance of this section in the form of a precept. Though it is, when strictly examined, inconsistent, both in speaking and reading, to imitate with action what we are describing, yet as in any thing *comic* such a practice may suggest ideas that will *accord* with those of the subject, it may there be now and then indulged in either of these articles.

"In a manner similar to that directed with regard to tones, moderate your bodily expressions of the signs of the emotions. And in order to supply, as it were, this deficiency, introduce into your carriage such an easy gracefulness, as may be consistent with your acquirements in these particulars, and the necessary dread which should ever be present of falling into any kind of affectation or grimace."

V. *Pauses.* Speech consisting of a succession of distinct words, must naturally be liable (both from a kind of accident, and a difficulty there may be in beginning certain sounds or portions of phrases immediately on the ending of certain others) to several small intermissions of voice; of which, as they can have no meaning, nothing farther need here be said. There are, however, some pauses, which the sense necessarily demands; and to these the substance of this section is directed.

The pauses are in part to distinguish the members of sentences from one another, the terminations of complete periods, and to afford an opportunity for taking breath. Besides this, they have a very graceful effect in the modulation, on the same account they are so essential in music.—In both articles, like blank spaces in pictures, they set off and render more conspicuous whatsoever they disjoin or terminate.

Were language made up of nothing but short colloquial sentences, these pauses, though they might do no harm, and would generally be graceful, would however be superseded as to use by the completeness and *nar-*

rowness, as we may say, of the meaning. But in more diffuse language, composed of several detached sentences, and which require some degree of attention in order to take in the sense, the intermissions of voice under consideration are of the greatest service, by signifying to the mind the progress and completion of the whole passage. Now, though in extensive and differently formed periods there may be members whose completeness of sense might be conceived of various degrees, and hence might seem to require a set of pauses equally numerous; yet, since the sense does not altogether depend upon these intermissions, and their ratios to one another, if capable of being properly defined, could not be accurately observed, grammarians have ventured to conceive the whole class of pauses as reducible to the four or five kinds now in use, and whose marks and ratios are well known (G); presuming that under the eye of taste, and with the assistance of a particular to be next mentioned, they would not fail in all cases to suggest intermissions of voice suitable to the sense. But in many of these extensive and complex periods, rounded with a kind of redundancy of matter, where the full sense is long suspended, and the final words are not very important, there would be some hazard of a misapprehension of the termination, had we not more evident and infallible notice of it than that which is given by the pause. This notice is the *cadence*, referred to in the section on *Modulation;* which, as is there observed, besides the ornamental variety it affords, appears from these remarks to be a very necessary and serviceable article in perspicuous delivery.

As this cadence naturally accompanies the end of every entire sense, circumstanced as above mentioned, it may sometimes fall before the *semicolon*, but more generally before the *colon*, as well as the period: For these marks are often found to terminate a complete sense: and in these cases, the relation what follows has to what went before, is signified to the mind by the relative shortness of the stop, and the form of introducing the additional matter. Nor can any bad consequence arise from thus founding distinctions on ratios of time, which it may be said are too nice to be often rightly hit upon: for if a confusion should happen between that of the *colon* and *period*, there is perhaps so trifling a difference between the nature of the passages they succeed, as to make a small inaccuracy of no consequence. And as to the rests of the semicolon and period, it will not be easy to mistake about them, as their ratio is that of two to one. Add to this the power which the matter and introduction of the subsequent passages have to rectify any slight error here made, and we shall be fully satisfied, that the pauses as usually explained, with the cadence above described, and a proper knowledge of the language, will convey sufficient information to the understanding of the constructive nature of the passages after which they are found.

It may be observed, that in natural speech, according to the warmth and agitation of the speaker, the rests are often short and injudiciously proportioned, and hence that every thing thus delivered cannot be so graceful as it might have been from a proper attention to their magnitude and effects.

Pauses then, though chiefly subjected to the sense, are, as was remarked at the outset, serviceable in beautifying the modulation, &c.—And since books are often inaccurately printed as to points, and people's tastes differ some little about their place and value, it appears, that, "although in reading great attention should be paid to the stops, yet a greater should be given to the sense, and their correspondent times occassionally lengthened beyond what is usual in common speech;" which observation contains all that we shall pretend to lay down by way of rule for the management of pauses in the delivery of written language.

As there are two or three species of writing, which have something singular in them, and, with regard to the manner in which they should be read, a few *particular* remarks seem necessarily required, we shall conclude this article with laying them before the reader:

1. Of PLAYS, and such like CONVERSATION-PIECES. Writings of this kind may be considered as intended for two different purposes; one to unfold subject matter for the exercise of theatric powers; and the other to convey amusement, merely as fable replete with pleasing incidents and characteristic manners. Hence there appears to be great latitude for the display of a *consistent* delivery of these performances: for while, on one hand, a good reader of very inferior talents for mimicry may be heard with a tolerable degree of pleasure; on the other, if any person is qualified to give a higher degree of life and force to the dialogue and characters by delivering them as an actor, he must be fully at liberty to start from the confinement of a chair to a posture and area more suited to his abilities; and, if he be not deceived in himself, his hearers will be considerable gainers by the change.—The next article is,

2. SERMONS or other ORATIONS, which in like manner may be conceived intended for a double purpose. First, as matter for the display of oratorical powers; and, secondly, as persuasive discourses, &c. which may be

(G) Supposing the *comma* (,) one *time*, the *semicolon* (;) will be two; the *colon* (:) three, and the *period* (.) as also the marks of *interrogation* (?) and *admiration* (!) four of these times. The blank line (— or ---), and the *breaks* between *paragraphs*, intimate still greater times; and by the same analogy may be reckoned a double and quadruple period respectively. Now and then these blank lines are placed immediately *after* the ordinary points, and then they are conceived only as separating for the *eye* the different natures of the matter;—as a question from an answer,—precept from example,—premises from inferences, &c. in which case their import is evident. But of late some authors have not scrupled to confound these distinctions; and to make a blank serve for all the pauses universally, or the mark of an indefinite rest, the quantity of which is left to the determination of the reader's taste. A practice, it is imagined, too destructive of the intended precision of these typical notices to be much longer adopted.

be read like any other book. Therefore it appears (for reasons similar to those above) that according as clergymen are possessed of the talents of elocution, they may consistently either rehearse their sermons, in the manner of an extemporary harangue, or deliver them in the more humble capacity of one who is content to entertain and instruct his hearers with reading to them his own or some other person's written discourse.

That either of these manners of delivery (or a mixture of them), in either of the cases above mentioned, is agreeable, we find on a careful examination. For this will show us how frequently they run into one another; and that we are so far from thinking such transitions wrong, that, without a particular attention that way, we scarce ever perceive them at all.

3. Poetry is the next and last object of our present remarks. This is a very peculiar kind of writing, and as much different from the language of ordinary discourse as the movements of the dance are from common walking. To ornament and improve whatever is subservient to the pleasures and amusements of life, is the delight of human nature. We are also pleased with a kind of *excess* in any thing which has a power to amuse the fancy, inspire us with enthusiasm, or awaken the soul to a consciousness of its own importance and dignity. Hence one pleasure, at least, takes its rise, that we feel in contemplating the performances of every art; and hence the language of poetry, consisting of a measured rythmus, harmonious cadences, and an elevated picturesque diction, has been studied by the ingenious, and found to have a powerful influence over the human breast in every age and region. There is such an affinity between this language and music, that they were in the earlier ages never separated; and though modern refinement has in a great measure destroyed this union, yet it is with some degree of difficulty in rehearsing these divine compositions we can forget the singing of the muse.

From these considerations (and some kindred ones mentioned in sect. iii.) in repeating verses they are generally accompanied with a modulation rather more ornamented and musical than is used in any other kind of writing. And accordingly, as there seems to be the greatest propriety in the practice, the rule for this particular in the section just referred to, will allow any latitude in it that can gain the sanction of taste and pleasure.

Rhymes in the lighter and more soothing provinces of poetry are found to have a good effect; and hence (for reasons like those just suggested) it is certainly absurd to endeavour to smother them by a feeble pronunciation, and running one line precipitately into another, as is often affected to be done by many of our modern readers and speakers. By this method they not only destroy one source of pleasure intended by the composer (which though not great is nevertheless genuine), but even often supply its place with what is really disagreeable, by making the rhymes, as they are interruptedly perceived, appear accidental blemishes of a different style, arising from an unmeaning recurrence of similar sounds. With regard then to reading verses terminated with rhyme, the common rule, which directs to pronounce the final words *full*, and to distinguish them by a slight pause even where there is none required by the sense, seems the most rational, and consequently most worthy of being followed. See Declamation, Narration, and Oratory.

Reading, a town of Berkshire in England, pleasantly situated on the river Kennet, near its confluence with the Thames. It had once a fine rich monastery, of which there are large ruins remaining. It had also a castle built by King Henry I. afterwards ruined. It is a corporation, enjoys several privileges, and sends two members to parliament. The two navigable rivers render it a fit place for trade. It had 10,788 inhabitants in 1811. W. Long. 1. 0. N. Lat. 51. 25.

READINGS, or *Various Readings*, in criticism, are the different manners of reading the texts of authors in ancient manuscripts, where a diversity has arisen from the corruption of time, or the ignorance of copyists. A great part of the business of critics lies in settling the readings by confronting the various readings of the several manuscripts, and considering the agreement of the words and sense.

Readings are also used for a sort of commentary or gloss on a law, text, passage, or the like, to shew the sense an author takes it in, and the application he conceives to be made of it.

RE-AGGRAVATION, in the Roman ecclesiastical law, the last monitory, published after three admonitions, and before the last excommunication. Before they proceed to fulminate the last excommunication, they publish an aggravation, and a re-aggravation. Fevret observes, that in France the minister is not allowed to come to re-aggravation, without the permission of the bishop or official, as well as that of the lay judge. See Excommunication.

REAL, Cæsar Vichard de St, a polite French writer, son of a counsellor to the senate of Chamberry in Savoy. He came young to France, distinguished himself at Paris by several ingenious productions, and resided there a long time without title or dignity, intent upon literary pursuits. He died at Chamberry in 1692, advanced in years, though not in circumstances. He was a man of great parts and penetration, a lover of the sciences, and particularly fond of history. A complete edition of his works was printed at Paris, in 3 vols 4to, 1745, and another in 6 vols 12mo.

Real Presence. See Transubstantiation.

REALGAR, a preparation of arsenic. See Arsenic, Chemistry *Index*.

REALISTS, a sect of school philosophers formed in opposition to the Nominalists. Under the Realists are included the Scotists, Thomists, and all excepting the followers of Ocham. Their distinguishing tenet is, that universals are realities, and have an actual existence out of an idea or imagination; or, as they express it in the schools, a *parte rei;* whereas the nominalists contend, that they exist only in the mind, and are only ideas, or manners of conceiving things.—Dr Odo, or Oudard, a native of Orleans, afterwards abbot of St Martin de Tournay, was the chief of the sect of the realists. He wrote three books of dialectics, where, on the principles of Boëthius and the ancients, he maintained that the object of that art is things, not words; whence the sect took its rise and name.

REALITY, in the schools, a diminutive of *res*, "thing," first used by the Scotists, to denote a thing which may exist of itself; or which has a full and absolute being of itself, and is not considered as a part of any other.

REALM, a country which gives its head or governor the denomination of a *king*.

RE-ANIMATION means the reviving or restoring to life those who are apparently dead. Sudden death is dreaded by every human being, and it is one of those evils against which the Church of England prays in her Litany. Accidents, however, cannot always be prevented; but, after they have happened, it is often possible to prevent their effects. This, by the establishment of what with great propriety has been called the *Humane Society*, has been abundantly proved: for, in the course of 12 years immediately after their institution, they were the means of saving the lives of 850 persons, who otherwise would in all human probability have been lost to the community. Since that period, they have saved many more; and various persons, even in the most distant parts of the kingdom, by following their directions, have done the same. To preserve one human being from premature death, we must consider as of the utmost consequence both as citizens and Christians; how much more the preservation of thousands. It appears from the writings of Doctors Mead, Winslow, Bruhier, Fothergill, Haller, Lecat, Tissot, Van Engelen, Gummer, and others, that they had prepared the way for institutions similar to the Humane Society: for in their works they have elucidated the principles on which they go, and furnished directions for the practice they favour. See DEATH, *Premature* INTERMENT, and DROWNING.

REAR, a term frequently used in composition, to denote something behind, or backwards, in respect of another; in opposition to *van*.

REAR of an Army, signifies, in general, the hindermost part of an army, battalion, regiment, or squadron; also the ground behind either.

REAR-Guard, is that body of an army which marches after the main-body; for the march of an army is always composed of an advanced-guard, a main body, and a rear-guard; the first and last commanded by a general. The old grand guards of the camp always form the rear-guard of the army, and are to see that every thing come safe to the new camp.

REAR Half files, are the three hindmost ranks of the battalion, when it is drawn up six deep.

REAR-Line of an army encamped, is always 1200 feet at least from the centre line; both of which run parallel to the front line, as also to the reserve.

REAR-Rank, is the last rank of a battalion, when drawn up, and generally 16 or 18 feet from the centre-line when drawn up in open order.

REASON, a faculty or power of the mind, whereby it distinguishes good from evil, truth from falsehood. See METAPHYSICS.

REASONING, RATIOCINATION, the exercise of that faculty of the mind called *reason;* or it is an act or operation of the mind, deducing some unknown proposition from other previous ones that are evident and known. See LOGIC, Part III.

REAUMUR, RENE ANTOINE FERCHAULT, SIEUR DE, a person distinguished for his laborious researches into natural knowledge, was born at Rochelle in 1683, of a family belonging to the law. After having finished his early studies in the place of his birth, he began a course of philosophy at Poitiers, and of civil law at Bourges; but soon relinquished the latter, to apply himself, according to his taste, to mathematics, physics, and natural history. Being come to Paris, he was received into the Academy of Sciences in 1708. From that hour he was wholly employed in natural history, to which his inclination particularly led him, and his inquiries were not confined to any one part of it. His memoirs, his observations, his discoveries on the formation of shells, spiders, muscles, the marine flea, the berry which affords the purple colour, and on the cause of the numbness of the torpedo, excited the curiosity of the public, and early procured our author the character of an able, curious, and entertaining naturalist. Filled with zeal for the welfare and advantage of society, and the progress and perfection of arts, he endeavoured in all his researches to promote the public good. We were indebted to him for the discovery of the turquois mines in Languedoc. He also found out a substance, which is used to give false stones a colour, which is obtained from a certain fish called in the French *Able* or *Ablete* * on account of its whiteness, and which is the *Bleak* or *Blay* of our writers †. His experiments on the art of turning iron into steel obtained him a pension of 12,000 livres; and this reward was to be continued to the Academy to support the expence which might accrue in this art.

He continued his inquiries on the art of making tin and porcelain ‡, and endeavoured to render our thermometers more useful than those of former times: he composed a curious history of rivers where gold dust is found in France; and gave so simple and easy a detail of the art of gathering this dust, that persons have been employed for that purpose.

* See Belon, 315. & Pennant's Zoology, vol. iii. p. 315.

† See Cyprinus, N° 9.

‡ See Porcelain.

He also made curious and important observations on the nature of flints, on the banks of fossil shells, from whence is obtained in Touraine an excellent manure for land; as likewise on birds and their preservation, on their method of building nests; on insects; and a great number of other subjects, not less curious than useful.

He imagined at first, that a certain varnish would keep eggs fresh; but the waste of time and money, &c. showed him the inconvenience of such a process. He afterwards adopted the method practised for time immemorial in Greece and the islands of the Archipelago, which is to steep or immerse eggs in oil, or melted fat; by this means, not being exposed to the air or to frost, they are well preserved, and contract no bad smell. Another experiment still more important made by our author, was to introduce into France the art of hatching fowls and birds, as practised in Egypt, without covering the eggs. Active, sedulous, and attentive, he was early in his study, often at six in the morning. Exact in his experiments and observations, he let no circumstance escape him. His writings must be of great use to future philosophers. In society, he was distinguished through life for his modest and agreeable behaviour. His probity, benevolence, goodness of heart, and other amiable qualities, as well natural as acquired, endeared him to his countrymen. He died in the 76th year of his age, on the 18th of October 1757, and left this world filled with sentiments of piety. His death was the consequence of a fall, which happened at the castle of Barnardiere on the Maine, where he went to pass his vacation. He bequeathed to the Academy of Sciences his

his manuscripts and all his natural productions. His works are, 1. A very great number of memoirs and observations on different parts of natural history; they are printed in the collections of the Academy of Sciences. 2. A large work printed separately in 6 vols in 4to, entitled, A Natural History of Insects. This important work contains a description of vast numbers of caterpillers, moths, gall insects, flies with two and four wings, lady birds, and those ephemeron flies which live only in that form a few hours; and lastly, of those singular and wonderful insects which are called *polypes*, which being cut into several pieces, each piece lives, grows, and becomes an insect, and affords to our eyes a great number of prodigies *. The works of M. de Reaumur are exact, curious, interesting, and very ingenious. They are written with much candour, clearness, and elegance; but it must be acknowledged his manner is somewhat too diffuse. But we must not deceive the reader; he often raises our expectations, and does not give us all the satisfaction we promise ourselves from his writings. His method of raising poultry, in particular, rather disappoints us. He spared neither care, time, nor expence, to render it practicable: he flattered himself and his countrymen with the greatest hopes; but notwithstanding his assiduous industry, and vast charges, it proved abortive. The late M. l'Advocat recommended him to obtain better information from Egypt on the subject; and if possible to procure a person versed in the art to instruct him in it; but his death prevented the completion of the scheme. If the native of Egypt had arrived, showed M. de Reaumur a better method than his own, and practised it with success, as in his country, the community would have been benefited; on the other hand he would have seen, had it failed, that the climate of France was not proper for such experiments. M. Maillet, consul at Cairo, to whom Monsieur the regent had written to obtain the art, offered to send over a native of Egypt, if the government would pay the expence of his voyage, and allow him a pension of 1500 livres. M. Maillet rightly judged, when he preferred this method of proceeding. M. de Reaumur was not ignorant of the design; but he flattered himself, that his efforts would be successful without further aid, and thought he should acquire some honour. He certainly had great talents, industry, sagacity, and every other requisite which are necessary in such attempts; but it is morally impossible that a single man, in a different climate, can attain such knowledge in an art as those who live in a more favourable country, and have had the experience of many ages to profit by: however M. de Reaumur may have been unsuccessful, posterity is indebted to him for his repeated trials. He has removed some difficulties in the road, and those that travel it may discover what he only saw at a distance.

* See *Polypus*, *Helminthology Index*.

REAUMURIA, a genus of plants belonging to the pentandria class; and in the natural method ranking under the 13th order, *Succulentæ*. See BOTANY *Index*.

REBATE, or REBATEMENT, in *Commerce*, a term much used at Amsterdam for an abatement in the price of several commodities, when the buyer, instead of taking time, advances ready money.

REBATEMENT, in *Heraldry*, a diminution or abatement, of the bearings in a coat of arms. See ABATEMENT.

REBELLION, *Rebellio*, among the Romans, was where those who had been formerly overcome in battle, and yielded to their subjection, made a second resistance: but with us it is generally used for the taking up of arms traiterously against the king, whether by natural subjects, or others when once subdued; and the word *rebel* is sometimes applied to him who wilfully breaks a law; also to a villein disobeying his lord.

There is a difference between enemies and rebels. Enemies are those who are out of the king's allegiance: therefore subjects of the king, either in open war, or rebellion, are not the king's enemies, but traitors. And David prince of Wales, who levied war against Edw. I. because he was within the allegiance of the king, had sentence pronounced against him as a traitor and rebel. Private persons may arm themselves to suppress rebels, enemies, &c.

REBELLIOUS ASSEMBLY, is a gathering together of twelve persons or more, intending or going about to practice or put in use unlawfully, of their own authority, any thing to change the law or statutes of the realm; or to destroy the inclosures of any ground, or banks of any fish-pond, pool, or conduit, to the intent the same shall lie waste and void; or to destroy the deer in any park, or any warren of conies, dovehouses, or fish in ponds; or any house, barns, mills, or bays; or to burn stacks of corn; or abate rents, or prices of victuals, &c.

REBUS, an enigmatical representation of some name, &c. by using figures or pictures instead of words, or parts of words. Camden mentions an instance of this absurd kind of wit in a gallant who expressed his love to a woman named *Rose Hill*, by painting in the border of his gown a rose, a hill, an eye, a loaf, and a well; which, in the style of the rebus, reads, "*Rose Hill I love well.*" This kind of wit was long practised by the great, who took the pains to find devices for their names. It was, however, happily ridiculed by Ben Jonson, in the humorous description of Abel Drugger's device in the Alchemist; by the Spectator, in the device of Jack of Newberry; at which time the rebus, being raised to sign-posts, was grown out of fashion at court.

REBUS is also used by the chemical writers sometimes to signify sour milk, and sometimes for what they call the ultimate matter of which all bodies are composed.

REBUS, in *Heraldry*, a coat of arms which bears an allusion to the name of the person; as three castles, for Castleton; three cups, for Butler; three conies, for Conisby; a kind of bearings which are of great antiquity.

REBUTTER, (from the Fr. *bouter*, i. e. *repellere*, to put back or bar), is the answer of defendant to plaintiff's *surrejoinder*; and plaintiff's answer to the rebutter is called a *surrebutter*: but it is very rare the parties go so far in pleading.

REBUTTER is also where a man by deed or fine grants to warranty any land or hereditament to another; and the person making the warranty, or his heir, sues him to whom the warranty is made, or his heir or assignee, for the same thing; if he who is so sued plead the deed or fine with warranty, and pray judgment, if the plaintiff shall be received to demand the thing which he ought to warrant to the party against the warranty in the deed, &c. this is called a *rebutter*. And if I grant to a tenant

nant to hold without impeachment of waste, and afterwards implead him for waste done, he may debar me of this action by showing my grant, which is a rebutter.

RECAPITULATION, is a summary, or a concise and transient enumeration of the principal things insisted on in the preceding discourse, whereby the force of the whole is collected into one view. See ORATORY, N° 37 and 127.

RECEIPT, or RECEIT, in *Commerce*, an acquittance, or discharge, in writing, intimating that the party has received a certain sum of money, either in full for the whole debt, or in part, or on account.

RECEIVER, in *Pneumatics*, a glass vessel for containing the thing on which an experiment in the air-pump is to be made.

RECEIVER, *receptor* or *receptator*, in *Law*, is commonly understood in a bad sense, and used for such as knowingly receive stolen goods from thieves, and conceal them. This crime is felony, and the punishment is transportation for 14 years.

RECENSIO, was an account taken by the censors, every lustrum, of all the Roman people. It was a general survey; at which the equites, as well as the rest of the people, were to appear. New names were now put upon the censor's list, and old ones cancelled. The *recensio*, in short, was a more solemn and accurate sort of *probatio*, and answered the purpose of a review, by showing who were fit for military service.

RECEPTACULUM, in *Botany*, one of the seven parts of fructification, defined by Linnæus to be the base which connects or supports the other parts.

RECEPTACULUM Chyli, or *Pecquet's Reservatory*, the reservoir or receptacle for the chyle, situated in the left side of the upper vertebra of the loins, under the aorta and the vessels of the left kidney.

RECHABITES, a kind of religious order among the ancient Jews, instituted by Jonadab the son of Rechab, comprehending only his own family and posterity. Their founder prescribed them three things: first, not to drink any wine; secondly, not to build any houses, but to dwell in tents; and thirdly, not to sow any corn, or plant vines.

The Rechabites observed these rules with great strictness, as appears from Jer. xxxv. 6, &c. Whence St Jerome, in his 13th epistle to Paulinus, calls them *monachi, monks*. Jonadab, their founder, lived under Jehoash, king of Judah, contemporary with Jehu king of Israel; his father Rechab, from whom his posterity were denominated, descended from Raguel or Jethro, father-in-law to Moses, who was a Kenite, or of the race of Ken: whence Kenite and Rechabite are used as synonymous in Scripture.

RECHEAT, in hunting, a lesson which the huntsman plays on the horn, when the hounds have lost their game, to call them back from pursuing a counter scent.

RECIPE, in *Medicine*, a prescription, or remedy, so called because always beginning with the word *recipe*, i. e. *take*; which is generally denoted by the abbreviature ℞. See *PRESCRIPTION*, *Extemporaneous*.

RECIPROCAL, in general, something that is mutual, or which is returned equally on both sides, or that affects both parties alike.

RECIPROCAL Terms, among logicians, are those which have the same signification; and consequently are convertible, or may be used for each other.

RECIPROCAL, in *Mathematics*, is applied to quantities which multiplied together produce unity. Thus $\frac{1}{x}$ and x, y and $\frac{1}{y}$, are reciprocal quantities. Likewise $\frac{1}{x}$ is said to be the reciprocal of x, which is again the reciprocal of $\frac{1}{x}$.

RECIPROCAL Figures, in *Geometry*, those which have the antecedents and consequents of the same ratio in both figures.

RECIPROCAL Proportion, is when in four numbers the fourth is less than the second by so much as the third is greater than the first, and *vice versa*. See PROPORTION and ARITHMETIC, chap. vi. Great use is made of this reciprocal proportion by Sir Isaac Newton and others, in demonstrating the laws of motion.

RECITAL, in *Law*, means the rehearsal or making mention in a deed or writing of something which has been done before.

RECITATIVO, or RECITATIVE, in *Music*, a kind of singing, that differs but little from ordinary pronunciation; such as that in which the several parts of the liturgy are rehearsed in cathedrals; or that wherein the actors commonly deliver themselves on the theatre at the opera, when they are to express some action or passion; to relate some event; or reveal some design.

RECKENHAUSEN, a strong town of Cologne, now of the Rhenish Prussia provinces. The abbess of its nunnery had formerly the power of punishing offenders with death, and she alone was obliged to the vow of chastity.

RECKONING, or a *Ship's RECKONING*, in *Navigation*, is that account whereby at any time it may be known where the ship is, and on what course or courses she is to steer, in order to gain her port; and that account taken from the log-board is called the *dead reckoning*. See NAVIGATION.

RECLAIMING, or RECLAMING, in our ancient customs, a lord's pursuing, prosecuting, and recalling his vassal, who had gone to live in another place without his permission.

Reclaiming is also used for the demanding of a person, or thing, to be delivered up to the prince or state to which it properly belongs: when, by any irregular means, it is come into another's possession.

RECLAIMING, in *Falconry*, is taming a hawk, &c. and making her gentle and familiar.

A partridge is said to reclaim, when she calls her young ones together, upon their scattering too much from her.

RECLINATION OF A PLANE, in *Dialling*. See DIALLING.

RECLUSE, among the Papists, a person shut up in a small cell of a hermitage, or monastery, and cut off not only from all conversation with the world, but even with the house. This is a kind of voluntary imprisonment, from a motive either of devotion or penance.

The word is also applied to incontinent wives, whom their husbands procure to be thus kept in perpetual imprisonment in some religious house.

Recluses were anciently very numerous. They took an oath never to stir out of their retreat: and having entered it, the bishop set his seal upon the door; and the recluse was to have every thing necessary for the support of life conveyed to him through a window. If he was a priest, he was allowed a small oratory, with a window, which looked into the church, through which he might make his offerings at the mass, hear the singing, and answer those who spoke to him; but this window had curtains before it, so that he could not be seen. He was allowed a little garden, adjoining to his cell, in which he might plant a few herbs, and breathe a little fresh air. If he had disciples, their cells were contiguous to his, with only a window of communication, through which they conveyed necessaries to him, and received his instructions. If a recluse fell sick, his door might be opened for persons to come in and assist him, but he himself was not to stir out.

RECOGNITION, in *Law*, an acknowledgement; a word particularly used in our law books for the first chapter of the statute 1 Jac. I. by which the parliament acknowledged, that, after the death of Queen Elizabeth, the crown had rightfully descended to King James.

RECOGNIZANCE, in *Law*, is an obligation of record, which a man enters into before some court of record or magistrate duly authorised, with condition to do some particular act; as to appear at the assizes, to keep the peace, to pay a debt, or the like. It is in most respects like another bond: the difference being chiefly this, that the bond is the creation of a fresh debt or obligation *de novo*, the recognizance is an acknowledgement of a former debt upon record; the form whereof is, "that A. B. doth acknowledge to owe to our lord the king, to the plaintiff, to C. D. or the like, the sum of ten pounds," with condition to be void on performance of the thing stipulated: in which case the king, the plaintiff, C. D. &c. is called the cognizee, *is cui cognoscitur;* as he that enters into the recognizance is called the cognizor, *is qui cognoscit*. This being certified to, or taken by the officer of some court, is witnessed only by the record of that court, and not by the party's seal: so that it is not in strict propriety a deed, though the effects of it are greater than a common obligation; being allowed a priority in point of payment, and binding the lands of the cognizor from the time of enrolment on record.

RECOIL, or REBOUND, the starting backward of a fire-arm after an explosion. Mersennus tells us, that a cannon 12 feet in length, weighing 6400lb. gives a ball of 24lb. an uniform velocity of 640 feet per second. Putting, therefore, $W=6400$, $w=14$, $V=640$, and $v=$ the velocity with which the cannon recoils; we shall have (because the momentums of the cannon and ball are equal) $W v = w V$; and so $v = \frac{wV}{W} = \frac{24 \times 64}{6400} = 2{,}4$; that is, it would recoil at the rate of $2\frac{4}{10}$ feet per second, if free to move.

RECOLLECTION, a mode of thinking, by which ideas sought after by the mind are found and brought to view.

RECONNOITRE, in military affairs, implies to view and examine the state of things, in order to make a report thereof.

Parties ordered to reconnoitre are to observe the country and the enemy; to remark the routes, conveniences, and inconveniences of the first; the position, march, or forces of the second. In either case, they should have an expert geographer, capable of taking plans readily: he should be the best mounted of the whole, in case the enemy happen to scatter the escorte, that he may save his works and ideas. See WAR.

RECORD, an authentic testimony in writing, contained in rolls of parchment, and preserved in a court of record. See COURT.

Trial by RECORD, a species of trial which is used only in one particular instance: and that is where a matter of record is pleaded in any action, as a fine, a judgement, or the like; and the opposite party pleads, *nul tiel record*, that there is no such matter of record existing. Upon this, issue is tendered and joined in the following form, "and this he prays may be inquired of by the record, and the other doth the like;" and hereupon the party pleading the record has a day given him to bring it in, and proclamation is made in court for him to "bring forth the record by him in pleading alleged, or else he shall be condemned;" and, on his failure, his antagonist shall have judgment to recover. The trial, therefore, of this issue is merely by the record: for, as Sir Edward Coke observes, a record or enrollment is a monument of so high a nature, and importeth in itself such absolute verity, that if it be pleaded that there is no such record, it shall not receive any trial by witness, jury, or otherwise, but only by itself. Thus titles of nobility, as whether earl or not earl, baron or not baron, shall be tried by the kings's writ or patent only, which is matter of record. Also in case of an alien, whether alien friend or enemy, shall be tried by the league or treaty between his sovereign and ours; for every league or treaty is of record. And also, whether a manor be held in ancient demesne or not, shall be tried by the record of domesday in the king's exchequer.

RECORDE, ROBERT, physician, and mathematician, was descended of a respectable family in Wales, and lived in the time of Henry VIII. Edward VI. and Mary. The time of his birth is not exactly known, but it must have been about the beginning of the 16th century; for he was entered of the university of Oxford about 1525, and was elected fellow of All-Souls college in 1531. As he made physic his profession, he went to Cambridge, where he was honoured with the degree of doctor in that faculty in 1545, and very much esteemed by all who were acquainted with him, for his extensive knowledge of many of the arts and sciences. He afterwards returned to Oxford, where he publicly taught arithmetic and mathematics, as he had done prior to his going to Cambridge, and that with great applause. It appears that he afterwards went to London, and was, it is said, physician to Edward VI. and to Mary, to whom some of his books are dedicated; yet he died in the king's-bench prison, Southwark, where he was confined for debt in the year 1558, at a very immature age.

He published several works on mathematical subjects, chiefly in the form of dialogue between master and scholar, of which the following is a list.

The Pathway to Knowledge, containing the first principles

Recorde ‖ Recovery.

ciples of geometry, as they may moste aptly be applied unto practice, bothe for the use of Instrumentes Geometricall and Astronomicall, and also for projection of Plattes, much necessary for all sortes of men. Lond. 4to, 1551.

The Ground of Arts, teaching the perfect worke and practice of Arithmeticke, both in whole numbers and fractions, after a more easie and exact forme then in former time hath been set furth, 8vo, 1552.

The Castle of Knowledge, containing the Explication of the Sphere both Celestiall and Materiall, and divers other things incident thereto. With sundry pleasaunt proofes and certaine newe demonstrations not written before in any vulgare woorkes. Lond. fol. 1556.

The Whetstone of Witte, which is the second part of Arithmetike, containing the extraction of rootes; the Cossike practice, with the rules of equation; and the woorkes of surde numbers. Lond. 4to, 1557.

Wood says that he was the author of several pieces on physic, anatomy, politics, and divinity, but it is uncertain whether these were ever published. Sherburne says that he also published *Cosmographiæ Isagogen;* that he wrote a book *De arte faciendi horologium*, and another *De usu globorum, et de statu temporum*, none of which we have had an opportunity of seeing.

RECORDER, a person whom the mayor and other magistrates of a city or corporation associate to them, for their better direction in matters of justice and proceedings in law; on which account this person is generally a counsellor, or other person well skilled in the law.

The recorder of London is chosen by the lord mayor and aldermen; and as he is held to be the mouth of the city, delivers the judgment of the courts therein, and records and certifies the city-customs. See LONDON, N° 58.

RECOVERY, or *Common Recovery*, in English law, a species of assurance by matter of record; concerning the original of which it must be remarked, that common recoveries were invented by the ecclesiastics to elude the statutes of mortmain (see TAIL); and afterwards encouraged by the finesse of the courts of law in 12 Edward IV. in order to put an end to all fettered inheritances, and bar not only estates-tail, but also all remainders and reversions expectant thereon. We have here, therefore, only to consider, first, the *nature* of a common recovery; and, secondly, its *force* and *effect*.

Blackst. Comment.

1. A common recovery is a suit or action, either actual or fictitious: and in it the lands are recovered against the tenant of the freehold; which recovery, being a supposed abjudication of the right, binds all persons, and vests a free and absolute fee-simple in the recoverer. To explain this as clearly and concisely as possible, let us, in the first place, suppose David Edwards to be tenant of the freehold, and desirous to suffer a common recovery, in order to bar all entails, remainders, and reversions, and to convey the same in fee-simple, to Francis Golding. To effect this, Golding is to bring an action against him for the lands; and he accordingly sues out a writ called a *præcipe quod reddat*, because these were its initial or most operative words when the law proceedings were in Latin. In this writ the demandant Golding alleges, that the defendant Edwards (here called the tenant) has no legal title to the land; but that he came into possession of it after one Hugh Hunt had turned the demandant out of it. The subsequent proceedings are made up into a record or recovery roll, in which the writ and complaint of the demandant are first recited: whereupon the tenant appears, and calls upon one Jacob Morland, who is supposed, at the original purchase, to have warranted the title to the tenant; and thereupon he prays, that the said Jacob Morland may be called in to defend the title which he so warranted. This is called the *voucher*, "vocatio," or calling of Jacob Morland to warranty; and Morland is called the *vouchee*. Upon this Jacob Morland, the vouchee, appears, is impleaded, and defends the title. Whereupon Golding the demandant desires leave of the court to imparl, or confer with the vouchee in private; which is (as usual) allowed him. And soon afterwards the demandant Golding returns to court; but Morland the vouchee disappears, or makes default. Whereupon judgment is given for the demandant Golding, now called the *recoverer*, to recover the lands in question against the tenant Edwards, who is now the recoveree: and Edwards has judgment to recover of Jacob Morland lands of equal value, in recompense for the lands so warranted by him, and now lost by his default; which is agreeable to the doctrine of warranty mentioned in the preceding chapter. This is called the *recompense* or *recovery in value*. But Jacob Morland having no lands of his own, being usually the crier of the court, who, from being frequently thus vouched, is called the *common vouchee*, it is plain that Edwards has only a nominal recompense for the lands so recovered against him by Golding; which lands are now absolutely vested in the said recoverer by judgment of law, and seisin thereof is delivered by the sheriff of the county. So that this collusive recovery operates merely in the nature of a conveyance in fee-simple, from Edwards the tenant in tail to Golding the purchaser.

The recovery here described, is with a single voucher only; but sometimes it is with a double, treble, or farther voucher, as the exigency of the case may require. And indeed it is now usual always to have a recovery with double voucher at the least: by first conveying an estate of freehold to any indifferent person, against whom the *præcipe* is brought; and then he vouches the tenant on tail, who vouches over the common vouchee. For, if a recovery be had immediately against tenant in tail, it bars only such estate in the premises of which he is then actually seised; whereas if the recovery be had against another person, and the tenant in tail be vouched, it bars every latent right and interest which he may have in the lands recovered. If Edwards therefore be tenant of the freehold in possession, and John Barker be tenant in tail in remainder, here Edwards doth first vouch Barker, and then Barker vouches Jacob Morland the common vouchee; who is always the last person vouched, and always makes default: whereby the demandant Golding recovers the land against the tenant Edwards, and Edwards recovers a recompense of equal value against Barker the first vouchee; who recovers the like against Morland the common vouchee, against whom such ideal recovery in value is always ultimately awarded.

This supposed recompense in value is the reason why the issue in tail is held to be barred by a common recovery. For, if the recoveree should obtain a recompense

pense in lands from the common vouchee (which there is a possibility in contemplation of law, though a very improbable one, of his doing), these lands would supply the place of those so recovered from him by collusion, and would descend to the issue in tail. The reason will also hold with equal force as to most remainder-men and reversioners, to whom the possibility will remain and revert, as a full recompense for the reality which they were otherwise entitled to: but it will not always hold; and therefore, as Pigott says, the judges have been even *astuti*, in inventing other reasons to maintain the authority of recoveries. And, in particular, it hath been said, that though the estate-tail is gone from the recoveree; yet it is not destroyed, but only transferred, and still subsists; and will ever continue to subsist (by construction of law) in the recoverer, his heirs and assigns: and as the estate-tail so continues to subsist for ever, the remainders or reversions expectant on the determination of such estate-tail can never take place.

To such awkward shifts, such subtile refinements, and such strange reasoning, were our ancestors obliged to have recourse, in order to get the better of that stubborn statute *de donis*. The design for which these contrivances were set on foot, was certainly laudable; the unrivetting the fetters of estates-tail, which were attended with a legion of mischiefs to the commonwealth: but, while we applaud the end, we cannot but admire the means. Our modern courts of justice have indeed adopted a more manly way of treating the subject; by considering common recoveries in no other light than as the formal mode of conveyance by which tenant in tail is enabled to aliene his lands. But, since the ill consequences of fettered inheritances are now generally seen and allowed, and of course the utility and expedience of setting them at liberty are apparent, it hath often been wished that the process of this conveyance was shortened, and rendered less subject to niceties, by either totally repealing the statute *de donis*; which perhaps, by reviving the old doctrine of conditional fees, might give birth to many litigations: or by vesting in every tenant in tail, of full age, the same absolute fee-simple at once, which now he may obtain whenever he pleases, by the collusive fiction of a common recovery; though this might possibly bear hard upon those in remainder or reversion, by abridging the chances they would otherwise frequently have, as no recovery can be suffered in the intervals between term and term, which sometimes continue for near five months together: or, lastly, by empowering the tenant in tail to bar the estate-tail by a solemn deed, to be made in term-time, and enrolled in some court of record; which is liable to neither of the other objections, and is warranted not only by the usage of our American colonies, but by the precedent of the statute 21 Jac. I. c. 19. which, in the case of a bankrupt tenant in tail, empowers his commissioners to sell the estate at any time, by deed indented and enrolled. And if, in so national a concern, the emoluments of the officers concerned in passing recoveries are thought to be worthy attention, those might be provided for in the fees to be paid upon each enrollment.

2. The force and effect of common recoveries may appear from what has been said, to be an absolute bar not only of all estates-tail, but of remainders and reversions expectant on the determination of such estates. So that a tenant in tail may, by this method of assurance, convey the lands held in tail to the recoverer, his heirs and assigns, absolutely free and discharged of all conditions and limitations in tail, and of all remainders and reversions. But, by statute 34 and 35 H. VII. c. 20. no recovery had against tenant in tail of the king's gift, whereof the remainder or reversion is in the king, shall bar such estate-tail, or the remainder or reversion of the crown. And by the statute 11 H. VII. c. 20. no woman, after her husband's death, shall suffer a recovery of lands settled on her by her husband, or settled on her husband and her by any of his ancestors. And by statute 14 Eliz. c. 8. no tenant for life, of any sort, can suffer a recovery so as to bind them in remainder or reversion. For which reason, if there be tenant for life, with remainder in tail, and other remainders over, and the tenant for life is desirous to suffer a valid recovery, either he, or the tenant to the *præcipe* by him made, must vouch the remainder-man in tail, otherwise the recovery is void: but if he does vouch such remainder-man, and he appears and vouches the common vouchee, it is then good; for if a man be vouched and appears, and suffers the recovery to be had, it is as effectual to bar the estate-tail as if he himself were the recoveree.

In all recoveries, it is necessary that the recoveree, or tenant to the *præcipe*, as he is usually called, be actually seized of the freehold, else the recovery is void. For all actions to recover the seisin of lands must be brought against the actual tenant of the freehold, else the suit will lose its effect; since the freehold cannot be recovered of him who has it not. And, though these recoveries are in themselves fabulous and fictitious, yet it is necessary that there be *actores fabulæ*, properly qualified. But the nicety thought by some modern practitioners to be requisite in conveying the legal freehold, in order to make a good tenant to the *præcipe*, is removed by the provisions of the statute 14 Geo. II. c. 20. which enacts, with a retrospect and conformity to the ancient rule of law, that, though the legal freehold be vested in lessees, yet those who are entitled to the next freehold estate in remainder, or reversion, may make a good tenant to the *præcipe*; and that, though the deed or fine which creates such tenant be subsequent to the judgment of recovery, yet if it be in the same term, the recovery shall be valid in law: and that though the recovery itself do not appear to be entered, or be not regularly entered on record, yet the deed to make a tenant to the *præcipe*, and declare the uses of the recovery, shall after a possession of 20 years be sufficient evidence on behalf of a purchaser for valuable consideration, that such recovery was duly suffered.

RECOVERY of persons drowned, or apparently dead. See RE-ANIMATION, and the articles there referred to.

RECREANT, COWARDLY, *Faint-hearted*; formerly a word very reproachful. See BATTEL.

RECREMENT, in *Chemistry*, some superfluous matter separated from some other that is useful; in which sense it is the same with *scoriæ*, *fæces*, and *excrements*.

RECRIMINATION, in *Law*, an accusation brought by the accused against the accuser upon the same fact.

RECRUITS, in military affairs, new-raised soldiers designed to supply the place of those who have lost their

their lives in the service, or who are disabled by age or wounds.

RECTANGLE, in *Geometry*, the same with a right-angled parallelogram. See GEOMETRY.

RECTIFICATION, in *Chemistry*, is nothing but the repetition of a distillation or sublimation several times, in order to render the substance purer, finer, and freer from aqueous and earthy parts.

RECTIFICATION, in *Geometry*, is the method of finding a right line equal to a curve. The rectification of curves is a branch belonging to the higher geometry, in which the use of the inverse method of fluxions is of singular utility.

RECTIFICATION of Spirits. See DISTILLATION.

RECTIFIER, in *Navigation*, an instrument consisting of two parts, which are two circles, either laid one upon, or let into the other, and so fastened together in their centres, that they represent two compasses, one fixed, the other moveable: each of them divided into the 32 points of the compass, and 360°, and numbered both ways, from the north and the south, ending at the east and west, in 90°.

The fixed compass represents the horizon, in which the north and all the other points of the compass are fixed and immoveable.

The moveable compass represents the mariner's compass; in which the north and all other points are liable to variation.

In the centre of the moveable compass is fastened a silk thread, long enough to reach the outside of the fixed compass. But if the instrument be made of wood, there is an index instead of the thread.

Its use is to find the variation of the compass, to rectify the course at sea; having the amplitude or azimuth given.

RECTIFYING the GLOBE. See GEOGRAPHY *Index*.

RECTILINEAR, in *Geometry*, right-lined; thus figures whose perimeter consists of right lines, are said to be rectilinear.

RECTITUDE, in *Philosophy*, refers either to the act of judging or of willing; and therefore whatever comes under the denomination of rectitude, is either what is true or what is good, these being the only objects about which the mind exercises its two faculties of judging and willing.

Moral rectitude, or uprightness, is the choosing and pursuing those things which the mind, upon due inquiry and attention, clearly perceives to be good; and avoiding those that are evil. See *MORAL Philosophy*.

RECTOR, a term applied to several persons whose offices are very different: as, 1. The rector of a parish is a clergyman that has the charge and cure of a parish, and possesses all the tithes, &c. 2. The same name is also given to the chief elective officer in several foreign universities, particularly in that of Paris, and also in those of Scotland. It is also applied to the head master of large schools in Scotland, as in the high school of Edinburgh. 3. Rector is also used in several convents for the superior officer who governs the house: and the Jesuits give this name to the superiors of such of their houses as are either seminaries or colleges.

RECTORY, a parish-church, parsonage, or spiritual living, with all its rights, tithes, and glebes.

RECTORY is sometimes used for the rector's mansion or parsonage-house.

RECTUM, in *Anatomy*, the third and last of the large intestines or guts. See ANATOMY, N° 93.

RECTUS, in *Anatomy*, a name common to several pairs of muscles, so called on account of the straightness of their fibres.

RECUPERATORES, among the Romans, were commissioners appointed to take cognizance of private matters in dispute, between the subjects of the state and foreigners, and to take care that the former had justice done them. It came at last to be used for commissioners, to whom the prætor referred the determination of any affair between one subject and another.

RECURRENTS, in *Anatomy*, a name given to several large branches of nerves sent out by the par vagum from the upper part of the thorax to the larynx.

RECURVIROSTRA, a genus of birds belonging to the order of grallæ of Linnæus, and that of palmipedes of Pennant and Latham. See ORNITHOLOGY *Index*.

RECUSANTS, such persons as acknowledge the pope to be the supreme head of the church, and refuse to acknowledge the king's supremacy; who are hence called *Popish recusants*. The penal laws against Papists are now abolished in Britain and in Ireland; and in all probability they will quickly be allowed the amplest privileges.

RED, one of the colours called *simple* or *primary*: being one of the shades into which the light naturally divides itself when refracted through a prism. See CHROMATICS.

RED, in *Dyeing*, see that article.—Some reckon six kinds or casts of red, viz. scarlet-red, crimson-red, madder-red, half-grain red, lively orange-red, and scarlet of cochineal: but it is easy to see that there can be but one proper species of red; namely, the reflection of the light exactly in such a manner as it is refracted by the prism; all other shades being adulterations of that pure colour, with yellow, brown, &c.

RED, in *Heraldry*. See GULES.

RED-Bird. See MUSCICAPA, ORNITHOLOGY *Index*.

RED-Breast. See MOTACILLA, ORNITHOLOGY *Index*.

RED-Book of the exchequer, an ancient record or manuscript volume, in the keeping of the king's remembrancer, containing divers miscellany treatises relating to the times before the conquest.

RED-Lead. See CHEMISTRY *Index*.

RED-Precipitate of Mercury. See CHEMISTRY *Index*.

RED Russia, or *Little Russia*, a province of Poland, bounded on the west by Upper Poland, on the north by Lithuania, on the east by Little Tartary, and on the south by Moldavia, Transylvania, and a part of Hungary. It comprehends Russia properly so called, Volhynia, and Podolia. It is about 650 miles in length, and from 150 to 250 in breadth. It consists chiefly of large fields, but little cultivated on account of the frequent inroads of the Tartars, and because there is no water carriage. It had the name of *Red Russia*, from the colour of the hair of its inhabitants. The western part is now subject to Austria, the east to Russia.

RED-Sea, or *Arabic Gulf*, so much celebrated in sacred

cred history, separates Arabia from Upper Ethiopia and part of Egypt. This sea is 350 leagues in length and 40 in breadth. As no river falls into it of sufficient force to counteract the influence of the tide, it is more affected by the motions of the great ocean than any of the inland seas nearly in the same latitude. It is not much exposed to tempests: the winds usually blow from north to south, and being periodical, like the monsoons of India, invariably determine the season of sailing into or out of this sea. It is divided into two gulfs; that to the east was called the *Ælanitic gulf*, from the city Ælana at the north end of it; and that to the west the *Heroopolitic*, from the city of Heroopolis; the former of which belongs to Arabia, and the latter to Egypt.

Mr Bruce has made many observations on this sea, which are worthy of notice.—With regard to the name, he says it was certainly derived from Edom or Esau the son of Jacob; though in another place he says, he wonders that writers have not rather supposed it to have got the epithet of *Red*, from the colour of the sand on its coasts, than for other reasons they have alleged. With regard to any redness in the water itself, or in the bottom, which some have asserted, our traveller assures us that there is no such thing. It is more difficult to assign a reason for the Hebrew name of it, which signifies the *Sea of Weeds;* as he never saw a weed throughout the whole extent of it. "Indeed, (says he) upon the slightest consideration, it will occur to any one, that a narrow gulf, under the immediate influence of the monsoons, blowing from contrary points six months each year, would have too much agitation to produce such vegetables, seldom found but in stagnant waters, and seldom, if ever, found in salt ones. My opinion then is, that it is from the large trees or plants of white coral, spread everywhere over the bottom of the Red sea, perfectly in imitation of plants on land, that the sea has obtained this name.—I saw one of these, which, from a root nearly central, threw out ramifications of an almost circular form, measuring 26 feet every way."

Our author has also made many useful observations on the navigation of this sea. "All the western shore (he says) is bold, and has more depth of water than the east; but on this side there is neither anchoring ground nor shoals. It is rocky, with a considerable depth of water everywhere; and there are a number of sunken rocks, which, though not visible, are sufficiently near the surface to destroy a large ship." The cause of this, in Mr Bruce's opinion, is, that the mountains on the side of Abyssinia and Egypt are all of hard stone, porphyry, many different kinds of marble, granite, alabaster, and basaltes. These being all composed of solid materials, therefore, can part with very little dust or sand, which might otherwise be blown from them into the sea. On the opposite coast, viz. that of Hejaz and Tahamah, on the Arabian side, the whole consists of moving sands; a large quantity of which is blown from the south-east by the dry winter monsoons; which being lodged among the rocks on that side, and confined there by the north-east or summer monsoon, which is in a contrary direction, hinders them from coming over to the Egyptian side. Hence the western coast is full of sunk rocks for want of sand to cover them, with which they would otherwise become islands. They are naked and bare all round, with sharp points like spears, while on the east side, every rock becomes an island, and every two or three islands become an harbour. On the ends of the principal of these harbours the people have piled up great heaps of stones to serve as signals: "and it is in these (says Mr Bruce) that the large vessels from Cairo to Jidda, equal in size to our large 74 gun ships (but from the cisterns of mason-work built within for holding water, I suppose double their weight), after navigating their portion of the channel in the day-time, come safely and quietly to at four o'clock in the afternoon; and in these little harbours pass the night, to sail into the channel again next morning."

The western channel of the Red sea was chosen, in the days of the Ptolemies, for the track of the Indian and African commerce. These monarchs erected a great number of cities all along the western coast; and notwithstanding the dangers of the navigation, we do not hear that it was ever abandoned on account of them.

From the observations made by our author on the navigation of the Red sea, he undertakes to point out a safe passage for large ships to the gulf of Suez, so that they may be able to judge of the propriety of their own course themselves, without trusting implicitly to the pilots they meet with, who are often very ignorant of their profession. This sea, according to Mr Bruce, may be divided into four parts, of which the channel occupies two, till near the latitude of 26°, or that of Cosseir. On the west it is deep water, with many rocks; and on the east it is full of islands, as has been already mentioned. Between these islands there are channels and harbours of deep water, where ships may be protected in any wind; but a pilot is necessary in sailing among these from Mocha to Suez, and the voyage besides can be continued only during part of the day. Ships bound to Suez without the consent of the sheriffe of Mecca, that is, without any intention of selling their cargo at Jidda, or paying custom there, ought to take in their fresh water at Mocha, or if there be any reason against this, a few hours will carry them to Azab or Saba on the Abyssinian coast, where they may be plentifully supplied: but it must be remembered, "that the people here are *Galla*, the most treacherous and villanous wretches on earth." Here not only water may be procured, but plenty of sheep, goats, with some myrrh, and incense in the proper season.—Great caution, however, must be used in dealing with the people, as even those of Mocha, who are absolutely necessary to them in their commercial dealings, cannot trust them without surety or hostages. Not many years ago, the surgeon and mate of the Elgin East Indiaman, with several other sailors, were murdered by these savages as they went ashore to purchase myrrh, though they had a letter of safe conduct from the shekh.

To such as do not want to be known, our author recommends a low black island on the coast of Arabia, named *Camaran*, in latitude 15° 30′. It is distinguished by a white house or fortress on the west end of it; where water is to be had in still greater plenty than at Azab; but no provisions, or such only as are very bad, can be procured. If it is necessary not to be seen at all on the coast, the island of Foosht is recommended by our author as having excellent water, with a saint or monk, whose office is to keep the wells clean. This is one of the chain of islands which stretches almost across the gulf from Loheiah to Masuah, and from actual observation by Mr Bruce, is found to be situated in N. Lat. 15° 59′ 43″. E. Long. 42° 47′. From this to Yamboo there is a safe watering-place; and there is an absolute necessity for having a pilot before you come to Ras Mahomet; because over the Ælanitic gulf, the mountains of Aucha, and the cape itself, there is often a thick haze, which lasts for many days together, and a number of ships are lost by mistaking the eastern bay or Ælanitic gulf for the entrance of the gulf of Suez; the former has a ridge of rocks nearly across it. After reaching Sheduan, a large island, about three leagues farther in a north-by-west direction, there is a bare rock distinguished by no particular name; but so situated that ships ought not to come within three leagues of it. This rock is to be left to the westward at the distance just mentioned; after passing which you meet with shoals forming a pretty broad channel, with soundings from 15 to 30 fathoms; and again, on standing directly for Tor, there are two other oval sands with sunk rocks in the channel, between which you are to steer. Tor may be known at a distance by two hills that stand near the water-side; which, in clear weather, may be seen six leagues off. Just to the south-east of these is the town and harbour, where there are some palm trees about the houses, the more remarkable, as being the first that are seen on the coast. The soundings in the way to Tor harbour are clean and regular; "and, by giving the beacon a small birth on the larboard hand, you may haul in a little to the northward, and anchor in five or six fathom." In spring tides, it is high water at Tor nearly about 12 o'clock: in the middle of the gulf there is no perceptible tide, but at the sides it runs at the rate of more than two knots in the hour. Tor itself is but a small village, with a convent of monks belonging to those of Mount Sinai. It was taken by Don John de Castro, and fortified, soon after its discovery by the Portuguese; but has never since been a place of any consideration; serving now only for a watering place to the ships trading to or from Suez.—From this place there is a distinct view of Mounts Horeb and Sinai, which appear above and behind the others, with their tops frequently covered with snow in the winter.

Mr Bruce next proceeds to consider some questions which may be reckoned matters of curiosity rather than any thing else. One of these is concerning the level of the water of this sea itself, which has been supposed several feet above that of the Mediterranean. "To this (says our author) I answer, that the fact has been supposed to be so by antiquity, and alleged as a reason why Ptolemy's canal was made from the bottom of the Heroopolitic gulf rather than brought due north across the isthmus of Suez; in which last case it was feared it would submerge a great part of Asia Minor. But who has ever attempted to verify this by experiment? or who is capable of settling the difference of levels, amounting, as supposed, to some feet and inches, between two points 120 miles distant from each other, over a desert that has no settled surface, but is changing its height every day? Besides, since all seas are in fact but one, what is it that hinders the Indian ocean to flow to its level? What is it that keeps the Indian ocean up? Till this last branch of the question is resolved, I shall take it for granted that no such difference of level exists, whatever Ptolemy's engineers might have pretended to him; because, to suppose it fact, is to suppose the violation of one very material law of nature."

The next thing considered by our author is the passage of the Israelites through the Red Sea. At the place where he supposes the passage to have been, the sea is not quite four leagues broad, so that it might easily have been crossed in one night without any miracle. There is about 14 fathom water in the channel, and nine at the sides, with good anchorage every where; the farthest side is a low sandy coast, and a very easy landing place. "The draught of the bottom of the gulf (says he) given by Dr Pococke, is very erroneous in every part of it. It was proposed to Mr Niebuhr, when in Egypt, to inquire upon the spot, whether there were not some ridges of rocks where the water was shallow, so that an army at particular times might pass over? Secondly, whether the Etesian winds, which blow strongly all summer from the north-west, could not blow so violently against the sea, as to keep it back on a heap, so that the Israelites might have passed without a miracle? And a copy of these queries was left for me to join my inquiries likewise. But I must confess, however learned the gentlemen were who proposed these doubts, I did not think they merited any attention to solve them. If the Etesian winds, blowing from the north-west in summer, could keep up the sea as a wall on the right or to the south, of fifty feet high, still the difficulty would remain of building the wall on the left hand or to the north. Besides, water standing in that position for a day, must have lost the nature of a fluid. Whence came that cohesion of particles that hindered that wall to escape at the sides? This is as great a miracle as that of Moses. If the Etesian winds had done this once, they must have repeated it many a time before and since, from the same causes. Yet Diodorus Siculus says, the Troglodytes, the indigenous inhabitants of that very spot, had a tradition from father to son, from their very earliest and remotest ages, that once this division of the sea did happen there; and that, after leaving the bottom some time dry, the sea again came back and covered it with great fury. The words of this author are of the most remarkable kind. We cannot think this heathen is writing in favour of revelation. He knew not Moses, nor says a word about Pharaoh and his host; but records the miracle of the division of the sea in words nearly as strong as those of Moses, from the mouths of unbiassed undesigning pagans."

Red-Shank. See SCOLOPAX, } ORNITHOLOGY *Index*.
Red-Start. See MOTACILLA, }
Red-Wing. See TURDUS, }

REDANS, in *Field Fortification*. See the article REDENS.

REDDENDUM, in *Law*, is used substantively for the clause in a lease wherein the rent is reserved to the lessor. The proper place for it is next after the limitation of estate.

REDDITIO, was the third part of the sacrifice of the heathens, and consisted of the solemn act of putting in again the entrails of the victims, after they had been religiously inspected. See SACRIFICE.

REDDLE, a soft, heavy, red, ferruginous earth, of great

great use in colouring; and being washed and freed from sand, is often sold by our druggists under the name of *bole armeniac*.

REDEMPTION, in *Law*, a faculty or right of re-entering upon lands, &c. that have been sold and assigned, upon reimbursing the purchase-money with legal costs.

REDEMPTION, in *Theology*, denotes the recovery of mankind from sin and death, by the obedience and sacrifice of Christ, who on this account is called the *Redeemer of the world*. See THEOLOGY.

REDENS, REDANS, or *Redant*, in *Fortification*, a kind of indented work in form of the teeth of a saw, with salient and re-entering angles; to the end that one part may flank or defend another. It is likewise called *saw-work* and *indented work*. The lines or faces in this flank one another.

Redens are used in fortifying walls, where it is not necessary to be at the expence of building bastions; as when they stand on the side of a river running through a garrison town, a marsh, the sea, &c. But the fault of such fortification is, that the besiegers from one battery may ruin both the sides of the tenaille or front of a place, and make an assault without fear of being enfiladed, since the defences are mined. The parapet of the corridor is likewise often redented or carried on by the way of redens. The redens was used before bastions were invented, and some people think them preferable.

REDI, FRANCIS, an Italian physician and polite scholar, was born at Arezzo in Tuscany in 1626. His ingenuity and learning recommended him to the office of first physician to Ferdinand II. duke of Tuscany; and he contributed not a little toward the compiling of the Dictionary of La Crusca. He wrote upon vipers, upon the generation of insects, and composed a good deal of poetry. All his writings are in Italian; and his language is so fine and pure, that the authors of the Dictionary of La Crusca have often cited it as a standard of perfection. He died in 1697.

REDINTEGRATION, is the finding the integral or fluent again from the fluxion. See FLUXIONS.

REDOUBT, in *Fortification*, a small square fort, without any defence but in front; used in trenches, lines of circumvallation, contravallation, and approach; as also for the lodgings of corps-de-gard, and to defend passages.

REDUCTION, in the schools, a manner of bringing a term or propositions, which was before opposite to some other, to be equivalent to it.

REDUCTION, in *Arithmetic*, that rule whereby numbers of different denominations are brought into one denomination. See ARITHMETIC.

REDUCTION *of Equations*, in *Algebra*, is the clearing them from all superfluous quantities, bringing them to their lowest terms, and separating the known from the unknown, till at length only the unknown quantity is found on one side, and known ones on the other. The reduction of an equation is the last part of the resolution of the problem. See ALGEBRA.

REDUCTION of a figure, design, or draught, is the making a copy thereof, either larger or smaller than the original; still preserving the form and proportion. The great use of the proportional compasses is the reduction of figures, &c. whence they are called *compasses of reduction*. See the article COMPASS.

There are various methods of reducing figures, &c. the most easy is by means of the pentagraph, or parallelogram; but this hath its defects. See the article PENTAGRAPH.

The best and most usual methods of reduction are as follow: 1. To reduce a figure, as ABCDE (fig. 1.), into a less compass. About the middle of the figure, as z, pitch on a point, and from this point draw lines to its several angles A, B, C, &c. then drawing the line ab parallel to AB, bc parallel to BC, &c. you will have the figure $abcde$ similar to ABCDE. Plate CCCCXLVIII. fig. 1.

If the figure $abcde$ had been required to be enlarged, there needed nothing but to produce the lines from the point beyond the angles, as zD, zC, &c. and to draw lines, viz. DC, CB, &c. parallel to the sides dc, cb, &c.

2. To reduce a figure by the angle of proportion, suppose the figure ABCDE (fig. 2.) required to be diminished in the proportion of the line AB to ab (fig. 3.) draw the indefinite line GH (fig. 4.), and from G to H set off the line AB. On G describe the arch HI. Set off the line ab as a chord on HI, and draw GI. Then with the angle IGH you have all the measures of the figure to be drawn. Thus to lay down the point c, take the interval BC, and upon the point G describe the arch KL. Also on the point G describe MN; and upon A, with the distance MN, describe an arch cutting the preceding one in c, which will determine the side bc. And after the same manner are the other sides and angles to be described. The same process will also serve to enlarge the figure. Fig. 2. Fig. 3. and 4.

3. To reduce a figure by a scale. Measure all the sides of the figure, as ABCDE (fig. 2). by a scale, and lay down the same measures respectively from a smaller scale in the proportion required.

4. To reduce a map, design, or figure, by squares. Divide the original into little squares, and divide a fresh paper of the dimensions required into the same number of squares, which are to be larger or less than the former, as the map is to be enlarged or diminished. This done in every square of the second figure, draw what you find in its correspondent one in the first.

REDUCTION, in *Metallurgy*, is the bringing back metalline substances which have been changed into scoriæ or ashes, or otherwise divested of their metallic form, into their natural and original state of metals again. See ORES, *Reduction of*.

REDUCTION, in *Surgery*, denotes an operation whereby a dislocated, luxated, or fractured bone, is restored to its former state or place.

REDUNDANCY, a fault in discourse, consisting in the use of a superfluity of words. Words perfectly synonymous are redundant, and ought to be retrenched.

REDUNDANT, in *Music*. What the French call *une accord superflue*, which we have translated *a redundant chord* in the article MUSIC (from D'Alembert), has by others been rendered *a chord extremely sharp*, as in the translation of Rameau's Principles of Composition. Their nature will be best understood by a few examples, and an account of the number of tones, semitones, or lesser intervals, contained in each.

The *second redundant* is composed of a major tone, and

and a minor semitone; as from *fa* to *sol* sharp. Its proportion is as 64 to 75.

The *third redundant* consists of two tones and a semitone, as *fa la*, sharp. Its proportion is as 96 to 125.

The *fourth redundant* is the same with the tritone.

From these examples compared with the same intervals in their natural state, the reader may form a general idea of what is meant by *redundant*.

REE, Reis, or *Res*, a little Portuguese coin. See *Money-Table*.

REED, in *Botany* See Arundo and Bamboo.

There are two sorts of reeds, says Hasselquist, growing near the Nile. One of them has scarce any branches; but is furnished with numerous leaves, which are narrow, smooth, channeled on the upper surface; and the plant is about 11 feet high. The Egyptians make ropes of the leaves. They lay them in water like hemp, and then make them into good strong cables. These, with the bark of the date tree, form almost the only cable used in the Nile. The other sort is of great consequence. It is a small reed, about two or three feet high, full branched, with short, sharp, lancet-shaped leaves. The roots, which are thick as the stem, creep and mat themselves together to a considerable distance. This plant seems useless in common life; but to it, continues the learned author, is the very soil of Egypt owing: for the matted roots have stopped the earth which floated in the waters, and thus formed, out of the sea, a country that is habitable.

Fire-Reeds. See *Fire-Ship*.

Reed, a term in the west of England for the straw used by thatchers, which is wheat straw finely combed, consisting of stiff, unbruised, and unbroken stalks of great length, carefully separated from the straw used for fodder by the thresher, and bound in sheaves or nitches, each of which weighs 28lb. and are sold from 21s. to 31s. per hundred nitches, according to the season. This is a great improvement in the art of thatching, as it gives a finish to the work which cannot be attained by straw, rough and tumbled together, without any separation of the long and short: it is also a readier mode of working.

REEF, a term in navigation. When there is a great gale of wind, they commonly roll up part of the sail below, that by this means it may become the narrower, and not draw so much wind; which contracting or taking up the sail they call a *reef*, or *reefing the sail*: so also when a *top-mast is sprung*, as they call it, that is when it is cracked, or almost broken in the cap, they cut off the lower piece that was near broken off, and setting the other part, now much shorter, in the step again, they call it a *reefed top-mast*.

REEL, in the manufactories, a machine serving for the office of reeling. There are various kinds of reels; some very simple, others very complex.

REELING, in the manufactories, the winding of silk, cotton, or the like, into a skain, or upon a button, to prevent its entangling. It is also used for the charging or discharging of bobbins, or quills, to use them in the manufacture of different stuffs, as thread, silk, cotton, &c. Reeling is performed in different ways, and on different engines.

REEVING, in the sea-language, the putting a rope through a block: hence to pull a rope out of a block, is called *unreeving*.

RE-EXCHANGE, in commerce, a second payment of the price of exchange, or rather the price of a new exchange due upon a bill of exchange that comes to be protested, and to be refunded the bearer by the drawer or indorser.

REFECTION, among ecclesiastics, a spare meal or repast, just sufficient for the support of life: hence the hall in convents, and other communities, where the monks, nuns, &c. take their refections or meals in common, is called the *refectory*.

REFERENCE, in writing, &c. a mark relative to another similar one in the margin, or at the bottom of the page, where something omitted in the text is added, and which is to be inserted either in reading or copying.

REFINING, in general, the art of purifying a thing; including not only the essaying or refining of metals, but likewise the depuration or clarification of liquors. See Clarification; and Pharmacy, under Materia Medica; and Ores, *Reduction of*.

Gold and silver may be refined by several methods, which are all founded on the essential properties of these metals, and acquire different names according to their kinds. Thus, for instance, gold having the property which no other metal, nor even silver, has of resisting the action of sulphur, of antimony, of nitrous acid, or marine acid, may be purified by these agents from all other metallic substances, and consequently may be refined. These operations are distinguished by proper names, as *purification of gold by antimony*, *parting*, *concentrated parting*, *dry parting*. The term *refining* is chiefly applied to the purification of gold and silver by lead in the cupel. See Ores, *Reduction of*.

REFLECTION, the return or progressive motion of a moving body, occasioned by some obstacle which hindered it from pursuing its former direction.

Circular Instrument of Reflection, an instrument for measuring angles to a very great degree of accuracy. It was invented by the celebrated astronomer Mr Tobias Mayer of Gottingen, principally with a view to do away the errors of the divisions of the limb; and has since been much improved by the Chevalier de Borda, and M. J. H. de Magellan. This instrument is particularly applicable to the measuring of the distances of the heavenly bodies, and was used by the French in their part of the operation for determining the difference of meridians of Paris and Greenwich. For the description, rectification, and use of this instrument, see Navigation.

Reflection of the Rays of Light, in *Catoptrics*, is their return, after approaching so near the surface of bodies as to be thereby repelled or driven backwards. For the causes of reflection, see Optics *Index*, at *Rays of Light*, and *Reflection of Light*, &c. For the application of the doctrine of reflection to mirrors, see Optics. See also Mirror, *Burning Glass*, and *Glass-Grinding*; and for the *coating* or *foliating* of mirrors, see the article *Foliating of Looking-glasses*, &c. See also Telescope.

Reflection of Heat, see Chemistry, N° 170.

Reflection of Cold. For an account of this curious phenomenon, see also Chemistry, N° 272.

It has been generally supposed that this fact was first noticed by Professor Pictet of Geneva; but we have been informed from good authority (for we have not yet

yet had an opportunity of seeing the book), that the same fact is distinctly mentioned by Baptista de Porta in his *Magia Naturalis*.

REFLECTION is also used figuratively, for an operation of the mind, whereby it turns its view backwards as it were upon itself, and makes itself and its own operations the object of its disquisition; and by contemplating the manner, order, and laws, which it observes in perceiving ideas, comparing them together, reasoning, &c. it frames new ideas of the relations discovered therein. See METAPHYSICS.

REFLECTORS *for Light-Houses*, have of late years been very successfully adopted instead of coal fires. They are composed of a number of square plane glass mirrors, similar to those, which, it is said, were employed by Archimedes in setting fire to the Roman fleet at the siege of Syracuse. The mirrors are an inch square, and are disposed close to each other in the concave of a parabolic segment, formed of stucco, or any other substance which retains them in their place. Stucco, however, is found to answer sufficiently well, and is employed in the reflectors of all the light-houses which have been erected round the coast of Scotland.

The parabolic moulds are from three to five or six feet in diameter, and in the centre of each there is a long shallow lamp of tin plate, filled with whale oil. There are six cotton wicks in each lamp nearly contiguous to each other, and so disposed as to stand in no need of trimming for the space of six hours. The light is reflected from each mirror spread over the concave surface, and is as it were multiplied by the number of mirrors. Tin plate covers the back of the stucco moulding, from which a tube immediately over the lamp proceeds to the roof of the light room, and answers the purpose of a funnel, through which the smoke passes without sullying the face of the mirror. The light-room is a lantern of from eight to twelve sides, entirely made of glass, fixed in frames of cast iron, and roofed with copper. The reflectors with their lamps are placed on circular benches passing round the inside of this lantern, at about 18 inches from the glass frames, so that the concave surfaces of two or three of the reflectors front every point of the compass, and throw a blaze of light in all directions.

There is a hole in the roof, directly over the centre of the room, through which all the funnels pass, and by which fresh air is also conveyed to the lamps. This light room is fixed in such a manner on the top of a round tower, that no weather can move it; and the number of the reflectors, and the height of the tower, are greater or less according as the light is intended to be seen at a greater or less distance.

It has been proposed to make the concave surface of the parabola one speculum of metal, instead of covering it over with a number of plain glass mirrors, or to diminish the size of each mirror, if they are preferred to the metallic speculum. It must be obvious to every man who knows any thing of optics, that either of these alterations would be improper. The brightest metal does not reflect so much light as plain clear glass, and if the size of the mirrors were diminished, the number of joinings would be increased, in each of which some light is lost.

A man wholly guided by theory, would be ready to condemn light-houses of this description; because a violent storm will shake the firmest building, which, in his opinion, would throw the whole rays of light into the air, and thus mislead the bewildered mariner. Experience, however, shows, that such apprehensions are groundless, and that light-houses with lamps and reflectors, are in all respects preferable to those with fires burning in the open air. They are less expensive; they give a more brilliant light, and are seen at a greater distance, and cannot be obscured by smoke, or driven down on the lee side by the most violent wind. If to this we add, that the lamps do not stand in need of trimming so often as fires require fuel, and that the light-man is never exposed to the weather, we must allow that light-houses with reflectors are not so liable to be neglected in stormy weather as those with open fires, which alone must give the former a preference over the latter.

It has been asserted, and particularly stated, in the supplement to the third edition of this work, that Mr Smith of Edinburgh, the principal, and we believe now the sole contractor for managing and keeping in repair the light-houses round the coast of Scotland, is the first who conceived the idea of illuminating light-houses by means of lamps and reflectors. We do not understand that Mr Smith himself ever claimed the merit of this invention; but it appears that reflectors, such as are described above, were invented by Mr Ezekiel Walker of Lynn Regis, who says, in a letter dated October 1801, and addressed to the editor of the Monthly Magazine *, that such reflectors were made and fixed up under his direction, in a light-house on the coast of Norfolk, in the year 1779; and adds farther, that in the year 1787, at the request of the trustees appointed by act of parliament for erecting four light-houses, on the northern coast of Great Britain, he instructed Mr Smith in this method of constructing light-houses. Mr Walker's statement of the fact is confirmed by a letter from Mr Grieve, then lord provost of Edinburgh, who informs Mr Walker that the trustees had agreed to pay the premium required for communicating the invention, and that Mr Smith was engaged to go to Lynn Regis to receive instructions from Mr Walker in the method of constructing the new reflectors.

* Vol. xii. p. 402.

REFLEX, in *Painting*, means those places in a picture which are supposed to be illuminated by light reflected from some other body in the same piece. See PAINTING, Part I. sect. 2. and 5.

REFLUX, the backward course of water, has the same meaning as the ebbing of the sea, and is opposed to flood, flux, or the flowing of the sea. See TIDES.

REFORM means a change from worse to better, a re-establishment or revival of former neglected discipline, or a correction of abuses therein. The term is much used in a monastic sense for the reducing an order or congregation of religious to the ancient severity of the rule from which it had gradually swerved, or even for improving on the ancient rule or institution itself, and voluntarily making it more severe. In this sense the order of St Bernard is said to be only a reform of that of St Benedict. In this country it is applied both to politics and religion, and may innocently be applied

to

Reform. to any endeavours to change an establishment from worse to better. But it appears at present to have been chiefly made a pretence for designs which could not fairly or safely be avowed.

A reform in religion and in parliament (see PARLIAMENT), has, we know, been most loudly called for by men whose religious notions are immensely different from what has been generally reckoned christianity, and whose designs, as has been legally proved, went to the overthrow of all civil order. For insidious purposes like these, the word reform is a good cloak, especially if any thing can be fixed upon, either in the religion or government of the state, which, with the help of exaggeration and distortion, can be represented to the weak and unthinking as extremely defective and erroneous.

The general error of these men seems to be, that having picked up a set of speculative notions which flatter their own pride and the pride of those who listen to them, they will allow nothing to the arguments of their opponents or the experience of mankind. They think so often and so much upon their ideal reforms, that while they imagine their notions are liberal and extensive, they become contracted beyond imagination; while their judgments, of course, are warped with the most inveterate prejudices (see PREJUDICE). They see, or think they see, the propriety of their schemes; but they seldom, perhaps never, reflect, that that may be true in speculation or in theory which cannot possibly be reduced to practice. They will not take the world as it is, and allow it to profit by the wisdom and experience of ages; but they will reform it according to those ideas of right which they have learned from their own speculations and airy theories; seldom considering what may be done, they are determined to do what they think ought to be done. Liberty of conscience, and liberty of action, have been claimed by them as the unalienable rights of man; and so we ourselves are disposed to think them: nor have we heard that in this country they have been denied to any man, or set of men, so far as has been thought consistent with the safety of the state, and that of the other individuals who compose it. At the same time, the very same men hesitate not to blame, with acrimony the most violent, and to the utmost of their power to restrain, the actions and opinions of those who, with equal conviction, often on better grounds, and generally with more modesty, differ from them.

Amidst that excessive ardour, too, with which they propagate their opinions, they forget the extreme danger of withdrawing the attention of that part of the community, who must earn their bread by the sweat of their brow, from their proper occupations, to the tempestuous sea of political debate, for which their education and mode of life cannot possibly have qualified them. It requires but very little penetration, however, to be able to see, that it can be of no real service either to the individuals themselves, or to the community at large, in whatever light we look upon it. Indeed, to make those the judges of the law, and the reformers of the legislature, who have all their lives been employed in manual labour, is the extreme of folly; and yet it is what some men of considerable abilities, and from whom we had reason to expect better things, have more than once attempted. The effect of such a mode of seduction, (and it deserves no better name), when it shall become general, instead of serving the purposes of a real reform, must be to annihilate all civil order. Dissatisfaction is the most powerful check to honest industry; and dissatisfaction and idleness must be the effect of the wanderings of such men in the labyrinths of politics; which, for uncultivated minds especially, paves the way for every species of vice, and gradually ripens them for any wickedness, however atrocious. For the truth of these remarks, we appeal to the history of mankind from the creation to the present time: and we would seriously request the *sober friends of reform*, and many such, we doubt not, there are, to reflect, that in the present day we have more to fear from licentiousness than from despotism; from reform carried to an extreme than from the pretended attempts either of kings or ministers to annihilate our real liberty.

It may also be worth their while to consider, that times of public danger are not generally the best adapted to attempt changes of government; because what might satisfy one party would probably be thought too little by another, and divisions at such a period are most dangerous. When, therefore, attempts are made for reform which appear to be inconsistent with the safety of the state, restrictions must be used, which may by speculative men be thought severe and unnecessary, but of which they themselves are the causes. These restrictions too will be patiently submitted to by the wiser part of the community, when in more peaceable times they would neither have been thought of nor allowed.

Speculative reasoners may speak as much as they will of enlightening the minds of men, and of reforming government by the dictates of a refined and dispassionate philosophy; but when they come to apply their notions to practice, they will either find their representations little better than empty sounds, and therefore ineffectual; or, as is more generally found to be the case, these schemes which in theory appeared to be perfect, will in practice, when combined with the malignant and ambitious passions of men, lead to ruin and disorder. The first institution of government, except among the Jews, was unquestionably the effect of passion and interest combined; and this passion and this interest, restrained within due bounds, is productive of much happiness. That government, we believe, too, will be best supported, and most productive of happiness, in which the mutual passions and interests of the individuals who compose it are so equally poised as to support one another, and to promote each the ends and success of the other: and this by the ablest reasoners and the best men has been thought to be the case with the British constitution. If the modern favourers of reform should think this an unstable support, if they will consider the world as it ever has been, and as it is, they will find it the only one we have, except religion; and they will thence be inclined to make the best of it. If after all, however, they should be disposed to doubt the position, we have only further to request them, with the sincerity of men and of Christians, to consult their own breasts, and seriously to consider the probable motives of those who act with them. They will then perhaps see, and they surely ought to acknowledge, that few

Reform, Reformation. few men have acted more according to the impulse of passion, interest, and ambition, than those who have for some time past sounded the toczin of reform.

REFORMATION, in general, an act of reforming or correcting an error or abuse in religion, discipline, or the like. By way of eminence the word is used for that great alteration and reformation in the corrupted system of Christianity, begun by Luther in the year 1517.

Under the article HISTORY (sect. ii.), the various corruptions in religion, the oppressions and usurpations of the clergy, and the extreme insolence of the popes, have been so fully treated of, that any further detail here is unnecessary. It is sufficient to observe, that, before the period of the Reformation, the pope had in the most audacious manner declared himself the sovereign of the whole world. All the parts of it which were inhabited by those who were not Christians, he accounted to be inhabited by *no-body*; and if Christians took it into their heads to possess any of those countries, he gave them full liberty to make war upon the inhabitants without any provocation, and to treat them with no more humanity than they would have treated wild beasts. The countries, if conquered, were to be parcelled out according to the pope's pleasure; and dreadful was the situation of that prince who refused to obey the will of the holy pontiff, of which many instances will occur to the reader in the various historical articles of this work. In consequence of this extraordinary authority which the pope had assumed, he at last granted to the king of Portugal all the countries to the eastward of Cape Non in Africa, and to the king of Spain all the countries to the westward of it. In this, according to the opinions of some, was completed in his person the character of *Antichrist sitting in the temple of God, and showing himself as God* *. He had long before, say they, assumed the supremacy belonging to the Deity himself in spiritual matters; and now he assumed the same supremacy in worldly matters also, giving the extreme regions of the earth to whom he pleased. The Reformation, therefore, they consider as the immediate effect of divine power taking vengeance on this and all other deviations from the system of truth; while others consider it merely as an effect of natural causes, and which might have been foreseen and prevented, without abridging the papal power in any considerable degree.

Be this as it will, however, the above-mentioned partition was the last piece of insolence which the pope ever had, or in all probability ever will have, in his power to exercise, in the way of parcelling out the globe to his adherents. Every thing was quiet, every heretic exterminated, and the whole Christian world supinely acquiesced in the enormous absurdities which were inculcated upon them; when, in 1517, the empire of superstition began to decline, and has continued to do so ever since. The person who made the first attack on the extravagant superstitions then prevailing was Martin Luther; the occasion of which is fully related under the article LUTHER. By some it is pretended, that the only motive which Luther had in beginning the Reformation was his enmity to the Dominican friars, who had excluded his order (the Augustins) from all share in the gainful traffic of indulgencies. But this does not seem at all probable, if we consider that such a motive would not naturally have led him to deny the virtue of indulgences, as such conduct could not but exclude him for ever from any chance of a share in the traffic, which otherwise perhaps he might have obtained. Besides, the extreme contrariety of this traffic to the common principles of reason and honesty was so great, that we cannot wonder at finding *one* man in the world who had sense enough to discern it, and virtue enough to oppose such an infamous practice. In all probability, however, the insignificancy of the first reformer was the reason why he was not persecuted and exterminated at his first beginning, as others had been before him. Another reason probably might be, that he did not at once attack the whole errors of Popery, but brought about his reformation gradually, probably as it occurred to himself, and as we have related in the account of his life.

1 pope ...mes the ...sal of whole ...d.

2 Reformation begun by Luther.

The Reformation began in the city of Wirtemberg in Saxony, but was not long confined either to that city or province. In 1520 the Franciscan friars, who had the care of promulgating indulgences in Switzerland, were opposed by Zuinglius, a man not inferior in understanding and knowledge to Luther himself. He proceeded with the greatest vigour, even at the very beginning, to overturn the whole fabric of Popery; but his opinions were declared erroneous by the universities of Cologne and Louvain. Notwithstanding this, the magistrates of Zurich approved of his proceedings; and that whole canton, together with those of Bern, Basil, and Chaffausen, embraced his opinions.

3 In Switzerland by Zuinglius.

In Germany, Luther continued to make great advances, without being in the least intimidated by the ecclesiastical censures which were thundered against him from all quarters, he being continually protected by the German princes either from religious or political motives, so that his adversaries could not accomplish his destruction as they had done that of others. The princes, who were upon bad terms with the court of Rome, took advantage of the success of the new doctrines; and in their own dominions easily overturned a church which had lost all the respect and veneration of the inferior ranks. The court of Rome had disobliged some of the smaller princes in the north of Germany, whom the pope probably thought too insignificant to be worth the managing, and they universally established the Reformation in their own dominions. Melancthon, Carlostadius, and other men of eminence, also greatly forwarded the work of Luther; and in all probability the Popish hierarchy would have soon come to an end, in the northern parts of Europe at least, had not the emperor Charles V. given a severe check to the progress of reformation in Germany. In order to follow out the schemes dictated by his ambition, he thought it necessary to ingratiate himself with the pope; and the most effectual method of doing this was by destroying Luther. The pope's legates insisted that Luther ought to be condemned by the diet of Worms without either trial or hearing; as being a most notorious, avowed, and incorrigible heretic. However, this appeared unjust to the members of the diet, and he was summoned to appear; which he accordingly did without hesitation *. There is not the least doubt that his appearance there had been his last in this world, had not the astonishing respect that was paid him, and the

4 Opposed in Germany by Char. V.

* ...hess.

* See Luther.

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the crowds who came daily to see him, deterred his judges from delivering the church from the author of such a pestilent heresy; which they were strongly solicited by the pope's party to do. He was therefore permitted to depart with a safe conduct for a certain time; after which he was in the state of a proscribed criminal, to whom it was unlawful to perform any of the offices of humanity.

During the confinement of Luther in a castle near Warburg, the Reformation advanced rapidly; almost every city in Saxony embracing the Lutheran opinions.

5 Form of worship first altered by Wittemberg.

At this time an alteration in the established forms of worship was first ventured upon at Wittemberg, by abolishing the celebration of private masses, and by giving the cup as well as the bread to the laity in the Lord's supper. In a short time, however, the new opinions were condemned by the university of Paris, and a refutation of them was attempted by Henry VIII. of England. But Luther was not to be thus intimidated. He published his animadversions on both with as much acrimony as if he had been refuting the meanest adversary; and a controversy managed by such illustrious antagonists drew a general attention, and the Reformers daily gained new converts both in France and England.

6 Disputes among the Reformers

But while the efforts of Luther were thus every where crowned with success, the divisions began to prevail which have since so much agitated the reformed churches. The first dispute was between Luther and Zuinglius concerning the manner in which the body and blood of Christ were present in the eucharist. Luther and his followers, though they had rejected the notion of transubstantiation, were nevertheless of opinion that the body and blood of Christ were really present in the Lord's supper, in a way which they could not pretend to explain. Carlostadt, who was Luther's colleague, first suggested another view of the subject, which was afterwards confirmed and illustrated by Zuinglius, namely, that the body and blood of Christ were not really present in the eucharist; and that the bread and wine were no more than external symbols to excite the remembrance of Christ's sufferings in the minds of those who received it. Both parties maintained their tenets with the utmost obstinacy; and, by their divisions, first gave their adversaries an argument against them, which to this day the Catholics urge with great force; namely, that the Protestants are so divided, that it is impossible to know who is right or wrong; and that there cannot be a stronger proof than these divisions, that the whole doctrine is false.

7 Disturbances in Germany.

To these intestine divisions were added the horrors of a civil war, occasioned by oppression on the one hand, and enthusiasm on the other. In 1525, a great number of seditious fanatics arose on a sudden in different parts of Germany, took arms, united their forces, and made war against the empire, laying waste the country with fire and sword, and committing everywhere the greatest cruelties. The greatest part of this furious mob was composed of peasants and vassals, who groaned under heavy burdens, and declared that they were no longer able to bear the despotic government of their chiefs; and hence this sedition had the name of *the rustic war*, or the *war of the peasants*. At first this rabble declared, that they had no other motives than the redress of their grievances; but no sooner had the enthusiast Munzer, or Munster, the anabaptist, put himself at their head, than the face of things was entirely changed, and the civil commotions in Saxony and Thuringia exceedingly increased, of which an account is given under the article ANABAPTISTS.

In the mean time Frederic, surnamed the *Wise*, elector of Saxony, and Luther's great patron, departed this life, and was succeeded by his brother John. Frederic, though he had protected and encouraged Luther, yet was at no pains to introduce the reformed religion into his dominions. But with his successor it was otherwise;

8 Reformation established in Saxony.

for he, convinced that Luther's doctrine must soon be totally destroyed and suppressed unless it received a speedy and effectual support, ordered Luther and Melancthon to draw up a body of laws relating to the form of ecclesiastical government, the method of public worship, &c. which was to be proclaimed by heralds throughout his dominions. This example was followed by all the princes and states of Germany who renounced the papal supremacy; and a like form of worship, discipline, and government, was thus introduced into all the churches which dissented from that of Rome. This open renunciation of the Romish jurisdiction soon changed the face of affairs; and the patrons of Popery soon intimated, in a manner not at all ambiguous, that they intended to make war on the Lutheran party; which would certainly have been put in execution, had not the troubles that took place in Europe disconcerted their measures. On the other hand, the Lutherans, apprised of these hostile intentions, began also to deliberate on a proper plan of defence against that superstitious violence with which they were in danger of being assailed.

9 Resolutions at the diet of Spire favourable to the Reformation.

The diet of the empire assembled at Spire, in the year 1526; where the emperor's ambassadors were desired to use their utmost endeavours to suppress all disputes about religion, and to insist upon the rigorous execution of the sentence which had been pronounced against Luther and his followers at Worms. The greatest part of the German princes opposed this motion with the utmost resolution, declaring that they could neither execute that sentence, nor come to any determination with regard to the doctrines by which it had been occasioned, before the whole matter was submitted to the decision of a council lawfully assembled; alleging farther, that the decision of controversies of this nature belonged properly to it, and to it alone. This opinion, after long and very warm debates, was adopted by a great majority, and at length consented to by the whole assembly: for it was unanimously agreed to present a solemn address to the emperor, intreating him to assemble, without delay, a free and general council; while in the mean time it was also agreed, that the princes of the empire should, in their respective dominions, be at liberty to manage ecclesiastical affairs in the manner they should think most proper; yet so as to be able to give to God and the emperor a proper account of their administration when it should be required of them.

These resolutions proved extremely favourable to the cause of reformation; neither had the emperor any leisure for some time to give disturbance to the reformed. The war, which at this time ensued between him and the pope, gave the greatest advantage to the friends of the reformed, and considerably augmented their number. Several princes, whom the fear of persecution and punishment

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punishment had hitherto prevented from lending their assistance, publicly renounced the Romish superstition, and introduced among their subjects the same forms of religious worship, and the same system of doctrine, that had been received in Saxony. Others, though placed in such circumstances as discouraged them from acting in an open manner against the interests of the Roman pontiff, were, however, far from discovering the smallest opposition to those who withdrew the people from his despotic yoke; nor did they molest the private assemblies of those who had separated themselves from the church of Rome. And in general, all the Germans who, before these resolutions of the diet of Spire, had rejected the papal discipline and doctrine, were now, in consequence of the liberty they enjoyed, wholly employed in bringing their schemes and plans to a certain degree of consistence, and in adding vigour and firmness to the cause in which they were engaged. But this tranquillity and liberty was of no long duration. In 1529, a new diet was assembled at the same place by the emperor, after he had quieted the troubles in various parts of his dominions, and concluded a peace with the pope. The power which had been granted to princes of managing ecclesiastical affairs till the meeting of a general council, was now revoked by a majority of votes; and every change declared unlawful that should be introduced into the doctrine, discipline, or worship of the established religion, before the determination of the approaching council was known. This decree was considered as iniquitous and intolerable by the elector of Saxony, the landgrave of Hesse, and other members of the diet, who were persuaded of the necessity of a reformation. The promise of speedily assembling a general council, they looked upon to be an artifice of the church of Rome; well knowing, that a free and lawful council would be the last thing to which the pope would consent. When, therefore, they found that all their arguments and remonstrances made no impression upon Ferdinand the emperor's brother, who presided in the diet, Charles himself being then at Barcelona, they entered a solemn protest against this decree on the 19th of April, and appealed to the emperor and a future council. Hence arose the denomination of *Protestants*, which from this period has been give to those who separated from the communion of the church of Rome. The princes of the empire who entered this protest, were John elector of Saxony; George elector of Brandenburg; Ernest and Francis dukes of Lunenburg; the landgrave of Hesse; and the prince of Anhalt. These were seconded by 13 imperial towns, viz. Strasburg, Ulm, Nuremberg, Constance, Rottengen, Windseim, Memmingen, Nortlingen, Lindaw, Kempton, Heilbron, Wissemburg, and St Gall.

10 [Rev]oked [b]y the em[p]eror.

11 [O]rigin of [th]e name [P]rotestants.

The dissenting princes, who were the protectors and heads of the reformed churches, had no sooner entered their protest, than they sent proper persons to the emperor, who was then upon his passage from Spain to Italy, to acquaint him with their proceedings in this matter. The ministers employed in this commission executed it with the greatest intrepidity, and presence of mind; but the emperor, exasperated at the audacity of those who presumed to differ from him, caused the ambassadors to be arrested. The news of this violent step made the Protestant princes conclude, that their personal safety, and the success of their cause, depended entirely upon their own courage and union. They determined, therefore, to enter into a solemn confederacy: for which purpose they held several meetings at Rot, Nuremberg, Smalcald, and other places; but so different were their opinions and views, that they could determine upon nothing.

12 Conference between Luther and Zuinglius.

One great obstacle to the intended confederacy was the dispute which had arisen between Luther and Zuinglius concerning the real presence of Christ in the Lord's Supper. To terminate this dispute, if possible, Philip, landgrave of Hesse, invited, in the year 1529, to a conference at Marpurg, Luther and Zuinglius, together with several other of the more eminent doctors who adhered to the respective parties of these contending chiefs: but this measure was not attended with the salutary effects which were expected from it. The divines disputed for four days in presence of the landgrave. Luther attacked Oecolampadius, and Zuinglius was attacked by Melancthon. Zuinglius was accused of heresy, not only on account of his explanation of the nature and design of the Lord's Supper, but also in consequence of the false notions he was supposed to have adopted concerning the divinity of Christ, the efficacy of the divine word, original sin, and some other parts of the Christian doctrine. This illustrious reformer, however, cleared himself from the greatest part of these charges with the most triumphant evidence, and in such a manner as appeared satisfactory even to Luther himself: but their dissension concerning the manner of Christ's presence in the eucharist still remained; nor could either of the contending parties be persuaded to abandon, or even to modify, their opinions on that matter. The only advantage, therefore, which resulted from the meeting was, that the jarring doctors formed a kind of truce, by agreeing to a mutual toleration of their sentiments, and leaving to the disposal of Providence the cure of their divisions.

In the mean time news were received that the emperor designed to come into Germany, with a view to terminate all religious differences at the approaching diet of Augsburg. Having foreseen some of the consequences of those disputes, and, besides, taken the advice of men of wisdom, sagacity, and experience, he became at certain times more cool in his proceedings, and more impartial in his opinions both of the contending parties and the merits of the cause. He, therefore, in an interview with the pope at Bologna, insisted, in the most serious and urgent manner, on the necessity of a general council. His remonstrances and expostulations, however, could not move the pontiff; who maintained with zeal the papal prerogatives, reproached the emperor with an ill-judged clemency, and alleged that it was the duty of that prince to support the church, and to execute speedy vengeance upon that obstinate heretical faction who dared to call in question the authority of Rome and its pontiff. To this discourse the emperor paid no regard; looking upon it as a most iniquitous thing, and a measure directly opposite to the laws of the empire, to condemn unheard a set of men who had always approved themselves good citizens, and deserved well of their country in several respects. Hitherto indeed it was not easy for the emperor to form a clear idea of the matters in debate, since there was no regular

13 Origin of the confession of Augsburg.

regular system as yet composed, by which it might be known with certainty what were the true causes of Luther's opposition to the pope. The elector of Saxony, therefore, ordered Luther, and other eminent divines, to commit to writing the chief articles of their religious system, and the principal points in which they differed from the church of Rome. Luther, in compliance with this order, delivered to the elector at Torgaw 17 articles which had been agreed upon in a conference at Sultzbach in 1529; from whence these received the name of *the articles of Torgaw*. But though these were deemed by Luther a sufficient declaration of the sentiments of the reformers, yet it was judged proper to enlarge them, in order to give perspicuity to their arguments, and strength to their cause. In this work Melancthon was employed; in which he showed a proper deference to the counsels of Luther, and expressed his sentiments and doctrine with the greatest elegance and perspicuity; and thus came forth to view the famous *Confession of Augsburg*.

On the 15th of June 1530, Charles arrived at Augsburg, and the diet was opened five days after. The Protestants received a formal permission to present an account of their tenets to the diet on the 25th of the same month; in consequence of which, at the time appointed, Christian Bayer, chancellor of Saxony, read, in the German language, before the emperor and the princes assembled, the confession of Augsburg above mentioned. It contained 28 chapters, of which 21 were employed in representing the religious opinions of the Protestants, and the other seven in pointing out the errors and superstitions of the church of Rome. The princes heard it with the deepest attention and recollection of mind: it confirmed some in the principles they had embraced; surprised others; and many, who before this time had little or no idea of the religious sentiments of Luther, were now not only convinced of their innocence, but delighted with their purity and simplicity. The copies of this Confession, which after being read were delivered to the emperor, were signed by John elector of Saxony, George marquis of Brandenburg, Ernest duke of Lunenburg, Philip landgrave of Hesse, Wolfgang prince of Anhalt, and by the imperial cities of Nuremburg and Reutlingen.

14
It is presented to the emperor.

15
A refutation of it, in which the Protestants are ordered to acquiesce.

The creatures of the church of Rome who were present at this diet employed John Faber, afterwards bishop of Vienna, together with Eckius, and another doctor named *Cocklæus*, to draw up a refutation of the Prostestant confession: which refutation having been publicly read, the emperor required the Protestant members to acquiesce in it, and put an end to the religious disputes by an unlimited submission to the opinions and doctrines contained in this answer. But this demand was far from being complied with. The Protestants declared on the contrary, that they were by no means satisfied with the reply of their adversaries; and earnestly desired a copy of it, that they might more fully demonstrate its extreme insufficiency and weakness. But this reasonable request was refused by the emperor; who interposed his supreme authority to prevent any farther proceedings in this matter, and solemnly prohibited the publication of any new writings or declarations that might contribute to lengthen out these religious debates. This, however, did not reduce the Protestants to silence. The divines of that communion, who had been present at the diet, endeavoured to recollect the arguments and objections employed by Faber, and had again recourse to the pen of Melancthon, who refuted them in an ample and satisfactory manner, in a piece which was presented to the emperor on the 22d of September, but which Charles refused to receive. This answer was afterwards enlarged by Melancthon, when he had obtained a copy of Faber's reply; and was published in the year 1531, with the other pieces that related to the doctrine and discipline of the Lutheran church, under the title of *A Defence of the Confession of Augsburg*.

Matters now began to draw towards a crisis. There were only three ways of bringing to a conclusion these religious differences. 1. To grant the Protestants a toleration and privilege of serving God as they thought proper: 2. To compel them to return to the church of Rome by the violent methods of persecution: or, 3. That a reconciliation should be made, upon fair, candid, and equitable terms, by engaging each of the parties to temper their zeal with moderation, to abate reciprocally the rigour of their pretensions, and remit something of their respective claims. The third expedient was most generally approved of, being peculiarly agreeable to all who had at heart the welfare of the empire; nor did the pope seem to look upon it either with aversion or contempt. Various conferences therefore were held between persons eminent for piety and learning on both sides; and nothing was omitted that might have the least tendency to calm the animosities and heal the divisions which reigned between the contending parties. But the differences were too great to admit of a reconciliation; and therefore the votaries of Rome had recourse to the powerful arguments of imperial edicts, and the force of the secular arm. On the 19th of November, a severe decree was issued out by the express order of the emperor (during the absence of the Hessian and Saxon princes, who were the chief supporters of the Protestant cause), in which every thing was manifestly adapted to deject the friends of religious liberty, excepting only a faint and dubious promise of engaging the pope to assemble a general council about six months after the separation of the diet. In this decree the dignity and excellence of the Popish religion were extolled beyond measure, a new degree of severity and force was added to that which had been published at Worms against Luther and his adherents, the changes which had been introduced into the doctrine and discipline of the Protestant churches were severely censured, and a solemn order was addressed to the princes, cities, and states, who had thrown off the Papal yoke, to return to their allegiance to Rome, on pain of incurring the indignation and vengeance of the emperor as the patron and protector of the church. Of this formidable decree the elector of Saxony and confederated princes were no sooner informed than they assembled in order to deliberate on the measures proper to be taken in such a crisis. In the years 1530 and 1531 they met, first at Smalcald, and afterwards at Francfort, where they formed a solemn alliance and confederacy, with the intention of defending vigorously their religion and liberties against the dangers and encroachments with which they were threatened by the edict of Augsburg, without attempting, however, any thing offensive against the votaries of Rome; and into this confederacy they invited

vited the kings of England, France, Denmark, &c. leaving no means unemployed that might corroborate and cement this important alliance.

This confederacy was at first opposed by Luther, from an apprehension of the calamities and troubles which it might produce; but at last, perceiving the necessity of it, he consented; though he uncharitably, as well as imprudently, refused to comprehend in it the followers of Zuinglius among the Swiss, together with the German states and cities who had adopted the sentiments and confession of Bucer. In the invitation addressed to Henry VIII. of England, whom the confederate princes were willing to declare the head and protector of their league, the following things, among others, were expressly stipulated: That the king should encourage, promote, and maintain, the true doctrine of Christ as it was contained in the confession of Augsburg, and defend the same at the next general council: that he should not agree to any council summoned by the bishop of Rome, but protest against it; and neither submit to its decrees, nor suffer them to be respected in his dominions: that he should never allow the Roman pontiff to have any pre-eminence or jurisdiction in his dominions; that he should advance 100,000 crowns for the use of the confederacy, and double that sum if it became necessary: all which articles the confederate princes were equally obliged to observe on their part. To these demands the king replied, that he would maintain and promote the true doctrine of Christ; but, at the same time, as the true ground of that doctrine lay only in the holy Scriptures, he would not accept at any one's hand what should be his own faith, or that of his kingdom; and therefore desired that they would send over two learned men to confer with him, in order to promote a religious union between him and the confederates. However, he declared himself of their opinion with regard to the meeting of a free general council, and promised to join with them in all such councils for the defence of the true doctrine; but thought the regulation of the ceremonial part of religion, being a matter of indifference, ought to be left to the choice of each sovereign for his own dominions. After this the king gave them a second answer more full and satisfactory; but after the execution of Queen Anne, this negotiation came to nothing. On the one hand the king grew cold when he perceived that the confederates were no longer of use to him in supporting the validity of his marriage; and, on the other hand, the German princes became sensible that they could never succeed with Henry, unless they allowed him an absolute dictatorship in matters of religion.

18 [...]ation [H]enry of [Engl]and.

While every thing thus tended to an open war between the two opposite parties, the elector Palatine and the elector of Mentz offered their mediation, and endeavoured to procure a reconciliation. The emperor himself, for various reasons, was at this time inclined to peace: for, on the one hand, he stood in need of succours against the Turks, which the Protestant princes refused to grant as long as the edicts of Worms and Augsburg remained in force; and, on the other, the election of his brother Ferdinand to the dignity of king of the Romans, which had been carried by a majority of votes at the diet of Cologne in 1531, was by the same princes contested, as being contrary to the fundamental laws of the empire. In consequence of all this, after many negotiations and projects of reconciliation, a treaty of peace was concluded at Nuremberg in 1532, between the emperor and the Protestant princes, on the following conditions; *viz.* That the latter should furnish a subsidy for carrying on the war against the Turks, and acknowledge Ferdinand lawful king of the Romans; and that the emperor on his part should abrogate and annul the edicts of Worms and Augsburg, and allow the Lutherans the free and undisturbed exercise of their religious doctrine and discipline, until a rule of faith was fixed either in the free general council that was to be assembled in the space of six months, or in a diet of the empire.

19 Peace of Nuremberg concluded.

Soon after the conclusion of the peace at Nuremberg died John elector of Saxony, who was succeeded by his son John Frederic, a prince of invincible fortitude and magnanimity, but whose reign was little better than one continued train of disappointments and calamities. The religious truce, however, gave new vigour to the reformation. Those who had hitherto been only secret enemies to the Roman pontiff, now publicly threw off his yoke; and various cities and provinces of Germany enlisted themselves under the religious standards of Luther. On the other hand, as the emperor had now no other hope of terminating the religious disputes but by the meeting of a general council, he repeated his requests to the pope for that purpose. The pontiff (Clement VII.), whom the history of past councils filled with the greatest uneasiness, endeavoured to retard what he could not with decency refuse. At last, in 1533, he made a proposal by his legate to assemble a council at Mantua, Placentia, or Bologna; but the Protestants refused their consent to the nomination of an Italian council, and insisted that a controversy which had its rise in the heart of Germany, should be determined within the limits of the empire. The pope, by his usual artifices, eluded the performance of his own promise; and, in 1534, was cut off by death, in the midst of his stratagems. His successor Paul III. seemed to show less reluctance to the assembling a general council, and in the year 1535 expressed his inclination to convoke one at Mantua; and, the year following, actually sent circular letters for that purpose through all the states and kingdoms under his jurisdiction. This council was summoned by a bull issued out on the 2d of June 1536, to meet at Mantua the following year: but several obstacles prevented its meeting; one of the most material of which was, that Frederic duke of Mantua had no inclination to receive at once so many guests, some of them very turbulent, into the place of his residence. On the other hand, the Protestants were firmly persuaded that, as the council was assembled in Italy, and by the authority of the pope alone, the latter must have had an undue influence in that assembly; of consequence, that all things must have been carried by the votaries of Rome. For this reason they assembled at Smalcald in the year 1537, where they solemnly protested against this partial and corrupt council, and, at the same time, had a new summary of their doctrine drawn up by Luther, in order to present it to the assembled bishops if it should be required of them. This summary, which had the title of *The Articles of Smalcald* is commonly joined with the creeds and confessions of the Lutheran church.

20 A general council proposed.

21 Protestation against it.

After the meeting of the general council in Mantua was thus prevented, many schemes of accommodation were proposed both by the emperor and the Protestants; but,

22 Fruitless schemes of accommodation.

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but, by the artifices of the church of Rome, all of them came to nothing. In 1541, the emperor appointed a conference at Worms on the subject of religion, between persons of piety and learning chosen from the contending parties. This conference, however, was, for certain reasons, removed to the diet which was to be held at Ratisbon that same year, and in which the principal subject of deliberation was a memorial presented by a person unknown, containing a project of peace. But the conference produced no other effect than a mutual agreement of the contending parties to refer their matters to a general council, or, if the meeting of such a council should be prevented, to the next German diet.

This resolution was rendered ineffectual by a variety of incidents, which widened the breach, and put off to a farther day the deliberations which were designed to heal it. The pope ordered his legate to declare to the diet of Spire, assembled in 1542, that he would, according to the promise he had already made, assemble a general council, and that Trent should be the place of its meeting, if the diet had no objection to that city. Ferdinand, and the princes who adhered to the cause of the pope, gave their consent to this proposal; but it was vehemently objected to by the Protestants, both because the council was summoned by the authority of the pope only, and also because the place was within the jurisdiction of the pope; whereas they desired a free council, which should not be biassed by the dictates, nor awed by the proximity of the pontiff. But this protestation produced no effect. Paul III. persisted in his purpose, and issued out his circular letters for the convocation of the council, with the approbation of the emperor. In justice to this pontiff, however, it must be observed, that he showed himself not to be averse to every reformation. He appointed four cardinals, and three other persons eminent for their learning, to draw up a plan for the reformation of the church in general, and of the church of Rome in particular. The reformation proposed in this plan was indeed extremely superficial and partial, yet it contained some particulars which could scarcely have been expected from those who composed it. They complained of the pride and ignorance of the bishops, and proposed that none should receive orders but learned and pious men; and that therefore care should be taken to have proper masters for the instruction of youth. They condemned translations from one benefice to another, grants of reservation, non-residence, and pluralities. They proposed that some convents should be abolished: that the liberty of the press should be restrained and limited; that the colloquies of Erasmus should be suppressed; that no ecclesiastic should enjoy a benefice out of his own country; that no cardinal should have a bishopric; that the questors of St Anthony and several other saints should be abolished; and, which was the best of all their proposals, that the effects and personal estates of ecclesiastics should be given to the poor. They concluded with complaining of the prodigious number of indigent and ragged priests who frequented St Peter's church; and declared, that it was a great scandal to see the whores lodged so magnificently at Rome, and riding through the streets on fine mules, while the cardinals and other ecclesiastics accompanied them in the most courteous manner.—This plan of reformation was turned into ridicule by Luther and Sturmius; and indeed it left unredressed the most intolerable grievances of which the Protestants complained.

23 Council of Trent proposed.

24 Plan of reformation proposed by the pope.

All this time the emperor had been labouring to persuade the Protestants to consent to the meeting of the council at Trent; but when he found them fixed in their opposition to this measure, he began to listen to the sanguinary measures of the pope, and resolved to terminate the disputes by force of arms. The elector of Saxony and landgrave of Hesse, who were the chief supporters of the Protestant cause, upon this took proper measures to prevent their being surprised and overwhelmed by a superior force; but, before the horrors of war commenced, the great reformer Luther died in peace at Ayselben, the place of his nativity, in 1546.

25 War between the emperor and the Protestants.

The emperor and the pope had mutually resolved on the destruction of all who should dare to oppose the council of Trent. The meeting of it was to serve as a signal for taking up arms; and accordingly its deliberations were scarcely begun in 1546, when the Protestants perceived undoubted signs of the approaching storm, and a formidable union betwixt the emperor and pope, which threatened to crush and overwhelm them at once. This year indeed there had been a new conference at Ratisbon upon the old subject of accommodating differences in religion; but from the manner in which the debates were carried on, it plainly appeared that these differences could only be decided in the field of battle. The council of Trent, in the mean time, promulgated their decrees; while the reformed princes, in the diet of Ratisbon, protested against their authority, and were on that account proscribed by the emperor, who raised an army to reduce them to obedience. See *Father Paul's History of the Council of Trent*, and our articles *Father* PAUL, and TRENT.

The elector of Saxony and the landgrave of Hesse led their forces into Bavaria against the emperor, and cannonaded his camp at Ingolstadt. It was supposed that this would bring on an engagement, which would probably have been advantageous to the cause of the reformed; but this was prevented, chiefly by the perfidy of Maurice duke of Saxony, who invaded the dominions of his uncle. Divisions were also fomented among the confederate princes, by the dissimulation of the emperor; and France failed in paying the subsidy which had been promised by its monarch: all which so discouraged the heads of the Protestant party, that their army soon dispersed, and the elector of Saxony was obliged to direct his march homewards. But he was pursued by the emperor, who made several forced marches, with a view to destroy his enemy before he should have time to recover his vigour. The two armies met near Mulberg, on the Elbe, on the 24th of April 1547; and, after a bloody action, the elector was entirely defeated, and himself taken prisoner.—Maurice, who had so basely betrayed him, was now declared elector of Saxony; and by his intreaties Philip landgrave of Hesse, the other chief of the Protestants, was persuaded to throw himself on the mercy of the emperor, and to implore his pardon. To this he consented, relying on the promise of Charles for obtaining forgiveness, and being restored to liberty; but, notwithstanding these expectations, he was unjustly detained prisoner, by a scandalous violation of the most solemn convention. It is said that the emperor retracted his promise, and deluded this unhappy prince by the ambiguity

26 Elector of Saxony defeated and taken prisoner.

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ambiguity of two German words. History indeed can scarcely afford a parallel to the perfidious, mean-spirited, and despotic behaviour of the emperor in the present case. After having received in public the humble submission of the prince on his knees, and after having set him at liberty by a solemn treaty, he had him arrested anew without any reason, nay, without any pretence, and kept him close prisoner for several years. When Maurice remonstrated against this new confinement, the emperor answered, that he had never promised that the landgrave should not be imprisoned anew, but only that he should be exempted from perpetual imprisonment; and, to support this assertion, he produced the treaty, into which his ministers had perfidiously foisted *ewiger gefangnis*, which signifies a "perpetual prison," instead of *einiger gefangnis*, which signifies "any prison." This, however, is contested by some historians.

The affairs of the Protestants now seemed to be desperate. In the diet of Augsburg, which was soon after called, the emperor required the Protestants to leave the decision of these religious disputes to the wisdom of the council which was to meet at Trent. The greatest part of the members consented to this proposal, being convinced by the powerful argument of an imperial army, which was at hand to dispel the darkness from the eyes of such as might otherwise have been blind to the force of Charles's reasoning. However, this general submission did not produce the effect which was expected from it. A plague which broke out, or was said to do so, in the city, caused the greatest part of the bishops to retire to Bologna; by which means the council was in effect dissolved, nor could all the intreaties and remonstrances of the emperor prevail upon the pope to re-assemble it without delay. During this interval, therefore, the emperor judged it necessary to fall upon some method of accommodating the religious differences, and maintaining peace until the council so long expected should be finally obtained. With this view he ordered Julius Pelugius, bishop of Naumberg, Michael Sidonius, a creature of the pope, and John Agricola, a native of Ayselben, to draw up a formulary which might serve as a rule of faith and worship, till the council should be assembled: but as this was only a temporary expedient, and had not the force of a permanent or perpetual institution, it thence obtained the name of the *Interim*.

27 [The] coun[cil] sudden[ly] dissolved.

28 [F]ormula[ry d]rawn [b]y the [emp]eror.

This project of Charles was formed partly with a design to vent his resentment against the pope, and partly to answer other political purposes. It contained all the essential doctrines of the church of Rome, though considerably softened by the artful terms which were employed, and which were quite different from those employed before and after this period by the council of Trent. There was even an affected ambiguity in many of the expressions, which made them susceptible of different senses, and applicable to the sentiments of both communions. The consequence of all this was, that the imperial creed was reprobated by both parties. However, it was promulgated with great solemnity by the emperor at Augsburg. The elector of Mentz, without even asking the opinion of the princes present, gave a sanction to this formula, as if he had been commissioned to represent the whole diet. Many kept silence through fear, and that silence was interpreted as a tacit consent. Some had the courage to oppose it, and these were reduced by force of arms; and the most deplorable scenes of bloodshed and violence were acted throughout the whole empire. Maurice, elector of Saxony, who had hitherto kept neutral, now assembled the whole of his nobility and clergy, in order to deliberate on this critical affair. At the head of the latter was Melancthon, whose word was respected as a law among the Protestants. But this man had not the courage of Luther; and was therefore on all occasions ready to make concessions, and to propose schemes of accommodation. In the present case, therefore, he gave it as his opinion, that the whole of the book called *Interim* could not by any means be adopted by the Protestants; but at the same time he declared, that he saw no reason why this book might not be approved, adopted and received, as an authorative rule in things that did not relate to the essential parts of religion, and which he accounted indifferent. But this scheme, instead of cementing the differences, made them worse than ever; and produced a division among the Protestants themselves, which might have overthrown the Reformation entirely, if the emperor and pope had seized the opportunity.

29 [Dis]pleases [both] par[ties].

30 Scheme of reconciliation by Melancthon.

31 A new council proposed at Trent.

In the year 1549, the pope (Paul III.) died; and was succeeded by Julius III. who, at the repeated solicitations of the emperor, consented to the re-assembling of a council at Trent. A diet was again held at Augsburg under the cannon of an imperial army, and Charles laid the matter before the princes of the empire. Most of those present gave their consent to it, and among the rest Maurice elector of Saxony; who consented on the following conditions: 1. That the points of doctrine which had already been decided there, should be re-examined. 2. That this examination should be made in presence of the Protestant divines. 3. That the Saxon Protestants should have a liberty of voting as well as of deliberating in the council. 4. That the pope should not pretend to preside in that assembly, either in person or by his legatees. This declaration of Maurice was read in the diet, and his deputies insisted upon its being entered into the registers, which the archbishop of Mentz obstinately refused. This diet was concluded in the year 1551; and, at its breaking up, the emperor desired the assembled princes and states to prepare all things for the approaching council, and promised to use his utmost endeavours to procure moderation and harmony, impartiality and charity, in the transactions of that assembly.

On the breaking up of the diet, the Protestants took such steps as they thought most proper for their own safety. The Saxons employed Melancthon, and the Wurtembergers Brengius, to draw up Confessions of Faith to be laid before the new council. The Saxon divines, however, proceeded no farther than Nuremberg, having received secret orders from Maurice to stop there: For the elector, perceiving that Charles had formed designs against the liberties of the German princes, resolved to take the most effectual measures for crushing his ambition at once. He therefore entered with the utmost secrecy and expedition into an alliance with the king of France and several of the German princes, for the security of the rights and liberties of the empire; after which, assembling a powerful army in 1552, he marched against the emperor, who lay with a handful of troops at Inspruck, and expected no such thing. By this sudden and unforeseen accident Charles was so much dispirited, that he was willing to make peace

32 The emperor is surprised, and forced to a peace by the elector of Saxony.

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peace almost on any terms. The consequence of this was, that he concluded a treaty at Passau, which by the Protestants is considered as the basis of their religious liberty. By the first three articles of this treaty it was agreed, that Maurice and the confederates should lay down their arms, and lend their troops to Ferdinand to assist him against the Turks; and that the landgrave of Hesse should be set at liberty. By the fourth it was agreed, that the rule of faith called the *Interim* should be considered as null and void: that the contending parties should enjoy the free and undisturbed exercise of their religion, until a diet should be assembled to determine amicably the present disputes (which diet was to meet in the space of six months); and that this religious liberty should continue always, in case it should be found impossible to come to an uniformity in doctrine and worship. It was also determined, that all those who had suffered banishment, or any other calamity, on account of their having been concerned in the league or war of Smalcald, should be reinstated in their privileges, possessions, and employments; that the imperial chamber at Spire should be open to the Protestants as well as to the Catholics; and that there should always be a certain number of Lutherans in that high court.—To this peace Albert, marquis of Brandenburg, refused to subscribe; and continued the war against the Roman Catholics, committing such ravages in the empire, that a confederacy was at last formed against him. At the head of this confederacy was Maurice elector of Saxony, who died of a wound he received in a battle fought on the occasion in 1553.

The assembling of the diet promised by Charles was prevented by various incidents; however, it met at Augsburg in 1555, where it was opened by Ferdinand in name of the emperor, and terminated those deplorable calamities which had so long desolated the empire. After various debates, the following acts were passed, on

33
Treaty of Augsburg.

the 25th of September: That the Protestants who followed the Confession of Augsburg should be for the future considered as entirely free from the jurisdiction of the Roman pontiff, and from the authority and superintendance of the bishops; that they were left at perfect liberty to enact laws for themselves relating to their religious sentiments, discipline, and worship; that all the inhabitants of the German empire should be allowed to judge for themselves in religious matters, and to join themselves to that church whose doctrine and worship they thought the most pure and consonant to the spirit of true Christianity; and that all those who should injure or persecute any person under religious pretences, and on account of their opinions, should be declared and proceeded against as public enemies of the empire, invaders of its liberty, and disturbers of its peace.

Thus was the Reformation established in many parts of the German empire, where it continues to this day; nor have the efforts of the Popish powers at any time been able to suppress it, or even to prevent it from gain-

34
Account of the Reformation in Sweden.

ing ground. It was not, however, in Germany alone that a reformation of religion took place. Almost all the kingdoms of Europe began to open their eyes to the truth about the same time. The reformed religion was propagated in Sweden, soon after Luther's rupture with the church of Rome, by one of his disciples named *Olaus Petri*. The zealous efforts of this missionary were seconded by Gustavus Vasa, whom the Swedes had raised to the throne in place of Christiern king of Denmark, whose horrid barbarity lost him the crown. This prince, however, was as prudent as he was zealous; and, as the minds of the Swedes were in a fluctuating state, he wisely avoided all kind of vehemence and precipitation in spreading the new doctrine. Accordingly, the first object of his attention was the instruction of his people in the sacred doctrines of the Holy Scriptures: for which purpose he invited into his dominions several learned Germans, and spread abroad through the kingdom the Swedish translation of the Bible that had been made by Olaus Petri. Some time after this, in 1526, he appointed a conference at Upsal, between this reformer and Peter Gallius, a zealous defender of the ancient superstition, in which each of the champions was to bring forth his arguments, that it might be seen on which side the truth lay. In this dispute Olaus obtained a signal victory; which contributed much to confirm Gustavus in his persuasion of the truth of Luther's doctrine, and to promote its progress in Sweden. The following year another event gave the finishing stroke to its propagation and success. This was the assembly of the states at Westeraas, where Gustavus recommended the doctrine of the reformers with such zeal, that, after warm debates fomented by the clergy in general, it was unanimously resolved that the reformation introduced by Luther should have place in Sweden. This resolution was principally owing to the firmness and magnanimity of Gustavus, who declared publicly, that he would lay down the sceptre and retire from the kingdom, rather than rule a people enslaved by the orders and authority of the pope, and more controuled by the tyranny of their bishops than by the laws of their monarch. From this time the papal empire in Sweden was entirely overthrown, and Gustavus declared head of the church.

35
In Denmark.

In Denmark, the reformation was introduced as early as the year 1521, in consequence of the ardent desire discovered by Christiern II. of having his subjects instructed in the doctrines of Luther. This monarch, notwithstanding his cruelty, for which his name has been rendered odious, was nevertheless desirous of delivering his dominions from the tyranny of the church of Rome. For this purpose, in the year 1520, he sent for Martin Reinard, one of the disciples of Carlostadt, out of Saxony, and appointed him professor of divinity at Hafnia; and after his death, which happened in 1521, he invited Carlostadt himself to fill that important place. Carlostadt accepted of this office indeed, but in a short time returned to Germany; upon which Christiern used his utmost endeavours to engage Luther to visit his dominions, but in vain. However, the progress of Christiern, in reforming the religion of his subjects, or rather of advancing his own power above that of the church, was checked, in the year 1523, by a conspiracy, by which he was deposed and banished; his uncle Frederic, duke of Holstein and Sleswic, being appointed his successor.

Frederic conducted the reformation with much greater prudence than his predecessor. He permitted the Protestant doctors to preach publicly the sentiments of Luther, but did not venture to change the established government and discipline of the church. However, he contributed greatly to the progress of the reformation, by his successful attempts in favour of religious liberty in an assembly of the states held at Odensee in 1527.

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1527. Here he procured the publication of a famous edict, by which every subject of Denmark was declared free either to adhere to the tenets of the church of Rome, or to the doctrine of Luther. The papal tyranny was totally destroyed by his successor Christiern III. He began by suppressing the despotic authority of the bishops, and restoring to their lawful owners a great part of the wealth and possessions which the church had acquired by various stratagems. This was followed by a plan of religious doctrine, worship, and discipline, laid down by Bugenhagius, whom the king had sent for from Wittemberg for that purpose; and in 1539 an assembly of the states at Odensee gave a solemn sanction to all these transactions.

36
In France.

In France also, the reformation began to make some progress very early. Margaret queen of Navarre, sister to Francis I. the perpetual rival of Charles V. was a great friend to the new doctrine; and it appears that, as early as the year 1523, there were in several of the provinces of France great numbers of people who had conceived the greatest aversion both to the doctrine and tyranny of the church of Rome; among whom were many of the first rank and dignity, and even some of the episcopal order. But as their number increased daily, and troubles and commotions were excited in several places on account of the religious differences, the authority of the king intervened, and many persons eminent for their virtue and piety were put to death in the most barbarous manner. Indeed Francis, who had either no religion at all, or, at best, no fixed and consistent system of religious principles, conducted himself towards the Protestants in such a manner as best answered his private views. Sometimes he resolved to invite Melancthon into France, probably with a view to please his sister the queen of Navarre, whom he loved tenderly, and who had strongly imbibed the Protestant principles. At other times he exercised the most infernal cruelty towards the reformed; and once made the following mad declaration, That if he thought the blood in his arm was tainted by the Lutheran heresy, he would have it cut off; and that he would not spare even his own children, if they entertained sentiments contrary to those of the Catholic church.

About this time the famous Calvin began to draw the attention of the public, but more especially of the queen of Navarre. His zeal exposed him to danger; and the friends of the reformation, whom Francis was daily committing to the flames, placed him more than once in the most perilous situation, from which he was delivered by the interposition of the queen of Navarre. He therefore retired out of France to Basil in Swisserland; where he published his Christian Institutions, and became afterwards so famous.

Those among the French who first renounced the jurisdiction of the Romish church, are commonly called *Lutherans* by the writers of those early times. Hence it has been supposed that they had all imbibed the peculiar sentiments of Luther. But this appears by no means to have been the case: for the vicinity of the cities of Geneva, Lausanne, &c. which had adopted the doctrines of Calvin, produced a remarkable effect upon the French Protestant churches; insomuch that, about the middle of this century, they all entered into communion with the church of Geneva. The French Protestants were called *Huguenots* * by their adversaries, by way of contempt. Their fate was very severe, being persecuted with unparalleled fury; and though many princes of the blood, and of the first nobility, had embraced their sentiments, yet in no part of the world did the reformers suffer so much †. At last all commotions were quelled by the fortitude and magnanimity of Henry IV. who in the year 1598 granted all his subjects full liberty of conscience by the famous Edict of Nantes, and seemed to have thoroughly established the reformation throughout his dominions. During the minority of Louis XIV. however, this edict was revoked by Cardinal Mazarine, since which time the Protestants have often been cruelly persecuted; nor was the profession of the reformed religion in France at any time so safe as in most other countries of Europe.

* See Huguenots.

† See France, N° 137, 141—149.

37
In the Netherlands, &c.

In the other parts of Europe the opposition to the church of Rome was but faint and ambiguous before the diet of Augsburg. Before that period, however, it appears from undoubted testimony, that the doctrine of Luther had made a considerable, though probably secret, progress through Spain, Hungary, Bohemia, Britain, Poland, and the Netherlands; and had in all these countries many friends, of whom several repaired to Wittemberg, in order to enlarge their knowledge by means of Luther's conversation. Some of these countries threw off the Romish yoke entirely, and in others a prodigious number of families embraced the principles of the reformed religion. It is certain indeed, and some Roman Catholics themselves acknowledge it without hesitation, that the Papal doctrines and authority would have fallen into ruin in all parts of the world at once, had not the force of the secular arm been employed to support the tottering edifice. In the Netherlands particularly, the most grievous persecutions took place, so that by the emperor Charles V. upwards of 100,000 were destroyed, while still greater cruelties were exercised upon the people by his son Philip II. The revolt of the United Provinces, however, and motives of real policy, at last put a stop to these furious proceedings; and, though in many provinces of the Netherlands, the establishment of the Popish religion was still continued, the Protestants have been long free from the danger of persecution on account of their principles.

38
In Italy.

The reformation made considerable progress in Spain and Italy soon after the rupture between Luther and the Roman pontiff. In all the provinces of Italy, but more especially in the territories of Venice, Tuscany, and Naples, the superstition of Rome lost ground, and great numbers of people of all ranks expressed an aversion to the Papal yoke. This occasioned violent and dangerous commotions in the kingdom of Naples in the year 1546; which, however, were at last quelled by the united forces of Charles V. and his viceroy Don Pedro di Toledo. In several places the pope put a stop to the progress of the reformation, by letting loose the inquisitors; who spread dreadful marks of their barbarity through the greatest part of Italy. These formidable ministers of superstition put so many to death, and perpetrated such horrid acts of cruelty and oppression, that most of the reformed consulted their safety by a voluntary exile, while others returned to the religion of Rome, at least in external appearance. But the inquisition, which frighted into the profession of Popery several Protestants in other parts of Italy, could never make its way into the kingdom of Naples; nor could either the

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the authority or entreaties of the pope engage the Neapolitans to admit even visiting inquisitors.

39 In Spain.

In Spain, several people embraced the Protestant religion, not only from the controversies of Luther, but even from those divines whom Charles V. had brought with him into Germany in order to refute the doctrines of Luther. For these doctors imbibed the pretended heresy instead of refuting it, and propagated it more or less on their return home. But the inquisition, which could obtain no footing in Naples, reigned triumphant in Spain, and by the most dreadful methods frightened the people back into Popery, and suppressed the desire of exchanging their superstition for a more rational plan of religion. It was indeed presumed that Charles himself died a Protestant; and it seems to be certain, that, when the approach of death had dissipated those schemes of ambition and grandeur which had so long blinded him, his sentiments became much more rational and agreeable to Christianity than they had ever been. All the ecclesiastics who had attended him, as soon as he expired, were sent to the inquisition, and committed to the flames, or put to death by some other method equally terrible. Such was the fate of Augustine Casal, the emperor's preacher; of Constantius Pontius, his confessor; of Egidius, whom he had named to the bishopric of Tortosa; of Bartholomew de Caranza, a Dominican, who had been confessor to King Philip and Queen Mary; with 20 others of less note.

40 In England.

In England, the principles of the reformation began to be adopted as soon as an account of Luther's doctrines could be conveyed thither. In that kingdom there were still great remains of the sect called *Lollards*, whose doctrine resembled that of Luther; and among whom, of consequence, the sentiments of our reformer gained great credit. Henry VIII. king of England at that time was a violent partisan of the church of Rome, and had a particular veneration for the writings of Thomas Aquinas. Being informed that Luther spoke of his favourite author with contempt, he conceived a violent prejudice against the reformer, and even wrote against him, as we have already observed. Luther did not hesitate at writing against his majesty, overcame him in argument, and treated him with very little ceremony. The first step towards public reformation, however, was not taken till the year 1529. Great complaints had been made in England, and of a very ancient date, of the usurpations of the clergy; and by the prevalence of the Lutheran opinions, these complaints were now become more general than before. The house of commons, finding the occasion favourable, passed several bills, restraining the impositions of the clergy: but what threatened the ecclesiastical order with the greatest danger were the severe reproaches thrown out almost without opposition in the house against the dissolute lives, ambition, and avarice of the priests, and their continual encroachments on the privileges of the laity. The bills for regulating the clergy met with opposition in the house of lords; and Bishop Fisher imputed them to want of faith in the commons, and to a formed design, proceeding from heretical and Lutheran principles, of robbing the church of her patrimony, and overturning the national religion. The commons, however, complained to the king, by their speaker Sir Thomas Audley, of these reflections thrown out against them; and the bishop was obliged to retract his words.

Though Henry had not the least idea of rejecting any, even of the most absurd Romish superstitions, yet as the oppressions of the clergy suited very ill with the violence of his own temper, he was pleased with every opportunity of lessening their power. In the parliament of 1531, he showed his design of humbling the clergy in the most effectual manner. An obsolete statute was revived, from which it was pretended that it was criminal to submit to the legatine power which had been exercised by Cardinal Wolsey. By this stroke the whole body of clergy was declared guilty at once. They were too well acquainted with Henry's disposition, however, to reply, that their ruin would have been the certain consequence of their not submitting to Wolsey's commission, which had been given by royal authority. Instead of making any defence of this kind, they chose to throw themselves on the mercy of their sovereign; which, however, it cost them 118,840l. to procure. A confession was likewise extorted from them, that the king was protector and supreme head of the church of England; though some of them had the dexterity to get a clause inserted, which invalidated the whole submission, viz. *in so far as is permitted by the law of Christ*.

The king, having thus begun to reduce the power of the clergy, kept no bounds with them afterwards. He did not indeed attempt any reformation in religious matters; nay, he persecuted most violently such as did attempt this in the least. Indeed, the most essential article of his creed seems to have been his own supremacy: for whoever denied this, was sure to suffer the most severe penalties, whether Protestant or Papist. But an account of the absurd and cruel conduct of this prince, and of his final quarrel with the pope on account of his refusing a dispensation to marry Anne Boleyn, is given under the article ENGLAND, N° 253—292.

He died in 1547, and was succeeded by his only son Edward VI. This amiable prince, whose early youth was crowned with that wisdom, sagacity, and virtue, that would have done honour to advanced years, gave new spirit and vigour to the Protestant cause, and was its brightest ornament, as well as its most effectual support. He encouraged learned and pious men of foreign countries to settle in England, and addressed a particular invitation to Martin Bucer and Paul Fagius, whose moderation added a lustre to their other virtues, that, by the ministry and labours of these eminent men, in concert with those of the friends of the Reformation in England, he might purge his dominions from the sordid fictions of popery, and establish the pure doctrines of Christianity in their place. For this purpose, he issued out the wisest orders for the restoration of true religion; but his reign was too short to accomplish fully such a glorious purpose. In the year 1553, he was taken from his loving and afflicted subjects, whose sorrow was inexpressible, and suited to their loss. His sister Mary (the daughter of Catharine of Arragon, from whom Henry had been separated by the famous divorce), a furious bigot to the church of Rome, and a princess whose natural character, like the spirit of her religion, was despotic and cruel, succeeded him on the British throne, and imposed anew the arbitrary laws and the tyrannical yoke of Rome upon the people of England. Nor were the methods she employed in the cause of of superstition better than the cause itself, or tempered by any sentiments of equity or compassion. Barbarous tortures, and death in the most shocking forms, awaited those who opposed her will, or made the least stand against the restoration of Popery. And among many other victims, the learned and pious Cranmer, archbishop of Canterbury, who had been one of the most illustrious instruments of the Reformation in England, fell a sacrifice to her fury. This odious scene of persecution was happily concluded in the year 1558, by the death of the queen, who left no issue; and, as soon as her successor the lady Elizabeth ascended the throne, all things assumed a new and a pleasing aspect. This illustrious princess, whose sentiments, councils, and projects, breathed a spirit superior to the natural softness and delicacy of her sex, exerted this vigorous and manly spirit in the defence of oppressed conscience and expiring liberty, broke anew the despotic yoke of Papal authority and superstition, and, delivering her people from the bondage of Rome, established that form of religious doctrine and ecclesiastical government which still subsists in England. This religious establishment differs, in some respects, from the plan that had been formed by those whom Edward VI. had employed for promoting the cause of the Reformation, and approaches nearer to the rites and discipline of former times; though it is widely different, and, in the most important points, entirely opposite to the principles of the Roman hierarchy. See ENGLAND, N° 293, &c.

The cause of the reformation underwent in Ireland the same vicissitudes and revolutions that had attended it in England. When Henry VIII. after the abolition of the Papal authority, was declared supreme head upon earth of the church of England, George Brown, a native of England, and a monk of the Augustine order, whom that monarch had created, in the year 1535, archbishop of Dublin, began to act with the utmost vigour in consequence of this change in the hierarchy. He purged the churches of his diocese from superstition in all its various forms, pulled down images, destroyed relics, abolished absurd and idolatrous rites, and, by the influence as well as authority he had in Ireland, caused the king's supremacy to be acknowledged in that nation. Henry showed, soon after, that this supremacy was not a vain title; for he banished the monks out of that kingdom, confiscated their revenues, and destroyed their convents. In the reign of Edward VI. still farther progress was made in the removal of Popish superstitions, by the zealous labours of Bishop Brown, and the auspicious encouragement he granted to all who exerted themselves in the cause of the Reformation. But the death of this excellent prince, and the accession of Queen Mary, had like to have changed the face of affairs in Ireland as much as in England; but her designs were disappointed by a very curious adventure, of which the following account has been copied from the papers of Richard earl of Corke. "Queen Mary having dealt severely with the Protestants in England, about the latter end of her reign signed a commission for to take the same course with them in Ireland; and to execute the same with greater force, she nominates Dr Cole one of the commissioners. The doctor coming, with the commission, to Chester on his journey, the mayor of that city hearing that her majesty was sending a messenger into Ireland, and he being a churchman, waited on the doctor, who in discourse with the mayor taketh out of a cloke-bag a leather box, saying unto him, *Here is a commission that shall lash the Heretics of Ireland*, calling the Protestants by that title. The good woman of the house being well affected to the Protestant religion, and also having a brother named *John Edmonds* of the same persuasion, then a citizen in Dublin, was much troubled at the doctor's words, but watching her convenient time while the mayor took his leave, and the doctor complimented him down the stairs, she opens the box, takes the commission out, and places in lieu thereof a sheet of paper with a pack of cards wrapt up therein, the knave of clubs being faced uppermost. The doctor coming up to his chamber, suspecting nothing of what had been done, put up the box as formerly. The next day going to the water-side, wind and weather serving him, he sails towards Ireland, and landed on the 7th of October 1558 at Dublin. Then coming to the castle, the lord Fitz-Walters being lord-deputy, sent for him to come before him and the privy-council; who, coming in, after he had made a speech relating upon what account he came over, he presents the box unto the lord-deputy; who causing it to be opened, that the secretary might read the commission, there was nothing save a pack of cards with the knave of clubs uppermost; which not only startled the lord-deputy and council, but the doctor, who assured them he had a commission, but knew not how it was gone. Then the lord-deputy made answer: Let us have another commission, and we will shuffle the cards in the meanwhile. The doctor being troubled in his mind, went away, and returned into England, and coming to the court obtained another commission: but staying for a wind on the water-side, news came to him that the queen was dead: and thus God preserved the Protestants of Ireland." Queen Elizabeth was so delighted with this story, which was related to her by Lord Fitz-Walter on his return to England, that she sent for Elizabeth Edmonds, whose husband's name was *Mattershad*, and gave her a pension of 40l. during her life.

43 Of the Reformation in Scotland.

In Scotland, the seeds of reformation were very early sown, by several noblemen who had resided in Germany during the religious disputes there. But for many years it was suppressed by the power of the pope, seconded by inhuman laws and barbarous executions. The most eminent opposer of the Papal jurisdiction was John Knox, a disciple of Calvin, a man of great zeal and invincible fortitude. On all occasions he raised the drooping spirits of the reformers, and encouraged them to go on with their work notwithstanding the opposition and treachery of the queen-regent; till at last, in 1561, by the assistance of an English army sent by Elizabeth, Popery was in a manner totally extirpated throughout the kingdom. From this period the form of doctrine, worship, and discipline established by Calvin at Geneva, has had the ascendancy in Scotland. But for an account of the difficulties which the Scottish reformers had to struggle with, and the manner in which these were overcome, &c. see SCOTLAND.

For further information on the subject of the reformation in general we refer our readers to the works of Burnet and Brandt, to Beausobre's *Histoire de la Reformation dans l'Empire, et les Etats de la Confession d'Augsbourg, depuis* 1517—1530, in 4 vols 8vo, Berlin 1785, 1785, and Mosheim's Ecclesiastical History. See also Sleidan *De Statu Religionis et Reipublicæ, Carolo V. Cæsare, Commentarii;* and Father Paul's History of the Council of Trent.

REFRACTION, in general, is the deviation of a moving body from its direct course, occasioned by the different density of the medium in which it moves; or it is a change of direction occasioned by a body's falling obliquely out of one medium into another. The word is chiefly made use of with regard to the rays of light. See OPTICS *Index*, at *Refraction*.

REFRACTION *of Altitude*, the arc or portion of a vertical circle, by which the altitude of a star is increased by the refraction of light.

REFRACTION *of Ascension and Descension*, an arc of the equator, by which the ascension and descension of a star, whether right or oblique, is increased or diminished by the refraction.

REFRACTION *of Declination*, is an arc of a circle of declination, by which the declination of a star is increased or diminished by refraction.

REFRACTION *of Latitude*, an arc of a circle of latitude, by which the latitude of a star is increased or diminished by the refraction.

REFRACTION *of Longitude*, an arc of the ecliptic, by which the longitude of a star is increased or diminished by means of the refraction.

REFRACTION, *Terrestrial*, is that which makes terrestrial objects appear to be raised higher than they are in reality, in observing their altitudes. The quantity of this refraction is estimated at one-tenth by Dr Maskelyne; at one-fourteenth by Le Gendre; and by De Lambre at one-eleventh. But there can be no fixed quantity of this refraction, since it depends upon the state of the atmosphere, which is extremely variable. Some singular effects of this refraction have been noticed, and in particular the following, which were observed by Mr Latham at Hastings, during a very hot day, on which it was high water about two o'clock P. M. The day was also perfectly calm.

"On Wednesday, July 26. about five o'clock in the afternoon, while I was sitting in my dining-room at this place, which is situated upon the Parade, close to the sea-shore, nearly fronting the south, my attention was excited by a number of people running down to the sea-side. Upon inquiring the reason, I was informed that the coast of France was plainly to be distinguished by the naked eye. I immediately went down to the shore, and was surprised to find that, even without the assistance of a telescope, I could very plainly see the cliffs on the opposite coast; which, at the nearest part, are between 40 and 50 miles distant, and are not to be discerned, from that low situation, by the aid of the best glasses. They appeared to be only a few miles off, and seemed to extend for some leagues along the coast. I pursued my walk along the shore eastward, close to the water's edge, conversing with the sailors and fishermen upon the subject. They at first could not be persuaded of the reality of the appearance; but they soon became so thoroughly convinced, by the cliffs gradually appearing more elevated, and approaching nearer, as it were, that they pointed out and named to me the different places they had been accustomed to visit; such as the Bay, the Old Head or Man, the Windmill, &c. at Boulogne; St Vallery, and other places on the coast of Picardy; which they afterwards confirmed when they viewed them through their telescopes. Their observations were, that the places appeared as near as if they were sailing at a small distance, into the harbours." *

REFRANGIBILITY OF LIGHT, the disposition of rays to be refracted. The term is chiefly applied to the disposition of rays to produce different colours, according to their different degrees of refrangibility. See CHROMATICS and OPTICS *passim*.

REFRIGERATIVE, in *Medicine*, a remedy which refreshes the inward parts by cooling them; as clysters, ptisans, &c.

REFRIGERATORY, in *Chemistry*, a vessel filled with cold water, through which the worm passes in distillations; the use of which is to condense the vapours as they pass through the worm.

CITIES OF REFUGE, were places provided as *asyla*, for such as against their will should happen to kill a man. Of these cities there were three on each side Jordan: on this side were Kedesh of Naphtali, Hebron, and Shechem; beyond Jordan were Bezer, Golan, and Ramoth-Gilead. When any of the Hebrews, or strangers that dwelt in their country, happened to spill the blood of a man, they might retire thither to be out of the reach of the violent attempts of the relations of the deceased, and to prepare for their defence and justification before the judges. The manslayer underwent two trials: first before the judges of the city of refuge to which he had fled; and secondly before the judges of his own city. If found guilty, he was put to death with all the severity of the law. If he was acquitted, he was not immediately set at liberty; but, to inspire a degree of horror against even involuntary homicide, he was reconducted to the place of refuge, and obliged to continue there in a sort of banishment till the death of the high-priest. If, before this time, he ventured out, the revenger of blood might freely kill him; but after the high-priest's death he was at liberty to go where he pleased without molestation. It was necessary that the person who fled to any of the cities of refuge should understand some trade or calling, that he might not be burthensome to the inhabitants. The cities of refuge were required to be well supplied with water and necessary provisions. They were also to be easy of access, to have good roads leading to them, with commodious bridges where there was occasion. The width of the roads was to be 32 cubits or 48 feet at least. It was further required, that at all cross-ways direction-posts should be erected, with an inscription pointing out the road to the cities of refuge. The 15th of Adar, which answers to our February moon, was appointed for the city magistrates to see that the roads were in good condition. No person in any of these cities was allowed to make weapons, lest the relations of the deceased should be furnished with the means of gratifying their revenge. Deut. xix. 3. iv. 41. 43.; Josh. xx. 7. Three other cities of refuge were conditionally promised, but never granted. See ASYLUM

REFUGEES, a term at first applied to the French Protestants, who, by the revocation of the edict of Nantz, were constrained to fly from persecution, and take refuge in foreign countries. Since that time, however, it has been extended to all such as leave their country in time of distress; and hence, since the revolt of the British

British colonies in America, we have frequently heard of *American refugees*.

REGALE, a magnificent entertainment or treat, given to ambassadors and other persons of distinction, to entertain or do them honour.

It is usual in Italy, at the arrival of a traveller of eminence, to send him a regale, that is, a present of sweetmeats, fruits, &c. by way of refreshment.

REGALIA, in *Law*, the rights and prerogatives of a king. See PREROGATIVE.

Regalia is also used for the apparatus of a coronation; as the crown, the sceptre with the cross, that with the dove, St Edward's staff, the globe, and the orb with the cross, four several swords, &c.—The regalia of Scotland were deposited in the castle of Edinburgh in the year 1707, in what is called the *jewel office*. The room was a few years ago opened by some commissioners appointed by the king, when the large chest in which it is supposed they were placed was examined; but nothing was found in it. It is very generally thought that the regalia were carried to the Tower of London in the reign of Queen Anne; and a crown is there shown which is called the Scotch crown. This, however, does not appear to be the real crown of Scotland. It seems, therefore, most probable that the Scottish regalia must have been taken away by stealth, and either destroyed or melted down.

Lord of REGALITY, in *Scots Law*. See LAW, N° clviii. 4.

Court of REGARD. See *Forest-Courts*.

REGARDANT, in *Heraldry*, signifies looking behind; and it is used for a lion or other beast, with his face turned towards his tail.

REGARDER, an ancient officer of the king's forest, sworn to make the regard of the forest every year; that is, to take a view of its limits, to inquire into all offences and defaults committed by the foresters within the forest, and to observe whether all the officers execute their respective duties. See *Forest-Laws*.

REGATA, or REGATTA, a species of amusement peculiar to the republic of Venice. This spectacle has the power of exciting the greatest emotions of the heart, admiration, enthusiasm, a sense of glory, and the whole train of our best feelings. The grand regata is only exhibited on particular occasions, as the visits of foreign princes and kings at Venice.

It is difficult to give a just idea of the ardour that the notice of a *regata* spreads among all classes of the inhabitants of Venice. Proud of the exclusive privilege of giving such a spectacle, through the wonderful local circumstances of that city, they are highly delighted with making preparations a long time before, in order to contribute all they can towards the perfection and enjoyment of the spectacle. A thousand interests are formed and augmented every day; parties in favour of the different competitors who are known; the protection of young noblemen given to the gondoliers in their service; the desire of honours and rewards in the aspirants; and, in the midst of all this, that ingenious national industry, which awakes the Venetians from their habitual indolence, to derive advantage and business from the agitation of the moment; all these circumstances united give to the numerous inhabitants of this lively city a degree of spirit and animation which render it during that time a delightful abode in the eyes of the philosopher and the stranger. Crowds of people flock from the adjacent parts, and travellers joyfully repair to this scene of gaiety and pleasure.

Although it is allowable for any man to go and inscribe his name in the list of combatants until the fixed number is complete, it will not be amiss to remark one thing, which has relation to more ancient times. The state of a gondolier * is of much consideration among the people; which is very natural, that having been the primitive condition of the inhabitants of this country. But, besides this general consideration, there are among them some families truly distinguished and respected by their equals, whose antiquity is acknowledged, and who, on account of a succession of virtuous men, able in their profession, and honoured for the prizes they have carried off in these contests, form the body of noble gondoliers; often more worthy of that title than the higher order of nobility, who only derive their honours from the merit of their ancestors, or from their own riches. The consideration for those families is carried so far, that, in the disputes frequently arising among the gondoliers in their ordinary passage of the canals, we sometimes see a quarrel instantly made up by the simple interposition of a third person, who has chanced to be of this revered body. They are rigid with respect to misalliances in their families, and they endeavour reciprocally to give and take their wives among those of their own rank. But we must remark here, with pleasure, that these distinctions infer no inequality of condition, nor admit any oppression of inferiors, being founded solely on laudable and virtuous opinions. Distinctions derived from fortune only, are those which always outrage nature, and often virtue.

* See *Gondola*.

In general, the competitors at the great regatas are chosen from among these families of reputation. As soon as they are fixed upon for this exploit, they spend the intermediate time in preparing themselves for it, by a daily, assiduous, and fatiguing exercise. If they are in service, their masters during that time not only give them their liberty, but also augment their wages. This custom would seem to indicate, that they look upon them as persons consecrated to the honour of the nation, and under a sort of obligation to contribute to its glory.

At last the grand day arrives. Their relations assemble together; they encourage the heroes, by calling to their minds the records of their families; the women present the oar, beseeching them, in an epic tone, to remember that they are the sons of famous men, whose steps they will be expected to follow: this they do with as much solemnity as the Spartan women presented the shield to their sons, bidding them either return with or upon it. Religion, as practised among the lower class of people, has its share in the preparation for this enterprise. They cause masses to be said; they make vows to some particular church; and they arm their boats for the contest with the images of those saints who are most in vogue. Sorcerers are not forgotten upon this occasion. For gondoliers who have lost the race often declare, that witchcraft had been practised against them, or certainly they must have won the day. Such a supposition prevents a poor fellow from thinking ill of himself, an opinion that might be unfavourable to him another time.

The

The course is about four miles. The boats start from a certain place, run through the great winding canal, which divides the town into two parts, turn round a picket, and, coming back the same way, go and seize the prize, which is fixed at the acutest angle of the great canal, on the convex side, so that the point of sight may be the more extended, and the prize seized in the sight of the spectators on both sides.

According to the number of competitors, different races are performed in different sorts of boats; some with one oar and others with two. The prizes proposed are four, indicated by four flags of different colours, with the different value of the prizes marked upon them.—These flags, public and glorious monuments, are the prizes to which the competitors particularly aspire. But the government always add to each a genteel sum of money; besides that the conquerors, immediately after the victory, are surrounded by the *beau monde*, who congratulate and make them presents; after which they go, bearing their honourable trophy in their hand down the whole length of the canal, and receive the applause of innumerable spectators.

This grand canal, ever striking by the singularity and beauty of the buildings which border it, is, upon these occasions, covered with an infinity of spectators, in all sorts of barges, boats, and gondolas. The element on which they move is scarcely seen; but the noise of oars, the agitation of arms and bodies in perpetual motion, indicate the spectacle to be upon the water. At certain distances, on each side of the shore are erected little amphitheatres and scaffoldings, where are placed bands of music; the harmonious sound of which predominates now and then over the buzzing noise of the people. Some days before a *regata*, one may see on the great canal many boats for pleasure and entertainment. The young noble, the citizen, the rich artizan, mounts a long boat of six or eight oars; his gondoliers decorated with rich and singular dresses, and the vessel itself adorned with various stuffs. Among the nobles there are always a number who are at a considerable expence in these decorations; and at the *regata* itself exhibit on the water personages of mythologic story, with the heroes of antiquity in their train, or amuse themselves with representing the costumes of different nations: in short, people contribute with a mad sort of magnificence, from all quarters, to this masquerade, the favourite diversion of the Venetians. But these great machines, not being the less in motion on account of their ornaments, are not merely destined to grace the show: they are employed at the regata, at every moment, to range the people, to protect the course, and to keep the avenue open and clear to the goal. The nobility, kneeling upon cushions at the prow of their vessels, are attentive to these matters, and announce their orders to the most restive, by darting at them little gilded or silvered balls, by means of certain bows, with which they are furnished on this occasion. And this is the only appearance of coercion in the Venetian police on these days of the greatest tumult: nor is there to be seen, in any part of the city, a body of guards or patrol, nor even a gun or a halbert. The mildness of the nation, its gaiety, its education in the habit of believing that the government is ever awake, that it knows and sees every thing; its respectful attachment to the body of patricians; the sole aspect of certain officers of the police in their robes, dispersed in different places, at once operate and explain that tranquillity, that security, which we see in the midst of the greatest confusion, and that surprising docility in so lively and fiery a people. Regatas have been attempted on the river Thames, but they were but humble imitations of the Venetian amusement.

REGEL, or RIGEL, a fixed star of the first magnitude, in Orion's left foot.

REGENERATION, in *Theology*, the act of being born again by a spiritual birth, or the change of heart and life experienced by a person who forsakes a course of vice, and sincerely embraces a life of virtue and piety.

REGENSBURG, or RATISBON. See RATISBON.

REGENT, one who governs a kingdom during the minority or absence of the king.

In France, the queen-mother had the regency of the kingdom during the minority of the king, under the title of *queen-regent*.

In England, the methods of appointing this guardian or regent have been so various, and the duration of his power so uncertain, that from hence alone it may be collected that his office is unknown to the common law; and therefore (as Sir Edward Coke says, 4 Inst. 58.) the surest way is to have him made by authority of the great council in parliament. The earl of Pembroke by his own authority assumed in very troublesome times the regency of Henry III. who was then only nine years old; but was declared of full age by the pope at 17, confirmed the great charter at 18, and took upon him the administration of the government at 20. A guardian and councils of regency were named for Edward III. by the parliament, which deposed his father; the young king being then 15, and not assuming the government till three years after. When Richard II. succeeded at the age of 11, the duke of Lancaster took upon him the management of the kingdom till the parliament met, which appointed a nominal council to assist him. Henry V. on his death-bed named a regent and a guardian for his infant son Henry VI. then nine months old: but the parliament altered his disposition, and appointed a protector and council, with a special limited authority. Both these princes remained in a state of pupilage till the age of 23. Edward V. at the age of 13, was recommended by his father to the care of the duke of Gloucester; who was declared proctector by the privy-council. The statutes 25 Hen. VIII. c. 12. and 28 Henry VIII. c. 7. provided, that the successor, if a male and under 18, or if a female and under 16, should be till such age in the governance of his or her natural mother (if approved by the king), and such other counsellors as his majesty should by will or otherwise appoint: and he accordingly appointed his 16 executors to have the government of his son Edward VI. and the kingdom, which executors elected the earl of Hartford protector. The statutes 24 Geo. II. c. 24. in case the crown should descend to any of the children of Frederic late prince of Wales under the age of 18, appointed the princess dowager;—and that of 5 Geo. III. c. 27. in case of a like descent to any of his present majesty's children, empowers the king to name either the queen or princess dowager, or any descendant of King George II. residing in this kingdom;—to be guardian and regent till the successor attains such age, assisted by a a council of regency; the powers of them all being expressly defined and set down in the several acts.

REGENT also signifies a professor of arts and sciences in a college, having pupils under his care; but it is generally restrained to the lower classes, as to rhetoric, logic, &c. those of philosophy being called *professors*. In the English universities it is applied to masters of arts under five years standing, and to doctors under two, as non-regent is to those above that standing.

REGGIO, an ancient and considerable town of Italy, in the kingdom of Naples, and in the Farther Calabria, with an archbishop's see, and a woollen manufactory. It is seated in a delightful country, which produces plenty of oranges, and all their kindred fruits. The olives are exquisite, and high-flavoured. The town, however, can boast of neither beautiful buildings nor strong fortifications. Of its edifices the Gothic cathedral is the only striking one, but it affords nothing curious in architecture. The citadel is far from formidable, according to the present system of tactics; nor could the city walls make a long resistance against any enemy but Barbary corsairs; and even these they have not always been able to repel, for in 1543 it was laid in ashes by Barbarossa. Mustapha sacked it 15 years after, and the desolation was renewed in 1593 by another set of Turks. Its exposed situation, on the very threshold of Italy, and fronting Sicily, has from the earliest period rendered it liable to attacks and devastation. The Chalcidians seized upon it, or, according to the usual Greek phrase, founded it, and called the colony *Rhegion*, from a word that means a break or crack, alluding to its position on the point where Sicily broke off from the continent. Anaxilas oppressed its liberties. Dionysius the Elder took it, and put many of the principal citizens to death, in revenge for their having refused his alliance. The Campanian legion, sent to protect the Rhegians, turned its sword against them, massacred many inhabitants, and tyrannized over the remainder, till the Roman senate thought proper to punish these traitors with exemplary severity, though at the same time it entered into league with the revolted garrison of Messina. This union with a set of villains guilty of the same crime, proved that no love of justice, but political reasons alone, drew down its vengeance on the Campanians.—It is about 12 miles S. E. of Messina, and 190 S. by E. of Naples. E. Long. 16. 0. N. Lat. 38. 4.

REGGIO, an ancient, handsome, and strong town of Italy, in the duchy of Modena, with a strong citadel, and a bishop's see. It has been ruined several times by the Goths, and other nations. In the cathedral are paintings by the greatest masters; and in the square is the statue of Brennus, chief of the Gauls. The inhabitants are about 22,000, who carry on a great trade in silk. It was taken by Prince Eugene in 1706, and by the king of Sardinia in 1742. It is seated in a fertile country to the south of the Apennines, and to the north of a spacious plain, 15 miles north-west of Modena, and 80 south-east of Milan. E. Long. 11. 5. N. Lat. 44. 43.—The duchy of this name is bounded on the west by that of Modena, and produces a great deal of silk. It fell under the dominion of the French along with the rest of Italy early in the Revolution, but was restored to the duke of Modena at the peace of 1814.

REGIAM MAJESTATEM. See LAW, N° clv. 3.

REGICIDE, KING-KILLER, a word chiefly used with us in speaking of the persons concerned in the trial, condemnation, and execution of Charles I.

REGIFUGIUM was a feast celebrated at Rome on the 24th of February, in commemoration of the expulsion of *Tarquinius Superbus*, and the abolition of regal power. It was also performed on the 26th of May. when the king of the sacrifices, or *Rex Sacrorum*, offered bean flour and bacon, in the place where the assemblies were held. The sacrifice being over, the people hasted away with all speed, to denote the precipitate flight of King Tarquin.

REGIMEN, the regulation of diet, and, in a more general sense, of all the non-naturals, with a view to preserve or restore health. See ABSTINENCE, ALIMENT, FOOD, DIET, DRINK, and MEDICINE.

The vicissitude of exercise and rest forms also a necessary part of regimen. See EXERCISE.

It is beneficial to be at rest now and then, but more so frequently to use exercise; because inaction renders the body weak and listless, and labour strengthens it. But a medium is to be observed in all things, and too much fatigue is to be avoided: for frequent and violent exercise overpowers the natural strength, and wastes the body; but moderate exercise ought always to be used before meals. Now, of all kinds of exercise, riding on horseback is the most convenient: or if the person be too weak to bear it, riding in a coach, or at least in a litter: next follow fencing, playing at ball, running, walking. But it is one of the inconveniences of old age, that there is seldom sufficient strength for using bodily exercise, though it be extremely requisite for health: wherefore frictions with the flesh-brush are necessary at this time of life; which should be performed by the person himself, if possible; if not, by his servants.

Sleep is the sweet soother of cares, and restorer of strength; as it repairs and replaces the wastes that are made by the labours and exercises of the day. But excessive sleep has its inconveniences; for it blunts the senses, and renders them less fit for the duties of life. The proper time for sleep is the night, when darkness and silence invite and bring it on: day-sleep is less refreshing; which rule, if it be proper for the multitude to observe, much more is the observance of it necessary for persons addicted to literary studies, whose minds and bodies are more susceptible of injuries.

REGIMEN, in *Grammar*, that part of syntax, or construction, which regulates the dependency of words, and the alterations which one occasions in another.

REGIMEN for Seamen. See SEAMEN.

REGIMENT, is a body of men, either horse, foot, or artillery, commanded by a colonel, lieutenant-colonel, and major. Each regiment of foot is divided into companies; but the number of companies differs: though in Britain our regiments are generally 10 companies, one of which is always grenadiers, exclusive of the two independent companies. Regiments of horse are commonly six troops, but there are some of nine. Dragoon regiments are generally in war time 8 troops, and in time of peace but 6. Each regiment has a chaplain, quarter master, adjutant, and surgeon. Some German regiments consist of 2000 foot; and the regiment of Picardy in France consisted of 6000, being 120 companies, of 50 men in each company.

Regiments

Regiments were first formed in France in the year 1558, and in England in the year 1660.

REGIOMONTANUS. See MULLER.

REGION, in *Geography*, a large extent of land, inhabited by many people of the same nation, and inclosed within certain limits or bounds.

The modern astronomers divide the moon into several regions, or large tracts of land, to each of which they give its proper name.

REGION, in *Physiology*, is taken for a division of our atmosphere, which is divided into the upper, middle, and lower regions.

The upper region commences from the tops of the mountains, and reaches to the utmost limits of the atmosphere. In this region reign a perpetual equable calmness, clearness, and serenity. The middle region is that in which the clouds reside, and where meteors are formed, extending from the extremity of the lowest to the tops of the highest mountains. The lowest region is that in which we breathe, which is bounded by the reflection of the sun's rays; or by the height to which they rebound from the earth. See ATMOSPHERE and AIR.

Æthereal REGION, in *Cosmography*, is the whole extent of the universe, in which is included all the heavenly bodies, and even the orb of the fixed stars.

Elementary REGION, according to the Aristotelians, is a sphere terminated by the concavity of the moon's orb, comprehending the atmosphere of the earth.

REGION, in *Anatomy*, a division of the human body, otherwise called *cavity*, of which anatomists reckon three, viz. the upper region, or that of the head; the middle region, that of the thorax or breast; and the lower, the abdomen or belly. See ANATOMY.

REGION, in ancient Rome, was a part or division of the city. The regions were only four in number, till Augustus Cæsar's time, who divided the city into fourteen; over each of which he settled two surveyors, called *curatores viarum*, who were appointed annually, and took their divisions by lot. These fourteen regions contained four hundred and twenty-four streets, thirty-one of which were called *greater* or *royal streets*, which began at the gilt pillar that stood at the entry of the open place in the middle of the city. The extent of these divisions varied greatly, some being from 12,000 or 13,000 to 33,000 feet or upwards in circumference. Authors, however, are not agreed as to the exact limits of each. The curatores viarum wore the purple, had each two lictors in their proper divisions, had slaves under them to take care of fires that happened to break out. They had also two officers, called *denunciatores*, in each region, to give account of any disorders. Four *vico-magistri* also were appointed in each street, who took care of the streets allotted them, and carried the orders of the city to each citizen.

REGIS, PETER SYLVAIN, a French philosopher, and a great propagator of the doctrines of Des Cartes, was born in Agenois in the year 1632. He studied languages and philosophy under the Jesuits at Cahors; and as his views were then directed to the church, he was afterwards occupied in the study of divinity at the university of that town. His progress in learning was so uncommon, that at the end of four years he was offered a doctor's degree without the usual charges; but he did not think it became him to accept of it till he had studied also in the Sorbonne at Paris. He went thither, but was soon disgusted with theology; and as the philosophy of Des Cartes began at that time to make a noise through the lectures of Rohault, he conceived a taste for it, and gave himself up entirely to it. He frequented these lectures; and becoming an adept, went to Toulouse in 1665, and read lectures in it himself. Having fine parts, a clear and fluent manner, and a happy way of making himself understood, he drew all sorts of people; the magistrates, the learned, the ecclesiastics, and the very women, who now all affected to abjure the ancient philosophy. In 1680 he returned to Paris; where the concourse about him was such, that the sticklers for Peripateticism began to be alarmed. They applied to the archbishop of Paris, who thought it expedient, in the name of the king, to put a stop to the lectures; which accordingly were discontinued for several months. The whole life of Regis was spent in propagating the new philosophy. In 1690 he published a formal system of it, containing logic, metaphysics, physics, and morals, in 3 vols. 4to, and written in French. It was reprinted the year after at Amsterdam, with the addition of a discourse upon ancient and modern philosophy. He wrote afterwards several pieces in defence of his system, in which he had disputes with M. Huet, Du Hamel, Malebranche, and others. His works, though abounding with ingenuity and learning, have been disregarded, in consequence of the great discoveries and advancement in philosophic knowledge that have been since made. He died in 1707. He had been chosen member of the academy of sciences in 1699.

The works of this author are the following:—*A System of Philosophy*, containing Logic, Metaphysics, and Morals; in 1690, 3 vols. 4to. being a compilation of the different ideas of Des Cartes.

The Use of Reason and of Faith.

An Answer to Huet's Censures of the Cartesian Philosophy; and an Answer to Du Hamel's Critical Reflections.

Some pieces against Malebranche, to shew that the apparent magnitude of an object depends solely on the magnitude of its image, traced on the retina.

A small piece upon the question, Whether pleasure makes our present happiness?

REGISTER, a public book, in which are entered and recorded memoirs, acts, and minutes, to be had recourse to occasionally for knowing and proving matters of fact. Of these there are several kinds; as,

1. Register of deeds in Yorkshire and Middlesex, in which are registered all deeds, conveyances, wills, &c. that affect any lands or tenements in those counties, which are otherwise void against any subsequent purchasers or mortgagees, &c.; but this does not extend to any copyhold estate, nor to leases at a rack-rent, or where they do not exceed 21 years. The registered memorials must be engrossed on parchment, under the hand and seal of some of the granters or grantees, attested by witnesses who are to prove the signing or sealing of them and the execution of the deed. But these registers, which are confined to two counties, are in Scotland general, by which the laws of North Britain are rendered very easy and regular. Of these there are two kinds; the one general, fixed at Edinburgh, under the direction of the lord-register; and the other is kept

in the several shires, stewartries, and regalities, the clerks of which are obliged to transmit the registers of their respective courts to the general register.

2. Parish-registers are books in which are registered the baptisms, marriages, and burials, of each parish.

REGISTERS were kept both at Athens and Rome, in which were inserted the names of such children as were to be brought up, as soon as they were born. Marcus Aurelius required all free persons to give in accounts of their children, within 30 days after the birth, to the treasurer of the empire, in order to their being deposited in the temple of Saturn, where the public acts were kept. Officers were also appointed as public registers in the provinces, that recourse might be had to their lists of names, for settling disputes, or proving any person's freedom.

REGISTER Ships, in *Commerce*, are vessels which obtain a permission, either from the king of Spain, or the council of the Indies, to traffic in the ports of the Spanish West Indies; which are thus called, from their being registered before they set sail from Cadiz for Buenos Ayres.

REGISTERS, in *Chemistry*, are holes, or chinks with stopples, contrived in the sides of furnaces, to regulate the fire; that is, to make the heat more intense or remiss, by opening them to let in the air, or keeping them close to exclude it. There are also registers in the steam-engine. See *STEAM-Engine*.

REGISTRAR, an officer in the English universities, who has the keeping of all the public records.

REGIUM, REGIUM *Lepidi*, *Regium Lepidum* in *Ancient Geography*, a town of Cisalpine Gaul, on the Via Æmilia, so called from Æmilius Lepidus, who was consul with C. Flaminius; but whence it was surnamed *Regium* is altogether uncertain. Tacitus relates, that at the battle of Bedriacum, a bird of an unusual size was seen perching in a famous grove near Regium Lepidum. Now called *Reggio*, a city of Modena. E. Long. 11. 0. N. Lat. 44. 45. See REGGIO.

REGNARD, JOHN FRANCIS, one of the best French comic writers after Moliere, was born at Paris in 1647. He had scarcely finished his studies, when an ardent passion for travelling carried him over the greatest part of Europe. When he settled in his own country, he was made a treasurer of France, and lieutenant of the waters and forests: he wrote a great many comedies; and, though naturally of a gay genius, died of chagrin in the 52d year of his age. His works, consisting of comedies and travels, were printed at Rouen, in 5 vols. 12mo, 1732.

REGNIER, MATHURIN, the first French poet who succeeded in satire, was born at Chartres in 1573. He was brought up to the church, a place for which his debaucheries rendered him very unsuitable; and these by his own confession were so excessive, that at 30 he had all the infirmities of age. Yet he obtained a canonry in the church of Chartres, with other benefices; and died in 1613. There is a neat Elzevir edition of his works, 12mo, 1652, Leyden; but the most elegant is that with notes by M. Brossette, 4to, 1729, London.

REGNIER DES MARETS, *Seraphin*, a French poet, born at Paris in 1632. He distinguished himself early by his poetical talents, and in 1684 was made perpetual secretary to the French academy on the death of Mezeray: it was he who drew up all those papers in the name

of the academy against Furetiere: the king gave him the priory of Grammont, and he had also an abbey. He died in 1713, and his works are, French, Italian, Spanish, and Latin poems, 2 vols.; a French grammar; and an Italian translation of Anacreon's odes, with some other translations.

REGNUM, in *Ancient Geography*, a town of the Regni, a people in Britain, next the Cantii, now Surry, Sussex, and the coast of Hampshire, (Camden); a town situated, by the Itinerary numbers, on the confines of the Belgæ, in a place now called *Ringwood*, in Hampshire, on the rivulet Avon, running down from Salisbury, and about ten miles or more distant from the sea.

REGRATOR, signifies him who buys and sells any wares or victuals in the *same* market or fair; and regrators are particularly described to be those who buy, or get into their hands, in fairs or markets, any grain, fish, butter, cheese, sheep, lambs, calves, swine, pigs, geese, capons, hens, chickens, pigeons, conies, or other dead victuals whatsoever, brought to a fair or market to be sold there, and do sell the same again in the same fair, market, or place, or in some other within four miles thereof.

Regrating is a kind of *huckstry*, by which victuals are made dearer; for every seller will gain something, which must of consequence enhance the price. And, in ancient times, both the engrosser and regrator were comprehended under the word *forestaller*. Regrators are punishable by loss and forfeiture of goods, and imprisonment, according to the first, second, or third offence, &c.

REGENSBERG, a handsome though small town of Swisserland, in the canton of Zurich, and capital of a bailiwick of the same name, with a strong castle, seated on a hill, which is part of Mount Jura. There is a well sunk through a rock, 36 fathoms deep.

REGULAR, denotes any thing that is agreeable to the rules of art: thus we say, a regular building, verb, &c.

A regular figure in geometry, is one whose sides, and consequently angles, are equal; and a regular figure with three or four sides is commonly termed an *equilateral triangle* or *square*, as all others with more sides are called *regular polygons*.

REGULAR *Body*, called also *Platonic Body*, is a body or solid comprehended by like, equal, and regular plane figures, and whose solid angles are all equal.

The plane figures by which the solid is contained are the faces of the solid; and the sides of the plane figures are the edges or linear sides of the solid.

There are only five regular solids, viz.

The tetrahedron, or regular triangular pyramid, having four triangular faces;

The hexahedron, or cube, having six square faces;

The octahedron, having eight triangular faces.

The dodecahedron, having twelve pentagonal faces;

The icosahedron, having twenty triangular faces.

Besides these five, there can be no other regular bodies in nature.

REGULAR, in a monastery, a person who has taken the vows; because he is bound to observe the rules of the order he has embraced.

REGULATION, a rule or order prescribed by a superior, for the proper management of some affair.

REGULATOR *of a* WATCH, the small spring belonging to the balance; serving to adjust its motions, and make it go faster or slower. See WATCH.

REGULBIUM, or REGULVIUM, (Notitia Imperii); mentioned nowhere else more early: a town of the Cantii, in Britain. Now Reculver, a village on the coast, near the island Thanet, towards the Thames, to the north of Canterbury, (Camden).

REGULUS, M. ATTILIUS, a consul during the first Punic war. He reduced Brundusium, and in his second consulship he took 64 and sunk 30 galleys of the Carthaginian fleet, on the coasts of Sicily. Afterwards he landed in Africa; and so rapid was his success, that in a short time he made himself master of about 200 places of consequence on the coast. The Carthaginians sued for peace, but the conqueror refused to grant it; and soon after he was defeated in a battle by Xanthippus, and 30,000 of his men were left on the field of battle, and 15,000 taken prisoners. Regulus was in the number of the captives, and he was carried in triumph to Carthage. He was sent by the enemy to Rome, to propose an accommodation and an exchange of prisoners; and if his commission was unsuccessful, he was bound by the most solemn oaths to return to Carthage without delay. When he came to Rome, Regulus dissuaded his countrymen from accepting the terms which the enemy proposed; and when his opinion had had due influence on the senate, Regulus retired to Carthage agreeable to his engagements. The Carthaginians were told that their offers of peace had been rejected at Rome by the means of Regulus; and therefore they prepared to punish him with the greatest severity. His eye-brows were cut, and he was exposed for some days to the excessive heat of the meridian sun, and afterwards confined in a barrel, whose sides were everywhere filled with large iron pikes, till he died in the greatest agonies. His sufferings were heard of at Rome; and the senate permitted his widow to inflict whatever punishment she pleased on some of the most illustrious captives of Carthage which were in their hands. She confined them also in presses filled with sharp iron points; and was so exquisite in her cruelty, that the senate interferred, and stopped the barbarity of her punishment. Regulus died about 251 years before Christ.—Memmius, a Roman, made governor of Greece by Caligula. While Regulus was in his province, the emperor wished to bring the celebrated statue of Jupiter Olympius by Phidias to Rome, but this was supernaturally prevented; and according to ancient authors, the ship which was to convey it was destroyed by lightning, and the workmen who attempted to remove the statue were terrified away by sudden noises. A man who condemned Sejanus.—Roscius, a man who held the consulship but for one day, in the reign of Vitellius.

REGULUS, in *Astronomy*, a star of the first magnitude, in the constellation Leo; called also, from its situation, *Cor Leonis*, or the *Lion's Heart;* by the Arabs, *Alhabor;* and by the Chaldeans, *Kalbeleced*, or *Karbeleceid;* from an opinion of its influencing the affairs of the heavens.

REGULUS, in *Chemistry*, the metallic matter that falls to the bottom of the crucible, in the melting of ores or impure metallic substances. It is the finest or purest part of the metal; and, according to the alchemists, is denominated *regulus*, or *little king*, as being the first-born of the royal metallic blood. According to them, it is really a son, but not a perfect man; i. e. not yet a perfect metal, for want of time and proper nourishment. To procure the regulus of metals, &c. flux powders are commonly used; as nitre, tartar, &c. which purge the sulphureous part adhering to the metal, by attracting and absorbing it to themselves.

REHEARSAL, in *Music* and the *Drama*, an essay or experiment of some composition, generally made in private, previous to its representation or performance in public, in order to render the actors and performers more perfect in their parts.

REICHENBERG, in Bohemia, 95 miles west of Prague, 205 north-west of Vienna, N. Lat. 50. 2. E. Long. 12. 25. is only remarkable as the place where the Prussian army defeated the Austrians on the 21st of April 1757. The Austrian army, commanded by Count Konigseck, was posted near Reichenberg, and was attacked by the Prussians under the command of the prince of Brunswick Bevern. The Prussians were 20,000 and the Austrians 28,000: the action began at half after six in the morning, when the Prussian lines were formed, and attacked the Austrian cavalry, which was ranged in three lines of 30 squadrons, and their two wings sustained by the infantry, which was posted among felled trees and intrenchments. The Austrians had a village on their right, and a wood on their left, where they were intrenched. The Prussian dragoons and grenadiers cleared the intrenchment and wood, and entirely routed the Austrian cavalry; at the same time, the redoubts that covered Reichenberg were taken by General Lestewitz; and the Austrians were entirely defeated. The Prussians had seven officers and 100 men killed; 14 officers and 150 men wounded. The Austrians had 1000 men killed and wounded; 20 of their officers and 400 men taken prisoners. The action ended at eleven.

REID, THOMAS, D. D. an eminent philosopher and distinguished literary character, was the son of Lewis Reid, minister of the parish of Strachan in the county of Kincardine, North Britain. His mother was the daughter of Mr Gregory of Kinnairdie in Banffshire, was one of twenty-nine children, and was sister to David, James, and Charles Gregories, who were at the same period professors of astronomy or mathematics, in the universities of Oxford, Edinburgh, and St Andrews.

Dr Reid was born at the parsonage house of Strachan, in April 1710, and received the elementary parts of his education at the parish-school of Kincardine-o-niel. The parochial schools of Scotland are said to have been much superior at that period to what they are at present, and young men went from them well furnished with philological learning to the different universities. The early progress of young Reid must have been very extraordinary, since he was qualified to profit by the lectures of the professors at the age of twelve. He soon gave very striking proofs that he inherited the genius of his mother's family, and was conspicuous among the students of mathematics, in a college where that science has always been cultivated with zeal and success. He continued longer at the university than the usual term of years, as he had been appointed to the office of librarian, which was a situation every way agreeable to him, as it gave him such an ample opportunity of gratifying his passion for study. About this time he became intimately attached to John Stewart, afterwards professor of mathematics in Marischal college, which connection greatly strengthed his predilection for mathematical studies.

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He resigned the office of librarian in the year 1736, and accompanied Mr Stewart to England, when they paid a visit to London, Oxford, and Cambridge, and were introduced to several persons of the first literary distinction. On account of his relation to Dr David Gregory, he had ready access to the celebrated Martin Folkes, whose house might be said to contain many of the most interesting objects to be met with in the metropolis. He saw Dr Bentley at Cambridge, with whose erudition he was much delighted, as well as amused with his vanity; and he also conversed frequently with Saunderson, the blind mathematician. Dr Reid refers in his speculations to this gentleman's blindness, as a singular phenomenon in the history of the human mind.

Dr Reid maintained an uninterrupted friendship with the learned and amiable Mr Stewart till the year 1766, at which time Mr Stewart was carried off by a malignant fever. The circumstances attending the death of this excellent man deeply wounded the sensibility of Dr Reid; for his wife and daughter were carried off by the same disorder, and buried with him in one grave.

The King's college of Aberdeen presented Dr Reid to the living of New-Machar in the year 1737; but such was the zeal of the people against the law of patronage at that time, that he not only met with violent opposition, but was also exposed to personal danger. But his attention to the duties of his office was so exemplary, his temper so mild and forbearing, and his spirit of humanity so active, that in a short time he subdued their prejudices; and when at last called in the course of providence to a different situation, the very people who had been guilty of gross and indecent outrages against him followed him, on his departure, with their benedictions and tears.

In 1740, he married Elizabeth, daughter of his uncle, Dr George Reid, physician in London, after which his popularity at New-Machar very much increased. Her manners were so accommodating, and so numerous were her kind offices to the sick and the indigent, that the departure of the family from the neighbourhood was looked upon as a general misfortune. The manner in which several old men were accustomed to speak upon the subject is worthy of being kept in remembrance. "We fought, said they, *against* Dr Reid when he came, and we would have fought *for* him when he went away."

The greater part of his residence at New-Machar was devoted to the most intense study, particularly directing his attention to the laws of external perception, and of the other principles which constitute the basis of human knowledge. He unbended his mind by the amusements of gardening and botany, of which he was extremely fond, even in old age.

The professors of *King's College*, in the year 1752, made choice of Dr Reid to be professor of philosophy, originating wholly from the high opinion they were led to entertain of his talents and erudition. We are not acquainted with the particular plan which he adopted and pursued in the course of his lectures; but his department at that period comprehended mathematics and physics, logics and ethics,—a practice then followed in the other universities of Scotland, instead of appointing a professor for each distinct branch.

Dr Reid had not been long in Aberdeen, till in conjunction with Dr John Gregory, he projected a literary society which continued for a number of years, and met once a week. The writings of Reid, Gregory, Campbell, Beattie and Gerard, evince the numerous advantages which the members derived from this institution, as they were in the habit of subjecting such works as they intended for publication, to the test of friendly criticism.

It is perhaps not too much to assert, that of all the publications which appeared about this time, the Inquiry into the Human Mind by Dr Reid, discovered by far the greatest originality and profound thinking. It appears that he had conceived the plan, and deeply meditated upon it, long before its publication; yet without the applause of his literary associates, it is more than probable that his native modesty might have prevented him from giving it to the world.

The publication of Mr Hume's *Treatise of Human Nature*, in 1739, led him to question the principles commonly received with regard to the human understanding. He admitted, when a youth, but without any attentive examination, the opinions on which Mr Hume's scepticism was raised; but when he carefully adverted to the consequences which these principles appeared to involve, he instantly began to suspect their truth. To subvert the sceptical theory of Mr Hume was the grand object of Dr Reid's *Inquiry*, which he submitted to the examination of Mr Hume himself. That philosopher, even after he had seen some parts of the Work, discovers not a little of the Jewish spirit of unbelief that any good thing should come out of Nazareth; and considering his antagonist as a clergyman, and belonging to an order of men from whom prejudice would not allow him to expect any soundness of reasoning in matters of science, he betrays more than want of good humour, as Dr Reid's biographer expresses himself, when he says in no very courteous language in a letter to Dr Blair, "I wish that the parsons would confine themselves to their old occupation of worrying one another, and leave philosophers to argue with temper, moderation, and good manners." But though Mr Hume, as appears from the words just quoted, was very angry that a clergyman should become a philosopher, on a second perusal of the Inquiry, he seems to have held very different sentiments, when he wrote to the author himself in the following terms. "By Dr Blair's means, I have been favoured with the perusal of your performance, which I have read with great pleasure and attention. It is certainly very rare, that a piece so deeply philosophical is wrote (written) with so much spirit, and affords so much entertainment to the reader; though I must still regret the disadvantages under which I read it, as I never had the whole performance at once before me, and could not be able fully to compare one part with another. To this reason, chiefly, I ascribe some obscurities, which, in spite of your short analysis or abstract, still seem to hang over your system. For I must do you the justice to own, that when I entered into your ideas, no man appears to express himself with greater perspicuity than you do; a talent which, above all others, is requisite in that species of literature which you have cultivated.—As I was desirous to be of some use to you, I kept a watchful eye all along over your style; but it is really so correct, and so good English, that I found not any thing worth the remarking. There is only one passage in this chapter, where you make use of the phrase *hinder to do* instead of *hinder from doing*, which is the English one; but I could not find

Reid.

find the passage when I sought for it. You may judge how unexceptionable the whole appeared to me, when I could remark so small a blemish."

The impression made on the minds of speculative men by the publication of Dr Reid's Inquiry was as great as could reasonably be expected from the nature of his undertaking. It was not level to the comprehension of the multitude, nor even addressed to them; and as it examined opinions with the utmost freedom which had obtained the sanction of the highest authorities, it had little prospect of conciliating the favour of the learned. Some, however, there were, who perceived the extent of his views, and beheld in his pages the true spirit and language of inductive investigation, which made proselytes of many, and was, by them, warmly recommended to the attention of others. The *Inquiry* of Dr Reid was so much esteemed by the learned body of teachers then in the university of Glasgow, that they gave him an invitation to the vacant professorship of moral philosophy, in the year 1763. It was no doubt with a considerable degree of reluctance that he resolved to leave Aberdeen; yet so numerous were the allurements which Glasgow presented to a man of his extensive erudition and deep research, that he gave it the preference. That seminary of learning could then boast of a Moor, a Simson, a Black, a Leechman, the two Wilsons, father and son, and an acute, discriminating Millar, with all of whom he was more or less intimate, and whose fascinating conversation made him in some measure forget that he was long acquainted with men of genius in the university of Aberdeen.

Dr Reid's merit as a public teacher arose principally from that fund of original philosophy which is characteristic of his writings; and from his invincible patience and perseverance in recommending such principles as he conceived to be of the last importance to human happiness. His style, too, was simple and perspicuous; his character grave and possessed of authority; and his students felt such an interest in the doctrines which he inculcated, that he never failed to be heard with the most profound attention.

In the year 1773 his remarks on Aristotle's logic appeared in Lord Kames's Sketches of the History of Man, of which he himself has favoured us with the following account. " In attempting to give some account of the Analytics, and of the Topics of Aristotle, ingenuity obliges me to confess, that though I have often purposed to read the whole with care, and to understand what is intelligible, yet my courage and patience always failed before I had done. Why should I throw away so much time and painful attention upon a thing of so little use? If I had lived in those ages when the knowledge of Aristotle's Organon entitled a man to the highest rank in philosophy, ambition might have induced me to employ upon it some years of painful study; and less, I conceive, would not be sufficient. Such reflections as these always got the better of my resolution when the first ardour began to cool. All I can say is, that I have read some part of the different books with care, some slightly, and some perhaps not at all. I have glanced over the whole often; and when any thing attracted my attention have dipped into it till my appetite was satisfied."

But in spite of his modest declarations, it is matter of doubt with some, whether any of his publications does him more honour than his perspicuous view of this complicated system. It is unquestionably superior to any other analysis of these writings we have yet seen, an opinion amply confirmed by the sentiments of different literary characters who were intimately acquainted with the works of Aristotle.

Dr Reid declined reading lectures in the university for some years before his death; and he devoted this period to the task of preparing for the press his great work, which was published in two volumes 4to, the first in 1785, entitled, " Essays on the Intellectual Powers of Man;" and the second in 1788, entitled, " Essays on the Active Powers of Man." His *Essay on Quantity, occasioned by reading a Treatise, in which Simple and Compound Ratios are applied to Virtue and Merit*, was composed previous to the year 1748, and was published in the Philosophical Transactions of London for that year. This paper affords some light with regard to the progress of his speculations about this time. The Inquiry into the Human Mind, of which we have already taken notice, appeared in 1764; and at this time he was complimented with the degree of Doctor in Divinity.

In the year 1796 (the last of his mortal existence), he was prevailed upon to spend with his friends at Edinburgh a few weeks during the summer. From that visit he returned to Glasgow in his usual health and spirits, and for some time continued to devote a portion of his time to the exercise both of body and mind. About the end of September the same year, he was seized with a violent disorder, with which he maintained a severe struggle; and this, together with repeated strokes of the palsy, put a final period to his long and useful life on the 7th of October, and in the 87th year of his age.

As to his bodily constitution, few men have been more indebted to nature than Dr Reid. In this respect he was athletic and vigorous, and his muscular strength was uncommonly great; advantages which were powerfully seconded by his temperance, exercise, and the unclouded serenity of his temper. Deep and collected thought was very conspicuous in his countenance, and all his looks were expressive of kindness and good will.

With respect to his character, his rectitude was inflexible and intrepid; his attachment to truth was pure; and he had an entire command over all his passions, which he acquired by the unwearied exertions of a long life. When, therefore, he found it necessary to dispute the conclusions of others in any of his writings, he never employed any expressions to irritate those whom he was anxious to convince, and the asperity of his opponents could not provoke him to repress his spirit of liberality and good-humour; for he considered the intemperance with which controversy is usually carried on, as an enemy to the progress of useful knowledge, and as having done more harm to the practice than service to the theory of morality. He uniformly maintained the dignity of philosophy in private life, and he united in his character the most amiable modesty and gentleness, with the noblest spirit of independence. He never solicited any favours from the great, and all his academical or other preferments were conferred upon him by those who were real judges of his merit, and thought he deserved them. To a sound, cautious, and discriminating judgment, a singular patience and perseverance of thought,

thought, and fixed attention to the operations of his own mind, he added the curiosity of a naturalist and the eyes of an observer, and of course his information was accurate and extensive. His sensibility was of an active and lively nature, and wherever he could command the means of relieving the distressed, he always employed them with the utmost secrecy possible.

His works are now in the hands of the public, and we believe we may venture to assert, that they will always be much esteemed, while sound sense continues to be preferred to unintelligible jargon, sophistry, or impiety. He has divested metaphysics of mystery, and rendered intelligible the most profound speculations, by the regular and constant use of words in one determined sense. In the state in which he found the philosophical world, it was Dr Reid's opinion, that his talents could not be so usefully employed, as in combating the schemes of those who aimed at the complete subversion of religion, both natural and revealed. He apprehended the operations of his own mind with a clearness which gave to his language a perspicuity and precision that the language of Locke never possessed; and in this respect he is decidedly superior to all his predecessors.

REIN-DEER, or *Tarandus*. See CERVUS, ENTOMOLOGY *Index*.

REINS, in *Anatomy*, the same with KIDNEYS. See ANATOMY *Index*.

REINS *of a Bridle*, are two long slips of leather, fastened on each side of a curb or snaffle, which the rider holds in his hand, to keep the horse in subjection.

There is also what is called *false reins;* which is a lath of leather, passed sometimes through the arch of the banquet, to bend the horse's neck.

REJOINDER, in *Law*, is the defendant's answer to the plaintiff's replication or reply. Thus, in the court of chancery, the defendant puts in an answer to the plaintiff's bill, which is sometimes also called an *exception;* the plaintiff's answer to that is called a *replication*, and the defendant's answer to that a *rejoinder*.

REISKE, JOHN JAMES, a profound scholar and eminent critic, was born in 1706 at a small town in the duchy of Anhalt in Germany. His connections, it would appear, were in a humble situation of life; and in consequence of the narrow circumstances in which he was placed, he had many difficulties to struggle with during the early part of his education. These, however, by unabating perseverance he surmounted, and in 1733 went to Leipsic, where he remained for five years in the ardent pursuit of his studies. Here he acquired an extensive knowledge of the Arabic, and was engaged in the translation of a book from that language, which was afterwards published. With the view of prosecuting with greater advantage the study of Arabic, which had become with him a favourite object of pursuit, he travelled on foot to Leyden, where new difficulties attended him. While he remained in Leyden he was employed in arranging the Arabic manuscripts belonging to the university; and for this labour he received a very small remuneration. During his residence here, part of his time was occupied in the translation of various essays from the German and French languages into Latin. These essays afterwards appeared in the *Miscellanea Critica*. About the same time also our learned author translated into Latin the whole of the *Chariton* from the Greek and the Geography of Abulfeda from the Arabic.

Having spent eight years at Leyden, Reiske was driven from this place by jealousy and calumny, which it is said were excited against him chiefly by the younger Burman, in consequence of his critical strictures on the edition of Petronius published by that author; but before his departure from this learned seminary, he had obtained the degree of doctor of physic, which was conferred in a manner highly to his honour. He afterwards visited different parts of Germany, and at last settled a second time at Leipsic, where he remained for twelve years. But although he had received the appointment of professor of Arabic, the emoluments of his office were so scanty, that he had yet to struggle with all the difficulties attendant on poverty, and merely to procure a subsistence was obliged to engage in the humbler employments of literary labour, and submit to the severe and ill-requited drudgery of editing works for booksellers, or contributing detached papers to periodical publications. About this time the *Acta Eruditorum* were greatly indebted to the labours of our author. But in the midst of all the difficulties and hardships now alluded to, he prepared and published a work of profound learning and great merit. This work, which extended to five volumes, appeared under the title of *Animadversiones in Auctores Græcos*, and added much to our author's reputation.

In the year 1758, in consequence of the death of Haltausius, he obtained a situation, which was not only honourable but lucrative. This was the place of rector of the academy of Leipsic, in which he continued during the remainder of his life. He was now raised above want, and being free from the difficulties and embarrassments which had hitherto constantly attended him, he was thus enabled in the midst of learned ease to prosecute his favourite studies.

In the year 1764 Reiske married E. C. Muller, a woman of great learning, and of whom it is said that her knowledge, especially in Greek literature, was little inferior to that of her husband. In all his literary labours she was an useful associate; but the assistance which she contributed to his great work, the edition of the Greek Orators, was particularly valuable. Thus passed the latter period of the life of this learned man. He died in 1774, possessing a very distinguished reputation as a scholar and a critic. The number of the works which he superintended and published is very great. The most approved are the following. "Remarks upon Greek Authors." An "Edition of the Greek Orators," in 12 vols. 8vo, which was completed by his widow. "Dionysius Halicarnassensis," in 7 vols. "Plutarch's Works," in 9 vols. "Theocritus," &c.

RELAND, ADRIAN, an eminent Orientalist, born at Ryp, in North Holland, in 1676. During three years study under Surenhusius, he made an uncommon progress in the Hebrew, Syriac, Chaldee, and Arabic languages, and these languages were always his favourite study. In 1701, he was, by the recommendation of King William, appointed professor of Oriental languages and ecclesiastical antiquities in the university of Utrecht, and died of the small-pox in 1718. He was distinguished by his modesty, humanity, and learning; and carried on a correspondence with the most

Reland ‖ Release.

eminent scholars of his time. His principal works are, 1. An excellent description of Palestine. 2. Five dissertations on the Medals of the ancient Hebrews, and several other dissertations on different subjects. 3. An Introduction to the Hebrew Grammar. 4. The Antiquities of the ancient Hebrews. 5. On the Mahometan Religion. These works are all written in Latin.

RELATION, the mutual respect of two things, or what each is with regard to the other. See METAPHYSICS, N° 93, &c. and 128, &c.

RELATION, in *Geometry*. See RATIO.

RELATION, is also used for analogy. See ANALOGY and METAPHYSICS.

RELATIVE, something relating to or respecting another.

RELATIVE, in *Music*. See MODE.

RELATIVE Terms, in *Logic*, are words which imply relation; such are master and servant, husband and wife, &c.

In grammar, relative words are those which answer to some other word foregoing, called the *antecedent;* such are the relative pronouns *qui, quæ, quod*, &c. and in English, *who, whom, which*, &c. The word answering to these relatives is often understood, as, "I know whom you mean;" for "I know the person whom you mean."

RELAXATION, in *Medicine*, the act of loosening or slackening; or the looseness or slackness of the fibres, nerves, muscles, &c.

RELAY, a supply of horses placed on the road, and appointed to be ready for a traveller to change, in order to make the greater expedition.

RELEASE, in *Law*, is a discharge or conveyance of a man's right in lands or tenements, to another that hath some former estate in possession. The words generally used therein are "remised, released, and for ever quitclaimed." And these releases may enure, either, 1. By way of *enlarging an estate*, or *enlarger l'estate:* as, if there be tenant for life or years, remainder to another in fee, and he in remainder releases all his right to the particular tenant and his heirs, this gives him the estate in fee. But in this case the relessee must be in *possession* of some estate, for the release to work upon; for if there be lessee for years, and, before he enters and is in possession, the lessor releases to him all his right in the reversion, such release is void for want of possession in the relessee. 2. By way of *passing an estate* or *mitter l'estate:* as when one of two coparceners releaseth all his right to the other, this passeth the fee-simple of the whole. And, in both these cases, there must be a privity of estate between the relessor and relessee; that is, one of their estates must be so related to the other, as to make but one and the same estate in law. 3. By way of *passing a right* or *mitter le droit:* as if a man be disseised, and releaseth to his disseisor all his right; hereby the disseisor acquires a new right, which changes the quality of his estate, and renders that lawful which before was tortius. 4. By way of *extinguishment:* as if my tenant for life makes a lease to A for life, remainder to B and his heirs, and I release to A; this extinguishes my right to the reversion, and shall enure to the advantage of B's remainder as well as of A's particular estate 5. By way of *entry and feoffment:* as if there be two joint disseisors, and the disseisee releases to one of them, he shall be sole seised, and shall keep out his former companion; which is the same in effect as if the disseisee had entered, and thereby put an end to the disseisors in fee. And hereupon we may observe, that when a man has in himself the possession of lands, he must at the common law convey the freehold by feoffment and livery: which makes a notoriety in the country: but if a man has only a right or a future interest, he may convey that right or interest by a mere release to him that is in possession of the land: for the occupancy of the relessee is a matter of sufficient notoriety already.

Blackst. Comment.

RELEVANCY, in *Scots Law*. See LAW, N° clxxxvi. 48.

RELICS, in the Romish church, the remains of the bodies or clothes of saints or martyrs, and the instruments by which they were put to death, devoutly preserved, in honour to their memory; kissed, revered, and carried in procession.

The respect which was justly due to the martyrs and teachers of the Christian faith, in a few ages increased almost to adoration; and at length adoration was really paid both to departed saints and to relics of holy men or holy things. The abuses of the church of Rome, with respect to relics, are very flagrant and notorious. For such was the rage for them at one time, that, as F. Mabillon a Benedictine justly complains, the altars were loaded with suspected relics; numerous spurious ones being everywhere offered to the piety and devotion of the faithful. He adds, too, that bones are often consecrated, which, so far from belonging to saints, probably do not belong to Christians. From the catacombs numerous relics have been taken, and yet it is not known who were the persons interred therein. In the 11th century, relics were tried by fire, and those which did not consume were reckoned genuine, and the rest not. Relics were, and still are, preserved on the altars whereon mass is celebrated; a square hole being made in the middle of the altar, big enough to receive the hand, and herein is the relic deposited, being first wrapped in red silk, and inclosed in a leaden box.

The Romanists plead antiquity in behalf of *relics:* For the Manichees, out of hatred to the flesh, which they considered as an evil principle, refused to honour the relics of saints; which is reckoned a kind of proof that the Catholics did it in the first ages.

We know, indeed, that the touching of linen cloths on relics, from an opinion of some extraordinary virtue derived therefrom, was as ancient as the first ages, there being a hole made in the coffins of the 40 martyrs at Constantinople expressly for this purpose. The honouring the relics of saints, on which the church of Rome afterwards founded her superstitious and lucrative use of them, as objects of devotion, as a kind of charms or amulets, and as instruments of pretended miracles, appears to have originated in a very ancient custom, that prevailed among Christians, of assembling at the cemeteries or burying-places of the martyrs, for the purpose of commemorating them, and of performing divine worship. When the profession of Christianity obtained the protection of the civil government, under Constantine the Great, stately churches were erected over their sepulchres, and their names and memories were treated with every possible token of affection and respect. This reverence, however, gradually exceeded all reasonable bounds;

bounds; and those prayers and religious services were thought to have a peculiar sanctity and virtue, which were performed over their tombs. Hence the practice, which afterwards obtained, of depositing relics of saints and martyrs under the altars in all churches. This practice was then thought of such importance, that St Ambrose would not consecrate a church because it had no relics; and the council of Constantinople in Trullo ordained, that those altars should be demolished under which there were found no relics. The rage of procuring relics for this and other purposes of a similar nature, became so excessive, that in 386 the emperor Theodosius the Great was obliged to pass a law, forbidding the people to dig up the bodies of the martyrs, and to traffic in their relics.

Such was the origin of that respect for sacred relics, which afterwards was perverted into a formal worship of them, and became the occasion of innumerable processions, pilgrimages, and miracles, from which the church of Rome hath derived incredible advantage.—In the end of the ninth century, it was not sufficient to reverence departed saints, and to confide in their intercessions and succours, to clothe them with an imaginary power of healing diseases, working miracles, and delivering from all sorts of calamities and dangers; their bones, their clothes, the apparel and furniture they had possessed during their lives, the very ground which they had touched, or in which their putrified carcases were laid, were treated with a stupid veneration, and supposed to retain the marvellous virtue of healing all disorders both of body and mind, and of defending such as possessed them against all the assaults and devices of the devil. The consequence of all this was, that every one was eager to provide himself with these salutary remedies; consequently, great numbers undertook fatiguing and perilous voyages, and subjected themselves to all sorts of hardships; while others made use of this delusion to accumulate their riches, and to impose upon the miserable multitude by the most impious and shocking inventions. As the demand for relics was prodigious and universal, the clergy employed the utmost dexterity to satisfy all demands, and were far from being nice in the methods they used for that end. The bodies of the saints were sought by fasting and prayer, instituted by the priest in order to obtain a divine answer and an infallible direction, and this pretended direction never failed to accomplish their desires; the holy carcase was always found, and that always in consequence, as they impiously gave out, of the suggestion and inspiration of God himself. Each discovery of this kind was attended with excessive demonstrations of joy, and animated the zeal of these devout seekers to enrich the church still more and more with this new kind of treasure. Many travelled with this view into the eastern provinces, and frequented the places which Christ and his disciples had honoured with their presence, that, with the bones and other sacred remains of the first heralds of the gospel, they might comfort dejected minds, calm trembling consciences, save sinking states, and defend their inhabitants from all sorts of calamities. Nor did these pious travellers return home empty; the craft, dexterity, and knavery of the Greeks, found a rich prey in the stupid credulity of the Latin relic-hunters, and made a profitable commerce of this new devotion. The latter paid considerable sums for legs and arms, skulls and jaw-bones (several of which were Pagan, and some not human), and other things that were supposed to have belonged to the primitive worthies of the Christian church; and thus the Latin churches came to the possession of those celebrated relics of St Mark, St James, St Bartholomew, Cyprian, Pantaleon, and others, which they show at this day with so much ostentation. But there were many who, unable to procure for themselves these spiritual treasures by voyages and prayers, had recourse to violence and theft; for all sorts of means, and all sorts of attempts in a cause of this nature, were considered, when successful, as pious and acceptable to the Supreme Being. Besides the arguments from antiquity to which the Papists refer, in vindication of their worship of relics, of which the reader may form some judgment from this article, Bellarmine appeals to Scripture in support of it, and cites the following passages, viz. Exod. xiii. 9.; Deut. xxxiv. 6.; 2 Kings xiii. 21.; 2 Kings xxiii. 16, 17, 18.; Isaiah xi. 10.; Matthew xi. 20, 21, 22.; Acts v. 12—15.; Acts xix. 11, 12. See POPERY.

The Roman Catholics in Great Britain do not acknowledge any worship to be due to relics, but merely a high veneration and respect, by which means they think they honour God, who, they say, has often wrought very extraordinary miracles by them. But, however proper this veneration and respect may be, its abuse has been so great and so general, as fully to warrant the rejection of them altogether.

Relics are forbidden to be used or brought into England by several statutes; and justices of peace are empowered to search houses for popish books and relics, which, when found, are to be defaced and burnt, &c. 3 Jac. I. cap. 26.

RELICT, in *Law*, the same with WIDOW.

RELIEF (*Relevamen*; but, in Domesday, *Relevatio*, *Relevium*), signifies a certain sum of money, which the tenant, holding by knight's service, grand serjeanty, or other tenure (for which homage or legal service is due), and being at full age at the death of his ancestor, paid unto his lord at his entrance. See PRIMER.

Though reliefs had their original while feuds were only life estates, yet they continued after feuds became hereditary; and were therefore looked upon, very justly, as one of the greatest grievances of tenure: especially when, at the first, they were merely arbitrary and at the will of the lord; so that, if he pleased to demand an exorbitant relief, it was in effect to disinherit the heir. The English ill brooked this consequence of their newly adopted policy; and therefore William the Conqueror by his laws *ascertained* the relief, by directing (in imitation of the Danish heriots), that a certain quantity of arms, and habiliments of war, should be paid by the earls, barons, and vavasours respectively; and, if the latter had no arms, they should pay 100 shillings. William Rufus broke through this composition, and again demanded arbitrary uncertain reliefs, as due by the feodal laws; thereby in effect obliging every heir to new-purchase or *redeem* his land: but his brother Henry I. by the charter before mentioned, restored his father's law; and ordained, that the relief to be paid should be according to the law so established, and not an arbitrary redemption.—But afterwards, when, by an ordinance in 27 Hen. II. called the *assise of arms*, it was provided, that every man's armour should descend to his heir, for defence of the realm, and it thereby became impracticable

cable to pay these acknowledgements in arms according to the laws of the Conqueror, the composition was universally accepted of 100 shillings for every knight's fee, as we find it ever after established. But it must be remembered, that this relief was only then payable, if the heir at the death of his ancestor had attained his full age of 21 years.

To RELIEVE *the Guard*, is to put fresh men upon guard, which is generally every 24 hours.

To Relieve the Trenches, is to relieve the guard of the trenches, by appointing those for that duty who have been there before.

To Relieve the Sentries, is to put fresh men upon that duty from the guard, which is generally done every two hours, by a corporal who attends the relief, to see that the proper orders are delivered to the soldier who relieves.

RELIEVO, or Relief, in *Sculpture*, &c. is the projecture or standing out of a figure which arises prominent from the ground or plane on which it is formed; whether that figure be cut with the chisel, moulded, or cast.

There are three kinds or degrees of relievo, viz. alto, basso, and demi-relievo. The alto-relievo, called also *haut-relief*, or *high-relievo*, is when the figure is formed after nature, and projects as much as the life. Basso-relievo, bass-relief, or low-relievo, is when the work is raised a little from the ground, as in medals, and the frontispieces of buildings; but particularly in the histories, festoons, foliages, and other ornaments of friezes. Demi-relievo is when one half of the figure rises from the plane. When, in a basso-relievo, there are parts that stand clear out, detached from the rest, the work is called a *demi-basso*.

In architecture, the relievo or projecture of the ornaments ought always to be proportioned to the magnitude of the building it adorns, and to the distance at which it is to be viewed.

Relievo, or *Relief*, in *Painting*, is the degree of boldness with which the figures seem, at a due distance, to stand out from the ground of the painting.

The relievo depends much upon the depth of the shadow, and the strength of the light; or in the height of the different colours, bordering on one another; and particularly on the difference of the colour of the figure from that of the ground; thus, when the light is so disposed as to make the nearest parts of the figure advance, and is well diffused on the masses, yet insensibly diminishing, and terminating in a large spacious shadow, brought off insensibly, the relievo is said to be bold, and the clare obscure well understood.

1 Religion defined;

RELIGION (Religio), is a Latin word derived, according to Cicero *, from *relegere*, "to re-consider;" but according to Servius and most modern grammarians, from *religare*, "to bind fast." The reason assigned by the Roman orator for deducing *religio* from *relego*, is in these words, "qui autem omnia, quæ ad cultum deorum pertinerent, diligenter retractarent, et tanquam relegerent, sunt dicti *religiosi* ex relegendo." The reason given by Servius for his derivation of the word is, "quod mentem religio religet." If the Ciceronian etymology be the true one, the word *religion* will denote the diligent study of whatever pertains to the worship of the gods; but according to the other derivation, which we are inclined to prefer, it denotes that obligation which we feel on our minds from the relation in which we stand to some superior power. In either case, the import of the word *religion* is different from that of *theology*, as the former signifies a number of practical duties, and the latter a system of speculative truths. *Theology* is therefore the foundation of *religion*, or the science from which it springs; for no man can study what pertains to the worship of superior powers till he believe that such powers exist, or feel any obligation on his mind from a relation of which he knows nothing.

* *De Natura Deorum*, lib. ii. § 28.

2 Religion, and distinguished from theology.

This idea of religion, as distinguished from theology, comprehends the duties not only of those more refined and complicated systems of theism or polytheism which have prevailed among civilized and enlightened nations, such as the polytheism of the Greeks and Romans, and the theism of the Jews, the Mahometans, and the Christians; it comprehends every sentiment of obligation which human beings have ever conceived themselves under to superior powers, as well as all the forms of worship which have ever been practised through the world, however fantastic, immoral, or absurd.

3 It is an important subject of speculation.

When we turn our eyes to this feature of the human character, we find it peculiarly interesting. Mankind are distinguished from the brutal tribes, and elevated to a higher rank, by the rational and moral faculties with which they are endowed; but they are still more widely distinguished from the inferior creation, and more highly exalted above them, by being made capable of religious notions and religious sentiments. The slightest knowledge of history is sufficient to inform us, that religion has ever had a powerful influence in moulding the sentiments and manners of men. It has sometimes dignified, and sometimes degraded, the human character. In one region or age it has been favourable to civilization and refinement; in another, it has occasionally cramped the genius, depraved the morals, and deformed the manners of men. The varieties of religion are innumerable; and the members of every distinct sect must view all who differ from them as more or less mistaken with respect to the most important concerns of man. Religion seems to be congenial to the heart of man; for wherever human society subsists, there we are certain of finding religious opinions and sentiments.

4 Three questions concerning religion.

It must, therefore, be an important subject of speculation to the man and the philosopher to consider the origin of religion; to inquire, How far religion in general has a tendency to promote or to injure the order and happiness of society? and, above all, to examine, What particular religion is best calculated to produce a happy influence on human life?

We shall endeavour to give a satisfactory answer to each of these questions; reserving to the article Theology the consideration of the dogmas of that particular religion which, from our present inquiries, shall appear to be true, and to have the happiest influence on human life and manners.

5 Of the source or foundation of religion.

I. The foundation of all religion rests on the belief of the existence of one or more superior beings, who govern the world, and upon whom the happiness or misery of mankind ultimately depends. Of this belief, as it may be said to have been universal, there seem to be but three sources that can be conceived. Either the image of Deity must be stamped on the mind of every human being, the savage as well as the sage; or the founders of societies, and other eminent persons, tracing, by the efforts

efforts of their own reason visible effects to invisible causes, must have discovered the existence of superior powers, and communicated the discovery to their associates and followers; or, lastly, the universal belief in such powers, must have been derived by tradition from a primæval revelation, communicated to the progenitors of the human race.

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One or other of these hypotheses must be true, because a fourth cannot be framed. But we have elsewhere (POLYTHEISM, N° 2.) examined the reasoning which has been employed to establish the first, and shewn that it proceeds upon false notions of human nature. We should likewise pronounce it contrary to fact, could we believe, on the authority of some of its patrons, who are not ashamed to contradict one another, that the Kamtschatkans and other tribes, in the lowest state of reasoning and morals, have no ideas whatever of Deity. We proceed, therefore, to consider the second hypothesis, which is much more plausible, and will bear a stricter scrutiny.

7 rom oning;

That the existence and many of the attributes of the Deity are capable of rigid demonstration, is a truth which cannot be controverted either by the philosopher or the Christian; for "the invisible things of Him from the creation of the world are clearly seen, being understood by the things that are made, even His eternal power and Godhead," (see METAPHYSICS, Part III. chap. vi. and THEOLOGY, N° 8, 9.). But surely it would be rash to infer, either that every truth for which, when it is known, the ingenuity of man can frame a demonstration, is therefore *discoverable* by human sagacity, or that all the truths which have been discovered by a *Newton* or a *Locke* might therefore have been discovered by untaught barbarians. In mathematical science there are few demonstrations of easier comprehension than that given by Euclid, of the theorem of which Pythagoras is the reputed author; yet no man ever dreamed that a boy capable of being made to understand that theorem, must therefore have sagacity equal to the sage of Samos; or that such a boy, having never heard of the relation between the hypothenuse and other two sides of a right-angled triangle, would be likely to *discover* that the square of the former is precisely equal to the sum of the squares of the latter. Just so it seems to be with the fundamental truths of theology. There can hardly be conceived a demonstration less intricate, or more conclusive, than that which the man of science employs to prove the existence of at least one God, possessed of boundless power and perfect wisdom. And could we suppose that the human race had remained without any knowledge of God in the world, till certain lucky individuals had by some means or other made themselves masters of the rules of logic, and the philosophy of causes, there can be no doubt but that these individuals might have discovered the existence of superior powers, and communicated their discovery to their associates and followers. But this supposition cannot be admitted, as it is contradicted by the evidence of all history. No nation or tribe has ever been found, in which there is not reason to believe that some notions were entertained of superior and invisible powers, upon which depends the happiness or misery of mankind: and from the most authentic records of antiquity, it is apparent that very pure principles of theism prevailed in some nations long before the rules of logic, and the philosophy of causes, were thought of by any people under heaven.

The supposition before us is inadmissible upon other accounts. Some modern philosophers have fancied that the original progenitors of mankind were left entirely to themselves from the moment of their creation; that they wandered about for ages without the use of speech and in the lowest state of savagism; but that they gradually civilized themselves, and at last stumbled upon the contrivance of making articulate sounds significant of ideas, which was followed by the invention of arts and sciences, with all the blessings of religion and legislation in their train. But this is a wild reverie, inconsistent with the phenomena of human nature.

It is a well known fact, that a man blind from his birth, and suddenly made to see, would not by means of his newly acquired sense discern either the magnitude or figure or distance of objects, but would conceive every thing which communicated to him visible sensations as inseparably united to his eye or his mind (see METAPHYSICS, N° 49—53.). How long his sense of sight would remain in such an imperfect state, we cannot positively say; but from attending to the visible sensations of infants, we are confident that weeks, if not months, elapse before they can distinguish one thing from another. We have indeed been told, that Cheselden's famous patient, though he was at first in the state which we have described, learned to distinguish objects by sight in the course of a few hours, or at the most of a few days: but admitting this to a certain extent to be true, it may easily be accounted for. The disease called a *cataract* does not always occasion total blindness; but let us suppose the eyes of this man to have been so completely dimmed as to communicate no sensation whatever upon being exposed to the rays of light; still we must remember that he had long possessed the power of loco-motion and all his other senses in perfection. He was therefore well acquainted with the real, i. e. the tangible magnitude, figure, and distance of many objects; and having been often told that the things which he touched would, upon his acquisition of sight, communicate new sensations to his mind, differing from each other according to the distance, figure, and magnitude of the objects by which they were occasioned, he would soon learn to infer the one from the other, and to distinguish near objects by means of his sight.

The progenitors of the human race, however, if left to themselves from the moment of their creation, had not the same advantages. When they first opened their eyes, they had neither moved, nor handled, nor heard, nor smelled, nor tasted, nor had a single idea or notion treasured up in their memories; but were in all these respects in the state of new-born infants. Now, we should be glad to be informed by those sages who have conducted mankind through many generations in which they were *mutum et turpe pecus* to that happy period when they invented language, how the first men were taught to distinguish objects by their sense of sight, and how they contrived to *live* till this most necessary faculty was acquired? It does not appear that men are like brutes, provided with a number of instincts which guide them blindfold and without experience to whatever is necessary for their own preservation (see INSTINCT): On the contrary, all voyagers tell us that in in strange and uninhabited countries, they dare not venture to taste unknown fruits unless they perceive that these fruits are eaten by the fowls of the air. But without the aid of instinct, or of some other guide equally to be depended upon, it is not in our power to conceive how men dropt from the hands of their Creator, and left from that instant wholly to themselves, could move a single step without the most imminent danger, or even stretch out their hands to lay hold of that food which we may suppose to have been placed within their reach. They could not, for many days, distinguish a precipice from a plane, a rock from a pit, or a river from the meadows through which it rolled. And in such circumstances, how could they possibly exist, till their sense of sight had acquired such perfection as to be a sufficient guide to all their necessary motions? Can any consistent theist suppose that the God whose goodness is so conspicuously displayed in all his works, would leave his noblest creature on earth, a creature for whose comfort alone many other creatures seem to have been formed, in a situation so forlorn as this, where his immediate destruction appears to be inevitable? No! This supposition cannot be formed, because mankind still exist.

8
but from an original revelation.

Will it then be said, that when God formed the first men, he not only gave them organs of sensation, and souls capable of arriving by discipline at the exercise of reason, but that he also impressed upon their minds adequate ideas and notions of every object in which they were interested; brought all their organs, external and internal, at once to their utmost possible state of perfection; taught them instantaneously the laws of reasoning; and, in one word, stored their minds with every branch of useful knowledge? This is indeed our own opinion; and it is perfectly agreeable to what we are taught by the Hebrew lawgiver. When God had formed Adam and Eve, Moses does not say that he left them to acquire by slow degrees the use of their senses and reasoning powers, and to distinguish as they could fruits that were salutary from those that were poisonous. No: he placed them in a garden where every tree but one bore fruit fit for food; he warned them particularly against the fruit of that tree; he brought before them the various animals which roamed through the garden; he arranged these animals into their proper genera and species; and by teaching Adam to give them names, he communicated to the first pair the elements of language. This condescension appears in every respect worthy of perfect benevolence; and indeed without it the helpless man and woman could not have lived one whole week. But it cannot be supposed, that amidst so much useful instruction the gracious Creator would neglect to communicate to his rational creatures the knowledge of himself; to inform them of their own origin, and the relation in which they stood to him; and to state in the plainest terms the duties incumbent on them in return for so much goodness.

9
This opinion agreeable to the writings of Moses.

10
The mode of communication not certainly known.

In what manner all this knowledge was communicated, cannot be certainly known. It may have been in either of the following ways conceivable by us, or in others of which we can form no conception. God may have miraculously stored the minds of the first pair with adequate ideas and notions of sensible and intellectual objects; and then by an internal operation of his own Spirit have enabled them to exert at once their rational faculties so as to discover his existence and attributes, together with the relation in which as creatures they stood to him their Almighty Creator. Or, after rendering them capable of distinguishing objects by means of their senses, of comparing their ideas, and understanding a language, he may have exhibited himself under some sensible emblem, and conducted them by degrees from one branch of knowledge to another, as a schoolmaster conducts his pupils, till they were sufficiently acquainted with every thing relating to their own happiness, and duty, as rational, moral, and religious creatures. In determining the question before us, it is of no importance whether infinite wisdom adopted either of these methods, or some other different from them, both which we cannot conceive. The ordinary process in which men acquire knowledge is, by the laws of their nature, extremely tedious. They cannot reason before their minds be stored with ideas and notions; and they cannot acquire these but through the medium of their senses long exercised on external objects.

11
But whether internal or external, it was equally a revelation.

The progenitors of the human race, left to inform themselves by this process, must have inevitably perished before they had acquired one distinct notion; and it is the same thing with respect to the origin of religion, whether God preserved them from destruction by an *internal* or *external* revelation. If he stored their minds at once with the rudiments of all useful knowledge, and rendered them capable of exerting their rational faculties, so as, by tracing effects to their causes, to discover his being and attributes, he *revealed* himself to them as certainly as he did afterwards to Moses, when to him he condescended to speak face to face.

12
Such a revelation must naturally be handed to posterity.

If this reasoning be admitted as fair and conclusive, and we apprehend that the principles on which it proceeds cannot be considered as ill-founded, we have advanced so far as to prove that mankind must have been originally enlightened by a revelation. But it is scarce necessary to observe, that this revelation must have been handed down through succeeding generations. It could not fail to reach the era of the deluge. It is not absurd to suppose, that he who spake from heaven to Adam, spake also to Noah. And both the revelation which had been handed down to the postdiluvian patriarch by tradition, and that which was communicated immediately to himself, would be by him made known to his descendants. Thus it appears almost impossible that some part of the religious sentiments of mankind should not have been derived from revelation; and that not of the religious sentiments of one particular family or tribe, but of almost all the nations of the earth.

13
The authority of the Jewish and Christian scriptures, &c.

This conclusion, which we have deduced by fair reasoning from the benevolence of God and the nature of man is confirmed by the authority of the Jewish and Christian Scriptures, which are entitled to more implicit credit than all the other records of ancient history.

When we review the internal and external evidence of the authenticity of these sacred books, we cannot for a moment hesitate to receive them as the genuine *word of God*. If we examine their internal character, they everywhere appear to be indeed the voice of Heaven. The creation of the world—the manner in which this globe was first peopled—the deluge which swept away its inhabitants—the succeeding views of the state of mankind ligion. mankind in the next ages after the deluge—the calling of Abraham—the legislation of Moses—the whole series of events which befel the Jewish nation—the prophecies—the appearance of Jesus Christ, and the promulgation of his gospel, as explained to us in the Scriptures—form one series, which is, in the highest degree, illustrative of the power, wisdom, and goodness of the Supreme Being.

While it must be allowed that the human mind is ever prone to debase the sublime principles of true religion by enthusiasm and superstition, reason and candour will not for a moment hesitate to acknowledge, that the whole system of revelation represents the Supreme Being in the most sublime and amiable light: that, in it, religion appears essentially connected with morality: that the legislative code of Moses was such as no legislator ever formed and established among a people equally rude and uncultivated: that the manners and morals of the Jews, vicious and savage as they may in some instances appear, yet merit a much higher character than those either of their neighbours, or of almost any other nation, whose circumstances and character were in other respects similar to theirs: that there is an infinite difference between the Scripture prophecies and the oracles and predictions which prevailed among heathen nations: and that the miracles recorded in those writings which we esteem sacred were attended with circumstances which entitle them to be ranked in a very different class from those which enthusiasm and imposture have fabricated among other nations. See MIRACLE and PROPHECY.

14 five . of s d to vine :

But as the evidence of the divine origin of the primæval religion rests particularly on the authority of the first five books of the Old Testament, it may be thought incumbent on us to support our reasoning on this subject, by proving, that the author of those books was indeed inspired by God. This we shall endeavour to do by one decisive argument; for the nature of the article, and the limits prescribed us, admit not of our entering into a minute detail of all that has been written on the divine legation of Moses.

If the miracles recorded in the book of Exodus, and the other writings of the Hebrew lawgiver, were really performed; if the first-born of the Egyptians were all cut off in one night, as is there related; and if the children of Israel passed through the Red sea, the waters being divided, and forming a wall on their right hand and on their left—it must necessarily be granted, that Moses was sent by God; because nothing less than a divine power was sufficient to perform such wonderful works. But he who supposes that those works were never performed, must affirm that the books recording them were *forged*, either at the era in which the miracles are said to have been wrought, or at some subsequent era: There is no other alternative.

5 was vise sible ose on ews in a to they , or

That they could not be *forged* at the era in which they affirm the miracles to have been wrought, a very few reflections will make incontrovertibly evident. These books inform the people for whose use they were written, that their author, after having inflicted various plagues upon Pharaoh and his subjects, brought them, to the number of 600,000, out of Egypt with a high hand; that they were led by a pillar of cloud through the day, and by a pillar of fire through the night, to the brink of the Red sea, where they were almost overtaken by the Egyptians, who had pursued them with chariots and horses; that, to make a way for their escape, Moses stretched out his rod over the sea, which was immediately divided, and permitted them to pass through on dry ground, between two walls of water; and that the Egyptians, pursuing and going in after them to the midst of the sea, were all drowned by the return of the waters to their usual state, as soon as the Hebrews arrived at the further shore. Is it possible now that Moses or any other man could have persuaded 600,000 persons, however barbarous and illiterate we suppose them, that they had been witnesses of all these wonderful works, if no such works had been performed? Could any art or eloquence persuade all the inhabitants of Edinburgh and Leith, that they had yesterday walked on dry ground through the Frith to Kinghorn, the waters being divided and forming a wall on their right hand and on their left? If this question must be answered in the negative, it is absolutely impossible that the books of Moses, supposing them to have been forged, could have been received by the people who were alive when those wonders are said to have been wrought.

Let us now inquire, whether, if they be forgeries, they could have been received as authentic at any subsequent period; and we shall soon find this supposition as impossible as the former. The books claiming Moses for their author speak of themselves as delivered by him, and from his days kept in the ark of the covenant *; an ark which, upon this supposition, had no existence prior to the forgery. They speak of themselves likewise, not only as a history of miracles wrought by their author, but as the statutes or municipal law of the nation, of which a copy was to be always in the possession of the priests, and another in that of the supreme magistrate †. Now, in whatever age we suppose these books to have been forged, they could not possibly be received as authentic; because no copy of them could then be found either with the king, with the priests, or in the ark, though, as they contain the statute law of the land, it is not conceiveable that, if they had existed, they could have been kept secret. Could any man, at this day, forge a book of statutes for England or Scotland, and make it pass upon these nations for the only book of statutes which they had ever known? Was there ever since the world began a book of sham statutes, and these, too, multifarious and burdensome, imposed upon any people as the only statutes by which they and their fathers had been governed for ages? Such a forgery is evidently impossible.

16 In any after period.

* Deut. xxxi. 24—27.

† Deut. xviii. 19.

But the books of Moses have internal proofs of authenticity, which no other books of ancient statutes ever had. They not only contain the laws, but also give an historical account of their enactment, and the reasons upon which they were founded. Thus they tell us ‡, that the rite of circumcision was instituted as a mark of the covenant between God and the founder of the Jewish nation, and that the practice of it was enforced by the declaration of the Almighty, that every uncircumcised man-child should be cut off from his people. They inform us that the annual solemnity of the passover was instituted in commemoration of their deliverance, when God slew, in one night, all the first-born of the Egyptians; that the first-born of Israel, both of men and beast, were on the same occasion dedicated for ever to God, who took the Levites instead of the first-born of the

‡ Gen. xvii.

the men *; that this tribe was consecrated as priests, by whose hands alone the sacrifices of the people were to be offered; that it was death for any person of a different tribe to approach the altar, or even to touch the ark of the covenant; and that Aaron's budding rod was kept in the ark in memory of the wonderful destruction of Korah, Dathan, and Abiram, for their rebellion against the priesthood.

* Exod. xii. and Numb. viii.

Is it possible now, if all these things had not been practised among the Hebrews from the era of Moses, with a retrospect to the signal mercies which they are said to commemorate, that any man or body of men could have persuaded a whole nation, by means of forged books, that they had always religiously observed such institutions? Could it have been possible, at any period posterior to the Exodus, to persuade the Israelites that they and their fathers had all been circumcised on the eighth day from their birth, if they had been conscious themselves that they had never been circumcised at all? or that the passover was kept in memory of their deliverance from Egyptian bondage, if no such festival was known among them?

But let us suppose that circumcision has been practised, and all their other rites and ceremonies observed from time immemorial, without their knowing any reason of such institutions: still it must be confessed, that the forger of these books, if they *were* forged, constructed his narrative in such a manner as that no man of common sense could receive it as authentic. He says it was death to touch the ark! As such an assertion was never heard of before, and as the ritual he was endeavouring to make them esteem sacred was oppressively multifarious; surely some daring spirit would have ventured to put his veracity to the test by moving the ark and even offering sacrifices; and such a test would at once have exposed the imposture. The budding rod, too, and the pot of manna, which, though long preserved, were never before heard of, must have produced inquiries that could not fail to end in detection. These books speak likewise of weekly sabbaths, daily sacrifices, a yearly expiation, and monthly festivals, all to be kept in remembrance of great things, particularly specified as done for the nation at an early period of its existence. If this was not the case, could the forger of the books have persuaded the people that it really was so? The enlightened reasoners of this nation would be offended were we to compare them with the ancient Israelites; but surely they will not say that we are partial to that people, if we bring them to a level with the most savage tribes of the Russian empire, who profess Christianity? Now, were a book to be forged containing an account of many strange things done a thousand years ago in Siberia by an *Apollonius*, or any other philosopher or hero, numbers of the barbarians inhabiting that country would, we doubt not, give implicit credit to the *legend:* But were the author, in confirmation of his narrative, to affirm, that all the Siberians had from that day to this kept sacred the first day of the week in memory of his hero; that they had all been baptized or circumcised in his name; that in their public judicatories they had sworn by his name, and upon that very book which they had never seen before; and that the very same book was their law and their gospel, by which for a thousand years back the actions of the whole people had been regulated—surely the grossest savage among them would reject with contempt and indignation a forgery so palpable.

If this reasoning be conclusive, the books of Moses most indubitably be authentic, and he himself must have been inspired by the spirit of God. But this point being established, the question respecting the origin of the primæval religion is completely answered. The writer of the book of Genesis informs us, that Adam and Noah received many revelations from the Author of their being, and that their religion was founded on the principles of the purest theism. How it degenerated among the greater part of their descendants into the grossest idolatry, has been shewn at large in another place. See POLYTHEISM.

17 Of the influence of religion on society.

II. Having thus answered the first question proposed for discussion in the present article, we now proceed to consider the second, and to inquire whether and how far religious sentiments have a tendency to injure or to promote the welfare of society? This is a subject of the utmost importance; and if we prove successful in our inquiries, we shall be enabled to determine whether the governors of mankind ought carefully to support religious establishments, or whether the philosopher who calls himself a citizen of the world, and professes to feel the most eager desire to promote the interests of his species, acts consistently when he labours to exterminate religion from among men.

A celebrated French financier *, a man of abilities and virtue, who has published a book on the importance of religious opinions, labours to show that religious establishments are indispensably necessary for the maintainance of civil order, and demonstrates how weak the influence of political institutions is on the morals of mankind; but he refuses to review the history of past ages in order to discover how far religious opinions have actually been injurious or beneficial to the welfare of society; choosing rather to content himself with the result of a series of metaphysical disquisitions.

* M. Necker.

We admire the spirit which induced a man who had spent a considerable part of his life amid the hurry of public business, to become the strenuous advocate of religion; but we cannot help thinking that, notwithstanding the eloquence, the acuteness, and the knowledge of mankind which he has displayed, his refusing to admit the evidence of facts, concerning the influence of religion on society, may possibly be regarded by its enemies as a tacit acknowledgment that the evidence of facts would be unfavourable to the cause which he wishes to defend. The fallacy of general reasonings, and the inutility of metaphysics for the purposes of life, are so universally acknowledged, that they have long been the theme of declamation. Though the abuses of religion, as well as the abuses of reason, the perversion of any of the principles of the human mind, and the misapplication of the gifts of Providence, may have often produced effects hurtful to the virtue and the happiness of mankind; yet, after tracing religion to a divine origin, we cannot, for a moment, allow ourselves to think that the primary tendency of religion must be hostile to the interest of society, or that it is necessary to view it abstractly in order that we may not behold it in an odious light. Often has the sceptic attacked religion with artful malice: but perhaps none of his attacks has been so skilfully directed as that which has first ridiculed the absurdity of the most absurd superstitions, and

18 Triumphs of the sceptic on account of the abuses of religion.

and afterwards laboured to prove that the most absurd system of polytheism is more favourable to the interests of society than the purest and most sublime theism. Instances in which the abuse of religion had tended to deprave the human heart, and had led to the most shocking crimes, have been assiduously collected, and displayed in all the aggravating colours in which eloquence could array them, till at length even the friends of true religion have been abashed; and it has become a fashionable opinion, that nothing but self-interest or bigotry can prompt men to represent religion as the friend of civil order. But let us try if, by a candid consideration of what effects have resulted to society from religious principles, in general, without comparing these with regard to truth or falsehood, we can advance any thing to vindicate the character of religion.

Notions of Deity in general, of various orders of divinities, of their moral character, of their influence on human life, of a future state, and of the immortality of the human soul, constitute the leading articles of religion. Let us view these together with the rites to which they have given rise; and we may perhaps be enabled to form some well-grounded notions on this important point.

19 first re- us opi- s en- ined en l not bly be ious to ty.

1. Having proved that the first religious principles entertained by men were derived from revelation, it is impossible to suppose that they could produce effects injurious to society. If religion of any kind has ever lessened the virtue or disturbed the peace of men, it must have been that religion which springs from a belief in a multitude of superior powers actuated by passions, and of whom some were conceived as benevolent and others as malicious beings. That such sentiments should have produced vices unknown in societies where pure theism is professed, will be readily admitted. Even the few *atheists* who live in Christian or Mahometan countries are restrained by the laws, by a desire to promote the honour of the sect, and by many other considerations, from indulging in practices which the example of the false gods of antiquity sanctioned in their votaries. But in determining the present question, we must not compare the virtues of the pagan world with those of individual atheists in modern Europe, but with those of *nations* professing atheism; and such nations are nowhere to be found. We can however easily conceive, that in a society unawed by any notions of God or a future state, no such laws would be enacted as those which restrain the sensual appetites; of which the criminal indulgence was one of the greatest stigmas on the pagan worship of antiquity. In such societies, therefore, those vices would be practised constantly to which paganism gave only an occasional sanction; and many others, in spite of the utmost vigilance of human laws, would be perpetrated in secret, which the most profligate pagans viewed with horror. Conscience, though acting with all her energy, would not be able to command any regard to the laws of morality: No virtue would be known; social order would be nowhere observed; the midnight assassin would everywhere be found; and in the general scramble mankind would be exterminated from the face of the earth.

20 effect heism e hers of ms.

The worst species of paganism, even that which prevails among savages who worship evil spirits, affords greater security than this. It is indeed shocking to think that demons should be worshipped, while deities, who are regarded as being all benevolence, are treated with contempt: And it has been asked, If the influence of such religious sentiments on the moral practice of the idolaters must not naturally be, to cause them to treat their friends and benefactors with ingratitude, and to humble themselves with mean submission before a powerful enemy?

21 would be more malignant than that of the most absurd paganism.

They do not appear to have produced such effects on the morality of the savages by whom they were entertained. The benevolent deities were neglected, only because their benevolence was necessary. A voluntary favour merits a grateful return: a designed injury provokes resentment. But when you become, by accident, the instrument of any man's good fortune, the world will scarce consider him as owing you any obligation: the stone which bruises your foot excites only a momentary emotion of resentment. Those gods who could not avoid doing good to men might not receive a profusion of thanks for their services; and yet a favour conferred by a human benefactor commands the warmest gratitude. But those rude tribes appear to have had so much wisdom as to confer a less absolute malice on their malevolent deities, than the benevolence which they attributed to their more amiable order of superior beings: though the latter could not possibly do them any thing but good, and that constantly; yet the former were not under an equally indispensable necessity of persevering in depressing them under calamities. On their malevolent deities they conferred a freedom of agency which they denied to the benevolent. No wonder, then, that they were more assiduous in paying their court to the one than to the other. They might with as much propriety have thought of being grateful to the boar or stag whose flesh supported them, as to deities who were always benevolent, because they could not possibly be otherwise. Though negligent of such deities, this can scarce be thought to have had any tendency to render them ungrateful to benefactors like themselves. And yet, it must not be dissembled, that the American Indians, among whom such religious sentiments have been found to prevail, are said to be very little sensible to the emotions of gratitude. An Indian receives a present without thinking of making any grateful acknowledgments to the bestower. He pleases his fancy or gratifies his appetite with what you have given, without seeming to consider himself as under the smallest obligation to you for the gift.

It may be doubted, however, whether this spirit of ingratitude originates from, or is only collateral with, that indifference which refuses adoration and worship to the benevolent divinities. If the former be actually the case, we must acknowledge that those religious notions which we now consider, though preferable to general atheism, are in this respect unfriendly to virtue. But if the Indians may be thought to owe the ingratitude for which they are distinguished to the opinion which they entertain of the existence of a benevolent order of deities, whose benevolence is necessary and involuntary, their ideas of the nature of their malevolent demons do not appear to have produced equal effects on their moral sentiments. However submissive to those dreaded beings, they are far from showing the same tame and cowardly submission to their human enemies: towards them.

Religion. them they seem rather to adopt the sentiments of their demons. Inveterate rancour and brutal fury, inhuman cruelty and inconceiveable cunning, are displayed in the hostilities of tribes at war; and we know not, after all, if even these sentiments do not owe somewhat of their force to the influence of religion.

Yet let us remember that these same Indians have not been always represented in so unamiable a light; or, at least, other qualities have been ascribed to them which seem to be inconsistent with those barbarous dispositions. They have been described as peculiarly susceptible of conjugal and parental love; and he who is so cannot be destitute of virtue.

21 The influence of Greek and Roman polytheism

2. But leaving the religion of savages, of which very little is known with certainty, let us proceed to examine what is the natural influence of that mixed system of theology which represents to the imagination of men a number of superior and inferior divinities, actuated by the same passions and feelings with themselves, and often making use of their superior power and knowledge for no other purpose but to enable them to violate the laws of moral order with impunity. This is the celebrated polytheism of the Greeks and Romans, and most other nations of antiquity (see POLYTHEISM). Could its influence be favourable to virtue?

22 apparently friendly to profligacy;

At a first view every person will readily declare, that such a system must have been friendly to profligacy. If you commit the government of the universe, and the inspection of human society, to a set of beings who are often disposed to regard vice with a no less favourable eye than virtue, and who, though there be an established order by which virtue is discriminated from vice, and right from wrong, yet scruple not to violate that order in their own conduct; you cannot expect them to require in you a degree of rectitude of which they themselves appear incapable. A Mercury will not discourage the thievish arts of the trader; a Bacchus and a Venus cannot frown upon debauchery; Mars will behold with savage delight all the cruelties of war. The Thracians indeed, one of the most barbarous nations of antiquity, whose ferocity was little if at all inferior to that of the Indians who have been distinguished as cannibals, was the favourite nation of Mars; among whom stood his palace, to which he repaired when about to mount his chariot, and arm himself for battle. Even Jupiter, who had been guilty of so many acts of tyrannical caprice, had been engaged in such a multitude of amorous intrigues, and seemed to owe his elevated station as monarch of the sky, not to superior goodness or wisdom, but merely to a superior degree of brutal force, could not be feared as the avenger of crimes, or revered as the impartial rewarder of virtues.

23 but when contrasted with atheism its effects were favourable:

That this system had a pernicious effect on morals, and that, as compared with pure theism, it was injurious to society, cannot be denied; but yet, when contrasted with atheism, it was not without its favourable effects. It was so connected with the order of society, that, without its support, that order could scarce have been maintained. The young rake might perhaps justify himself by the example of Jupiter, or Apollo, or some other amorous divinity; the frail virgin or matron might complain of Cupid, or boast of imitating Venus; and the thief might practise his craft under the patronage of Mercury: But if we take the whole system together, if we consider with what views those deities were publicly worshipped, what temples were raised, what rites instituted, what sacrifices offered, and what *feriæ* consecrated; we shall perhaps find it necessary to acknowledge that the general effects even of that mixed and incoherent system of polytheism which prevailed among the Greeks and Romans were favourable to society. To state a particular instance; the *ancilia* of Mars and the fire of Vesta were thought to secure the perpetuity of the Roman empire. As long as the sacred *ancile*, which had been dropped from heaven for that benevolent purpose, was safely preserved in those holy archives in which it had been deposited; and as long as the sacred fire of Vesta was kept burning, without being once extinguished, or at least suffered to remain for an instant in that state; so long was Rome to subsist and flourish. And, however, simple and absurd the idea which connected the prosperity of a nation with the preservation of a piece of wood in a certain place, or with the constant blazing of a flame upon an hearth: yet no fact can be more certain, than that the patriotism and enthusiastic valour of the Romans, which we so much extol and admire, were, in many instances, owing in no inconsiderable degree to the veneration which they entertained for the *ancilia* and the vestal fire.

24 as is proved by a numerous series of facts, &c.

A numerous series of facts occur in the Roman history, which show the happy effects of their religious opinions and ceremonies on their sentiments concerning social order and the public welfare. How powerful was the influence of the *sacramentum* administered to the soldiers when they enlisted in the service of their country? The promises made, the idea of the powers invoked, and the rites performed on that occasion, produced so deep and so awful an impression on their minds, that no danger, nor distress, nor discontent, could prompt them to violate their engagements. The responses of the oracles, too, though the dictates of deceit and imposture, were often of singular service to those to whom they were uttered; when they inspired the warrior, as he marched out to battle, with the confidence of success, they communicated to him new vigour, and more heroic valour, by which he was actually enabled to gain, or at least to deserve, the success which they promised. Again, when in times of public distress, the augur and the priest directed some games to be celebrated, certain sacrifices to be offered, or some other solemnities to be performed, in order to appease the wrath of the offended deities; it is plain that the means were not at all suited to accomplish the end proposed by them; yet still they were highly beneficial. When the attention of the whole people was turned entirely to those solemnities by which the wrath of heaven was to be averted, they were roused from that despondency under which the sense of the public distress or danger might have otherwise caused them to sink: the public union was at the same time more closely cemented, and the hearts of the people knit together; and when persuaded, that by propitiating the gods they had removed the cause of their distress, they acquired such calmness and strength of mind as enabled them to take more direct and proper measures for the safety of the state.

Could we view the ancient Greeks and Romans acting in public or in private life under the influence of that system of superstition which prevailed among them; could ligion. could we perceive how much it contributed to the maintenance of civil order; could we behold Numa and Lycurgus establishing their laws, which would otherwise have met with a very different reception, under the sanction of divinities; could we observe all the beneficial effects which arose to communities from the celebration of religious ceremonies, we should no longer hesitate to acknowledge, that those principles in the human heart by which we are susceptible of religious sentiments, are so eminently calculated to promote the happiness of mankind, that even when perverted and abused, their influence is still favourable.

25 ir no- of a re state tribu- incor-

The ideas which prevailed among the nations of the heathen world concerning a future state of retribution were, it must be confessed, not very correct. Some of the poets, we believe, have represented them in no unfair light: both Homer and Virgil have conducted their heroes through the realms of Pluto, and have taken occasion to unfold to us the secrets of those dreary abodes. The scenes are wild and fanciful; the rewards of the just and virtuous are of no very refined or dignified nature: and of the punishments inflicted on the guilty, it is often hard to say for what ends they could be inflicted; whether to correct and improve, or for the gratification of revenge or whim: they are often so whimsical and unsuitable, that they cannot with any degree of propriety be ascribed to any cause but blind chance or wanton caprice. A great dog with three tongues, a peevish old boatman with a leaky ferry boat, demanding his freight in a surly tone, and an uxorious monarch, are objects too familiar and ludicrous not to degrade the dignity of those awful scenes which are represented as the mansions of the dead, and to prevent them from making a deep enough impression on the imagination. The actions and qualities too, for which departed spirits were admitted into Elysium, or doomed to the regions of suffering, were not always of such a nature as under a well-regulated government on earth would have been thought to merit reward, or to be worthy of punishment. It was not always virtue or wisdom which conducted to the Elysian fields, or gained admission into the society of the immortal gods.—Ganimede was for a very different reason promoted to be the cup-bearer of Jove; and Hercules and Bacchus could not surely plead that any merits of that kind entitled them to seats in the council, and at the banquets of the immortals. That doctrine, likewise, which represented mortals as hurried by fate to the commission of crimes, which they could no more abstain from committing than the sword can avoid to obey the impulse of a powerful and furious arm plunging it into the breast of an unresisting antagonist, could not but produce effects unfavourable to virtue; and it afforded a ready excuse for the most extravagant crimes.

26 ever- s fa- ble to and or-

Yet, after all, he who attentively considers the ideas of the Greeks and Romans concerning the moral government of the world and a future state of rewards and punishments, will probably acknowledge, that their general influence must have been favourable to virtue and moral order. Allow them to have been incorrect and dashed with absurdity; still they represent punishments prepared for such qualities and actions as were injurious to the welfare of society; whilst, for those qualities which rendered men eminently useful in the world, they hold forth a reward. Though incorrect, their ideas concerning a future state were exceedingly distinct; they Religion. were not vague or general, but such as might be readily conceived by the imagination, in all their circumstances, as really existing. When a man is told that for such a deed he will be put to death, he may shudder and be alarmed, and think of the deed as what he must by no means commit; but place before him the scene and the apparatus for his execution, call him to behold some other criminal mounting the scaffold, addressing his last words in a wild scream of despair to the surrounding spectators, and then launching into eternity—his horror of the crime, and his dread of the punishment, will now be much more powerfully excited. In the same manner, to encourage the soldier marching out to battle, or the mariner setting sail under the prospect of a storm, promise not, merely in general terms, a liberal reward; be sure to specify the nature of the reward which you mean to bestow; describe it so as that it may take hold on the imagination, and may rise in opposition to the images of death and danger with which his courage is to be assailed.

If these phenomena of the human mind are fairly stated, if it be true that general ideas produce no very powerful effects on the sentiments and dispositions of the human heart, it must then be granted, that though the scenes of future reward and punishment, which the heathens considered as prepared for the righteous and the wicked, were of a somewhat motley complexion; yet still, as they were distinct and even minute draughts, they must have been favourable to virtue, and contributed in no inconsiderable degree to the support of civil order.

Another thing of which we may take notice under this head, is the vast multiplicity of deities with which the Greek and Roman mythology peopled all the regions of nature. Flocks and fields, and woods and oaks and flowers, and many much more minute objects, had all their guardian deities. These were somewhat capricious at times, it is true, and expected to have attention paid them. But yet the faithful shepherd, and the industrious farmer, knew generally how to acquire their friendship; and in the idea of deities enjoying the same simple pleasures, partaking in the same labours, protecting their possessions, and bringing forward the fruits of the year, there could not but be something of a very pleasing nature, highly favourable to industry, which would animate the labours, and cheer the festivals, of the good people who entertained such a notion: nay, would diffuse a new charm over all the scenes of the country, even in the gayest months of the year. 27 The notion of deities peopling all nature of a useful tendency when compared with atheism.

From all of these particular observations, we think ourselves warranted to conclude, that notwithstanding the mixed characters of the deities who were adored by the celebrated nations of antiquity; though they are in many instances represented as conspicuous for vices and frolics; however vain, absurd, and morally criminal, some of the rites by which they were worshipped may have been, and however, incorrect the notions of the heathens concerning the moral government of the universe and a future state of retribution; yet still, after making a just allowance for all these imperfections, the general influence of their religious system was rather favourable than unfavourable to virtue and to the order and happiness of society.

It

28 The advantage of establishing law, &c. on the basis of religion.

It was not without good reason that the earliest legislators generally endeavoured to establish their laws and constitutions on the basis of religion; government needs the support of opinion; the governed must be impressed with a belief that the particular establishment to which they are required to submit, is the best calculated for their security and happiness, or is supported on some such solid foundation, that it must prove impossible for them to overturn it, or is connected with some awful sanction, which it would be the most heinous impiety to oppose. Of these several notions, the last will ever operate on most men with the most steady influence. We are frequently blind to our own interest; even when eager for the attainment of happiness, we often refuse to take the wisest measures for that end. The great bulk of the people in every community are so little capable of reasoning and foresight, that the public minister who shall most steadily direct his views to the public good will often be the most unpopular. Those laws, and that system of government, which are the most beneficial, will often excite the strongest popular discontents. Again, it is not always easy to persuade people that your power is superior to theirs, when it is not really so. No one man will ever be able to persuade a thousand that he is stronger than they all together: and therefore, in order to persuade one part of his subjects or army that it is absolutely necessary for them to submit to him, because any attempts to resist his power would prove ineffectual, a monarch or general must take care first to persuade another part that it is for their interest to submit to him; or to impress the whole with a belief that, weak and pitiful as he himself may appear, when viewed singly in opposition to them all, yet by the assistance of some awful invisible beings his friends and protectors, he is so powerful, that any attempts to resist his authority must prove presumptuous folly. Here, then, the aid of religion becomes requisite. Religious sentiments are the most happily calculated to serve this purpose. Scarce ever was there a society formed, a mode of government established, or a code of laws framed and enacted, without having the religious sentiments of mankind, their notions of the existence of superior invisible beings, and their hopes and fears from those beings, as its fundamental principle. Now, we believe, it is almost universally agreed, that even the rudest form of society is more favourable to the happiness of mankind, and the dignity of the human character, than a solitary and savage state. And if this, with what we have asserted concerning religion as the basis of civil government, be both granted, it will follow, that even the most imperfect religious notions, the most foolish and absurd rites, and the wildest ideas that have been entertained concerning the moral government of the universe by superior beings, and a future state of retribution, have been more advantageous than atheism to the happiness and virtue of human life. We have already granted, nor can it be denied, indeed, that many of the religious opinions which prevailed among the ancient heathens, did contribute, in some degree, to the depravation of their morals: and all that we argue for is, that on a comparative view of the evil and the good which resulted from them, the latter must appear more than adequate to counterbalance the effects of the former.

29 The infinite advantage of a pure, rational, and true religion.

But if such be the natural tendency of those principles by which the human heart is made susceptible of religious sentiments, that even the enthusiasm and absurd superstition are productive of beneficial effects more than sufficient to counterbalance whatever is malignant in their influence on society—surely a pure rational religion, the doctrines of which are founded in undeniable truth, and all the observances which it enjoins calculated to promote by their direct and immediate effects some useful purposes, must be in a very high degree conducive to the dignity and the happiness of human nature. Indeed one collateral proof of the truth of any religion, which must have very considerable weight with all who are not of opinion that the system of the universe has been produced and hitherto maintained in order and existence by blind chance, will be its having a stronger and more direct tendency than others to promote the interests of moral virtue and the happiness of mankind in the present life. Even the testimony of thousands, even miracles, prophecies, and the sanction of remote antiquity, will scarce have sufficient weight to persuade us, that a religion is of divine origin, if its general tendency appear to be rather unfavourable than advantageous to moral virtue.

30 Comparative view of the effects of different religious systems.

III. We shall therefore, in the next place, endeavour to determine, from a comparative view of the effects produced on the character and circumstances of society by the most eminent of these various systems of religion which have been in different ages or in different countries established in the world, how far any one of them has in this respect the advantage over the rest; and, if the utility of a system of religion were to be received as a test of its truth, what particular system might, with the best reason, be received as true, while the rest were rejected.

31 Advantage of civilization;

1st, The principle upon which we here set out is, that all, or almost all, systems of religion with which we are acquainted, whether true or false, contribute more or less to the welfare of society. But as one field is more fruitful, and one garden less overgrown with weeds than another; so, in the same manner, one system of religious opinions and ceremonies may be more happily calculated than others to promote the truest interests of mankind. In opposition to those philosophers who are so vehement in their declamations against the inequality of ranks, we have ever been of opinion, that refinement and civilization contribute to the happiness of human life. The character of the solitary savage is, we are told, more dignified and respectable than that of the philosopher and the hero, in proportion as he is more independent. He is indeed more independent; but his independence is that of a stone, which receives no nourishment from the earth or air, and communicates none to animals or vegetables around it. In point of happiness, and in point of respectability, we cannot hesitate a moment, let philosophers say what they will, to prefer a virtuous, enlightened, and polished Briton, to any of the rudest savages, the least acquainted with the restraints and the sympathies of social life, that wander through the wild forests of the western world. But if we prefer civilization to barbarism, we must admit, than in this view Christianity has the advantage over every other religious system which has in any age or country prevailed

32 and therefore of Christianity.

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prevailed among men; for nowhere has civilization and useful science been carried to such a height as among Christians.

33 View of the various religious notions of Pagan nations.

It is not, indeed, in any considerable degree that the absurd superstitions of those rude tribes, who can scarce be said to be formed into any regular society, can contribute to their happiness. Among them the faculty of reason is but in a very low state; and the moral principle usually follows the improvement or the depression of the reasoning faculty. Their appetites and merely animal passions are almost their only principles of action: their first religious notions, if we suppose them not to be derived from revelation or tradition, are produced by the operation of gratitude, or grief, or hope, or fear, upon their imaginations. And to these, however wild and fanciful, it is not improbable that they may owe some of their earliest moral notions. The idea of superior powers naturally leads to the thought that those powers have some influence on human life. From this they will most probably proceed to fancy one set of actions agreeable, another offensive, to those beings to whom they believe themselves subject And this, perhaps, is the first distinction that savages can be supposed to form between actions, as right or wrong, to be performed or to be avoided. But if this be the case, we must acknowledge, that the religious notions of the savage, however absurd, contribute to elevate his character, and to improve his happiness, when they call forth the moral principle implanted in his breast.

But if the social state be preferable to a state of wild and solitary independence, even the rude superstitions of unenlightened tribes of savages are in another respect beneficial to those among whom they prevail. They usually form, as has been already observed under this article, the basis of civil order. Religious opinions may lead the great body of the community to reverence some particular set of institutions, some individual, or some family, which are represented to them as peculiarly connected with the gods whom they adore. Under this sanction some form of government is established; they are taught to perform social duties, and rendered capable of social enjoyments. Not only Numa and Lycurgus, but almost every legislator who has sought to civilize a rude people, and reduce them under the restraints of legal government, have endeavoured to impress their people with an idea that they acted with the approbation, and under the immediate direction of superior powers. We cannot but allow that the rude superstitions of early ages are productive of these advantages to society; but we have already acknowledged, and it cannot be denied, that they are also attended with many unhappy effects. When we view the absurdities intermixed with the systems of religion which prevailed among most of the nations of antiquity, we cannot help lamenting that so noble a principle of human nature as our religious sentiments should be liable to such gross perversion; and when we view the effects which they produce on the morals of mankind, and the forms of society, though we allow them to have been upon the whole rather beneficial than hurtful, yet we cannot but observe, that their unfavourable effects are by far more numerous than if they had been better directed. What unhappy effects, for instance, have been produced by false notions concerning the condition of human souls in a future state. Various nations have imagined that the scenes and objects of the world of spirits are only a shadowy representation of the things of the present world. Not only the souls of men, according to them, inhabit those regions; all the inferior animals and vegetables, and even inanimate bodies that are killed or destroyed here, are supposed to pass into that visionary world; and, existing there in unsubstantial forms, to execute the same functions, or serve the same purposes, as on earth. Such are the ideas of futurity that were entertained by the inhabitants of Guinea. And by these ideas they were induced, when a king or great man died among them, to provide for his comfortable accommodation in the world of spirits, by burying with him meat and drink for his subsistence, slaves to attend and serve him, and wives with whom he might still enjoy the pleasures of love. His faithful subjects vied with each other in offering, one a servant, another a wife, a third a son or daughter, to be sent to the other world in company with the monarch, that they might there be employed in his service. In New Spain, in the island of Java, in the kingdom of Benin, and among the inhabitants of Indostan, similar practices on the same occasion, owing no doubt to similar notions of futurity, have been prevalent. But such practices as these cannot be viewed with greater contempt on account of the opinions which have given rise to them, than horror on account of their unhappy effects on the condition of those among whom they prevail. A lively impression of the enjoyments to be obtained in a future state, together with some very false or incorrect notions concerning the qualities or actions which were to entitle the departing soul to admission into the scene of those enjoyments, is said to have produced equally unhappy effects among the Japanese. They not only bribe their priests to solicit for them; but looking upon the enjoyments of the present life with disgust or contempt, they used to dash themselves from precipices, or cut their throats, in order to get to paradise as soon as possible. Various other superstitions subsisting among rude nations might here be enumerated, as instances of the perversion of the religious principles of the human heart, which render them injurious to virtue and happiness. The austerities which have been practised, chiefly among rude nations, as means of propitiating superior powers, are especially worthy of notice.— When the favourite idol of the Banians is carried in solemn procession, some devotees prostrate themselves on the ground, that the chariot in which the idol is carried may run over them; others, with equal enthusiasm, dash themselves on spikes fastened on purpose to the car. Innumerable are the ways of torture which have been invented and practised on themselves by men ignorantly striving to recommend themselves to the favour of heaven. These we lament as instances in which religious sentiments have been so ill directed by the influence of imagination, and unenlightened erring reason, as to produce unfavourable effects on the human character, and oppose the happiness of social life.— Though we have argued, that even the most absurd systems of religion that have prevailed in the world, have been upon the whole rather beneficial than injurious to the dignity and happiness of human nature; yet if it shall not appear, as we proceed farther in our compara-

Religion. tive view of the effects of religion on society, that others have been attended with happier effects than these superstitions which belong to the rude ages of society, we may scarce venture to brand the infidel with the appellation of *fool*, for refusing to give his assent to religious doctrines, or to act under their influence.

2d, The polytheism of the Greeks and Romans, and other heathen nations in a similar state of civilization, we have already considered as being, upon the whole, rather favourable than unfavourable to virtue; but we must not partially conceal its defects. The vicious characters of the deities which they worshipped, the incorrect notions which they entertained concerning the moral government of the universe and a future retribution, the absurdity of their rites and ceremonies, and the criminal practices which were intermixed with them, must have altogether had a tendency to pervert both the reasoning and the moral principles of the human mind. The debaucheries of the monarch of the gods, and the fidelity with which his example in that respect was followed by the whole crowd of the inferior deities, did, we know, dispose the devout heathen, when he felt the same passions which had asserted their power over the gods, to gratify them without scruple. It is a truth, however, and we will not attempt to deny or conceal it, that the genius of the polytheism of the Greeks and Romans was friendly to the arts; to such of them especially as are raised to excellence by the vigorous exertion of a fine imagination; music, poetry, sculpture, architecture, and painting, all of these arts appear to have been considerably indebted for that perfection, to which they attained, especially among the Greeks, to the splendid and fanciful system of mythology which was received among that ingenious people.— But we cannot give an equally favourable account of its influence on the sciences. There was little in that system that could contribute to call forth reason. We may grant indeed, that if reason can be so shocked with absurdity as to be roused to a more vigorous exertion of her powers, and a more determined assertion of her rights in consequence of surveying it; in that case, this system of mythology might be favourable to the exercise and improvement of reason; not otherwise.

The connection of paganism with morality was too imperfect for it to produce any very important effects on the morals of its votaries. Sacrifices and prayers, and temples and festivals, not purity of heart and integrity of life, were the means prescribed for propitiating the favour of the deities adored by the Pagans. There were other means, too, besides true heroism and patriotism, of gaining admission into the Elysian fields, or obtaining a seat in the council of the gods. Xenophon, in one of the most beautiful parts of his Memoirs of Socrates, represents Hercules wooed by Virtue and Pleasure in two fair female forms, and deliberating with much anxiety which of the two he should prefer. But this is the fiction of a philosopher desirous to improve the fables of antiquity in such a way as to render them truly useful. Hercules does not appear, from the tales which are told us of his adventures, to have been at any such pains in choosing his way of life. He was received into the palace of Jove, without having occasion to plead that he had through life been the faithful follower of that goddess to whom the philosopher makes him give the preference; his being the son of Jove, and his wild adventures, were sufficient without any other merits to gain him that honour. The same may be said concerning many of the other demi-gods and heroes who were advanced to heaven, or conveyed to the blissful fields of Elysium. And whatever might be the good effects of the religion of Greece and Rome in general upon the civil and political establishments, and in some few instances on the manners of the people, yet still it must be acknowledged to have been but ill calculated to impress the heart with such principles as might in all circumstances direct to a firm, uniform tenor of virtuous conduct.

But after what has been said on the character of this religion elsewhere (see POLYTHEISM), and in the second part of this article, we cannot without repetition enlarge farther on it here. Of the Jewish religion, however, we have as yet said little, having on purpose reserved to this place whatever we mean to introduce under the article, concerning its influence on society.

34 View of Judaism.

3d, When we take a general view of the circumstances in which the Jewish religion was established, the effects which it produced on the character and fortune of the nation, the rites and ceremonies which it enjoined, and the singular political institutions to which it gave a sanction, it may perhaps appear hard to determine, whether it were upon the whole more or less beneficial to society than the polytheism of the Egyptians, Greeks, and Romans. But if such be the judgement which preconceived prejudices, or a hasty and careless view, have induced some to form of this celebrated system; there are others who, with equal keenness, and sounder reasoning, maintain, that it was happily calculated, not only to accomplish the great design of preparing the way for the promulgation of the Gospel, but likewise to render the Jews a more refined and virtuous people, and a better regulated community, than any neighbouring nation. In the first place, the attributes of the Deity were very clearly exhibited to the Jews in the establishment of their religion. The miracles by which he delivered them from servitude, and conducted them out of Egypt, were striking demonstrations of his power; that condescension with which he forgave their repeated acts of perverseness and rebellion, was a most convincing proof of his benevolence; and the impartiality with which the observance and the violation of his laws were rewarded and punished, even in the present life, might well convince them of his justice. A part of the laws which he dictated to Moses are of eternal and universal obligation; others of them were local and particular, suited to the character of the Jews, and their circumstances in the land of Canaan. The Jewish code, taken altogether, is not to be considered as a complete system of religion, or laws calculated for all countries and all ages of society. When we consider the expediency of this system, we must take care not to overlook the design for which the Jews are said to have been separated from other nations, the circumstances in which they had lived in Egypt, the customs and manners which they had contracted by their intercourse with the natives of that country, the manner in which they were to acquire to themselves settlements by extirpating the nations of Canaan, the rank which they were to hold among the nations of Syria and the adjacent countries, together with the difficulty of

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of restraining a people so little civilized and enlightened from the idolatrous worship which prevailed among their neighbours: All these circumstances were certainly to be taken into account; and had the legislator of the Jews not attended to them, his institutions must have remained in force only for a short period; nor could they have produced any lasting effects on the character of the nation. With a due attention to these circumstances, let us descend to an examination of particulars.

35 The sabbath.

Although in every religion or superstition that has prevailed through the world, we find one part of its institutions to consist in the enjoining of certain festivals to be celebrated by relaxation from labour, and the performance of certain ceremonies in honour of the gods; yet in none, or almost none besides the Jewish, do we find every seventh day ordained to be regularly kept holy. One great end which the legislator of the Jews had in view in the institution of the Sabbath was, to impress them with a belief that God was the maker of the universe. In the early ages of the world a great part of mankind imagined the stars, the sun, the moon, and the other planets, to be eternal, and consequently objects highly worthy of adoration. To convince the Israelites of the absurdity of this belief, and prevent them from adopting that idolatry, Moses taught them, that those conspicuous objects which the Gentile nations regarded as eternal, and endowed with divine power and intelligence, were created by the hand of God; who, after bringing all things out of nothing, and giving them form, order, and harmony, in the space of six days, rested on the seventh from all his works. Various passages in the Old Testament concur to show, that this was one great end of the institution of the Sabbath. The observance of the Sabbath, and detestation of idolatrous worship, are frequently inculcated together; and, again, the breach of the Sabbath, and the worship of idols, are usually reprobated at the same time. Another good reason for the institution of a Sabbath might be, to remind the Jews of their deliverance from bondage, to inspire them with humanity to strangers and domestics, and to mitigate the rigours of servitude.

36 and other festivals.

The purposes for which the other festivals of the Jewish religion were instituted appear also of sufficient importance. The great miracle, which, after a series of other miracles, all directed to the same end, finally effected the deliverance of the Jews out of Egypt, and their actual departure from that land of servitude, might well be commemorated in the feast of the passover. To recal to the minds of posterity the history of their ancestors, to impress them with an awful and grateful sense of the goodness and greatness of God, and to make them think of the purposes for which his almighty power had been so signally exerted, were surely good reasons for the institution of such a festival. The feast of Pentecost celebrated the first declaration of the law by Moses, in the space of fifty days after the feast of the passover. It served also as a day of solemn thanksgiving for the blessings of a plenteous harvest. On the feast of tabernacles, they remembered the wanderings of their ancestors through the wilderness, and expressed their gratitude to heaven for the more comfortable circumstances in which they found themselves placed. The feast of new moons served to fix their kalendar, and determine the times at which the other festivals were to be celebrated; on it trumpets were sounded, to give public notice of the event which was the cause of the festival; no servile works were performed, divine service was carefully attended, and the first fruits of the month were offered to the Lord. The Jewish legislator limited his festivals to a very small number, while the heathens devoted a considerable part of the year to the celebration of theirs. But we perceive the occasions upon which the Jewish festivals were celebrated to have been of suitable importance; whereas those of the heathens were often celebrated on trifling or ridiculous occasions. Piety and innocent recreation shared the Jewish festival; the festivals of the heathens were chiefly devoted to debauchery and idleness.

37 The sabbatical year, jubilee, and laws of usury.

The Hebrews had other solemn seasons of devotion besides the weekly Sabbath and these annual festivals. Every seventh year they rested from labour: they were then neither to plough, to sow, nor to prune; and whatever the earth produced spontaneously that year belonged rather to strangers, orphans, and the poor, than to the proprietors of the ground. On this year insolvent debtors were discharged from all debts contracted by purchasing the necessaries of life; and the great end of this release from debts contracted during the preceding six years, appears to have been to prevent the Hebrew from flying to the Gentiles and forsaking his religion when embarrassed in his circumstances. None but native Israelites and proselytes of righteousness were admitted to this privilege; it was refused to strangers, and even to proselytes of the gate. The jubilee was a festival to be celebrated every fiftieth year. It produced the same effect with the sabbatical year as to rest from labour and the discharge of debts; with this addition, that in the year of the jubilee slaves obtained their freedom, and the lands reverted to the old proprietors. On the year of the jubilee, as on the sabbatical year, the lands were to rest uncultivated, and lawsuits were now to terminate. The chief design of this institution appears to have been, to preserve the order of ranks and property originally established in the Hebrew state. None but Israelites or circumcised converts could enjoy the benefit of this institution; nor could even these hope to regain their estates on the year of the jubilee, if they sold them for any other purpose but to supply their necessities. The law relative to usury was evidently founded on the same plan of polity with respect to property. To almost any other nation such a law, it must be confessed, would have been unsuitable and unjust: but as the Jews were not designed for a trading nation, they could have little occasion to borrow, unless to relieve distress; and as an indulgence to people in such circumstances, the Jew was forbidden to exact usury from his brother to whom he had lent money.

38 Of clean and unclean beasts, and the place of worship.

The Jewish legislator, we may well think, would be disposed to adopt every proper method to prevent his nation from falling away into the idolatry of heathen nations. Probably one reason of the distinctions between *clean* beasts which they were permitted to eat, and *unclean* beasts, the eating of which they were taught to consider as pollution, was to prevent them from convivial intercourse with profane nations, by which they might be seduced to idolatry. We do not readily sit down at table with people who are fond of dishes which

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we regard with abhorrence. And if the Jews were taught to loathe the flesh of some of those animals which were among the greatest delicacies of the Gentiles, they would naturally of consequence avoid sitting down at meat with them, either at their ordinary meals or at those entertainments which they prepared in honour of their deities; and this we may with good reason consider as one happy mean to preserve them from idolatry. Besides, the Jews were permitted, or rather enjoined, to eat animals which the Gentiles reverenced as sacred, and from which they religiously withheld all violence. Goats, sheep, and oxen, were worshipped in Egypt (see POLYTHEISM and PAN); and several learned writers are of opinion, that Moses directed his people to sacrifice and eat certain of the favourite animals of the Egyptians, in order to remove from their minds any opinions which they might have otherwise entertained of the sanctity of those pretended deities. Many of the observances which Moses enjoined with regard to food, appear to have been intended to inspire the Israelites with contempt for the superstitions of the people among whom they had so long sojourned. They were to kill the animal which the Egyptians worshipped; to roast the flesh which that people ate raw; to eat the head, which they never ate; and to dress the entrails, which they set apart for divination. These distinctions concurred with the peculiarities of their dress, language, government, customs, places and times of worship, and even the natural situation of their country, by which they were in a manner confined and fortified on all sides, to separate them in such a manner from neighbouring nations, that they might escape the infection of their idolatry. And if we reflect both on the design for which Providence separated the Israelites from other nations, and on the probability that, in the state of society in which mankind were during the earlier period of the Jewish history, the Jews, by mixing with other nations would rather have been themselves converted to idolatry than have converted idolatrous nations to the worship of the true God; we cannot but be satisfied, that even this, however it may at first appear, was a benefit, not a disadvantage; and in the author of their legislation wisdom, not caprice.

39
Other distinguishing particulars in the Jewish ritual.

But not only in the distinctions of meats, and between clean and unclean animals, does the legislator of the Jews appear to have laboured to fix a barrier between them and other nations, which might preserve them from the contagion of idolatry—we shall not err, perhaps, if we ascribe many particulars of their worship to this design in the institutor. The heathens had gods who presided over woods, rivers, mountains, and valleys, and to each of these they offered sacrifices, and performed other rites of worship in a suitable place. Sometimes the grove, sometimes the mountain top, at other times the bank of the river or the brink of the spring, was the scene of their devotions. But as the unity of the divine nature was the truth the most earnestly inculcated on the children of Israel; so in order to impress that truth on their minds with the more powerful efficacy, they were taught to offer their sacrifices and other offerings only in one place, the place chosen by the Lord; and death was threatened to those who dared to disobey the command. To confirm this idea, one of the prophets intimates, that when idolatry should be abolished, the worship of God should not be confined to Jerusalem, but it would then be lawful to worship him anywhere.

40
Effects of these institutions, &c. in impressing a respect for the Deity.

The whole institutions and observances of the Jewish religion appear to have been designed and happily calculated to impress the minds of the people with veneration and respect for the Deity. All the festivals which either commemorated some gracious dispensation of his providence towards their ancestors, or served as days of thanksgiving for the constant returns of his goodness to those who celebrated them, and all the other rites designed to fortify them against idolatry, served at the same time to impress their hearts with awful reverence for the God of Jacob. Various other particulars in the institutions of the Jewish economy appear to have been directed solely to that end. Into the most sacred place, the Holy of Holies, none but the high priest was admitted, and he only once a-year. No fire was used in sacrifice but what was taken from the altar. Severe punishments were on various occasions inflicted on such as presumed to intermeddle in the service of the sanctuary in a manner contrary to what the law had directed. All the laws respecting the character, the circumstances, and the services, of the priests and the Levites, appear plainly to have a similar tendency.

In compliance with the notions of Deity which naturally prevailed among a gross and rude people, though no visible object of worship was granted to the Jews, yet they were allowed in their wanderings through the wilderness to have a tabernacle or portable temple, in which the sovereign of the universe sometimes deigned to display some rays of his glory. Incapable as they were of conceiving aright concerning the spiritual nature and the omnipresence of the Deity, they might possibly have thought Jehovah careless and indifferent about them, had they been at no time favoured with a visible demonstration of his presence.

41
Sacrifices and lustrations.

The sacrifices in use among the Gentiles in their worship of idols were permitted by the Jewish legislator; but he directed them to be offered with views very different from those with which the Gentiles sacrificed to their idols. Some of the sacrifices of the Jewish ritual were designed to avert the indignation of the Deity; some to expiate offences and purify the heart; and all of them to abolish or remove idolatry. Lustrations or ablutions entered likewise into the Jewish ritual; but these were recommended and enjoined by Moses for purposes widely different from those which induced the heathens to place so high a value upon them. The heathens practised them with magical and superstitious ceremonies; but in the Jewish ritual they were intended simply for the cleansing away of impurities and pollutions.

42
Tendency of the theocracy and temporal sanctions.

The theocratical form of government to which the Jews were subject, the rewards which they were sure of receiving, and the punishments which they were equally liable to suffer in the present life, had a powerful effect to remove superstition and preserve them from idolatry, as well as to support all the social virtues among them. They were promised a numerous offspring, a land flowing with milk and honey, long life, and victory over their enemies, on the condition of their paying a faithful obedience to the will of their heavenly Sovereign; plague, famine, disease, defeats, and death, were threatened as the punishments to be inflicted on those who violated

violated his laws; and these sanctions, it must be allowed, were happily accommodated to the genius of a rude and carnal-minded people, attentive only to present objects, and not likely to be influenced by remote and spiritual considerations.

43 ...s and ...ibi- ...s of ...appa- ...utility.

There were other rites and prohibitions in the Mosaic law, which appear to have had but little connection with religion, morals, or policy. These may be more liable to be objected against, as adding an unnecessary weight to a burden which, though heavy, might yet have been otherwise borne in consideration of the advantages connected with it. Even these, however, may perhaps admit of being viewed in a light in which they shall appear to have been in no way unfavourable to the happiness of those to whom they were enjoined. They appear to have had none of them an immoral tendency: all of them had, in all probability, a tendency to remove or prevent idolatry, or to support, in some way or other, the religious and the civil establishment to which they belonged.

44 ...whole ...irably ...ulated ...he pur ...s in- ...ed.

From these views of the spirit and tendency of the Jewish religion, we may fairly conclude it to have been happily calculated to promote the welfare of society. In comparing it with other religions, it is necessary to reflect on the peculiar purposes for which it was given; that its two principal objects were to preserve the Jews a separate people, and to guard them against the contagion of the surrounding idolatry. When these things are taken into consideration, every candid mind acquainted with the history of ancient nations will readily acknowledge that the whole system, though calculated indeed in a peculiar manner for them, was as happily adapted for the purposes for which it had been wisely and graciously intended, as it is possible to imagine any such system to be. It would be unhappy, indeed, if on a comparison of pure theism with polytheism, the latter, with all its absurdities, should be found more beneficial to mankind than the former. The theism of the Jews was not formed to be disseminated through the earth; that would have been inconsistent with the purposes for which it is said to have been designed. But while the Jews were separated by their religion from all other nations, and perhaps, in some degree, fixed and rendered stationary in their progress towards refinement, they were placed in circumstances, in respect to laws, and government, and religion, and moral light, which might with good reason render them the envy of every other nation in the ancient world.

45 ...y of ...stia-

IV. The Christian religion next demands our attention. It is to be considered as an improvement of the Jewish, or a new superstructure raised on the same basis. If the effects of the Jewish religion were beneficial to those among whom it was established, they were confined almost to them alone. But is the spirit of Christianity equally pure and benignant? Is its influence equally beneficial and more diffusive than that of Judaism? Does it really merit to have triumphed over both the theism of the Jews and the polytheism of the heathens?

46 ...loc ...pure ...ites ...e.

If we consider the doctrines and precepts of the Christian religion, nothing can be more happily calculated to raise the dignity of human nature, and promote the happiness of mankind. The happiness of the individual is best promoted by the exercise of love and gratitude towards God, and resignation to his providence; of humanity, integrity, and good will towards men; and by the due government of our appetites and passions. Social happiness again proceeds from the members of society entertaining a disinterested regard for the public welfare; being actively industrious each in his proper sphere of exertion; and being strictly just and faithful, and generously benevolent in their mutual intercourse. The tenor of the gospel inculcates these virtues; it seems everywhere, through the whole of the Christian code, to have been the great design of its Author to inspire mankind with mild, benevolent, and peaceable dispositions, and to form them to courteous manners. Christianity again represents the Deity and his attributes in the fairest light; even so as to render our ideas of his nature, and the manner in which he exerts his power, consistent with the most correct principles of morality that can be collected from all the other religions that have prevailed in the earth, and from the writings of the most admired philosophers. The ritual observances which Christianity enjoins are few in number, easy to perform, decent, expressive, and edifying. It inculcates no duties but what are founded on the principles of human nature, and on the relation in which men stand to God, their Creator, Redeemer, and Sanctifier; and it prescribes accurate rules for the regulation of the conduct. The assistance of the spirit of God is promised in this sacred volume to those who assiduously labour to discharge the duties which it enjoins; and it exhibits a striking example of spotless purity, which we may safely venture to imitate. The gospel teaches that worldly afflictions are incident to both good and bad men; a doctrine highly conducive to virtue, which consoles us in distress, prevents despair, and encourages us to persist firmly in our integrity under every difficulty and trial. Christianity represents all men as children of the same God, and heirs of the same salvation, and levels all distinctions of rich and poor, as accidental and insignificant in the sight of him who rewards or punishes with impartiality according to the merits or demerits of his creatures. This doctrine is highly favourable to virtue, as it tends to humble the proud, and to communicate dignity of sentiment to the lowly; to render princes and inferior magistrates moderate and just, gentle and condescending, to their inferiors. It farther requires husbands to be affectionate and indulgent to their wives, wives to be faithful and respectful to their husbands, and both to be true and constant to each other. Such is the purity of the gospel, that it forbids us even to harbour impure thoughts; it requires us to abandon our vices, however dear to us; and to the cautious wisdom of the serpent it directs us to join the innocent simplicity of the dove. The Christian dispensation, to prevent a perseverance in immorality, offers pardon for the past, provided the offender forsake his vicious practices, with a firm resolution to act differently in future. The sanctions of the gospel have a natural tendency to exalt the mind above the paltry pursuits of this world, and to render the Christian incorruptible by wealth, honours, or pleasures. The true Christian not only abstains from injustice towards others, but even forgives those injuries which he himself suffers, knowing that he cannot otherwise hope for forgiveness from God. Such are the precepts, such the spirit, and such the general tendency of the gospel. Even those who refused to give credit to its doctrines and history have yet acknowledged the excellence

cellence of its precepts. They have acknowledged, that "no religion ever yet appeared in the world, of which the natural tendency was so much directed to promote the peace and happiness of mankind as the Christian; and that the gospel of Christ is one continued lesson of the strictest morality, of justice, benevolence, and universal charity." These are the words of Bolingbroke, one of its keenest and most insidious opponents. Without examining the effects of this religion on society, we might almost venture to pronounce with confidence, that a religion, the precepts of which are so happily formed to promote all that is just and excellent, cannot but be in the highest degree beneficial to mankind. By reviewing the effects which it has actually produced, the favourable opinion which we naturally conceive of it, after considering its precepts, cannot but be confirmed.

47
The virtues it recommends unostentatious.

One circumstance we must take notice of as rather unfavourable to this review. It is really impossible to do justice to Christianity by such a discussion of its merits. The virtues which it has a natural tendency to produce and cherish in the human heart, are not of a noisy ostentatious kind; they often escape the observation of the world. Temperance, gentleness, patience, benevolence, justice, and general purity of manners, are not the qualities which most readily attract the admiration and obtain the applause of men. The man of Ross, whom Mr Pope has so justly celebrated, was a private character; his name is now likely to live, and his virtues to be known to the latest posterity: and yet, however disinterested his virtues, however beneficial his influence to all around him, had his character not attracted the notice of that eminent poet, his name would perhaps ere this time have been lost in oblivion. Individuals in private life seldom engage the attention of the historian; his object is to record the actions of princes, warriors, and statesmen. Had not the professors of Christianity in the earlier ages of its existence been exposed to persecutions, and unjust accusations from which they were called on to vindicate themselves, we should be strangers to the names and virtues of saints and martyrs, and to the learning and endowments of the first apologists for Christianity. We can therefore only trace the general influence of the institutions of Christianity on society. We cannot hope to make an accurate enumeration of particulars. In many of the countries in which it has been established, it has produced a very favourable change on the circumstances of domestic life. Polygamy, a practice repugnant to the will of our Creator (see POLYGAMY), who has declared his intentions in this instance in the plainest manner, by causing nearly equal numbers of males and females to be brought into the world, was never completely abolished but by Christianity.

48
Its effects on the manners of nations.

The practice of divorce, too, though in some cases proper and even necessary, had been so much abused at the time of our Saviour's appearance in the world, that he found reason to declare it unlawful, unless in the case of adultery. The propriety and reasonableness of this prohibition will sufficiently appear, if we consider, that when divorces are easily obtained, both parties will often have nothing else in view at the period of marriage than the dissolution of their nuptial engagements after a short cohabitation; the interests of the husband and the wife will almost always be separate; and the children of such a marriage are scarce likely to enjoy the cordial affection and tender watchful care of either parent. The husband in such a case will naturally be to his wife, not a friend and protector, but a tyrant; fear and deceit, not love, gratitude, or a sense of duty, will be the principles of the wife's obedience.

In another instance, likewise, Christianity has produced an happy change on the circumstances of domestic life; it must be acknowledged to have contributed greatly to the abolition of slavery, or at least to the mitigation of the rigour of servitude. The customs and laws of the Romans in relation to slaves were cruel and severe. Masters were often so inhuman as to remove aged, sick, or infirm slaves, into an island in the Tiber, where they suffered them to perish without pity or assistance. The greater part of the subjects of many of those republics which enjoyed the most liberty, groaned under tyrannical oppression; they were condemned to drag out a miserable existence in hard labour, under inhuman usage, and to be transferred like beasts from one master to another. The hardships of slavery were eased, not by any particular precept of the Gospel, but by the gentle and humane spirit which breathed through the general tenor of the whole system of doctrines and precepts of which the Gospel consists. It must indeed be allowed, that a trade in slaves is at present carried on by people who presume to call themselves Christians, and protected by the legislature of Christian states: but the spirit of the Christian code condemns the practice, and the true Christian will not engage in it.

Partly by the direct and conspicuous, partly by the secret and unseen, influence of Christianity since its promulgation in the world, the hearts of men have been gradually softened; even barbarians have been formed to mildness and humanity; the influence of selfishness has been checked and restrained; and even war, amid all the pernicious improvements by which men have sought to render it more terrible, has assumed much more of the spirit of mildness and peace than ever entered into it during the reign of heathenism.

If we review the history of mankind with a view to their political circumstances, we shall find, that by some means or other, it has happened, since the time when the Gospel was first preached, that both systems of legislature and forms of government have been raised to much greater perfection, at least in those parts of the world into which the religion of Jesus has made its way, and obtained an establishment.

The popular government of the Romans, notwithstanding the multiplicity of their laws, and the imperfections of their political constitution, was, no doubt, happily enough adapted to promote the increase of the power and the extension of the empire of Rome. In Greece there were various republics, the wisdom and impartiality of whose laws have been highly celebrated. But we apprehend that there is a sufficient number of well authenticated facts to warrant us to affirm, that since Christianity has been propagated, and has had sufficient time to produce its full effect on arts, manners, and literature, even under governments the form of which might appear less favourable than the celebrated models of antiquity to the liberty and happiness of the people in general, these actually have been much better provided for than under the laws of Athens or Sparta, or even of Rome in the days of the consuls. It is a just and happy observation of Montesquieu, who has attributed so much to the influence of climate and local circumstances, that "the mildness so frequently recommended in the Gospel is incompatible with the despotic rage with which an arbitrary tyrant punishes his subjects, and exercises himself in cruelty. It is the Christian religion (says he) which, in spite of the extent of empire, and the influence of climate, has hindered despotism from being established in Ethiopia, and has carried into Africa the manners of Europe. The heir to the empire of Ethiopia enjoys a principality, and gives to other subjects an example of love and obedience.—Nor far from hence may be seen the Mahometan shutting up the children of the king of Sennaar, at whose death the council sends to murder them in favour of the prince who ascends the throne. Let us set before our eyes (continues that eloquent writer), in the third chapter of the 24th book of his Spirit of Laws, on one hand the continual massacres of the kings and generals of the Greeks and Romans, and on the other the destruction of people and cities by the famous conquerors Timur Beg and Jenghiz Khan, who ravaged Asia; and we shall perceive, that we owe to Christianity in government a certain political law, and in war a certain law of nations, which allows to the conquered the great advantages of liberty, laws, wealth, and always religion, when the conqueror is not blind to his own interest."

These are the reflections of no common judge in this matter, but one who had long studied the history of nations, and observed the phenomena of the various forms of society, with such success as few others have attained.

49 Effects in softening and humanizing barbarians.

But on no occasion has the mild influence of Christianity been more eminently displayed, or more happily exerted, than in softening and humanizing the barbarians who overturned the Roman empire. The idolatrous religion which prevailed among those tribes before their conversion to Christianity, instead of disposing them to cultivate humanity and mildness of manners, contributed strongly to render them fierce and bloodthirsty, and eager to distinguish themselves by deeds of savage valour. But no sooner had they settled in the dominions of Rome, and embraced the principles of Christianity, than they became a mild and generous people.

We are informed by Mosheim, who was at pains to collect his materials from the most authentic sources, that in the 10th century Christian princes exerted themselves in the conversion of nations whose fierceness they had experienced, in order to soften and render them more gentle. The mutual humanity with which nations at war treat each other in modern times, is certainly owing, in a great measure, to the influence of the mild precepts of the Gospel. It is a fact worthy of notice, too, that during the barbarous ages, the spiritual courts of justice were more rational and impartial in their decisions than civil tribunals.

How many criminal practices which prevailed among heathen nations have been abolished by their conversion to Christianity! Christians of all nations have been observed to retain the virtues and reject the vicious practices of their respective countries. In Parthia, where polygamy prevailed, they are not polygamists; in Persia, the Christian father does not marry his own daughter. By the laws of Zoroaster the Persians committed incest until they embraced the Gospel; after which period they abstained from that crime, and observed the duties of chastity and temperance, as enjoined by its precepts. Even the polished and enlightened Romans were cruel and blood-thirsty before the propagation of the Gospel. The breaking of a glass, or some such trifling offence, was sufficient to provoke Vidius Pollio to cast his slaves into fish-ponds to be devoured by lampreys. The effusion of human blood was their favourite entertainment; they delighted to see men combating with beasts, or with one another; and we are informed on respectable authority, that no wars ever made such havock on mankind as the fights of gladiators, which sometimes deprived Europe of 20,000 lives in one month. Not the humanity of Titus, nor the wisdom and virtue of Trajan, could abolish the barbarous spectacle. However humane and wise in other instances, in this practice those princes complied with the custom of their country, and exhibited splendid shows of gladiators, in which the combatants were matched by pairs; who, though they had never injured nor offended each other, yet were obliged to maim and murder one another in cold blood. Christian divines soon exercised their pens against these horrid practices; the Christian emperor Constantine restrained them by edicts, and Honorius finally abolished them. It would be tedious to proceed through an enumeration of particulars; but wherever Christianity has been propagated, it has constantly operated to the civilization of the manners of mankind, and to the abolition of absurd and criminal practices. The Irish, the Scotch, and all the ancient inhabitants of the British isles, were, notwithstanding their intercourse with the Romans, rude barbarians, till such time as they were converted to Christianity. The inhuman practice of exposing infants, which once prevailed so generally over the world, and still prevails among some Pagan nations, even under very humane and enlightened legislatures, yielded to the influence of Christianity.

50 Learning is much indebted to Christianity.

Let us likewise remember, in honour of Christianity, that it has contributed eminently to the diffusion of knowledge, the preservation and the advancement of learning. When the barbarians overspread Europe, what must have become of the precious remains of polished, enlightened antiquity, had there been no other depositaries to preserve them but the heathen priests? We allow that even the Romish clergy during the dark ages did not study the celebrated models of ancient times with much advantage themselves, and did not labour with much assiduity to make the laity acquainted with them. It must even be acknowledged, that they did not always preserve those monuments of genius with sufficient care, as they were often ignorant of their real value. Yet, after all, it will be granted, it cannot be denied, that had it not been for the clergy of the Christian church, the lamp of learning would, in all probability, have been entirely extinguished, during that night of ignorance and barbarity in which all Europe was buried for a long series of centuries, after the irruption of the barbarians into the Roman empire.

51 The beneficial influence of Christianity has extended even to those who have not embraced it.

Such is the excellence of the Christian system, and such its tendency to meliorate the human character, that its beneficial influence has not been confined to those who have received its doctrines and precepts, and have professed themselves Christians; it has even produced many

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many happy effects on the circumstances and the characters of Pagans and infidels, who have had opportunities of beholding the virtues of Christians, and learning the excellence of the morality of the gospel. Those virtues which distinguished the character of the apostate Julian were surely owing in no inconsiderable degree to his acquaintance with Christianity; and it is an undeniable fact, that after the propagation of Christianity through the Roman empire, even while the purity of that holy religion was gradually debased, the manners of those Pagans who remained unconverted became more pure, and their religious doctrines and worship less immoral and absurd.—We might here adduce a tedious series of facts to the same purpose. Whenever Christians have had any intercourse with Pagan idolaters, and have not concealed the laws of the gospel, nor shewn by their conduct that they disregarded them, even those who have not been converted to Christianity have, however, been improved in their dispositions and manners by its influence. The emperor, whose virtues we have mentioned as arising, in a certain degree, from his acquaintance with Christianity, in a letter to an Heathen pontiff, desires him to turn his eyes to the means by which the superstition of Christians was propagated; by kindness to strangers, by sanctity of life, and by the attention which they paid to the burial of the dead. He recommends an imitation of their virtues, exhorts him to cause the priests of Galatia to be attentive to the worship of their gods, and authorises him to strip them of the sacerdotal function, unless they obliged their wives, children, and servants, to pay attention to the same duties. He likewise enjoins works of beneficence, desires the priest to relieve the distressed, and to build houses for the accommodation of strangers of whatever religion: and says it is a disgrace for Pagans to disregard those of their own religion, while Christians do kind offices to strangers and enemies. This is indeed an eminent instance of the happy influence of Christianity even on the sentiments and manners of those who regarded the Christian name with abhorrence.

52 Christianity to be preferred to all other religions.

Upon the whole, then, may we not, from the particulars here exhibited concerning the influence of this religion on the manners and happiness of men in society, conclude that Christianity is infinitely superior to the superstitions of Paganism? as being in its tendency uniformly favourable to the virtue and the happiness of mankind, and even to the system of religion and laws delivered by Moses to the children of Israel. because, while the religion of the Jews was calculated only for one particular nation, and it may almost be said for one particular stage in the progress of society, Christianity is an universal religion, formed to exert its happy influence in all ages and among all nations; and has a tendency to dispel the shades of barbarism and ignorance, to promote the cultivation of the powers of the human understanding, and to encourage every virtuous refinement of manners.

53 View of Mahometanism.

V. Another religion, which has made and still makes a conspicuous figure in the world, remains yet to be examined. The religion of Mahomet is that which we here allude to. Whether we consider through what an extensive part of the globe that religion prevails, the political importance of the nations among whom it is professed, or the striking peculiarity of character by which it is distinguished from all other religious systems—it is for all these reasons well worthy of particular notice. Like the Jewish religion, it is not barely a system of religious doctrines and general moral precepts; it forms both the civil legislature and the religious system of those nations among whom it is professed; and, like it too, it would appear to be calculated rather for one particular period in the progress of mankind from rudeness to refinement, than for all ages and all states of society.

The history of its origin is pretty well known, and we have had occasion to enlarge upon it under a former article (see Mahomet and Mahometanism). We are not here to trace the impostures of the prophet, or to consider the arts by which he so successfully accomplished his designs; but merely to consider the morality of his religion, and its influence on civil order and the happiness of society.

54 It is friendly to ignorance, despotism, and impurity.

If we view the state of the nations among whom it is established, we cannot hesitate a moment to declare it friendly to ignorance, to despotism, and to impurity of manners. The Turks, the Persians, and the Malays, are all Mahometans; and in reviewing their history and considering their present state, we might find a sufficient number of facts to justify the above assertion: and we must not neglect to observe, that, as those nations are not known to have ever been since their conversion to Mahometanism under a much happier government, or in a much more civilized state than at present, it cannot be, with any degree of fairness, argued, with respect to Mahometanism as with respect to Christianity, that it is only when its influence is so opposed by other causes as to prevent it from producing its full effects, that it does not conduct those societies among which it is established to a high state of civilization and refinement.

55 Remarks on the Koran, &c.

One, and that by no means an inconsiderable, part of the Koran, was occasionally invented to solve some difficulty with which the prophet found himself at the time perplexed, or to help him to the gratification of his ruling passions, lust and ambition. When he and his followers were, at any time, unsuccessful in those wars by which he sought to propagate his religion, to prevent them from falling away into unbelief, or sinking into despondency, he took care to inform them that God suffered such misfortunes to befal believers, as a punishment for their sins, and to try their faith. The doctrine of predestination, which he assiduously inculcated, had a happy effect to persuade his followers to rush boldly into the midst of death and danger, at his command. He prevailed with Zeyd to put away his wife, married her himself, and pretended that his crime had the approbation of heaven; and, in the Koran, he introduces the Deity approving of this marriage. Being repulsed from the siege of Mecca, he made a league with the inhabitants; but on the very next year, finding it convenient to surprise the city, by violating this treaty, he justified his perfidy by teaching his followers to disregard promises or leagues made with infidels. In some instances again, we find absurd prohibitions enjoined for similar reasons: his officers, having on some occasion drunk to excess, excited much riot and confusion in the camp, he prohibited the use of wine and other inebriating liquors among his followers in future. Now, though it must be acknowledged that many evils arise from the use of these liquors, yet we cannot but think that, gion

that, when used in moderation, they are in many cases beneficial to men; and certainly as much allowed by God as opium, which the Mahometans have substituted in their place.

56 ...me- ...n a ...re of ...tia- Ju- ..., and ...per- ...s of ...a.

Mahomet is allowed to have copied from the Christian and the Jewish religions, as well as from the idolatrous superstitions which prevailed through Arabia, and thus to have formed a motley mixture of reason and absurdity, of pure theism and wild superstition. He considered also the circumstances of his country, and the prejudices of his countrymen. When he attended to the former, he was generally judicious enough to suit his doctrines and decisions to them with sufficient skill; the latter he also managed with the greatest art: but he entered into accommodation with them in instances when a true prophet or a wise and upright legislator would surely have opposed them with decisive vigour. Where the prophet indulges his own fancy, or borrows from the superstitions of his countrymen, nothing can be more ridiculous than that rhapsody of lies, contradictions, and extravagant fables, which he delivers to his followers. Amazing are the absurdities which he relates concerning the patriarchs, concerning Solomon, and concerning the animals that were assembled in Noah's ark.

57 ...n of ...n and

But in the whole tissue of absurdities of which his system consists, there is nothing more absurd, or more happily calculated to promote impurity of manners, than his descriptions of heaven and hell; the ideas of future rewards and punishments which he sought to impress on the minds of his followers. Paradise was to abound with rivers, trees, fruits, and shady groves; wine which would not intoxicate was to be there plentifully served up to believers; the inhabitants of that happy region were all to enjoy perpetual youth; and their powers of enjoyment were to be enlarged and invigorated, in order that so many fine things might not be thrown away upon them. "Instead of inspiring the blessed inhabitants of paradise with a liberal taste for harmony and science, conversation and friendship (says Mr Gibbon), Mahomet idly celebrates the pearls and diamonds, the robes of silk, palaces of marble, dishes of gold, rich wines, artificial dainties, numerous attendants, and the whole train of sensual luxury.—Seventy two houris, or black-eyed girls of resplendent beauty, blooming youth, virgin purity, and exquisite sensibility, will be created for the use of the meanest believer; a moment of pleasure will be prolonged for 1000 years, and his faculties will be increased 100 fold, to render him worthy of his felicity." It must be acknowledged that he allows believers other more refined enjoyments than these; thus they are to see the face of God morning and evening; a pleasure which is far to exceed all the other pleasures of paradise. The following is his description of the punishments of hell: The wicked are there to drink nothing but boiling stinking water; breathe nothing but hot winds; dwell for ever in continual burning fire and smoke; eat nothing but briars and thorns, and the fruit of a tree that riseth out of the bottom of hell, whose branches resemble the heads of devils, and whose fruits shall be in their bellies like burning pitch.

All that we can conclude from a general view of the religion of Mahomet, from considering the character of the prophet, or from reviewing the history of the nations among whom it has been established, is, that it is one tissue of absurdities, with a few truths, however, and valuable precepts incongruously intermixed; that a great part of it is unfavourable to virtuous manners, to wise and equal laws, and to the progress of knowledge and refinement. It often inculcates in a direct manner sentiments that are highly immoral; it substitutes trifling superstitious observances in the room of genuine piety and moral virtue; and it gives such views of futurity as render purity of heart no necessary qualification for seeing God.

Religion, Religious.

58 Mahometanism to be preferred to paganism.

Surely, therefore, even the deist, who rejects all but natural religion, would not hesitate to prefer Christianity, and even Judaism, to the religion of Mahomet. Judaism, calculated for a peculiar people, was undoubtedly much more sublime and much more happily framed to render that people virtuous and happy in the circumstances in which they were placed; and Christianity we find to be an universal religion, suited to all circumstances and to all the stages of society, and acting, wherever it is received, with more or less force to the support of civil order, virtuous manners, improvement of arts, and the advancement of science. However, as Mahometanism forms in some measure a regular system, as it has borrowed many of the precepts and doctrines of Judaism and Christianity, not indeed without corrupting and degrading them; and as it has contributed considerably to the support of civil government, although in a very imperfect form, in those countries in which it has obtained an establishment; for all these reasons we cannot but give it the preference to the superstitions of Paganism.

59 Conclusion.

THE whole result of our inquiries under this article, therefore, is, 1. That as man, by the constitution of his mind, is naturally fitted for acquiring certain notions concerning the existence of invisible superior beings, and their influence on human life; so the religious ideas which we find to have in all ages of the world, and in all the different stages of the progress of society, prevailed among mankind, appear to have originated partly from the natural exertions of the human imagination, understanding, and passions, in various circumstances, and partly from supernatural revelation.

2. That though religious opinions, together with the moral precepts, and the rites of worship connected with them, may appear to have been in numerous instances injurious to the virtue and happiness of society; yet, as they have often contributed to lead the mind to form moral distinctions, when it would otherwise in all probability have been an entire stranger to such distinctions; and as they have always contributed in an essential manner to the establishment and the support of civil government—it must therefore be acknowledged that they have always, even in their humblest state, been more beneficial than hurtful to mankind.

3. That when the different systems of religion that have prevailed in the world are comparatively viewed with respect to their influence on the welfare of society, we find reason to prefer the polytheism of the Greeks and Romans to the ruder, wilder, religious ideas and ceremonies that have prevailed among savages; Mahometanism, perhaps in some respects, to the polytheism of the Greeks and Romans; Judaism, however, to Mahometanism; and Christianity to all of them.

RELIGIOUS, in a general sense something that relates to religion.—We say, a religious life, religious society,

society, &c.—Churches and churchyards are religious places.—A religious war is also called a *croisade*. See Croisade.

Religious, is also used substantially for a person engaged by solemn vows to the monastic life; or a person shut up in a monastery to lead a life of devotion and austerity, under some rule or institution. The male religious we popularly call *monks* and *friars;* the female, *nuns* and *canonesses*.

REMBRANDT Van Rhin, a Flemish painter and engraver of great eminence, was born in 1606, in a mill upon the banks of the Rhine, from whence he derived his name of *Van Rhin*. This master was born with a creative genius, which never attained perfection. It was said of him, that he would have invented painting, if he had not found it already discovered. Without study, without the assistance of any master, but by his own instinct, he formed rules, and a certain practical method for colouring; and the mixture produced the designed effect. Nature is not set off to the greatest advantage in his pictures; but there is such a striking truth and simplicity in them, that his heads, particularly his portraits, seem animated, and rising from the canvas. He was fond of strong contrasts of light and shade. The light entered in his working-room only by a hole, in the manner of a camera obscura, by which he judged with greater certainty of his productions. This artist considered painting like the stage, where the characters do not strike unless they are exaggerated. He did not pursue the method of the Flemish painters, of finishing his pieces. He sometimes gave his light such thick touches, that it seemed more like modelling than painting. A head of his has been shown, the nose of which was as thick of paint, as that which he copied from nature. He was told one day, that by his peculiar method of employing colours, his pieces appeared rugged and uneven—he replied, he was a painter, and not a dyer. He took a pleasure in dressing his figures in an extraordinary manner: with this view he had collected a great number of eastern caps, ancient armour, and drapery long since out of fashion. When he was advised to consult antiquity to attain a better taste in drawing, as his was usually heavy and uneven, he took his counsellor to the closet where these old vestments were deposited, saying, by way of derision, those were his antiques.

Rembrandt, like most men of genius, had many caprices. Being one day at work, painting a whole family in a single picture, word being brought him that his monkey was dead, he was so affected at the loss of this animal, that, without paying any attention to the persons who were sitting for their pictures, he painted the monkey upon the same canvas. This whim could not fail of displeasing those for whom the piece was designed; but he would not efface it, choosing rather to lose the sale of his picture.

This freak will appear still more extraordinary in Rembrandt, when it is considered that he was extremely avaricious; which vice daily grew upon him. He practised various stratagems to sell his prints at a high price. The public were very desirous of purchasing them, and not without reason. In his prints the same taste prevails as in his pictures; they are rough and irregular, but picturesque. In order to heighten the value of his prints, and increase their price, he made his son sell them as if he had purloined them from his father; others he exposed at public sales, and went thither himself in disguise to bid for them; sometimes he gave out that he was going to leave Holland, and settle in another country. These stratagems were successful, and he got his own price for his prints. At other times he would print his plates half finished, and expose them to sale; he afterwards finished them, and they became fresh plates. When they wanted retouching, he made some alterations in them, which promoted the sale of his prints a third time, though they differed but little from the first impressions.

His pupils, who were not ignorant of his avarice, one day painted some pieces of money upon cards; and Rembrandt no sooner saw them, than he was going to take them up. He was not angry at the pleasantry; but it had no effect in checking his avarice. He died in 1674.

REMEMBRANCE, is when the idea of something formerly known recurs again to the mind without the operation of a like object on the external sensory. See Memory and Reminiscence.

REMEMBRANCERS, anciently called *clerks of the remembrance*, certain officers in the exchequer, whereof three are distinguished by the names of the *king's remembrancer*, the *lord treasurer's remembrancer*, and the *remembrancer of the first fruits*. The king's remembrancer enters in his office all recognizances taken before the barons for any of the king's debts, for appearances or observing of orders; he also takes all bonds for the king's debts, &c. and makes out processes thereon. He likewise issues processes against the collectors of the customs, excise, and others, for their accounts; and informations upon penal statutes are entered and sued in his office, where all proceedings in matters upon English bills in the exchequer-chamber remain. His duty farther is to make out the bills of compositions upon penal laws, to take the statement of debts; and into his office are delivered all kinds of indentures and other evidences which concern the assuring any lands to the crown. He every year *in crastino animarum*, reads in open court the statute for election of sheriffs; and likewise openly reads in court the oaths of all the officers, when they are admitted.

The lord treasurer's remembrancer is charged to make out process against all sheriffs, escheators, receivers, and bailiffs for their accounts. He also makes out writs of *fieri facias*, and extent for debts due to the king, either in the pipe or with the auditors: and process for all such revenue as is due to the king on account of his tenures. He takes the account of sheriffs; and also keeps a record, by which it appears whether the sheriffs or other accountants pay their proffers due at Easter and Michaelmas; and at the same time he makes a record, whereby the sheriffs or other accountants keep their prefixed days: there are likewise brought into his office all the accounts of customers, comptrollers, and accountants, in order to make entry thereof on record; also all estreats and amercements are certified here, &c.

The remembrancer of the first-fruits takes all compositions and bonds for the payments of first-fruits and tenths; and makes out process against such as do not pay the same.

REMINISCENCE, that power of the human mind, whereby it recollects itself, or calls again into its remembrance,

brance, such ideas or notions as it had really forgot: in which it differs from memory, which is a treasuring up of things in the mind, and keeping them there, without forgetting them.

REMISSION, in *Physics*, the abatement of the power or efficacy of any quality; in opposition to the *increase* of the same, which is called *intension*.

REMISSION, in *Law*, &c. denotes the pardon of a crime, or giving up the punishment due thereto.

REMISSION, in *Medicine*, is when a distemper abates for a time, but does not go quite off.

REMITTANCE, in *Commerce*, the traffic or return of money from one place to another, by bills of exchange, orders, or the like.

REMONSTRANCE, an expostulation or humble supplication, addressed to a king, or other superior, beseeching him to reflect on the inconveniences or ill consequences of some order, edict, or the like. This word is also used for an expostulatory counsel, or advice; or a gentle and handsome reproof, made either in general, or particular, to apprize of or correct some fault, &c.

REMONSTRANTS, in church history, a title which was given to the Arminians in consequence of the remonstrance made by them in the year 1610 to the states of Holland, against the sentence of the synod of Dort, which pronounced them to be heretics. The chief leaders of the Remonstrants were Episcopius and Grotius; and their principles were first openly countenanced in England by Archbishop Laud. In opposition to the representation or remonstrance of the Arminians, the Dutch Calvinists presented an address, which was called a counter-remonstrance; and hence they obtained the denomination of *Counter-remonstrants*. A great deal of keen controversy was agitated in this affair, by these rival sects. See ARMINIANS.

REMORA, or SUCKING-FISH, a species of ECHENEIS. See ECHENEIS, ICHTHYOLOGY *Index*.—Many incredible things are related of this animal by the ancients; as that it had the power of stopping the largest and swiftest vessel in its course; and even to this day it is asserted by the fishermen in the Mediterranean, that it has a power of retarding the motion of their boats by attaching itself to them; for which reason they kill it whenever they fancied this retardation took place.

REMORSE, in its worst sene, means that pain or anguish which one feels after having committed some bad action. It also means tenderness, pity, or sympathetic sorrow. It is most generally used in a bad sense, and is applied to persons who feel compunction for some great crime, as murder and such like. Murders which have been committed with the utmost circumspection and secrecy, and the authors of which could never have been discovered by any human investigation, have been frequently unfolded by the remorse and confession of the perpetrators, and that too many years afterwards. Of this there are numerous instances, which are well authenticated, and which are so generally known that it is needless to relate them here. See REPENTANCE.

REMPHAN, an idol or Pagan god whom St Stephen says the Israelites worshipped in the wilderness as they passed from Egypt to the land of Promise: "Yea, ye took up the tabernacle of Moloch, and the star of your god REMPHAN; figures which ye made to worship them." That the martyr here quotes the following words of the prophet Amos, all commentators are agreed: "Ye have borne the tabernacle of your Moloch, and CHIUN your images, the star of your god, which ye made to yourselves." But if this coincidence between the Christian preacher and the Jewish prophet be admitted, it follows, that *Chiun* and *Remphan* are two names of one and the same deity. This is indeed farther evident from the LXX translators having substituted in their version the word Ραιφαν, instead of *Chiun*, which we read in the Hebrew and English Bibles. But the question which still remains to be answered is, what god was worshipped by the name of *Remphan*, *Raiphan*, or *Chiun*? for about the other divinity here mentioned there is no dispute. See MOLOCH.

That *Chiun* or *Remphan* was an Egyptian divinity, cannot be questioned; for at the era of the *Exodus* the Hebrews must have been strangers to the idolatrous worship of all other nations; nor are they ever accused of any other than Egyptian idolatries during their 40 years wanderings in the wilderness, till towards the end of that period that they became infected by the Moabites with the worship of *Baal-peor*. That *Moloch*, *Moleck*, *Melek*, or *Milcom*, in its original acceptation, denotes a *king* or *chief*, is known to every oriental scholar; and therefore when it is used as the name of a god, it undoubtedly signifies the *sun*, and is the same divinity with the *Egyptian Osiris*. Reasoning in this way, many critics, and we believe Selden is in the number, have concluded that *Chiun*, and of course *Remphan*, is the planet *Saturn*; because *Chiun* is written *Ciun*, *Cevan*, *Ceuan*, *Chevvin*; all of which are modern oriental names of that planet.

But against this hypothesis insurmountable objections present themselves to our minds. It is universally allowed (see POLYTHEISM), that the first objects of idolatrous worship were the *sun* and *moon*, considered as the king and queen of heaven. The fixed stars, indeed, and the planets, were afterwards gradually admitted into the Pagan rubric; but we may be sure that those would be first associated with the two prime luminaries which most resembled them in brightness, and were supposed to be most benignant to man. But the planet Saturn appears to the naked eye with so feeble a lustre, that, in the infancy of astronomy, it could not make such an impression on the mind as to excite that admiration which we must conceive to have always preceded planetary worship. It is to be observed, too, that by the Pagan writers of antiquity Saturn is constantly represented as a star of baleful influence. He is termed the *leaden planet*; the *planet of malevolent aspect*; the *dismal*, the *inhuman star*. That the Egyptians, at so early a period as that under consideration, should have adored as one of their greatest gods a planet obscure in its appearance, distant in its situation, and baleful in its influence, is wholly incredible.

There is, however, another star which they might naturally adore, and which we know they actually did adore, as one of their most beneficent gods, at a very early period. This is the ἀστροκύων or σειριος of the Greeks, the *canis* or *stella canicularis* of the Romans, and the *dog-star* of modern Europe. By the Egyptians it was called *Sothis* or *Soth*, which signifies *safety*, *beneficence*, *fecundity*; and it received this name, because making its appearance in the heavens at the very time when the Nile overflowed the country, it was supposed

Remphan. to regulate the inundation. On this account Plutarch (*Is. et Osir.*) tells us, they believed the soul of their illustrious benefactress *Isis* to have transmigrated into the star *Sothis*, which they therefore worshipped as the divinity which rendered their country fruitful. It made its appearance, too, on the first day of the month *Thoth* (A), which was the beginning of the Egyptian year, and as such celebrated with feasting and festivity; and being by much the brightest star in the heavens, Horapollo (cap. 3. informs us it was considered as sovereign over the rest. A combination of so many important circumstances might have induced a people less superstitious than the Egyptians to pay divine homage to that glorious luminary, which was confounded with *Isis*, who had been long regarded with the highest veneration; and as Isis was the wife and sister of Osiris, and always associated with him, the star of Isis or *Remphan* was naturally associated with *Moloch*, the same with Osiris.

But it will be asked, how the star which by the Egyptians was called *Soth* or *Sothis* came to be worshipped by the Hebrews under the appellation of *Chiun* or *Remphan*? This is a very pertinent question, and we shall endeavour to answer it.

Every one knows that the pronunciation of oriental words is very uncertain; and that as the vowels were often omitted in writing, it is of very little importance to the meaning how they be supplied, provided we retain the radical consonants. The word *Chiun* may with equal propriety be written *Kiun*, *Kion*, or even *Kyon*, the Hebrew *jod* being convertible into the Greek υ or the Roman *y*; but the words *Cane*, *Chan*, *Kan*, or *Khan*, which are often diversified into *Khen*, *Kyn*, *Cohen*, *Cahan*, signifying *Head*, *Chief*, *Prince*, *King*, &c. are diffused through a great part of Asia and Europe. In the Chinese language *Quin*, which signifies a *King*, is so similar to the word *Chiun* or *Khiun* under consideration, that no etymologist will hesitate to pronounce them of the same original and the same import. The word *Kan* or *Khan* is universally known to be an honorary title in Tartary; and *Kaian* or *Kain*, which is manifestly cognate of the word *Chiun* or *Kiun*, is, in the *Plhevi* or old Persian language, the epithet applied to the dynasty of princes which succeeded Cyrus the Great. Among the Scythians or ancient Tartars, *Ghiun* signifies the *Sun* and likewise the *day*; and *Kung*, *Kinung*, *Kun*, runs through all the dialects of the Gothic tongue, everywhere denoting a *chief* or *sovereign*. In the Syrian dialect, *Kon* signifies a prince; and hence the Almighty is styled (Gen. xiv. 19.) *Konah*, which is translated *possessor*, but might have, with perhaps more propriety, been rendered *Sovereign* of heaven and earth. In Hebrew, the word *Kahan* or *Kahen*, which is the very same with *Khan* or *Kan*, signifies either a *priest* or a *prince*; and in Egypt *Kon* was the name of the first Hercules or the *sun*. Hence the same word in composition denotes greatness, as *Can-obus* the great serpent; *Can-athoth*, the great *Thoth* or Mercury; *Can-osiris*, the great *Osiris*.

From this deduction we would conclude, that the word, which is found in so many tongues, and always denotes *Chief*, *Prince*, *Sovereign*, is the very word *Chiun* which the Egyptians and Hebrews applied to *Sothis*, as being, in their conceptions, the chief or sovereign of all the stars. This will appear still more probable, when we have ascertained the import of the word *Remphan*, or, as the LXX have it, *Raiphan*.

Remphan, Remonstei.

Phan, the latter part of this word, is unquestionably the same with *Pan*, the most ancient of the Egyptian gods (see PAN). It is likewise a cognate of the Hebrew *Phanah*, conspexit, spectavit, vidit; and the radical word seems to be PHAH, which signifies sometimes the countenance, and sometimes *light*. Hence *Phaethon*, which is compounded of *pha* "light," *eth* or *esh*, "fire," and *on*, "strength," came to be one of the names of the sun. *Rai*, which we commonly write *Rajah*, has long signified, among the Indians, a subordinate prince; and we know, that between India and Egypt there was a very early intercourse. *Raiphan*, therefore, may be either the *royal light* or the *bright prince*, subordinate to Osiris; and in either sense, it was a very proper epithet of *Sothis* in the Egyptian kalendar. The word *Rem* or *Rom*, again (for it is sometimes written Remphan, and sometimes Rompha), is no other than the Hebrew רום, *Rum*, "high, exalted." Hence Remphan is the *high* or *exalted light*, which Sothis certainly was.

For this etymological disquisition we are indebted to Dr Doig, the learned author of *Letters on the Savage State*, who has written a dissertation on *Chiun* and *Remphan*, of such value that we hope it will not be much longer withheld from the public. The ascertaining the identity of those names, and the god to which they belonged, is the least of its merit; for it will be found to throw much light upon many passages in the Old Testament. What confirms his interpretation is, that the idol consecrated by the Egyptians to *Sothis* or the dog-star, was a female figure with a star on her head; and hence the prophet upbraids his countrymen with having borne the *Star* of their deity.

ACTION OF REMOVING, in *Scots Law*. See LAW, N° clxvii. 18.

REMURIA, festivals established at Rome by Romulus to appease the manes of his brother Remus. They were afterwards called *Lemuria*, and celebrated yearly.

REMUS, the brother of Romulus, was exposed together with his brother, by the cruelty of his grandfather. In the contest which happened between the two brothers about building a city, Romulus obtained the preference, and Remus, for ridiculing the rising walls, was put to death by his brother's orders, or by Romulus himself (see ROMULUS). The Romans were afflicted with a plague after this murder; upon which the oracle was consulted, and the manes of Remus appeased by the institution of the Remuria.

RENAL, something belonging to the reins or KIDNEYS.

RENCOUNTER, in the military art, the encounter of two little bodies or parties of forces. In which sense *rencounter* is used in opposition to a pitched battle.

RENCOUNTER, in single combats, is used by way of contradistinction

(A) This was the case at a very remote period; but it is otherwise at present, owing to the *PRECESSION of the Equinoxes*. See that article.

contradistinction to DUEL.—When two persons fall out and fight on the spot without having premeditated the combat, it is called a *rencounter*.

RENDEZVOUS, or RENDEVOUS, a place appointed to meet in at a certain day and hour.

RENDSBURG, the frontier town in Holstein, is regularly built, and better fortified than any in the Danish dominions. It is situated on a canal which runs from the Baltic. This is a work of considerable commercial consequence, and deserves to be particularly noticed. It has its source three miles north of Keil, forming the boundary of Holstein and Sleswick, and by means of it ships of 140 tons can come up from the Baltic. This canal was begun in 1777, and it is intended to make it stretch across the whole peninsula, the utility of which will be clearly perceived by all those who are acquainted with the value of inland navigation. Rendsburg is a place of considerable trade, and contains about 2800 inhabitants, including the garrison which is usually stationed there.

RENEALMIA, a genus of plants belonging to the monandria class. See BOTANY *Index*.

RENEGADE, or RENEGADO, a person who has apostatized or renounced the Christian faith to embrace some other religion, particularly Mahometanism.

RENFREW, a royal borough, and the county town of Renfrewshire, situated not far from the south bank of the Clyde, about five miles west from Glasgow, and three north from Paisley. It has only one narrow street half a mile long, and its trade is inconsiderable, though favourably situated for commerce. The river Clyde having shifted its bed, a canal was formed in it, by which vessels of 200 tons burden can come up to the town during spring tides. The manufacture of thread has been long carried on here, and that of soap and candles to a great extent. Many looms are constantly employed in the fabrication of silk and muslin. In the year 1164 it became memorable for a battle between Somerled thane of Argyle and Gilchrist earl of Angus, in which the former was defeated. King Robert II. made it a royal borough; and charters were afterwards granted to it by James VI. and Queen Anne. Its political constitution consists of a provost, two bailies, and 16 counsellors, who have the management of about 360l. of annual revenue, arising from lands, salmon fishing, &c. In the year 1791 the population amounted to 1628. The soil consists of clay, sand, and rich loam, the latter of which is the most predominant. The whole of the land is enclosed and well cultivated. It is a place of very great antiquity, as we find mention is made of it in the chartularies of the abbeys of Dunfermline and Paisley.

RENFREWSHIRE, a small but populous county of Scotland, bounded on the south-west by the hills which run along the northern part of Ayrshire; towards the west and north by the river Clyde, and on the east by Lanarkshire. It is rather level along the north-east and north part of it; and it has few hills which rise to any considerable height. But the summits of Balagich and Dunware, in the parish of Eaglesham, are about 1000 feet above the level of the sea.

The waters of Renfrewshire are not extensive, but human industry has rendered them of considerable importance; and they are rather employed to turn some vast water wheel or other pieces of machinery, than to give variety to the beauties of a park, or to please the eye with the romantic scenery which nature sometimes delights to display. The chief rivers are the White and Black Carts, and the Grief, which ultimately form a junction and discharge themselves into the Clyde below Inchinnan bridge.

The number of lakes in this county is increased for the purpose of collecting water to give motion to the machinery of cotton mills, or to answer the demands of extensive bleachfields.

The general appearance of this county is favourable to agriculture, the population being very extensive, and the inclosures numerous, while manure in abundance is obtained from the neighbouring towns. Commerce and manufactures have been so often successfully pursued, producing great and sudden riches, that in a greater or less degree they occupy the attention of almost every individual. Although a considerable part of it might be constantly kept with advantage under arable crops, yet so extensive is the demand for the products of the dairy, that a very large proportion of the soil is perpetually kept in grass. With respect to crops, potatoes generally constitute a part of every rotation. This is the usual arrangement: Oats from grass; potatoes or barley dunged; oats, with five pounds of red clover and three firlots of rye-grass; hay for two years; pasture.

The proprietors of land in this county have shewn a laudable zeal for the making of excellent roads, which are constantly kept in the best repair, and steelyards are fixed at every toll-bar to prevent carts from being overloaded; 15 cwt. being allowed in the vicinity of Paisley as the load for a cart with one horse.

The mineral productions are not very extensive, but they are very abundant in the vicinity of Paisley. No coal has been met with near Greenock or Port-Glasgow; but what is called *osmund stone* is found in the parishes of Eaglesham and Kilbarchan, so very soft at first that it may be cut with a chisel, but it becomes much harder by exposure to the air. It is of various colours; breaks in every direction; readily absorbs water; and if recently heated in the fire, the absorption is accompanied with a hissing noise. There are two mineral springs in the same vicinity of Eaglesham; the one possessing a purgative quality, and the other is regarded as a remedy for what is called the *moor-ill* in black cattle.

The most remarkable field of minerals is in the vicinity of Paisley; the most singular being the coal at Quarreltown, upwards of 50 feet thick, consisting of five strata in contact with each other (A). The Hurlet coal, belonging to Lord Glasgow, about three miles south-east of Paisley, is five feet three inches thick, and supposed to have been wrought for more than two centuries. Inflammable air and fixed air are met with in this mine, but from the precautions adopted accidents are not so frequent as might otherwise be apprehended. The coal-mines of Hurlet have for a long time afforded the materials for a copperas manufactory on a small scale; and one

(A) For a detailed account of this singular mass of coal, the reader is referred to the Appendix to Williams's Mineral Kingdom, by Dr Millar, 2 vols. 8vo, 1809.

one of the most extensive manufactories of alum in Britain has been established and successfully carried on by a spirited and enterprising company, for several years past, at the same place. Coal is also found in the upper part of the county, as in the parish of Cathcart, and also not far from Renfrew. Limestone is abundant in many parts of the county, as in the parish of Cathcart; and at Lord Glasgow's coal work at Hurlet, it forms a very considerable stratum covering the coal. But one of the most remarkable masses of limestone is found at the entrance to a romantic glen called Glenniffer, three miles to the south of Paisley. The limestone is in a mass of about 10 feet thick, dips to the centre, and is wrought by driving mines under a thick mass of whinstone which covers it. Ironstone is also abundant along with the coal strata in some parts of the county.

The ruins of an old castle, called the Peel, to which the lairds of Semple retreated in times of imminent danger, are still to be seen in an island of Castle Semple loch; and the ruins of the castle of Newark, lower down the country, are even at this day deserving of attention. They are lofty, and have still an air of magnificence, and some parts of it were inhabited about half a century ago. It is situated on the eastern part of the bay containing the town and harbour of Port Glasgow and Newark. This castle is very ancient, is the property of Lord Belhaven, but when it was erected cannot be fully ascertained. Mearns Castle, another ruin, stands in the south-east part of the county, near the village and church of the same name. Crookstone Castle is situated about three miles to the south-east of Paisley. The strong position and commanding prospect of this magnificent ruin must have rendered it a favourite residence of the powerful family of Lennox, to whom it originally belonged. Near the castle there is a yew-tree, venerable from its antiquity, but still more so, according to the legendary lore of the country, as having afforded its shade to the unfortunate Queen Mary and her equally unfortunate husband Darnley. If this be true, the said tree is not less than three centuries old.

There are four cups in the parish of Kilmacolm which were used by the celebrated reformer John Knox at the dispensation of the Lord's supper. They are formed of the purest silver, and seem to have been originally intended for candlesticks, although necessity converted them into communion cups. This sacred use of them, joined to their antiquity, makes them much esteemed by the people at large.

Renfrew is the only royal borough in this county, a privilege which was conferred upon it by Robert Bruce. It elects a member of parliament along with Glasgow, Dunbarton, and Rutherglen.

The other towns are Paisley, Greenock, Port Glasgow; and some of smaller note, as Kilbarchan, Lochwinnoch, Neilston, Gourock, and Auldkirk. Among these deserves also to be mentioned Johnston, which within a period of little more than 20 years has become a large town, owing to the progress and prosperity of the cotton manufacture.

The manufacture of silk gauze was introduced into Paisley about the year 1760, in imitation of that of Spittalfields in London; experiencing at first many difficulties to which new inventions are very frequently exposed. Patterns and designs of fancy works were originally composed at Paris; but the manufacturers at Paisley established draughtsmen of their own, and the patterns thus executed were sent to London and Paris in order to be approved of. By means of industry and genius properly encouraged, the most curious fabrics came to be devised; and the vast variety of elegant and highly ornamented gauze manufactured here is allowed to be superior to every thing of the kind which had formerly made its appearance. Even London itself was obliged to relinquish this manufacture; merchants from the metropolis came to carry it on at Paisley; and warehouses were opened in London, in Dublin, and Paris, for vending their commodities. We formerly said that Paisley must contain upwards of 25,000 inhabitants see (PAISLEY); but we have since seen a more recent computation, by which they are stated at upwards of 31,000.

The whole population of Renfrewshire amounted to 78,000 in 1801, of which Paisley alone contained much more than a third, and in 1811 it was 92,596. In the year 1755 the population of this county was 26,645, so that in the course of sixty years it has more than tripled. The following table exhibits a view of the population of each parish according to the reports communicated to the Statistical History of Scotland.

	Parishes.	Population in 1755.	Population in 1790—1798.
1	Cathcart	499	697
	Eaglesham	1103	1000
	Eastwood	1142	2642
	Erskine	829	808
5	Greenock	3858	15,000
	Houston	947	1034
	Inchinnan	347	306
	Innerkip	1590	1280
	Kilbarchan	1485	2506
10	Kilmacolm	1495	951
	Lochwinnoch	1530	2613
	Mearns	886	1430
	Neilston	1299	2330
	Paisley, town	4290	13,800
15	Ditto, Abbey parish	2509	10,792
	Port Glasgow	1695	4036
17	Renfrew	1091	1628
		26,645	62,853

See RENFREWSHIRE, SUPPLEMENT.

RENNES, a town of France, and capital of the department of Ille and Vilaine. Before the revolution it had a bishop's see, two abbeys, a parliament, and a mint. The houses are six or seven stories high, and the suburbs of larger extent than the town itself. The cathedral church is large, and the parliament-house a handsome structure. The great square belonging to it is surrounded with handsome houses. There is a tower, formerly a pagan temple, which now contains the town-clock. It is seated on the river Vilaine, which divides it into two parts, and was anciently fortified, but the walls are now in ruins, and the ditch nearly filled up. The population in 1817 was 29,000. The siege of the city by Edward III. king of England is very celebrated in history. The English and Breton army consisted of 40,000 men; and nevertheless, after having remained before it six months, were

were obliged to retire without success. E. Long. 0. 23. N. Lat. 48. 7.

RENNET. See RUNNET.

RENT, in *Law*, a sum of money, or other consideration, issuing yearly out of lands or tenements.

RENTERING, in the manufactories, the same with fine-drawing. It consists in sewing two pieces of cloth edge to edge, without doubling them, so that the seam scarcely appears; and hence it is denominated *fine drawing*. It is a French word meaning the same thing, and is derived from the Latin *retrahere*, of *re*, *in*, and *trahere*, because the seam is drawn in or covered. We are told *, that in the East Indies, if a piece of fine muslin be torn and afterwards mended by the fine drawers, it will be impossible to discover where the rent was. In this country the dexterity of the fine-drawers is not so great as that of those in the east; but it is still such as to enable them to defraud the revenue, by sewing a head or slip of English cloth on a piece of Dutch, Spanish, or other foreign cloth; or a slip of foreign cloth on a piece of English, so as to pass the whole as of a piece, and by that means avoid the duties, penalties, &c. The trick was discovered in France by M. Savary.

* *Lettres edifiantes Curieuses.*

RENTERING, in tapestry, is the working new warp into a piece of damaged tapestry, whether eaten by the rats or otherwise destroyed, and on this warp to restore the ancient pattern or design. The warp is to be of woollen, not linen. Among the titles of the French tapestry-makers is included that of renterers. Fine-drawing is particularly used for a rent or hole, which happens in dressing or preparing a piece of cloth artfully sewed up or mended with silk. All fine-drawings are reckoned defects or blemishes, and should be allowed for in the price of the piece.

RENVERSE, INVERTED, in *Heraldry*, is when any thing is set with the head downwards, or contrary to its natural way of standing. Thus, a chevron renverse is a chevron with the point downwards. They use also the same term when a beast is laid on its back.

RENUNCIATION, the act of renouncing, abdicating, or relinquishing, any right, real or pretended.

REPARTEE, a smart, ready reply, especially in matters of wit, humour, or raillery. See RAILLERY.

REPEALING, in *Law*, the revoking or annulling of a statute or the like.

No act of parliament shall be repealed the same session in which it was made. A deed or will may be repealed in part, and stand good for the rest. It is held that a pardon of felony may be repealed on disproving the suggestion thereof.

REPELLENTS, in *Medicine*, remedies which are supposed to drive back a morbid humour into the mass of blood, from whence it was unduly secreted.

REPENTANCE, in general, means sorrow for any thing past. In theology it means such a sorrow for sin as produces newness of life, or such a conviction of the evil and danger of a sinful course as is sufficient to produce shame and sorrow in the review of it, and effectual resolutions of amendment. In this sense the evangelical writers use μεταμελεια and μετανοια. See PENITENCE and THEOLOGY.

REPERCUSSION, in *Music*, a frequent repetition of the same sound.

REPERTORY, a place wherein things are orderly disposed, so as to be easily found when wanted. The indices of books are repertories, showing where the matters sought for are treated of. Common-place books are also kinds of repertories.

REPETEND, in *Arithmetic*, signifies that part of an infinite decimal fraction, which is continually repeated *ad infinitum*. Thus in the numbers 2. 13 13 13 &c. the figures 13 are the repetend and marked thus $\dot{1}\dot{3}$. These repetends chiefly arise in the reduction of vulgar fractions to decimals. Thus, $\frac{1}{3}=0.333$ &c.$=0.\dot{3}$.

REPETITION, the reiterating of an action.

REPETITION, in *Music*, denotes a reiterating or playing over again the same part of a composition, whether it be a whole strain, part of a strain, or double strain, &c.

When the song ends with a repetition of the first strain, or part of it, the repetition is denoted by *da capo*, or D. C. *i. e.* "from the beginning."

REPETITION, in *Rhetoric*, a figure which gracefully and emphatically repeats either the same word, or the same sense in different words. See ORATORY, N° 67—80.

The nature and design of this figure is to make deep impressions on those we address. It expresses anger and indignation, full assurance of what we affirm, and a vehement concern for what we have espoused.

REPHIDIM, in *Ancient Geography*, a station of the Israelites near Mount Horeb, where they murmured for want of water; when Moses was ordered to smite the rock Horeb, upon which it yielded water. Here Joshua discomfited the Amalekites. This rock, out of which Moses brought water, is a stone of a prodigious height and thickness, rising out of the ground; on two sides of which are several holes, by which the water ran. (Thevenot).

REPLEGIARE, in *Law*, signifies to redeem a thing taken or detained by another, by putting in legal sureties.

DE HOMINE REPLEGIANDO. See HOMINE.

REPLEVIN, in *Law*, a remedy granted on a distress, by which the first possessor has his goods restored to him again, on his giving security to the sheriff that he will pursue his action against the party distraining, and return the goods or cattle if the taking them shall be adjudged lawful.

In a replevin the person distrained becomes plaintiff; and the person distraining is called the *defendant* or *avowant*, and his justification an *avowery*.

At the common law replevins are by writ, either out of the king's-bench or common-pleas; but by statute, they are by plaint in the sheriff's court, and court baron, for a person's more speedily obtaining the goods distrained.

If a plaint in replevin be removed into the court of king's bench, &c. and the plaintiff makes default and becomes non-suited, or judgment is given against him, the defendant in replevin shall have the writ of *retorno habendo* of the goods taken in distress. See the next article.

REPLEVY, in *Law*, is a tenant's bringing a writ of replevin, or *replegiari facias*, where his goods are taken by distress for rent; which must be done within five days after the distress, otherwise at the five days end they are to be appraised and sold.

This word is also used for bailing a person, as in the case of a *homine replegiando*.

REPORT,

REPORT, the relation made upon oath, by officers or persons appointed to visit, examine, or estimate the state, expences, &c. of any thing.

Report, in *Law*, is a public relation of cases judicially argued, debated, resolved, or adjudged in any of the king's courts of justice, with the causes and reasons of the same, as delivered by the judges. Also when the court of chancery, or any other court, refers the stating of a case, or the comparing of an account, to a master of chancery, or other referee, his certificate thereon is called a *report*.

REPOSE, in *Poetry*, &c. the same with rest and pause. See Rest, &c.

Repose, in *Painting*, certain masses or large assemblages of light and shade, which being well conducted, prevent the confusion of objects and figures, by engaging and fixing the eye so as it cannot attend to the other parts of the painting for some time; and thus leading it to consider the several groups gradually, proceeding as it were from stage to stage.

REPRESENTATION, in the drama, the exhibition of a theatrical piece, together with the scenes, machinery, &c.

REPRESENTATIVE, one who personates or supplies the place of another, and is invested with his right and authority. Thus the house of commons are the representatives of the people in parliament. See Commons and Parliament.

REPRIEVE, in *Criminal Law*, (from *reprendre*, "to take back") is the withdrawing of a sentence for an interval of time; whereby the execution is suspended. See Judgment.

Blackst. Comment. This may be, first, *ex arbitrio judicis*, either before or after judgment: as, where the judge is not satisfied with the verdict, or the evidence is suspicious, or the indictment is insufficient, or he is doubtful whether the offence be within clergy: or sometimes if it be a small felony, or any favourable circumstances appear in the criminal's character, in order to give room to apply to the crown for either an absolute or conditional pardon. These arbitrary reprieves may be granted or taken off by the justices of gaol-delivery, although their session be finished, and their commission expired: but this rather by common usage than of strict right.

Reprieves may also be *ex necessitate legis*: as where a woman is capitally convicted, and pleads her pregnancy. Though this is no cause to stay judgment, yet it is to respite the execution till she be delivered. This is a mercy dictated by the law of nature, *in favorem prolis*; and therefore no part of the bloody proceedings in the reign of Queen Mary hath been more justly detested, than the cruelty that was exercised in the island of Guernsey, of burning a woman big with child; and, when through the violence of the flame the infant sprang forth at the stake, and was preserved by the bystanders, after some deliberations of the priests who assisted at the sacrifice, they cast it into the fire as a young heretic. A barbarity which they never learned from the laws of ancient Rome; which direct, with the same humanity as our own, *quod prægnantis muliers damnatæ pœna differatur, quoad pariat*: which doctrine has also prevailed in England, as early as the first memorials of our laws will reach. In case this plea be made in stay of execution, the judge must direct a jury of twelve matrons or discreet women to inquire into the fact: and if they bring in their verdict *quick with child* (for barely *with child*, unless it be alive in the womb, is not sufficient), execution shall be staid generally till the next session; and so from session to session, till either she is delivered, or proves by the course of nature not to have been with child at all. But if she once hath had the benefit of this reprieve, and been delivered, and afterwards becomes pregnant again, she shall not be intitled to the benefit of a farther respite for that cause. For she may now be executed before the child is quick in the womb; and shall not, by her own incontinence, evade the sentence of justice.

Another cause of regular reprieve is, if the offender become *non compos* between the judgment and the award of execution: for regularly, though a man be *compos* when he commits a capital crime, yet if he becomes *non compos* after, he shall not be indicted; if after indictment, he shall not be convicted; if after conviction, he shall not receive judgment; if after judgment, he shall not be ordered for execution: for *furiosus solo furore punitur;* and the law knows not but he might have offered some reason, if in his senses, to have stayed these respective proceedings. It is therefore an invariable rule, when any time intervenes between the attainder and the award of execution, to demand of the prisoner what he hath to allege why execution should not be awarded against him; and, if he appears to be insane, the judge in his discretion may and ought to reprieve him. Or, the party may plead in bar of execution; which plea may be either pregnancy, the king's pardon, an act of grace, or diversity of person, viz. that he is not the same that was attainted, and the like. In this case a jury shall be impanelled to try this collateral issue, namely, the identity of his person; and not whether guilty or innocent, for that has been decided before. And in these collateral issues the trial shall be *instanter;* and no time allowed the prisoner to make his defence or produce his witnesses, unless he will make oath that he is not the person attainted: neither shall any peremptory challenges of the jury be allowed the prisoner, though formerly such challenges were held to be allowable whenever a man's life was in question. If neither pregnancy, insanity, non-identity, nor other plea, will avail to avoid the judgment, and stay the execution consequent thereupon, the last and surest resort is in the king's most gracious pardon; the granting of which is the most amiable prerogative of the crown. See the article Pardon.

REPRISALS, a right which princes claim of taking from their enemies any thing equivalent to what they unjustly detain from them or their subjects. For as the delay of making war may sometimes be detrimental to individuals who have suffered by depredations from foreign potentates, our laws have in some respects armed the subject with power to impel the prerogative; by directing the ministers of the crown to issue letters of marque and reprisal upon due demand: the prerogative of granting which is nearly related to, and plainly derived from, that other of making war; this being indeed only an incomplete state of hostilities, and generally ending in a formal denunciation of war. These letters are grantable by the law of nations, whenever the subjects of one state are oppressed and injured by those of another; and justice is denied by that state to which the oppressor belongs. In this case letters of marque

and

and reprisal (words used as synonymous; and signifying, the latter a taking in return, the former the passing the frontiers in order to such taking) may be obtained, in order to seize the bodies or goods of the subjects of the offending state, until satisfaction be made, wherever they happen to be found. And indeed this custom of reprisals seems dictated by nature herself; for which reason we find in the most ancient times very notable instances of it. But here the necessity is obvious, of calling in the sovereign power, to determine when reprisals may be made; else every private sufferer would be a judge in his own cause. In pursuance of which principle, it is with us declared by the stat. 4 Hen. V. c. 7. that, if any subjects of the realm are oppressed in time of truce by any foreigners, the king will grant marque in due form, to all that feel themselves grieved. Which form is thus directed to be observed: the sufferer must first apply to the lord privy-seal, and he shall make out letters of request under the privy-seal; and if after such request of satisfaction made, the party required do not within convenient time make due satisfaction or restitution to the party grieved, the lord chancellor shall make him out letters of marque under the great seal; and by virtue of these he may attack and seize the property of the aggressor nation, without hazard of being condemned as a robber or pirate.

Reprisal, or *Recaption*, is a species of remedy allowed to an injured person. This happens when any one has deprived another of his property in goods or chattels personal, or wrongfully detains one's wife, child, or servant: in which case the owner of the goods, and the husband, parent, or master, may lawfully claim and retake them, wherever he happens to find them; so it be not in a riotous manner, or attended with a breach of the peace. The reason for this is obvious; since it may frequently happen that the owner may have this only opportunity of doing himself justice: his goods may be afterwards conveyed away or destroyed; and his wife, children, or servants, concealed or carried out of his reach; if he had no speedier remedy than the ordinary process of law. If therefore he can so contrive it as to gain possession of his property again, without force or terror, the law favours and will justify his proceeding. But, as the public peace is a superior consideration to any one man's private property; and as, if individuals were once allowed to use private force as a remedy for private injuries, all social justice must cease, the strong would give law to the weak, and every man would revert to a state of nature; for these reasons it is provided, that this natural right of recaption shall never be exerted, where such exertion must occasion strife and bodily contention, or endanger the peace of society. If, for instance, my horse is taken away, and I find him in a common, a fair, or a public inn, I may lawfully seize him to my own use; but I cannot justify breaking open a private stable, or entering on the grounds of a third person, to take him, except he be feloniously stolen; but must have recourse to an action at law.

REPROBATION, in *Theology*, means the act of abandoning, or state of being abandoned, to eternal destruction; and is applied to that decree or resolve which God has taken from all eternity to punish sinners who shall die in impenitence; in which sense it is directly opposed to election. When a sinner is so hardened as to feel no remorse or misgiving of conscience, it is considered as a sign of reprobation; which by the casuists has been distinguished into positive and negative. The first is that whereby God is supposed to create men with a positive and absolute resolution to damn them eternally. This opinion is countenanced by St Augustine and other Christian fathers, and is a peculiar tenet of Calvin and most of his followers. The church of England, in *The thirty-nine Articles*, teaches something like it; and the church of Scotland, in the *Confession of Faith*, maintains it in the strongest terms. But the notion is generally exploded, and is believed by no rational divine in either church, being totally injurious to the justice of the Deity. Negative or conditional reprobation is that whereby God, though he has a sincere desire to save men, and furnishes them with the necessary means, so that all if they will may be saved, yet sees that there are many who will not be saved by the means, however powerful, that are afforded them; though by other means which the Deity sees, but will not afford them, they might be saved. Reprobation respects angels as well as men, and respects the latter either fallen or unfallen. See PREDESTINATION.

REPRODUCTION is usually understood to mean the restoration of a thing before existing, and since destroyed. It is very well known that trees and plants may be raised from slips and cuttings; and some late observations have shown, that there are some animals which have the same property. The polype * was the first instance we had of this; but we had scarce time to wonder at the discovery Mr Trembley had made, when Mr Bonnet discovered the same property in a species of water-worm. Amongst the plants which may be raised from cuttings, there are some which seems to possess this quality in so eminent a degree, that the smallest portion of them will become a complete tree again.

* See *Polypus*.

It deserves inquiry, whether or not the great Author of nature, when he ordained that certain insects, as these polypes and worms, should resemble those plants in that particular, allowed them this power of being reproduced in the same degree? or, which is the same thing, whether this reproduction will or will not take place in whatever part the worm is cut? In order to try this, Mr Bonnet entered on a course of many experiments on the water-worms which have this property. These are, at their common growth, from two to three inches long, and of a brownish colour, with a cast of reddish. From one of these worms he cut off the head and tail, taking from each extremity only a small piece of a twelfth of an inch in length; but neither of these pieces was able to reproduce what was wanting. They both perished in about 24 hours; the tail first, and afterwards the head. As to the body of the worm from which these pieces were separated, it lived as well as before, and seemed indeed to suffer nothing by the loss, the head-part being immediately used as if the head was thereon, boring the creature's way into the mud. There are, besides this, two other points in which the reproduction will not take place; the one of these is about the fifth or sixth ring from the head, and the other at the same distance from the tail; and in all probability the condition of the great artery in these parts is the cause of this.

What is said of the want of the reproductive power of these parts relates only to the head and tail ends; for as to the body, it feels very little inconvenience from the

the loss of what is taken off, and very speedily reproduces those parts. Where then does the principle of life reside in such worms, which, after having their heads cut off, will have not only the same motions, but even the inclinations, that they had before? and yet this difficulty is very small, compared to several others which at the same time offer themselves to our reason. Is this wonderful reproduction of parts only a natural consequence of the laws of motion? or is there lodged in the body of the creature a chain of minute buds or shoots, a sort of little embryos, already formed and placed in such parts where the reproductions are to begin? Are these worms only mere machines? or are they, like more perfect animals, a sort of compound, the springs of whose motions are actuated or regulated by a sort of soul? And if they have themselves such a principle, how is it that this principle is multiplied, and is found in every separate piece? Is it to be granted that there are in these worms, not a single soul (if it is to be so called) in each, but that each contains as many souls as there are pieces capable of reproducing perfect animals? Are we to believe with Malpighi, that these sorts of worms are all heart and brain from one end to the other! This may be; but yet if we knew that it was so, we should know in reality but very little the more for knowing it: and it seems, after all, that in cases of this kind we are only to admire the works of the great Creator, and sit down in silence.

The nice sense of feeling in spiders has been much talked of by naturalists; but it appears that these worms have yet somewhat more surprising in them in regard to this particular. If a piece of stick, or any other substance, be brought near them, they do not stay for its touching them, but begin to leap and frisk about as soon as it comes towards them. There want, however, some farther experiments to ascertain whether this be really owing to feeling or to sight; for though we can discover no distinct organs of sight in these creatures, yet they seem affected by the light of the sun or a candle, and always frisk about in the same manner at the approach of either; nay, even the moon-light has some effect upon them.

A twig of willow, poplar, or many other trees, being planted in the earth, takes root, and becomes a tree, every piece of which will in the same manner produce other trees. The case is the same with these worms: they are cut in pieces, and these several pieces become perfect animals; and each of these may be again cut into a number of pieces, each of which will in the same manner produce an animal. It had been supposed by some that these worms were oviparous: but Mr Bonnet, on cutting one of them to pieces, having observed a slender substance, resembling a small filament, to move at the end of one of these pieces, separated it; and on examining it with glasses, found it to be a perfect worm, of the same form with its parent, which lived and grew larger in a vessel of water into which he put it. These small bodies are easily divided, and very readily complete themselves again, a day usually serving for the production of a head to the part that wants one; and, in general, the smaller and slenderer the worms are, the sooner they complete themselves after this operation. When the bodies of the large worms are examined by the microscope, it is very easy to see the appearance of the young worms alive, and moving about within them: but it requires greater precision and exactness to be certain of this; since the ramifications of the great artery have very much the appearance of young worms, and they are kept in a sort of continual motion by the systoles and diastoles of the several portions of the artery, which serve as so many hearts. It is very certain, that what we force in regard to these animals by our operations, is done also naturally every day in the brooks and ditches where they live. A curious observer will find in these places many of them without heads or tails, and some without either: as also other fragments of various kinds, all which are then in the act of completing themselves: but whether accidents have reduced them to this state, or they thus purposely throw off parts of their own body for the reproduction of more animals, it is not easy to determine. They are plainly liable to many accidents, by which they lose the several parts of their body, and must perish very early if they had not a power of reproducing what was lost: they often are broken into two pieces, by the resistance of some hard pieces of mud which they enter; and they are subject to a disease, a kind of gangrene, rotting off the several parts of their bodies, and must inevitably perish by it, had they not this surprising property.

This worm was a second instance, after the polype, of the surprising power in an animal of recovering its most essential parts when lost. But nature does not seem to have limited her beneficence in this respect to these two creatures. Mr Bonnet tried the same experiments on another species of water-worm, differing from the former in being much thicker. This kind of worm, when divided in the summer season, very often shows the same property: for if it be cut into two or three pieces, the pieces will lie like dead for a long time, but afterwards will move about again; and will be found in this state of rest to have recovered a head, or a tail, or both. After recovering their parts, they move very little; and, according to this gentleman's experiments, seldom live more than a month.

It should seem, that the more difficult success of this last kind of worm, after cutting, and the long time it takes to recover the lost parts, if it do recover them at all, is owing to its thickness; since we always find in that species of worms which succeeds best of all, that those which are thinest always recover their parts much sooner than the others.

The water-insects also are not the only creatures which have this power of recovering their lost parts. The earth affords us some already discovered to grow in this manner from their cuttings, and these not less deserving our admiration than those of the water: the common earth-worms are of this kind. Some of these worms have been divided into two, others into three or four pieces; and some of these pieces, after having passed two or three months without any appearance of life or motion, have then begun to produce a head or tail, or both. The reproduction of the anus, after such a state of rest, is no long work; a few days do it; but it is otherwise with the head, that does not seem to perform its functions in the divided pieces till about seven months after the separation. It is to be observed, that in all these operations both on earth and water-worms, the hinder part suffers greatly more than the fore part in the cutting; for it always twists itself about a long time, as if actuated by strong convulsions; whereas the head

head usually crawls away without the appearance of any great uneasiness.

The reproduction of several parts of lobsters, crabs, &c. makes also one of the great curiosities in natural history. That, in lieu of an organical part of an animal broken off, another shall rise perfectly like it, may seem inconsistent with the modern system of generation, where the animal is supposed to be wholly formed in the egg. Yet has the matter of fact been well attested by the fishermen, and even by several virtuosos who have taken the point into examination, particularly M. de Reaumur and M. Perrault, whose skill and accuracy in things of this nature will hardly be questioned. The legs of lobsters, &c. consist each of five articulations: now, when any of the legs happen to break by any accident, as in walking, &c. which frequently happens, the fracture is always found to be in a part near the fourth articulation; and what they thus lose is precisely reproduced some time afterwards; that is, a part of a leg shoots out, consisting of four articulations, the first whereof has two claws as before; so that the loss is entirely repaired.

If a lobster's leg be broken off by design at the fourth or fifth articulation, what is thus broken off always comes again; but it is not so if the fracture be made in the first, second, or third articulation. In those cases, the reproduction is very rare if things continue as they are. But what is exceedingly surprising is, that they do not: for, upon visiting the lobster maimed in these barren and unhappy articulations, at the end of two or three days, all the other articulations are found broken off to the fourth; and it is suspected they have performed the operation on themselves, to make the reproduction of a leg certain.

The part reproduced is not only perfectly like that retrenched, but also, in a certain space of time, grows equal to it. Hence it is that we frequently see lobsters, which have their two big legs unequal, and that in all proportions. This shows the smaller leg to be a new one.

A part thus reproduced being broken, there is a second reproduction. The summer, which is the only season of the year when the lobsters eat, is the most favourable time for the reproduction. It is then performed in four or five weeks; whereas it takes up eight or nine months in any other season. The small legs are sometimes reproduced, but more rarely, as well as more slowly, than the great ones: the horns do the same. The experiment is most easily tried on the common crab.

REPTILES, in *Natural History*, a kind of animals denominated from their creeping or advancing on the belly. Or reptiles are those animals, which, instead of feet, rest on one part of the body, while they advance forward with the rest. Such are earthworms, snakes, caterpillars, &c. Indeed, most of the reptiles have feet; only those very small, and the legs short in proportion to the bulk of the body.

Naturalists observe a world of artful contrivance for the motion of reptiles. Thus, particularly in the earthworm, Dr Willis tells us, the whole body is only a chain of annular muscles; or, as Dr Derham says, it is only one continued spiral muscle, the orbicular fibres whereof being contracted, render each ring narrower and longer than before; by which means it is enabled, like the worm of an augre, to bore its passage into the earth. Its reptile motion might also be explained by a wire wound on a cylinder, which when slipped off, and one end extended and held fast, will bring the other near to it. So the earthworm having shot out or extended his body (which is with a wreathing), it takes hold by these small feet it hath, and so contracts the hinder part of its body. Dr Tyson adds, that when the forepart of the body is stretched out, and applied to a plane at a distance, the hind part relaxing and shortening is easily drawn towards it as a centre.

Its feet are disposed in a quadruple row the whole length of the worm, with which, as with so many hooks it fastens down sometimes this and sometimes that part of the body to the plane, and at the same time stretches out or drags after it another.

The creeping of serpents is effected after a somewhat different manner; there being a difference in their structure, in that these last have a compages of bones articulated together.

The body here is not drawn together, but as it were complicated; part of it being applied on the rough ground, and the rest ejaculated and shot from it, which being set on the ground in its turn, brings the other after it. The spine of the back variously wreathed has the same effect in leaping, as the joints in the feet of other animals; they make their leaps by means of muscles, and extend the plicæ or folds. See ERPETOLOGY and OPHIOLOGY.

REPTILIA, the name of one of the orders of the class amphibia, including tortoises, frogs, lizards. See ERPETOLOGY.

REPUBLIC, or COMMONWEALTH, a popular state or government; or a nation where the people have the government in their own hands. See GOVERNMENT, ARISTOCRACY, DEMOCRACY, and MONARCHY.

REPUBLIC of Letters, a phrase used collectively of the whole body of the studious and learned people.

REPUDIATION, in the *Civil Law*, the act of divorcing. See DIVORCE.

REPULSION, in *Physics*, that property of bodies whereby they recede from each other, and, on certain occasions, mutually avoid coming into contact.

REPULSION, as well as attraction, has of late been considered as one of the primary qualities of all matter, and has been much used in explaining the phenomena of nature: thus the particles of air, fire, steam, electric fluid, &c. are all said to have a repulsive power with respect to one another.—That this is the case with the air, and vapour of all kinds, is certain; because when they are compressed into a small space, they expand with great force: but as to fire, light, and electricity, our experiments fail; nay, the supposition of a repulsive power among the particles of the electric fluid is inconsistent with the phenomena, as has been demonstrated under the article ELECTRICITY. Even in those fluids, air and steam, where a repulsive power most manifestly exists, it is demonstrable that the repulsion cannot be a *primary* quality, since it can be increased to a great degree by heat, and diminished by cold: but it is impossible that a *primary* quality of matter can be increased or diminished by any external circumstances whatever; for whatever property depends upon external circumstances, is not a primary but a secondary one.—The repulsion

Repulsion || Requests.

pulsion of electrified bodies is explained under the article Electricity: that of others is less subject to investigation; and the most that can be said concerning it is, that in many cases it seems to be the consequence of a modification of fire, and in others of electricity.

REPUTATION means credit, honour, or the character of good; and since we are destined to live in society, is necessary and useful more or less to every human being. There is no man, except one who is overgrown with pride and self-conceit, or whose actions are bad, but pays attention to his reputation, and wishes to possess the good opinion of his neighbours or the world. The love of reputation and of fame are most powerful springs of action; but though they proceed from the same principle, the means of attaining them, and the effects of them, are not altogether the same.

Many means indeed serve equally to support the reputation, and to increase the fame, differing only in degrees; others, however, belong peculiarly either to the one or to the other. An honest reputation is within the reach of the bulk of mankind; it is obtained by the social virtues and the constant practice of the common duties of life. This kind of reputation indeed is neither extensive nor brilliant, but it is often the most useful in point of happiness. Wit, talents, and genius, are the necessary requisites for fame; but those advantages are perhaps less real in their consequence than those arising from a good reputation. What is of real use costs little; things rare and splendid require the greatest labour to procure, and yield perhaps a more ideal happiness.

Fame can be possessed, comparatively speaking, but by few individuals; as it requires either very superior abilities, supported by great efforts, or very fortunate circumstances. It is constituted by the applause of mankind, or at least by that of a single nation; whilst reputation is of much less extent, and arises from different circumstances. That reputation which is founded on deceit and artifice is never solid; and the most honourable will always be found to be the most useful. Every one may safely, and indeed ought to, aspire to the consideration and praise due to his condition and merit; but he who aspires to more, or who seeks it by dishonest means, will at length meet with contempt.

REQUEST, in *Law*, a supplication or petition preferred to a prince, or to a court of justice; begging relief in some conscionable cases where the common law grants no immediate redress.

Court of Requests (*curia requisitionum*) was a court of equity, of the same nature with the court of chancery, but inferior to it; principally instituted for the relief of such petitioners as in conscionable cases addressed themselves by supplication to his majesty. Of this court the lord privy-seal was chief judge, assisted by the masters of requests; and it had beginning about the 9 Hen. VII. according to Sir Julius Cæsar's tractate upon this subject: Though Mr Gwyn, in his preface to his Readings, saith it began from a commission first granted by King Henry VIII. This court, having assumed great power to itself, so that it became burthensome, *Mich.* anno 40 and 41 *Eliz.* in the court of common-pleas it was adjudged upon solemn argument, that the court of requests was no court of judicature, &c. and by stat. 16 and 17 Car I. cap. 10. it was taken away.

Blackst. Comment.

There are still courts of requests, or courts of conscience, constituted in London and other trading and populous districts for the recovery of small debts. The first of these was established in London so early as the reign of Henry VIII. by an act of their common council; which however was certainly insufficient for that purpose, and illegal, till confirmed by statute 3 Jac. I. c. 15. which has since been explained and amended by statute 14 Geo. II. c. 10. The constitution is this: two aldermen and four commoners sit twice a week to hear all causes of debt not exceeding the value of forty shillings; which they examine in a summary way, by the oath of the parties or other witnesses, and make such order therein as is consonant to equity and good conscience. The time and expence of obtaining this summary redress are very inconsiderable, which make it a great benefit to trade; and thereupon divers trading towns and other districts have obtained acts of parliament for establishing in them courts of conscience upon nearly the same plan as that in the city of London.

Requests, Requiem.

By 25 Geo. III. c. 45. (which is confined to prosecutions in courts of conscience in London, Middlesex, and the borough of Southwark), and by 26 Geo. III. c. 38. (which extends the provisions of the former act to all other courts instituted for the recovery of small debts), it is enacted, that after the first day of September 1786, no person whatsoever, being a debtor or defendant, and who has been or shall be committed to any gaol or prison, by order of any court or commissioners authorised by any act or acts of parliament for constituting or regulating any court or courts for the recovery of small debts, where the debt does not exceed twenty shillings, shall be kept or continued in custody, on any pretence whatsoever, more than twenty days from the commencement of the last mentioned act; or from the time of his, her, or their commitment to prison: and where the original debt does not amount to or exceed the sum of forty shillings, more than forty days from the commencement of the said act, or from the time of his, her, or their commitment as aforesaid; and all gaolers are thereby required to discharge such persons accordingly. And by sect. 2. if it shall be proved to the satisfaction of the court, that any such debtor has money or goods which he has wilfully and fraudulently concealed: in that case the court shall have power to enlarge the aforesaid times of imprisonment for debts under twenty shillings, to any time not exceeding thirty days, and for debts under forty shillings, to any time not exceeding sixty days; which said ground of farther detention shall be specified in the said commitment. And that (by sect. 3.) at the expiration of the said respective times of imprisonment, every such person shall immediately be discharged, without paying any sum of money, or other reward or gratuity whatsoever, to the gaoler of such gaol on any pretence whatsoever; and every gaoler demanding or receiving any fee for the discharge of any such person, or keeping any such person prisoner after the said respective times limited by the said act, shall forfeit five pounds, to be recovered in a summary way before two justices of the peace, one moiety thereof to be paid to the overseers of the poor of the parish where the offence shall be committed, and the other to the informer.

REQUIEM, in the Romish history, a mass sung for the rest of the soul of a person deceased.

Rescission | Resemblance.

RESCISSION, in the *Civil Law*, an action intended for the annulling or setting aside any contract, deed, &c.

RESCRIPT, an answer delivered by an emperor, or a pope, when consulted by particular persons on some difficult question or point of law, to serve as a decision thereof.

RESEDA, a genus of plants belonging to the dodecandria class; and in the natural method ranking under the 54th order, *Miscellaneæ*. See BOTANY *Index*. The *Luteola* or *Dyer's-weed*, *Yellow-weed*, *Weld*, or *Wild-woad*, is one of the most valuable of the species, on account of its extensive use in dyeing. See DYEING. The *odorata* or mignionette is well known for the sweetness of its fragrance, and as an ornament of the flower-garden.

RESEMBLANCE *and* DISSIMILITUDE, the relations of likeness and difference among objects. See COMPARISON.

Elem. of Criticism.

The connection that man hath with the beings around him, requires some acquaintance with their nature, their powers, and their qualities, for regulating his conduct. For acquiring a branch of knowledge so essential to our well-being, motives alone of reason and interest are not sufficient: nature hath providentially superadded curiosity, a vigorous propensity, which never is at rest. This propensity alone attaches us to every new object †; and incites us to compare objects, in order to discover their differences and resemblances.

† See *Novelty*.

Resemblance among objects of the same kind, and dissimilitude among objects of different kinds, are too obvious and familiar to gratify our curiosity in any degree: its gratification lies in discovering differences among things where resemblance prevails, and resemblances where difference prevails. Thus a difference in individuals of the same kind of plants or animals, is deemed a discovery, while the many particulars in which they agree are neglected; and in different kinds, any resemblance is greedily remarked, without attending to the many particulars in which they differ.

A comparison of the former neither tends to gratify our curiosity, nor to set the objects compared in a stronger light: two apartments in a palace, similar in shape, size, and furniture, make separately as good a figure as when compared; and the same observation is applicable to two similar compartments in a garden: on the other hand, oppose a regular building to a fall of water, or a good picture to a towering hill, or even a little dog to a large horse, and the contrast will produce no effect. But a resemblance between objects of the same kind, have remarkably an enlivening effect. The poets, such of them as have a just taste, draw all their similies from things that in the main differ widely from the principal subject; and they never attempt a contrast, but where the things have a common genus, and a resemblance in the capital circumstances: place together a large and a small sized animal of the same species, the one will appear greater, the other less, than when viewed separately: when we oppose beauty to deformity, each makes a greater figure by the comparison. We compare the dress of different nations with curiosity, but without surprise; because they have no such resemblance in the capital parts as to please us by contrasting the smaller parts. But a new cut of a sleeve, or of a pocket, enchants by its novelty; and, in opposition to the former fashion, raises some degree of surprise.

That resemblance and dissimilitude have an enlivening effect upon objects of sight, is made sufficiently evident; and that they have the same effect upon objects of the other senses, is also certain. Nor is that law confined to the external senses; for characters contrasted make a greater figure by the opposition: Iago, in the tragedy of Othello, says,

He hath a daily beauty in his life
That makes me ugly.

The character of a fop, and of a rough warrior, are nowhere more successfully contrasted than in Shakespeare:

Hotspur. My liege, I did deny no prisoners:
But I remember, when the fight was done,
When I was dry with rage, and extreme toil,
Breathless and faint, leaning upon my sword,
Came there a certain lord, neat, trimly dress'd,
Fresh as a bridegroom; and his chin, new-reap'd,
Show'd like a stubble-land at harvest-home.
He was perfumed like a milliner;
And 'twixt his finger and his thumb he held
A pouncet-box, which ever and anon
He gave his nose:—and still he smil'd and talk'd;
And as the soldiers bare dead bodies by,
He call'd them untaught knaves, unmannerly,
To bring a slovenly unhandsome corse
Betwixt the wind and his nobility.
With many holiday and lady terms
He question'd me: among the rest, demanded
My pris'ners in your Majesty's behalf.
I then, all smarting with my wounds; being gall'd
To be so pester'd with a popinjay,
Out of my grief, and my impatience,
Answer'd, neglectingly, I know not what:
He should, or should not; for he made me mad,
To see him shine so brisk, and smell so sweet,
And talk so like a waiting gentlewoman,
Of guns, and drums, and wounds, (God save the mark!)
And telling me, the sovereign'st thing on earth
Was parmacity for an inward bruise;
And that it was great pity, so it was,
This villanous saltpetre should be digg'd
Out of the bowels of the harmless earth,
Which many a good tall fellow had destroy'd
So cowardly: and but for these vile guns,
He would himself have been a soldier.——

First part, Henry IV. act i. sc. 4.

Passions and emotions are also inflamed by comparison. A man of high rank humbles the bystanders even to annihilate them in their own opinion: Cæsar, beholding the statue of Alexander, was greatly mortified, that now, at the age of 32, when Alexander died, he had not performed one memorable action.

Our opinions also are much influenced by comparison. A man whose opulence exceeds the ordinary standard is reputed richer than he is in reality; and wisdom or weakness, if at all remarkable in an individual, is generally carried beyond the truth.

The opinion a man forms of his present distress is is heightened by contrasting it with his former happiness:

————————Could I forget
What I have been, I might the better bear
What I'm destin'd to. I'm not the first
That have been wretched: but to think how much
I have been happier.
Southern's Innocent Adultery, act ii.

The distress of a long journey makes even an indifferent inn agreeable: and, in travelling, when the road is good, and the horseman well covered, a bad day may be agreeable, by making him sensible how snug he is.

The same effect is equally remarkable, when a man opposes his condition to that of others. A ship tossed about in a storm, makes the spectator reflect upon his own ease and security, and puts these in the strongest light.

A man in grief cannot bear mirth; it gives him a more lively notion of his unhappiness, and of course makes him more unhappy. Satan, contemplating the beauties of the terrestrial paradise, has the following exclamation:

With what delight could I have walk'd thee round,
If I could joy in ought, sweet interchange
Of hill and valley, rivers, woods, and plains,
Now land, now sea, and shores with forest crown'd,
Rocks, dens, and caves! but I in none of these
Find place or refuge; and the more I see
Pleasures about me, so much more I feel
Torment within me, as from the hateful siege
Of contraries: all good to me becomes
Bane, and in heav'n much worse would be my state.
Paradise Lost, book ix. l. 114.

The appearance of danger gives sometimes pleasure, sometimes pain. A timorous person upon the battlements of a high tower, is seized with fear, which even the consciousness of security cannot dissipate. But upon one of a firm head, this situation has a contrary effect: the appearance of danger heightens, by opposition, the consciousness of security, and consequently the satisfaction that arises from security: here the feeling resembles that above mentioned, occasioned by a ship labouring in a storm.

The effect of magnifying or lessening objects by means of comparison is to be attributed to the influence of passion over our opinions. This will evidently appear by reflecting in what manner a spectator is affected, when a very large animal is for the first time placed beside a very small one of the same species. The first thing that strikes the mind is the difference between the two animals, which is so great as to occasion surprise; and this, like other emotions, magnifying its object, makes us conceive the difference to be the greatest that can be: we see, or seem to see, the one animal extremely little, and the other extremely large. The emotion of surprise arising from any unusual resemblance, serves equally to explain, why at first view we are apt to think such resemblance more entire than it is in reality. And it must be observed, that the circumstances of more or less, which are the proper subjects of comparison, raise a perception so indistinct and vague as to facilitate the effect described; we have no mental standard of great and little, nor of the several degrees of any attribute; and the mind, thus unrestrained, is naturally disposed to indulge its surprise to the utmost extent.

In exploring the operations of the mind, some of which are extremely nice and slippery, it is necessary to proceed with the utmost circumspection: and after all, seldom it happens that speculations of that kind afford any satisfaction. Luckily, in the present case, our speculations are supported by facts and solid argument. First, a small object of one species opposed to a great object of another, produces not, in any degree, that deception which is so remarkable when both objects are of the same species. The greatest disparity between objects of different kinds, is so common as to be observed with perfect indifference; but such disparity between the objects of the same kind being uncommon, never fails to produce surprise: and may we not fairly conclude, that surprise, in the latter case, is what occasions the deception, when we find no deception in the former? In the next place, if surprise be the sole cause of the deception, it follows necessarily that the deception will vanish as soon as the objects compared become familiar. This holds so unerringly, as to leave no reasonable doubt that surprise is the prime mover: our surprise is great, the first time a small lapdog is seen with a large mastiff; but when two such animals are constantly together, there is no surprise, and it makes no difference whether they be viewed separately or in company. We set no bounds to the riches of a man who has recently made his fortune; the surprising disproportion between his present and his past situation being carried to an extreme: but with regard to a family that for many generations hath enjoyed great wealth, the same false reckoning is not made. It is equally remarkable, that a trite simile has no effect: a lover compared to a moth scorching itself at the flame of a candle, originally a sprightly simile, has by frequent use lost all force; love cannot now be compared to fire, without some degree of disgust. It has been justly observed against Homer, that the lion is too often introduced into his similes; all the variety he is able to throw into them not being sufficient to keep alive the reader's surprise.

To explain the influence of comparison upon the mind, we have chosen the simplest case, viz. the first sight of two animals of the same kind, differing in size only; but to complete the theory, other circumstances must be taken in. And the next supposition we make, is where both animals, separately familiar to the spectator, are brought together for the first time. In that case, the effect of magnifying and diminishing is found remarkably greater than in that first mentioned; and the reason will appear upon analysing the operation: the first feeling we have is of surprise at the uncommon difference of two creatures of the same species; we are next sensible, that the one appears less, the other larger, than they did formerly; and that new circumstance increasing our surprise, makes us imagine a still greater opposition between the animals, than if we had formed no notion of them beforehand.

Let us make one other supposition, that the spectator was acquainted beforehand with one of the animals only; the lapdog, for example. This new circumstance will vary the effect; for, instead of widening the natural

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ral difference, by enlarging in appearance the one animal, and diminishing the other in proportion, the whole apparent alteration will rest upon the lapdog: the surprise to find it less than it appeared formerly, directs to it our whole attention, and makes us conceive it to be a most diminutive creature: the mastiff in the mean time is quite overlooked. To illustrate this effect by a familiar example. Take a piece of paper or of linen tolerably white, and compare it with a pure white of the same kind; the judgment we formed of the first object is instantly varied; and the surprise occasioned by finding it less white than was thought, produceth a hasty conviction that it is much less white than it is in reality: withdrawing now the pure white, and putting in its place a deep black, the surprise occasioned by that new circumstance carries us to the other extreme, and makes us conceive the object first mentioned to be a pure white; and thus experience compels us to acknowledge, that our emotions have an influence even upon our eye-sight. This experiment leads to a general observation, that whatever is found more strange and beautiful than was expected, is judged to be more strange and beautiful than it is in reality. Hence a common artifice, to deprecate beforehand what we wish to make a figure in the opinion of others.

The comparisons employed by poets and orators are of the kind last mentioned: for it is always a known object that is to be magnified or lessened. The former is effected by likening it to some grand object, or by contrasting it with one of an opposite character. To effectuate the latter, the method must be reversed: the object must be contrasted with something superior to it, or likened to something inferior. The whole effect is produced upon the principal object; which by that means is elevated above its rank, or depressed below it.

In accounting for the effect that any unusual resemblance or dissimilitude hath upon the mind, no cause has been mentioned but surprise; and to prevent confusion, it was proper to discuss that cause first. But surprise is not the only cause of the effect described: another occurs, which operates perhaps not less powerfully, viz. a principle in human nature that lies still in obscurity, not having been unfolded by any writer, though its effects are extensive: and as it is not distinguished by a proper name, the reader must be satisfied with the following description. Every man who studies himself or others, must be sensible of a tendency or propensity in the mind to complete every work that is begun, and to carry things to their full perfection. There is little opportunity to display that propensity upon natural operations, which are seldom left imperfect; but in the operations of art it hath great scope: it impels us to persevere in our own work, and to wish for the completion of what another is doing: we feel a sensible pleasure when the work is brought to perfection; and our pain is not less sensible when we are disappointed. Hence our uneasiness when an interesting story is broke off in the middle, when a piece of music ends without a close, or when a building or garden is left unfinished. The same propensity operates in making collections; such as the whole works, good and bad, of any author. A certain person attempted to collect prints of all the capital paintings, and succeeded except as to a few. La Bruyere remarks, that an anxious search was made for these; not for their value, but to complete the set.

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The final cause of the propensity is an additional proof of its existence. Human works are of no significancy till they be completed; and reason is not always a sufficient counterbalance to indolence: some principle over and above is necessary to excite our industry, and to prevent our stopping short in the middle of the course.

We need not lose time to describe the co-operation of the foregoing propensity with surprise, in producing the effect that follows any unusual resemblance or dissimilitude. Surprise first operates, and carries our opinion of the resemblance or dissimilitude beyond truth. The propensity we have been describing carries us still farther; for it forces upon the mind a conviction, that the resemblance or dissimilitude is complete. We need no better illustration, than the resemblance that is fancied in some pebbles to a tree or an insect; which resemblance, however faint in reality, is conceived to be wonderfully perfect. The tendency to complete a resemblance acting jointly with surprise, carries the mind sometimes so far, as even to presume upon future events. In the Greek tragedy entitled *Phineides*, those unhappy women seeing the place where it was intended they should be slain, cried out with anguish, "They now saw their cruel destiny had condemned them to die in that place, being the same where they had been exposed in their infancy." *Arist. Poet. cap.* 17.

The propensity to advance every thing to its perfection, not only co-operates with surprise to deceive the mind, but of itself is able to produce that effect. Of this we see many instances where there is no place for surprise; and the first we shall give is of resemblance. *Unumquodque eodem modo dissolvitur quo colligatum est*, is a maxim in the Roman law that has no foundation in truth; for tying and loosing, building and demolishing, are acts opposite to each other, and are performed by opposite means: but when these acts are connected by their relation to the same subject, their connection leads us to imagine a sort of resemblance between them, which by the foregoing propensity is conceived to be as complete as possible. The next instance shall be of contrast. Addison observes, "That the palest features look the most agreeable in white; that a face which is overflushed appears to advantage in the deepest scarlet; and that a dark complexion is not a little alleviated by a black hood." *Spectator*, N° 265. The foregoing propensity serves to account for these appearances: to make this evident, one of the cases shall suffice. A complexion, however dark, never approaches to black: when these colours appear together, their opposition strikes us; and the propensity we have to complete the opposition, makes the darkness of complexion vanish out of sight.

The operation of this propensity, even where there is no ground for surprise, is not confined to opinion or conviction: so powerful it is, as to make us sometimes proceed to action, in order to complete a resemblance or dissimilitude. If this appear obscure, it will be made clear by the following instance. Upon what principle is the *lex talionis* founded, other than to make the punishment resemble the mischief? Reason dictates, that there ought to be a conformity or resemblance between

tween a crime and its punishment; and the foregoing propensity impels us to make the resemblance as complete as possible. Titus Livius*, under the influence of that propensity, accounts for a certain punishment, by a resemblance between it and the crime too subtile for common apprehension. Speaking of Mettus Fuffetius, the Alban general, who, for treachery to the Romans his allies, was sentenced to be torn to pieces by horses, he puts the following speech in the mouth of Tullus Hostillius, who decreed the punishment. "*Mette Fuffeti, inquit, si ipse discere posses fidem ac fœdera servare, vivo tibi eu disciplina à me adhibita esset. Nunc, quoniam tuum insanabile ingenium est, at tu tuo supplicio doce humanum genus ea sancta credere, quæ à te violata sunt. Ut igitur paulo ante animum inter Fidenatem Romanamque rem ancipitem gessisti, ita jam corpus passim distrahendum dabis.*" By the same influence, the sentence is often executed upon the very spot where the crime was committed. In the *Electra* of Sophocles, Egistheus is dragged from the theatre into an inner room of the supposed palace, to suffer death where he murdered Agamemnon. Shakespeare, whose knowledge of nature is not less profound than extensive, has not overlooked this propensity:

* Lib. I. § 28.

"*Othello*. Get me some poison, Iago, this night. I'll not expostulate with her, lest her body and her beauty unprovide my mind again. This night, Iago."

"*Iago*. Do it not with poison; strangle her in her bed, even in the bed she hath contaminated."

"*Othello*. Good, good: the justice of it pleases: very good." *Othello*, act iv. sc. 5.

Persons in their last moments are generally seized with an anxiety to be buried with their relations. In the *Amynta* of Tasso, the lover, hearing that his mistress was torn to pieces by a wolf, expresses a desire to die the same death.

Upon the subject in general we have two remarks to add. The first concerns resemblance, which, when too entire, hath no effect, however different in kind the things compared may be. The remark is applicable to works of art only; for natural objects of different kinds have scarce ever an entire resemblance. To give an example in a work of art: Marble is a sort of matter very different from what composes an animal; and marble cut into a human figure, produces great pleasure by the resemblance: but if a marble statue be coloured like a picture, the resemblance is so entire as at a distance to make the statue appear a real person: we discover the mistake when we approach; and no other emotion is raised, but surprise occasioned by the deception: the figure still appears a real person, rather than an imitation; and we must use reflection to correct the mistake. This cannot happen in a picture; for the resemblance can never be so entire as to disguise the imitation.

The other remark belongs to contrast. Emotions make the greatest figure when contrasted in succession; but then the succession ought neither to be rapid, nor immoderately slow: if too slow, the effect of contrast becomes faint by the distance of the emotions; and if rapid, no single emotion has room to expand itself to its full size, but is stifled, as it were, in the birth by a succeeding emotion. The funeral oration of the bishop of Meaux upon the duchess of Orleans, is a perfect hodge-podge of cheerful and melancholy representations, following each other in the quickest succession: opposite emotions are best felt in succession; but each emotion separately should be raised to its due pitch, before another be introduced.

What is above laid down, will enable us to determine a very important question concerning emotions raised by the fine arts, viz. Whether ought similar emotions to succeed each other, or dissimilar? The emotions raised by the fine arts are for the most part too nearly related to make a figure by resemblance; and for that reason their succession ought to be regulated as much as possible by contrast. This holds confessedly in epic and dramatic compositions; and the best writers, led perhaps by taste more than by reasoning, have generally aimed at that beauty. It holds equally in music: in the same cantata all the variety of emotions that are within the power of music, may not only be indulged, but, to make the greatest figure, ought to be contrasted. In gardening, there is an additional reason for the rule: the emotions raised by that art, are at best so faint, that every artifice should be employed to give them their utmost vigour: a field may be laid out in grand, sweet, gay, neat, wild, melancholy scenes; and when these are viewed in succession, grandeur ought to be contrasted with neatness, regularity with wildness, and gaiety with melancholy, so as that each emotion may succeed its opposite: nay, it is an improvement to intermix in the succession rude uncultivated spots as well as unbounded views, which in themselves are disagreeable, but in succession heighten the feeling of the agreeable object; and we have nature for our guide, which in her most beautiful landscapes often intermixes rugged rocks, dirty marshes, and barren stony heaths. The greatest masters of music have the same view in their compositions: the second part of an Italian song seldom conveys any sentiment: and, by its harshness, seems purposely contrived to give a greater relish for the interesting part of the composition.

A small garden, comprehended under a single view, affords little opportunity for that embellishment. Dissimilar emotions require different tones of mind; and therefore in conjunction can never be pleasant: gaiety and sweetness may be combined, or wildness and gloominess; but a composition of gaiety and gloominess is distasteful. The rude uncultivated compartment of furze and broom in Richmond garden, hath a good effect in the succession of objects; but a spot of that nature would be insufferable in the midst of a polished parterre or flower-plot. A garden, therefore, if not of great extent, admits not dissimilar emotions; and in ornamenting a small garden, the safest course is to confine it to a single expression. For the same reason, a landscape ought also to be confined to a single expression; and accordingly it is a rule in painting, that if the subject be gay, every figure ought to contribute to that emotion.

It follows from the foregoing train of reasoning, that a garden near a great city ought to have an air of solitude. The solitariness, again, of a waste country ought to be contrasted in forming a garden; no temples, no obscure walks; but *jets d'eau*, cascades, objects active, gay, and splendid. Nay, such a garden should in some measure, avoid imitating nature, by taking on an extraordinary

traordinary appearance of regularity and art, to show the busy hand of man, which in a waste country has a fine effect by contrast.

Wit and ridicule make not an agreeable mixture with grandeur. Dissimilar emotions have a fine effect in a slow succession; but in a rapid succession, which approaches to co-existence, they will not be relished. In the midst of a laboured and elevated description of battle, Virgil introduces a ludicrous image, which is certainly out of its place:

Obvius ambustum torrem Chorinæus ab ara
Corripit, et venienti Ebuso plagamque ferenti
Occupat os flammis: illi ingens barba reluxit,
Nidoremque ambusta dedit. *Æn.* xii. 298.

E qual tauro ferito, il suo dolore
Verso mugghiando e sospirando fuore.
Gierusal. cant. iv. st. 1.

It would however be too austere to banish altogether ludicrous images from an epic poem. This poem doth not always soar above the clouds: it admits great variety; and upon occasion can descend even to the ground without sinking. In its more familiar tones, a ludicrous scene may be introduced without impropriety. This is done by Virgil * in a foot-race: the circumstances of which, not excepting the ludicrous part, are copied from Homer †. After a fit of merriment, we are, it is true, the less disposed to the serious and sublime: but then, a ludicrous scene, by unbending the mind from severe application to more interesting subjects, may prevent fatigue, and preserve our relish entire.

RESEN, (Moses); a town on the Tigris, built by Nimrod; thought to be the *Larissa* of Xenophon; which see. But as *Larissa* is a name in imitation of a Greek city; and as there were no Greek cities, consequently no *Larissa*, in Assyria, before Alexander the Great; it is probable that the Greeks asking of what city those were the ruins they saw, the Assyrians might answer, *Laresen*, "Of *Resen*;" which word Xenophon expressed by *Larissa*, a more familiar sound to a Greek ear, (Wells).

RESENTMENT, means a strong perception of good or ill, generally a deep sense of injury, and may be distinguished into *anger* and *revenge*. "By anger (says Archdeacon Paley), I mean the pain we suffer upon the receipt of an injury or affront, with the usual effects of that pain upon ourselves. By revenge, the inflicting of pain upon the person who has injured or offended us, farther than the just ends of punishment or reparation require. Anger prompts to revenge; but it is possible to suspend the effect when we cannot altogether quell the principle. We are bound also to endeavour to qualify and correct the principle itself. So that our duty requires two different applications of the mind: and for that reason anger and revenge should be considered separately." See REVENGE.

RESERVATION, in *Law*, an action or clause whereby something is reserved, or secured to one's self.

Mental RESERVATION, a proposition which, strictly taken, and according to the natural import of the terms, is false; but, if qualified by something concealed in the mind, becomes true.

Mental reservations are the great refuge of religious hypocrites, who use them to accommodate their consciences with their interests: the Jesuits are zealous advocates for mental reservations; yet are they real lies, as including an intention to deceive.

Reservation || Residual.

RESERVE, in *Law*, the same with reservation. See RESERVATION.

Body of RESERVE, or *Corps de* RESERVE, in military affairs, the third or last line of an army, drawn up for battle; so called because they are reserved to sustain the rest as occasion requires, and not to engage but in case of necessity.

RESERVOIR, a place where water is collected and reserved, in order to be conveyed to distant places through pipes, or supply a fountain or jet d'eau.

RESET, in *Law*, the receiving or harbouring an outlawed person. See OUTLAWRY.

RESET *of Theft*, in *Scots Law*. See LAW, N° clxxxvi. 29.

RESIDENCE, in the *Canon* and *Common Law*, the abode of a person or incumbent upon his benefice; and his assiduity in attending on the same.

RESIDENT, a public minister, who manages the affairs of a kingdom or state, at a foreign court.

They are a class of public ministers, inferior to ambassadors or envoys; but, like them, are under the protection of the law of nations.

RESIDUAL ANALYSIS, a calculus invented by Mr Landen, and proposed as a substitute for the method of fluxions. The design of it was to avoid introducing the idea of motion, and of quantities infinitely small, into mathematical investigation. The residual analysis accordingly proceeds, by taking the difference of the same function of a variable quantity in two different states of that quantity, and denoting the relation of this difference to the difference between the two states of the said variable quantity. This relation being first generally expressed, is next considered in the case when the difference of the two states of the variable quantity is $=0$; and by that means it is obvious, that the same thing is done as when the function of a variable quantity is assigned by the ordinary methods.

The evolutions of the functions, considered in this very general view, requires the aid of a new theorem, discovered by Mr Landen, and remarkable for its simplicity and great extent. It is, that

if x and v are any two variable quantities $\dfrac{x^{\frac{m}{n}}-v^{\frac{m}{n}}}{x-v}$

$$=x^{\frac{m}{n}-1}\times\frac{1+\frac{v}{x}+\frac{v^2}{x^2}+\frac{v^3}{x^3}+\cdots(m)}{1+\left(\frac{v}{x}\right)^{\frac{m}{n}}+\left(\frac{v}{x}\right)^{\frac{2m}{n}}+\left(\frac{v}{x}\right)^{\frac{3m}{n}}\cdots(n)}$$

where m and n are any integer numbers.

This theorem is the basis of the calculus, and from the expressions $x^{\frac{m}{n}}-v^{\frac{m}{n}}$, and $x-v$ having the form of what algebraists denominate *residuals*, the inventor gave to his method the name of the *residual analysis*.

Mr Landen published the first account of this method in 1758, which he denominated *A Discourse concerning* the

Residual | Resin.

the Residual Analysis. The first book of the analysis appeared in 1764, which contained an explanation of the principles of the new calculus, with its application to problems of the direct method of fluxions, and the second book solved several problems of the inverse method, but it was never published.

If we estimate the value of this analysis by its practical utility, it may be said to possess no great merit. Its principles are much less easily apprehended than the fluxionary calculus; they are not so luminous, and less direct in their application, as well as inferior to it for enlarging the boundaries of mathematical science.

RESIDUAL Figure in *Geometry*, the figure remaining after the subtraction of the less from the greater.

RESIDUAL Root, is a root composed of two members only connected by the sign — or minus. Thus, $a-b$, or $5-3$, is a residual root; and is so called, because its true value is no more than the residue, or difference between the parts a and b or 5 and 3, which in this case is 2.

RESIDUE, the remainder or balance of an account, deb t or obligation.

RESIGNATION, in general, signifies the implicit submission of ourselves, or of something we possess, to the will of another. In a religious sense it signifies a perfect submission, without discontent, to the will of God. See MORAL PHILOSOPHY, N° 119.

RESIN, in *Natural History*, a viscid juice oozing either spontaneously, or by incision, from several trees, as the pine, fir, &c.—A premium for several years has been offered by the London Society for Encouraging Arts, &c. for discovering a method of reducing the inflammable quality of resin, so as to adapt it to the purposes of making candles; but no such discovery has yet been made.

Elastic RESIN. See CAOUTCHOUC, CHEMISTRY *Index.*

Resin | Resistance.

Gum RESIN, a mixture of gum and resin. See CHEMISTRY and MATERIA MEDICA *Index.*

Red Gum RESIN, is procured from the red gum tree, or eucalyptus resinifera; a tree so large and lofty as to exceed in size the English oak. To obtain the juice from this tree, incisions are made in the trunk of it, and sometimes upwards of 60 gallons of red resinous juice have been obtained from one of them. "When this juice is dried, it becomes a very powerful astringent gum-resin, of a red colour, much resembling that known in the shops by the name of *kino*, and, for all medical purposes, fully as efficacious. Mr White administered it to a great number of patients in the dysentery, which prevailed much soon after the landing of the convicts, and in no one instance found it to fail.

White's Voyage, Appendix.

Yellow Gum RESIN, is procured from the yellow resin tree, which is as large as the English walnut tree The properties of this resin are equal to those of the most fragrant balsams. It exudes from the bark spontaneously, but more readily if incisions are made. The colour of it is yellow, and at first it is fluid; but after being inspissated in the sun, it becomes solid. When burnt on hot coals, it smells like a mixture of balsam of Tolu and benzoin, approaching somewhat to storax. "It is perfectly soluble in spirit of wine, but not in water, nor even in essential oil of turpentine, unless it be digested in a strong heat. The varnish which it makes with either is very weak. With respect to its medicinal qualities, Mr White has found it, in many cases, a good pectoral medicine, and very balsamic."

White's Voyage, Appendix.

RESINOUS ELECTRICITY, is that kind of electricity which is produced by exciting bodies of the resinous kind, and which is generally negative. See ELECTRICITY *passim.*

RESISTANCE OF FLUIDS.

RESISTANCE, or *Resisting Force*, in *Philosophy*, denotes, in general, any power which acts in an opposite direction to another, so as to destroy or diminish its effect. See MECHANICS, HYDRODYNAMICS, and PNEUMATICS.

1 Importance of the subject.

Of all the resistances of bodies to each, there is undoubtedly none of greater importance than the resistance or reaction of fluids. It is here that we must look for a theory of naval architecture, for the impulse of the air is our moving power, and this must be modified so as to produce every motion we want by the form and disposition of our sails; and it is the resistance of the water which must be overcome, that the ship may proceed in her course; and this must also be modified to our purpose, that the ship may not drive like a log to leeward, but on the contrary may ply to windward, that she may answer her helm briskly, and that she may be easy in all her motions on the surface of the troubled ocean. The impulse of wind and water makes them ready and indefatigable servants in a thousand shapes for driving our machines; and we should lose much of their service did we remain ignorant of the laws of their action: they would sometimes become terrible masters, if we did not fall upon methods of eluding or softening their attacks.

2 The ancients were tolerably well acquainted with it.

We cannot refuse the ancients a considerable knowledge of this subject. It was equally interesting to them as to us; and we cannot read the accounts of the naval exertions of Phœnicia, Carthage, and of Rome, exertions which have not been surpassed by any thing of modern date, without believing that they possessed much practical and experimental knowledge of this subject. It was not, perhaps, possessed by them in a strict and systematic form, as it is now taught by our mathematicians; but the master-builders, in their dockyards, did undoubtedly exercise their genius in comparing the forms of their finest ships, and in marking those circumstances of form and dimension which were *in fact* accompanied with the desirable properties of a ship, and thus framing to themselves maxims of naval architecture in the same manner as we do now. For we believe that our naval architects are not disposed to grant

Resistance of Fluids. grant that they have profited much by all the labours of the mathematicians. But the ancients had not made any great progress in the physicomathematical sciences, which consist chiefly in the application of calculus to the phenomena of nature. In this branch they could make none, because they had not the means of investigation. A knowledge of the motions and actions of fluids is accessible only to those who are familiarly acquainted with the fluxionary mathematics; and without this key there is no admittance. Even when possessed of this guide, our progress has been very slow, hesitating, and devious; and we have not yet been able to establish any set of doctrines which are susceptible of an easy and confident application to the arts of life. If we have advanced farther than the ancients, it is because we have come after them, and have profited by their labours, and even by their mistakes.

3 But even now it is not perfectly understood.

4 Sir I. Newton first applied mathematics to it.

Sir Isaac Newton was the first (as far as we can recollect) who attempted to make the motions and actions of fluids the subject of mathematical discussion. He had invented the method of fluxions long before he engaged in his physical researches; and he proceeded in these *suâ mathesi facem præferente*. Yet even with this guide he was often obliged to grope his way, and to try various bye-paths, in the hopes of obtaining a legitimate theory. Having exerted all his powers in establishing a theory of the lunar motions, he was obliged to rest contented with an approximation instead of a perfect solution of the problem which ascertains the motions of three bodies mutually acting on each other. This convinced him that it was in vain to expect an accurate investigation of the motions and actions of fluids, where millions of unseen particles combine their influence. He therefore cast about to find some particular case of the problem which would admit of an accurate determination, and at the same time furnish circumstances of analogy or resemblance sufficiently numerous for giving limiting cases, which should include between them those other cases that did not admit of this accurate investigation. And thus, by knowing the limit to which the case proposed did approximate, and the circumstance which regulated the approximation, many useful propositions might be deduced for directing us in the application of these doctrines to the arts of life.

5 Difficulties he met with in it.

6 He proposed a theory,

He therefore figured to himself a hypothetical collection of matter which possessed the characteristic property of fluidity, viz. the *quâquâversum* propagation of pressure, and the most perfect intermobility (pardon the uncouth term) of parts, and which formed a physical whole or aggregate, whose parts were connected by mechanical forces, determined both in degree and in direction, and such as rendered the determination of certain important circumstances of their motion susceptible of precise investigation. And he concluded, that the laws which he should discover in these motions must have a great analogy with the laws of the motions of real fluids: And from this hypothesis he deduced a series of propositions, which form the basis of almost all the theories of the impulse and resistance of fluids which have been offered to the public since his time.

7 which does not, however, agree with experiment.

It must be acknowledged, that the results of this theory agree but ill with experiment, and that, *in the way in which it has been zealously prosecuted by subsequent mathematicians*, it proceeds on principles or assumptions which are not only gratuitous, but even false. But it affords such a beautiful application of geometry and calculus, that mathematicians have been as it were fascinated by it, and have published systems so elegant and so extensively applicable, that one cannot help lamenting that the foundation is so flimsy. John Bernoulli's theory, in his dissertation on the communication of motion, and Bouguer's in his *Traité du Navire*, and in his *Theorie du Manœuvre et de la Mâture des Vaisseaux*, must ever be considered as among the finest specimens of physicomathematical science which the world has seen. And, with all its imperfections, this theory still furnishes (as was expected by its illustrious author) many propositions of immense practical use, they being the limits to which the real phenomena of the impulse and resistance of fluids really approximate. So that when the law by which the phenomena deviate from the theory is once determined by a well chosen series of experiments, this hypothetical theory becomes almost as valuable as a true one. And we may add, that although Mr d'Alembert, by treading warily in the steps of Sir Isaac Newton in another route, has discovered a genuine and unexceptionable theory, the process of investigation is so intricate, requiring every finesse of the most abstruse analysis, and the final equations are so complicated, that even their most expert author has not been able to deduce more than one simple proposition (which too was discovered by Daniel Bernoulli by a more simple process) which can be applied to any use. The hypothetical theory of Newton, therefore, continues to be the groundwork of all our practical knowledge of the subject.

8 But its utility is still very considerable.

We shall therefore lay before our readers a very short view of the theory, and the manner of applying it. We shall then show its defects (all of which were pointed out by its great author), and give a historical account of the many attempts which have been made to amend it or to substitute another; in all which we think it our duty to show, that Sir Isaac Newton took the lead, and pointed out every path which others have taken, if we except Daniel Bernoulli and D'Alembert; and we shall give an account of the chief sets of experiments which have been made on this important subject, in the hopes of establishing an empirical theory, which may be employed with confidence in the arts of life.

9 The term resistance, as here applied, explained.

We know by experience that force must be applied to a body in order that it may move through a fluid, such as air or water; and that a body projected with any velocity is gradually retarded in its motion, and generally brought to rest. The analogy of nature makes us imagine that there is a force acting in the opposite direction, or opposing the motion, and that this force resides in, or is exerted by, the fluid. And the phenomena resemble those which accompany the known resistance of active beings, such as animals. Therefore we give to this supposed force the metaphorical name of RESISTANCE. We also know that a fluid in motion will hurry a solid body along with the stream, and that it requires force to maintain it in its place. A similar analogy makes us suppose that the fluid exerts force, in the same manner as when an active being impels the body before him; therefore we call this the *IMPULSION of a Fluid*. And as our knowledge of nature informs us that the mutual actions of bodies are in every case equal and opposite, and that the observed change of motion is the only indication, characteristic, and measure of the changing force, the forces are the same (whether we call them impulsions or resistances) when the relative motions are the same, and therefore depend entirely on these relative motions. The force, therefore, which is necessary for keeping a body immoveable in a stream of water, flowing with a certain velocity, is the same with what is required for moving this body with this velocity through stagnant water. To any one who admits the motion of the earth round the sun, it is evident that we can neither observe nor reason from a case of a body moving through still water, nor of a stream of water pressing upon or impelling a quiescent body.

A body in motion appears to be resisted by a stagnant fluid, because it is a law of mechanical nature that force must be employed in order to put any body in motion. Now the body cannot move forward without putting the contiguous fluid in motion, and force must be employed for producing this motion. In like manner, a quiescent body is impelled by a stream of fluid, because the motion of the contiguous fluid is diminished by this solid obstacle; the resistance, therefore, or impulse, no way differs from the ordinary communications of motion among solid bodies.

10 Sir Isaac Newton supposes two systems similar in their parts, and each part having a constant ratio to each.

Sir Isaac Newton, therefore, begins his theory of the resistance and impulse of fluids, by selecting a case where, although he cannot pretend to ascertain the motions themselves which are produced in the particles of a contiguous fluid, he can tell precisely their mutual ratios.

He supposes two systems of bodies such, that each body of the first is similar to a corresponding body of the second, and that each is to each in a constant ratio He also supposes them to be similarly situated, that is, at the angles of similar figures, and that the homologous lines of these figures are in the same ratio with the diameters of the bodies. He farther supposes, that they attract or repel each other in similar directions, and that the accelerating connecting forces are also proportional; that is, the forces in the one system are to the corresponding forces in the other system in a constant ratio, and that, in each system taken apart, the forces are as the squares of the velocities directly, and as the diameters of the corresponding bodies, or their distances, inversely.

11 Effect of the similar parts being put in motion.

This being the case, it legitimately follows, that if similar parts of the two systems are put into similar motions, in any given instant, they will *continue* to move similarly, each correspondent body describing similar curves, with proportional velocities: For the bodies being similarly situated, the forces which act on a body in one system, arising from the combination of any number of adjoining particles, will have the same direction with the force acting on the corresponding body in the other system, arising from the combined action of the similar and similarly directed forces of the adjoining correspondent bodies of the other system; and these compound forces will have the same ratio with the simple forces which constitute them, and will be as the squares of the velocities directly, and as the distances, or any homologous lines inversely; and therefore the chords of curvature, having the direction of the centripetal or centrifugal forces, and similarly inclined to the tangents of the curves described by the corresponding bodies, will have the same ratio with the distances of the particles. The curves described by the corresponding bodies will therefore be similar, the velocities will be proportional, and the bodies will be similarly situated at the end of the first moment, and exposed to the action of similar and similarly situated centripetal or centrifugal forces; and this will again produce similar motions during the next moment, and so on for ever. All this is evident to any person acquainted with the elementary doctrines of curvilineal motions, as delivered in the theory of physical astronomy.

12 Consequence deduced from it.

From this fundamental proposition, it clearly follows, that if two similar bodies, having their homologous lines proportional to those of the two systems, be similarly projected among the bodies of those two systems with any velocities, they will produce similar motions in the two systems, and will themselves continue to move similarly; and therefore will, in every subsequent moment, suffer similar diminutions or retardations. If the initial velocities of projection be the same, but the densities of the two systems, that is, the quantities of matter contained in an equal bulk or extent, be different, it is evident that the quantities of motion produced in the two systems in the same time will be proportional to the densities; and if the densities are the same, and uniform in each system, the quantities of motion produced will be as the squares of the velocities, because the motion communicated to each corresponding body will be proportional to the velocity communicated, that is, to the velocity of the impelling body; and the number of similarly situated particles which will be agitated will also be proportional to this velocity. Therefore, the whole quantities of motion produced in the same moment of time will be proportional to the squares of the velocities. And lastly, if the densities of the two systems are uniform, or the same through the whole extent of the systems, the number of particles impelled by similar bodies will be as the surfaces of these bodies.

Now the diminutions of the motions of the projected bodies are (by Newton's third law of motion) equal to the motions produced in the systems; and these diminutions are the measures of what are called the resistances opposed to the motions of the projected bodies. Therefore, combining all these circumstances, the resistances are proportional to the similar surfaces of the moving bodies, to the densities of the systems through which the motions are performed, and to the squares of the velocities, jointly.

13 A fluid considered as a system of small bodies similarly arranged.

We cannot form to ourselves any distinct notion of a fluid, otherwise than as a system of small bodies, or a collection of particles, similarly or symetrically arranged, the centres of each being situated in the angles of regular solids. We must form this notion of it, whether we suppose, with the vulgar, that the particles are little globules in mutual contact, or, with the partisans of corpuscular attractions and repulsions, we suppose the particles kept at a distance from each other by means of these attractions and repulsions mutually balancing each other. In this last case, no other arrangement is consistent with a quiescent equilibrium; and in this case, it is evident, from the theory of curvilineal motions, that the agitations ance luids. tations of the particles will always be such, that the connecting forces, in actual exertion, will be proportional to the squares of the velocities directly, and to the chords of the curvature having the direction of the forces inversely.

4 law of sist- &c. ls. PROP. I. The resistances, and (by the third law of motion), the impulsions of fluids on similar bodies, are proportional to the surfaces of the solid bodies, to the densities of the fluids, and to the squares of the velocities, jointly.

We must now observe, that when we suppose the particles of the fluid to be in mutual contact, we may either suppose them elastic or unelastic. The motion communicated to the collection of elastic particles must be double of what the same body, moving in the same manner, would communicate to the particles of an elastic fluid. The impulse and resistance of elastic fluids must therefore be double of those of unelastic fluids.—But we must caution our readers not to judge of the elasticity of fluids by their sensible compressibility. A diamond is incomparably more elastic than the finest foot ball, though not

5 icity ter. compressible in any sensible degree.—It remains to be decided, by well chosen experiments, whether water be not as elastic as air. If we suppose, with Boscovich, the particles of perfect fluids to be at a distance from each other, we shall find it difficult to conceive a fluid void of elasticity. We hope that the theory of their impulse and resistance will suggest experiments which will decide this question, by pointing out what ought to be the absolute impulse or resistance in either case. And thus the fundamental proposition of the impulse and resistance of fluids, taken in its proper meaning, is susceptible of a rigid demonstration, relative to the only distinct notion that we can form of the internal constitution of a fluid. We say, *taken in its proper meaning;* namely, that the impulse or resistance of fluids is a pressure, opposed and measured by another pressure, such as a pound weight, the force of a spring, the pressure of the atmosphere, and the like. And we apprehend that it would be very difficult to find any legitimate demonstration of this leading proposition different from this, which we have now borrowed from Sir Isaac Newton, Prop. 23. B. II. *Princip.* We acknowledge that it is prolix and even circuitous: but in all the attempts made by his commentators and their copyists to simplify it, we see great defects of logical argument, or assumption of principles, which are not only gratuitous, but inadmissible. We shall have occasion, as we proceed, to point out some of these defects; and doubt not but the illustrious author of this demonstration had exercised his uncommon patience and sagacity in similar attempts, and was dissatisfied with them all.

Before we proceed farther, it will be proper to make a general remark, which will save a great deal of discussion. Since it is a matter of universal experience, that every action of a body on others is accompanied by an equal and contrary re-action; and since all that we can demonstrate concerning the resistance of bodies during their motions through fluids proceeds on this supposition (the resistance of the body being *assumed* as equal and opposite to the sum of motions communicated to the particles of the fluid, estimated in the direction of the bodies motion), we are intitled to proceed in the contrary order, and to consider the impulsions which each of the particles of fluid exerts on the body at rest, as equal and opposite to the motion which the body would communicate to that particle if the fluid were at rest, and the body were moving equally swift in the opposite direction. And therefore the whole impulsion of the fluid must be conceived as the measure of the whole motion which the body would thus communicate to the fluid. It must therefore be also considered as the measure of the resistance which the body, moving with the same velocity, would sustain from the fluid. When, therefore, we shall demonstrate any thing concerning the impulsion of a fluid, estimated in the direction of its motion, we must consider it as demonstrated concerning the resistance of a quiescent fluid to the motion of that body, having the same velocity in the opposite direction. The determination of these impulsions being much easier than the determination of the motions communicated by the body to the particles of the fluid, this method will be followed in most of the subsequent discussions.

Resistance of Fluids.

The general proposition already delivered is by no means sufficient for explaining the various important phenomena observed in the mutual actions of solids and fluids. In particular, it gives us no assistance in ascertaining the modifications of this resistance or impulse, which depend on the shape of the body and the inclination of its impelled or resisted surface to the direction of the motion. Sir Isaac Newton found another hypothesis necessary; namely, that the fluid should be so extremely rare that the distance of the particles may be incomparably greater than their diameters. This additional condition is necessary for considering their actions as so many separate collisions or impulsions on a solid body. Each particle must be supposed to have abundant room to rebound, or otherwise escape, after having made its stroke, without sensibly affecting the situations and motions of the particles which have not yet made their stroke: and the motion must be so swift as not to give time for the sensible exertion of their mutual forces of attractions and repulsions.

Keeping these conditions in mind, we may proceed to determine the impulsions made by a fluid on surfaces of every kind: And the most convenient method to pursue in this determination, is to compare them all either with the impulse which the *same surface* would receive from the fluid impinging on it perpendicularly, or with the impulse which the *same stream of fluid* would make when coming perpendicularly on a surface of such extent as to occupy the whole stream.

It will greatly abbreviate language, if we make use of a few terms in an appropriate sense. 16 Terms explained.

By a *stream*, we shall mean a quantity of fluid moving in one direction, that is, each particle moving in parallel lines; and the *breadth* of the stream is a line perpendicular to all these parallels.

A *filament* means a portion of this stream of very small breadth, and it consists of an indefinite number of particles following one another in the same direction, and successively impinging on, or gliding along, the surface of the solid body.

The *base* of any surface exposed to a stream of fluid, is that portion of a plane perpendicular to the stream, which is covered or protected from the action of the stream.

Plate CCCCLXI. fig. 1.

stream by the surface exposed to its impulse. Thus the base of a sphere exposed to a stream of fluid is its great circle, whose plane is perpendicular to the stream. If BC (fig. 1.) be a plane surface exposed to the action of a stream of fluid, moving in the direction DC, then BR, or SE, perpendicular to DC, is its base.

Direct impulse shall express the energy or action of the particle or filament, or stream of fluid, when meeting the surface perpendicularly, or when the surface is perpendicular to the direction of the stream.

Absolute impulse means the actual pressure on the impelled surface, arising from the action of the fluid, whether striking the surface perpendicularly or obliquely; or it is the force impressed on the surface, or tendency to motion which it acquires, and which must be opposed by an equal force in the opposite direction, in order that the surface may be maintained in its place. It is of importance to keep in mind, that this pressure is always perpendicular to the surface. It is a proposition founded on universal and uncontradicted experience, that the mutual actions of bodies on each other are always exerted in a direction perpendicular to the touching surfaces. Thus, it is observed, that when a billiard ball A is struck by another B, moving in any direction whatever, the ball A always moves off in the direction perpendicular to the plane which touches the two balls in the point of mutual contact, or point of impulse. This inductive proposition is supported by every argument which can be drawn from what we know concerning the forces which connect the particles of matter together, and are the immediate causes of the communication of motion. It would employ much time and room to state them here; and we apprehend that it is unnecessary: for no reason can be assigned why the pressure should be in *any particular* oblique direction. If any one should say that the impulse will be in the direction of the stream, we have only to desire him to take notice of the effect of the rudder of a ship. This shows that the impulse *is not in the direction of the stream*, and is therefore in some direction transverse to the stream.—He will also find, that when a plane surface is impelled obliquely by a fluid, there is no direction in which it can be supported but the direction perpendicular to itself. It is quite safe, in the mean time, to take it as an experimental truth. We may, perhaps, in some other part of this work, give what will be received as a rigorous demonstration.

Relative or *effective impulse* means the pressure on the surface estimated in some particular direction. Thus BC (fig. 1.) may represent the sail of a ship, impelled by the wind blowing in the direction DC. GO may be the direction of the ship's keel, or the line of her course. The wind strikes the sail in the direction GH parallel to DC; the sail is urged or pressed in the direction GI, perpendicular to BC. But we are interested to know what tendency this will give the ship to move in the direction GO. This is the effective or relative impulse. Or BC may be the transverse section of the sail of a common wind-mill. This, by the construction of the machine, can move only in the direction GP, perpendicular to the direction of the wind; and it is only in this direction that the impulse produces the desired effect. Or BC may be half of the prow of a punt or lighter, riding at anchor by means of the cable DC, attached to the prow C. In this case, GQ, parallel to DC, is that part of the absolute impulse which is employed in straining the cable.

The *angle of incidence* is the angle FGC contained between the direction of the stream FG and the plane BC.

The *angle of obliquity* is the angle OGC contained between the plane and the direction GO, in which we wish to estimate the impulse.

Prop. II. The direct impulse of a fluid on a plane surface, is to its absolute oblique impulse on the same surface, as the square of the radius to the square of the sine of the angle of incidence. 17 Second law of resist.

Let a stream of fluid, moving in the direction DC, (fig. 1.), act on the plane BC. With the radius CB describe the quadrant ABE; draw CA perpendicular to CE, and draw MNBS parallel to CE. Let the particle F, moving in the direction FG, meet the plane in G, and in FG produced take GH to represent the magnitude of the direct impulse, or the impulse which the particle would exert on the plane AC, by meeting it in V. Draw GI and HK perpendicular to BC, and HI perpendicular to GI. Also draw BR perpendicular to DC. Fig. 11

The force GH is equivalent to the two forces GI and GK; and GK being in the direction of the plane has no share in the impulse. The absolute impulse, therefore, is represented by GI; the angle GHI is equal to FGC, the angle of incidence; and therefore GH is to GI as radius to the sine of the angle of incidence. Therefore the direct impulse of each particle or filament is to its absolute oblique impulse as radius to the sine of the angle of incidence. But further, the number of particles or filaments which strike the surface AC, is to the number of those which strike the surface BC as AC to NC: for all the filaments between LA and MB go past the oblique surface BC without striking it. But BC : NC = rad. : sin. NBC, = rad. : sin. FGC, = rad. : sin. incidence. Now the whole impulse is as the impulse of each filament, and as the number of filaments exerting equal impulses jointly; therefore the whole direct impulse on AC is to the whole absolute impulse on BC, as the square of radius to the square of the sine of the angle of incidence.

Let S express the extent of the surface, i the angle of incidence, o the angle of obliquity, v the velocity of the fluid, and d its density. Let F represent the direct impulse, f the absolute oblique impulse, and φ the relative or effective impulse: And let the tabular sines and cosines be considered as decimal fractions of the radius unity.

This proposition gives us $F : f = R^2 : \text{Sin.}^2\, i, = 1 : \text{Sin.}^2\, i$, and therefore $f = F \times \text{Sin.}^2\, i$. Also, because impulses are in the proportion of the extent of surface similarly impelled, we have, in general, $f = FS \times \text{Sin.}^2, i$.

The first who published this theorem was Pardies, in his *Oeuvres de Mathematique*, in 1763. We know that Newton had investigated the chief propositions of the Principia before 1670.

Prop. III. The direct impulse on any surface is to the effective oblique impulse on the same surface, as the cube of radius to the solid, which has for its base the square of the sine of incidence, and the sine of obliquity for its height. 18 Third law.

For,

For, when GH represents the direct impulse of a particle, GI is the absolute oblique impulse, and GO is the effective impulse in the direction GO: Now GI is to GO as radius to the sine of GIO, and GIO is the complement of IGO, and is therefore equal to CGO, the angle of obliquity.

$$\text{Therefore } f : \varphi = \text{R} : \text{Sin. O.}$$
$$\text{But } \text{F} : f = \text{R}^2 : \text{Sin.}^2 i$$
$$\text{Therefore } \text{F} : \varphi = \text{R}^3 : \text{Sin.}^2 i \times \text{Sin. O. and}$$
$$\varphi = \text{F} \times \text{Sin.}^2 i \times \text{Sin. O.}$$

19 Proportion of the direct impulse to the effective oblique impulse.

Cor.—The direct impulse on any surface is to the effective oblique impulse in the direction of the stream, as the cube of radius to the cube of the sine of incidence. For draw IQ and GP perpendicular to GH, and IP perpendicular to GP; then the absolute impulse GI is equivalent to the impulse GQ in the direction of the stream, and GP, which may be called the transverse impulse. The angle GIQ is evidently equal to the angle GHI, or FGC, the angle of incidence.

$$\text{Therefore } f : \varphi = \text{GI} : \text{GQ}, = \text{R} : \text{Sin. } i.$$
$$\text{But } \text{F} : f = \text{R}^2 : \text{Sin.}^2 i.$$
$$\text{Therefore } \text{F} : \varphi = \text{R}^3 : \text{Sin.}^3 i.$$
$$\text{And } \varphi = \text{F} \times \text{Sin}^3 i.$$

20 Impulse on a surface in motion.

Before we proceed further, we shall consider the impulse on a surface which is also in motion. This is evidently a frequent and an important case. It is perhaps the most frequent and important: It is the case of a ship under sail, and of a wind or water-mill at work.

Fig. 2. Therefore, let a stream of fluid, moving with the direction and velocity DE, meet a plane BC, (fig. 2.) which is moving parallel to itself in the direction and with the velocity DF: It is required to determine the impulse?

Nothing is more easy: The mutual actions of bodies depend on their relative motions only. The motion, DE of the fluid relative to BC, which is also in motion, is compounded of the real motion of the fluid and the opposite to the real motion of the body. Therefore produce FD till Df = DF, and complete the parallelogram DfeE, and draw the diagonal De. The impulse on the plane is the same as if the plane were at rest, and every particle of the fluid impelled it in the direction and with the velocity De; and may therefore be determined by the foregoing proposition. This proposition applies to every possible case; and we shall not bestow more time on it, but reserve the important modification of the general proposition for the cases which shall occur in the practical applications of the whole doctrine of the impulse and resistance of fluids.

21 Proportion of the direct impulse of a given stream to the effective oblique impulse in the same direction.

Prop. IV. The direct impulse of a stream of fluid, whose breadth is given, is to its oblique effective impulse in the direction of the stream, as the square of radius to the square of the sine of the angle of incidence.

For the number of filaments which occupy the oblique plane BC, would occupy the portion NC of a perpendicular plane, and therefore we have only to compare the perpendicular impulse on any point V with the effective impulse made by the same filament FV on the oblique plane at G. Now GH represents the impulse which this filament would make at V; and GQ is the effective impulse of the same filament at G, estimated in the direction GH of the stream; and GH is to GQ as GH^2 to GI^2, that is, as rad.^2 to $\text{sin.}^2\, i$.

Cor. 1. The effective impulse in the direction of the stream on any plane surface BC, is to the direct impulse on its base BR or SE, as the square of the sine of the angle of incidence to the square of the radius.

2. If an isosceles wedge ACB (fig. 3.) be exposed to a stream of fluid moving in the direction of its height CD, the impulse on the sides is to the direct impulse on the base as the square of half the base AD to the square of the side AC, or as the square of the sine of half the angle of the wedge to the square of the radius. For it is evident, that in this case the two transverse impulses, such as GP in fig. 1. balance each other, and the only impulse which can be observed is the sum of the two impulses, such as GQ of fig. 1. which are to be compared with the impulses on the two halves AD, DB of the base. Now AC : AB = rad. : sin. ACD, and ACD is equal to the angle of incidence. Fig. 3.

Therefore, if the angle ACB is a right angle, and ACD is half a right angle, the square of AC is twice the square of AD, and the impulse on the sides of a rectangular wedge is half the impulse on its base.

Also, if a cube ACBE (fig. 4.) be exposed to a stream moving in a direction perpendicular to one of its sides, and then to a stream moving in a direction perpendicular to one of its diagonal planes, the impulse in the first case will be to the impulse in the second as $\sqrt{2}$ to 1. Call the perpendicular impulse on a side F, and the perpendicular impulse on its diagonal plane f, and the effective oblique impulse on its sides φ;—we have Fig. 4.

$$\text{F} : f = \text{AC} : \text{AB} = 1 : \sqrt{2}, \text{ and}$$
$$f : \varphi = \text{AC}^2 : \text{AD}^2 = 2 : 1. \text{ Therefore}$$
$$\text{F} : \varphi = 2 : \sqrt{2}, = \sqrt{2} : 1,$$

or very nearly as 10 to 7.

The same reasoning will apply to a pyramid whose base is a regular polygon, and whose axis is perpendicular to the base. If such a pyramid is exposed to a stream of fluid moving in the direction of the axis, the direct impulse on the base is to the effective impulse on the pyramid, as the square of the radius to the square of the sine of the angle which the axis makes with the sides of the pyramid.

And, in like manner, the direct impulsion on the base of a right cone is to the effective impulsion on the conical surface, as the square of the radius to the square of the sine of half the angle at the vertex of the cone. This is demonstrated, by supposing the cone to be a pyramid of an infinite number of sides.

We may in this manner compare the impulse on any polygonal surface with the impulse on its base, by comparing apart the impulses on each plane with those in their corresponding bases, and taking their sum.

And we may compare the impulse on a curved surface with that on its base, by resolving the curved surface into elementary planes, each of which is impelled by an elementary filament of the stream.

The following beautiful proposition, given by Le Sueur and Jaquier, in their Commentary on the second book of Newton's Principia, with a few examples of its application, will suffice for any further account of this theory.

Prop.

Resistance of Fluids.

22
The impulse on a curved surface compared with that on its base.
Fig. 5.

Prop. V. Let ADB (fig. 5.) be the section of a surface of simple curvature, such as is the surface of a cylinder. Let this be exposed to the action of a fluid moving in the direction AC. Let BC be the section of the plane (which we have called its base), perpendicular to the direction of the stream. In AC produced, take any length CG; and on CG describe the semicircle CHG, and complete the rectangle BCGO. Through any point D of the curve draw ED parallel to AC, and meeting BC and OG in Q and P. Let DF touch the curve in D, and draw the chord GH parallel to DF, and HKM perpendicular to CG, meeting ED in M. Suppose this to be done for every point of the curve ADB, and let LMN be the curve which passes through all the points of intersection of the parallels EDP and the corresponding perpendiculars HKM.

The effective impulse on the curve surface ADB in the direction of the stream, is to its direct impulse on the base BC as the area BCNL is to the rectangle BCGO.

Draw $c\,d\,q\,m\,p$ parallel to EP and extremely near it. The arch D d of the curve may be conceived as the section of an elementary plane, having the position of the tangent DF. The angle EDF is the angle of incidence of the filament ED $d\,e$. This is equal to CGH, because ED, DF, are parallel to CG, GH; and (because CHG is a semicircle) CH is perpendicular to GH. Also CG : CH$=$CH : CK, and CG : CK$=$ $\text{GG}^2 : \text{CH}^2, = \text{rad.}^2 : \text{sin.}^2$, CGH, $= \text{rad.}^2 : \text{sin.}^2$ incid. Therefore if CG, or its equal DP, represent the direct impulse on the point Q of the base, CK, or its equal QM, will represent the effective impulse on the point D of the curve. And thus, Q $q\,p$ P will represent the direct impulse of the filament on the element Q p of the base, and Q $q\,m$ M will represent the effective impulse of the same filament on the element D d of the curve. And, as this is true of the whole curve ADB, the effective impulse on the whole curve will be represented by the area BCNML; and the direct impulse on the base will be represented by the rectangle BCGO; and therefore the impulse on the curve-surface is to the impulse on the base as the area BLMNC is to the rectangle BOGC.

It is plain, from the construction, that if the tangent to the curve at A is perpendicular to AC, the point N will coincide with G. Also, if the tangent to the curve at B is parallel to AC, the point L will coincide with B.

Whenever, therefore, the curve ADB is such that an equation can be had to exhibit the general relation between the abscissa AR and the ordinate DR, we shall deduce an equation which exhibits the relation between the absciss CK and the ordinate KM of the curve LMN; and this will give us the ratio of BLNC to BOGC.

Fig. 6.

Thus, if the surface is that of a cylinder, so that the curve BDAb (fig. 6.), which receives the impulse of the fluid, is a semicircle, make CG equal to AC, and construct the figure as before. The curve BMG is a parabola, whose axis is CG, whose vertex is G, and whose parameter is equal to CG. For it is plain, that CG$=$DC, and GH $=$ CQ, $=$ MK. And CG$\times$GK $=\text{GH}^2=\text{KM}^2$. That is, the curve is such, that the square of the ordinate KM is equal to the rectangle of the abscissa GK and a constant line GC; and it is therefore a parabola whose vertex is G. Now, it is well known, that the parabolic area BMGC is two thirds of the parallelogram BCGO. Therefore the impulse on the quadrant ADB is two thirds of the impulse on the base BC. The same may be said of the quadrant A $d\,b$ and its base $c\,b$. Therefore, *The impulse on a cylinder or half cylinder is two thirds of the direct impulse on its transverse plane through the axis*; or it is two thirds of the direct impulse on one side of a parallelopiped of the same breadth and height.

Prop. VI. If the body be a solid generated by the revolution of the figure BDAC (fig. 5.) round the axis AC; and if it be exposed to the action of a stream of fluid moving in the direction of the axis AC; then the effective impulse in the direction of the stream is to the direct impulse on its base, as the solid generated by the revolution of the figure BLMNC round the axis CN to the cylinder generated by the revolution of the rectangle BOGC.

This scarcely needs a demonstration. The figure ADBLMNA is a section of these solids by a plane passing through the axis; and what has been demonstrated of this section is true of every other, because they are all equal and similar. It is therefore true of the whole solids, and (their base) the circle generated by the revolution of BC round the axis AC.

Hence we easily deduce, that *The impulse on a sphere is one half of the direct impulse on its great circle, or on the base of a cylinder of equal diameter.*

For in this case the curve BMN (fig. 6.) which generates the solid expressing the impulse on the sphere is a parabola, and the solid is a parabolic conoid. Now this conoid is to the cylinder generated by the revolution of the rectangle BOGC round the axis CG, as the sum of all the circles generated by the revolution of ordinates to the parabola such as KM, to the sum of as many circles generated by the ordinates to the rectangle such as KT; or as the sum of all the squares described on the ordinates KM to the sum of as many squares described on the ordinates KT. Draw BG cutting MK in S. The square on MK is to the square on BC or TK as the abscissa GK to the abscissa GC (by the nature of the parabola), or as SK to BC; because SK and BC are respectively equal to GK and GC. Therefore the sum of all the squares on ordinates, such as MK, is to the sum of as many squares on ordinates, such as TK, as the sum of all the lines SK to the sum of as many lines KT: that is, as the triangle BGC to the rectangle BOGC: that is, as one to two: and therefore the impulse on the sphere is one half of the direct impulse on its great circle.

From the same construction we may very easily deduce a very curious and seemingly useful truth, that of all conical bodies having the circle whose diameter is AB (fig. 3.) for its base, and FD for its height, the one which sustains the smallest impulse or meets with the smallest resistance is the frustum AGHB of a cone ACB so constructed, that EF being taken equal to ED, EA is equal to EC. This frustum, though more capacious than the cone AFB of the same height, will be less resisted.

Also, if the solid generated by the revolution of BDAC (fig. 5.) have its anterior part covered with a

frustum

frustum of a cone generated by the lines D a, a A, forming the angle at a of 135 degrees; this solid, though more capacious than the included solid, will be less resisted.

And, from the same principles, Sir Isaac Newton determined the form of the curve ADB, which would generate the solid which, of all others of the same length and base, should have the least resistance.

These are curious and important deductions, but are not introduced here, for reasons which will soon appear.

The reader cannot fail to observe, that all that we have hitherto delivered on this subject, relates to the comparison of different impulses or resistances. We have always compared the oblique impulsions with the direct, and by their intervention we compare the oblique impulsions with each other. But it remains to give absolute measures of some individual impulsion; to which, as to an unit, we may refer every other. And as it is by their pressure that they become useful or hurtful, and they must be opposed by other pressures, it becomes extremely convenient to compare them all with that pressure with which we are most familiarly acquainted, the pressure of gravity.

The manner in which the comparison is made, is this. When a body advances in a fluid with a known velocity, it puts a known quantity of the fluid into motion (as is supposed) with this velocity; and this is done in a known time. We have only to examine what weight will put this quantity of fluid into the same motion, by acting on it during the same time. This weight is conceived as equal to the resistance. Thus, let us suppose that a stream of water, moving at the rate of eight feet per second, is perpendicularly obstructed by a square foot of solid surface held fast in its place. Conceiving water to act in the manner of the hypothetical fluid now described, and to be without elasticity, the whole effect is the gradual annihilation of the motion of eight cubic feet of water moving eight feet in a second. And this is done in a second of time. It is equivalent to the gradually putting eight cubic feet of water into motion with this velocity; and doing this by acting uniformly during a second. What weight is able to produce this effect? The weight of eight feet of water, acting during a second on it, will, as is well known, give it the velocity of thiry-two feet per second; that is, four times greater. Therefore, the weight of the fourth part of eight cubic feet, that is, the weight of two cubic feet, acting during a second, will do the same thing, or the weight of a column of water whose base is a square foot, and whose height is two feet. This will not only produce this effect in the same time with the impulsion of the solid body, but it will also do it by the same degrees, as any one will clearly perceive, by attending to the gradual acceleration of the mass of water urged by one-fourth of its weight, and comparing this with the gradual production or extinction of motion in the fluid by the progress of the resisted surface.

Now it is well known that eight cubic feet of water, by falling one foot, which it will do in one fourth of a second, will acquire the velocity of eight feet per second by its weight; therefore the force which produces the same effect in a whole second is one-fourth of this. This force is therefore equal to the weight of a column of water, whose base is a square foot, and whose height is two feet; that is, twice the height necessary for acquiring the velocity of the motion by gravity. The conclusion is the same whatever be the surface that is resisted, whatever be the fluid that resists, and whatever be the velocity of the motion. In this inductive and familiar manner we learn, that *the direct impulse or resistance of an unelastic fluid on any plane surface, is equal to the weight of a column of the fluid having the surface for its base, and twice the fall necessary for acquiring the velocity of the motion for its height:* and if the fluid is considered as elastic, the impulse or resistance is twice as great. See Newt. *Princip.* B. II. prop. 35. and 38.

27 This theory tried by different experiments.

It now remains to compare this theory with experiment. Many have been made, both by Sir Isaac Newton and by subsequent writers. It is much to be lamented, that in a matter of such importance, both to the philosopher and to the artist, there is such a disagreement in the results with each other. We shall mention the experiments which seem to have been made with the greatest judgment and care. Those of Sir Isaac Newton were chiefly made by the oscillations of pendulums in water, and by the descent of balls both in water and in air. Many have been made by Mariotte (*Traité de Mouvement des Eaux*). Gravesande has published, in his *System of Natural Philosophy*, experiments made on the resistance or impulsions on solids in the midst of a pipe or canal. They are extremely well contrived, but are on so small a scale that they are of very little use. Daniel Bernoulli, and his pupil Professor Krafft, have published in the *Comment. Acad. Petropol.* experiments on the impulse of a stream or vein of water from an orifice or tube: These are of great value. The Abbé Bossut has published others of the same kind in his *Hydrodynamique*. Mr Robins has published, in his *New Principles of Gunnery*, many valuable experiments on the impulse and resistance of air. The Chev. de Borda, in the *Mem. Acad. Paris*, 1763 and 1767, has given experiments on the resistance of air and also of water, which are very interesting. The most complete collection of experiments on the resistance of water are those made at the public expence by a committee of the academy of sciences, consisting of the marquis de Condorcet, Mr d'Alembert, Abbé Bossut, and others. The Chev. de Buat, in his *Hydraulique*, has published some most curious and valuable experiments, where many important circumstances are taken notice of, which had never been attended to before, and which give a view of the subject totally different from what is usually taken of it. Don George d'Ulloa, in his *Examine Maritimo*, has also given some important experiments, similar to those adduced by Bouguer in his *Manœuvre des Vaisseaux* but leading to very different conclusions. All these should be consulted by such as would acquire a practical knowledge of this subject. We must content ourselves with giving their most general and steady results. Such as,

1. It is very consonant to experiment that the resistances are proportional to the squares of the velocities. When the velocities of water do not exceed a few feet per second, no sensible deviation is observed. In very small velocities the resistances are sensibly greater than in this proportion, and this excess is plainly owing to the viscidity or imperfect fluidity of water. Sir Isaac Newton has shown that the resistance arising from this cause

cause is constant, or the same in every velocity; and when he has taken off a certain part of the total resistance, he found the remainder was very exactly proportionable to the square of the velocity. His experiments to this purpose were made with balls a very little heavier than water, so as to descend very slowly; and they were made with his usual care and accuracy, and may be depended on.

28
Causes of its disagreement with them.

In the experiments made with bodies floating on the surface of water, there is an addition to the resistance arising from the inertia of the water. The water heaps up a little on the anterior surface of the floating body, and is depressed behind it. Hence arises a hydrostatical pressure, acting in concert with the true resistance. A similar thing is observed in the resistance of air, which is condensed before the body and rarefied behind it, and thus an additional resistance is produced by the unbalanced elasticity of the air; and also because the air, which is *actually* displaced, is denser than common air. These circumstances cause the resistances to increase faster than the squares of the velocities: but, even independent of this, there is an additional resistance arising from the tendency to rarefaction behind a very swift body; because the pressure of the surrounding fluid can only make the fluid fill the space left with a determined velocity.

We have had occasion to speak of this circumstance more particularly under GUNNERY and PNEUMATICS, when considering very rapid motions. Mr Robins had remarked that the velocity at which the observed resistance of the air began to increase so prodigiously, was that of about 1100 or 1200 feet per second, and that this was the velocity with which air would rush into a void. He concluded, that when the velocity was greater than this, the ball was exposed to the additional resistance arising from the unbalanced statical pressure of the air, and that this constant quantity behoved to be added to the resistance arising from the air's inertia in all greater velocities. This is very reasonable: But he imagined that in smaller velocities there was no such unbalanced pressure. But this cannot be the case: for although in smaller velocities the air will still fill up the space behind the body, it will not fill it up with air of the same density. This would be to suppose the motion of the air into the deserted place to be instantaneous. There must therefore be a rarefaction behind the body, and a pressure backward; arising from unbalanced elasticity, independent of the condensation on the anterior part. The condensation and rarefaction are caused by the same thing, viz. the limited elasticity of the air. Were this infinitely great, the smallest condensation before the body would be instantly diffused over the whole air, and so would the rarefaction, so that no pressure of unbalanced elasticity would be observed; but the elasticity is such as to propagate the condensation with the velocity of sound only, i. e. the velocity of 1142 feet per second. Therefore this additional resistance does not commence precisely at this velocity, but is sensible in all smaller velocities, as is very justly observed by Euler But we are not yet able to ascertain the law of its increase, although it is a problem which seems susceptible of a tolerably accurate solution.

Precisely similar to this is the resistance to the motion of floating bodies, arising from the accumulation or gorging up of the water on their anterior surface, and its depression behind them. Were the gravity of the water infinite, while its inertia remains the same, the wave raised up at the prow of a ship would be instantly diffused over the whole ocean, and it would therefore be infinitely small, as also the depression behind the poop. But this wave requires time for its diffusion; and while it is not diffused, it acts by hydrostatical pressure. We are equally unable to ascertain the law of variation of this part of the resistance, the mechanism of waves being but very imperfectly understood. The height of the wave in the experiments of the French academy could not be measured with sufficient precision (being only observed *en passant*) for ascertaining its relation to the velocity. The Chev. Buat attempted it in his experiments, but without success. This must evidently make a part of the resistance in all velocities: and it still remains an undecided question, 'What relation it bears to the velocities?" When the solid body is wholly buried in the fluid, this accumulation does not take place, or at least not in the same way: It may, however, be observed. Every person may recollect, that in a very swift running stream a large stone at the bottom will produce a small swell above it; unless it lies very deep, a nice eye may still observe it. The water, on arriving at the obstacle, glides past it in every direction, and is deflected on all hands; and therefore what passes over it is also deflected upwards, and causes the water over it to rise above its level. The nearer that the body is to the surface, the greater will be the perpendicular rise of the water, but it will be less diffused; and it is uncertain whether the *whole* elevation will be greater or less. By the whole elevation we mean the area of a perpendicular section of the elevation by a plane perpendicular to the direction of the stream. We are rather disposed to think that this area will be greatest when the body is near the surface. D'Ulloa has attempted to consider this subject scientifically; and is of a very different opinion, which he confirms by the single experiment to be mentioned by and by. Mean time, it is evident, that if the water, which glides past the body cannot fall in behind it with sufficient velocity for filling up the space behind, there must be a void there; and thus a hydrostatical pressure must be superadded to the resistance arising from the inertia of the water. All must have observed, that if the end of a stick held in the hand be drawn slowly through the water, the water will fill the place left by the stick, and there will be no curled wave: but if the motion be very rapid, a hollow trough or gutter is left behind, and is not filled up till at some distance from the stick, and the wave which forms its sides is very much broken and curled. The writer of this article has often looked into the water from the poop of a second rate man of war when she was sailing 11 miles per hour, which is a velocity of 16 feet per second nearly; and he not only observed that the back of the rudder was naked for about two feet below the load water-line, but also that the trough or wake made by the ship was filled up with water which was broken and foaming to a considerable depth, and to a considerable distance from the vessel: There must therefore have been a void. He never saw the wake perfectly transparent (and therefore completely filled with water) when the velocity exceeded 9 or 10 feet per second. While this broken

broken water is observed, there can be no doubt that there is a void and an additional resistance. But even when the space left by the body, or the space behind a still body exposed to a stream, is completely filled, it may not be filled sufficiently fast, and there may be (and certainly is, as we shall see afterwards) a quantity of water behind the body, which is moving more slowly away than the rest, and therefore hangs in some shape by the body, and is dragged by it, increasing the resistance. The quantity of this must depend partly on the velocity of the body or stream, and partly on the rapidity with which the surrounding water comes in behind. This last must depend on the pressure of the surrounding water. It would appear, that when this adjoining pressure is very great, as must happen when the depth is great, the augmentation of resistance now spoken of would be less. Accordingly this appears in Newton's experiments, where the balls were less retarded as they were deeper under water.

These experiments are so simple in their nature, and were made with such care, and by a person so able to detect and appreciate every circumstance, that they deserve great credit, and the conclusions *legitimately* drawn from them deserve to be considered as physical laws. We think that the present deduction is unexceptionable: for in the motion of balls, which hardly descended, their preponderancy being hardly sensible, the effect of depth must have borne a very great proportion to the whole resistance, and must have greatly influenced their motions; yet they were observed to fall as if the resistance had no way depended on the depth.

The same thing appears in Borda's experiments, where a sphere which was deeply immersed in the water was less resisted than one that moved with the same velocity near the surface; and this was very constant and regular in a course of experiments. D'Ulloa, however, affirms the contrary: He says that the resistance of a board, which was a foot broad, immersed one foot in a stream moving two feet per second, was $15\frac{1}{7}$ lbs. and the resistance to the same board, when immersed 2 feet in a stream moving $1\frac{1}{7}$ feet per second (in which case the surface was 2 feet), was $26\frac{1}{4}$ pounds (A).

We are very sorry that we cannot give a proper account of this theory of resistance by Don George Juan D'Ulloa, an author of great mathematical reputation, and the inspector of the marine academies in Spain. We have not been able to procure either the original or the French translation, and judge of it only by an extract by Mr Prony in his *Architecture Hydraulique*, § 868, &c. The theory is enveloped (according to Mr Prony's custom) in the most complicated expressions, so that the physical principles are kept almost out of sight. When accommodated to the simplest possible case, it is nearly as follows.

Let o be an elementary orifice or portion of the surface of the side of a vessel filled with a heavy fluid, and let h be its depth under the horizontal surface of the fluid. Let δ be the density of the fluid, and φ the accelerative power of gravity, $=32$ feet velocity acquired in a second.

It is known, says he, that the water would flow out at this hole with the velocity $u=\sqrt{2\varphi h}$, and $u^2=2\varphi h$ and $h=\frac{u^2}{2\varphi}$. It is also known that the pressure p on the orifice o is $\varphi o \delta h, =\varphi o \delta \frac{u^2}{2\varphi}, =\frac{1}{2}\delta o u^2$.

Now, let this little surface o be supposed to move with the velocity v. The fluid would meet it with the velocity $u+v$, or $u-v$, according as it moved in the opposite or in the same direction with the efflux. In the equation $p=\frac{1}{2}\delta o u^2$, substitute $u\pm v$ for u, and we have the pressure on $o=p=\frac{\delta o}{2}(u\pm\ )^2, =\frac{\delta o}{2}(\sqrt{2\varphi h}\pm u^2)$.

This pressure is a weight, that is, a mass or matter m actuated by gravity φ, or $p=\varphi m$, and $m=\delta o\left(\sqrt{h}\pm\frac{v}{\sqrt{2\varphi}}\right)^2$.

This elementary surface being immersed in a stagnant fluid, and moved with the velocity v, will sustain on one side a pressure $\delta o\left(\sqrt{h}+\frac{v}{\sqrt{2\varphi}}\right)^2$, and on the other side a pressure $\delta o\left(\sqrt{h}-\frac{v}{\sqrt{2\varphi}}\right)^2$; and the sensible resistance will be the difference of these two pressures, which is $\delta o 4\sqrt{h}\frac{v}{\sqrt{2\varphi}}$, or $\delta o 4\sqrt{h}\frac{v}{8}$, that is, $\frac{\delta o\sqrt{h}v}{2}$, because $\sqrt{2\varphi}=8$; a quantity which is in the subduplicate ratio of the depth under the surface of the fluid, and the simple ratio of the velocity of the resisted surface jointly.

There is nothing in experimental philosophy more certain than that the resistances are very nearly in the duplicate ratio of the velocities; and we cannot conceive by what experiments the ingenious author has supported this conclusion.

But there is, besides, what appears to us to be an essential defect in this investigation. The equation exhibits no resistance in the case of a fluid without weight. Now a theory of the resistance of fluids should exhibit the retardation arising from inertia alone, and should distinguish it from that arising from any other cause: and moreover, while it *assigns* an ultimate sensible resistance proportional (*cæteris paribus*) to the simple velocity, it *assumes* as a first principle that the pressure p is as $u\pm v^2$. It also gives a false measure of the statical pressures: for these (in the case of bodies immersed in our waters at least) are made up of the pressure of the incumbent water, which is measured by h, and the pressure of the atmosphere, a constant quantity. 31 Defect in his investigation.

Whatever reason can be given for setting out with the principle that the pressure on the little surface o, moving with the velocity u, is equal to $\frac{1}{2}\delta o(u\pm v)^2$, makes it indispensably necessary to take for the velocity u, not that with which water would issue from a hole whose depth under the surface is h, but the velocity with

(A) There is something very unaccountable in these experiments. The resistances are much greater than any other author has observed.

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with which it will issue from a hole whose depth is $h + 33$ feet. Because the pressure of the atmosphere is equal to that of a column of water 33 feet high: for this is the acknowledged velocity with which it would rush in to the void left by the body. If therefore this velocity (which does not exist) has any share in the effort, we must have for the fluxion of pressure not $\frac{4\sqrt{hv}}{\sqrt{2\varphi}}$, but $\frac{4\sqrt{\overline{h+33}|}\,v}{\sqrt{2\varphi}}$. This would not only give pressure or resistances many times exceeding those that have been observed in our experiments, but would also totally change the proportions which this theory determines. It was at any rate improper to embarrass an investigation, already very intricate, with the pressure of gravity, and with two motions of efflux, which do not exist, and are necessary for making the pressures in the ratio of $\overline{u+v^2}$ and $\overline{u-v^2}$.

Mr Prony has been at no pains to inform his readers of his reasons for adopting this theory of resistance, so contrary to all received opinions, and to the most distinct experiments. Those of the French academy, made under greater pressures, gave a much smaller resistance; and the very experiments adduced in support of this theory are extremely deficient, wanting fully one-third of what the theory requires. The resistances by experiment were $15\frac{3}{4}$ and $26\frac{1}{7}$, and the theory required $20\frac{1}{7}$ and 39. The equation, however, deduced from the theory is greatly deficient in the expression of the pressures caused by the accumulation and depression, stating the heights of them as $= \frac{v^2}{2\varphi}$. They can never be so high, because the heaped-up water flows off at the sides, and it also comes in behind by the sides; so that the pressure is much less than half the weight of a column whose height is $\frac{v^2}{2\varphi}$; both because the accumulation and depression are less at the sides than in the middle, and because, when the body is wholly immersed, the accumulation is greatly diminished. Indeed in this case, the final equation does not include their effects, though as real in this case as when part of the body is above water.

Upon the whole, we are somewhat surprised that an author of D'Ulloa's eminence should have adopted a theory so unnecessarily and so improperly embarrassed with foreign circumstances; and that Mr Prony should have inserted it with the explanation by which he was to abide, in a work destined for practical use.

This point, on the effect of deep immersion, is still much contested; and it is a received opinion, by many not accustomed to mathematical researches, that the resistance is greater in greater depths. This is assumed as an important principle by Mr Gordon author of a *Theory of Naval Architecture;* but on very vague and slight grounds: and the author seems unacquainted with the manner of reasoning on such subjects. It shall be considered afterwards.

With these corrections it may be asserted that theory and experiment agree very well in this respect, and that the resistance may be asserted to be in the duplicate ratio of the velocity.

We have been more minute on this subject, because it is the leading proposition in the theory of the action of fluids. Newton's demonstration of it takes no notice of the manner in which the various particles of the fluid are put in motion, or the motion which each in particular acquires. He only shows, that if there be nothing concerned in the communication but pure inertia, the sum total of the motions of the particles, estimated in the direction of the bodies motion, or that of the stream, will be in the duplicate ratio of the velocity. It was therefore of importance to show that this part of the theory was just. To do this, we had to consider the effect of every circumstance which could be combined with the inertia of the fluid. All these had been foreseen by that great man, and are most briefly, though perspicuously, mentioned in the last scholium to prop. 36. B. II.

32 Impulses and resistances nearly in proportion of the surfaces.

2. It appears from a comparison of all the experiments, that the impulses and resistances are very nearly in the proportion of the surfaces. They appear, however, to increase somewhat faster than the surfaces. The chevalier Borda found that the resistance, with the same velocity, to a surface of

Surface		Resistance		Instead of
9 inches	was	9	instead of	9
16		17,535		16
36		42,750		36
81		104,737		81

The deviation in these experiments from the theory increases with the surface, and is probably much greater in the extensive surfaces of the sails of ships and windmills, and the hulls of ships.

3. The resistances do by no means vary in the duplicate ratio of the sines of the angles of incidence.

As this is the most interesting circumstance, having a chief influence on all the particular modifications of the resistance of fluids, and as on this depends the whole theory of the construction and working of ships, and the action of water on our most important machines, and seems most immediately connected with the mechanism of fluids, it merits a very particular consideration. We cannot do a greater service than by rendering more generally known the excellent experiments of the French academy.

33 Experiments of the French academy. Fig. 8.

Fifteen boxes or vessels were constructed, which were two feet wide, two feet deep, and four feet long. One of them was a parallelopiped of these dimensions; the others had prows of a wedge-form, the angle ACB (fig. 8.) varying by 12° degrees from 12° to 180°; so that the angle of incidence increased by 6° from one to another. These boxes were dragged across a very large bason of smooth water (in which they were immersed two feet) by means of a line passing over a wheel connected with a cylinder, from which the actuating weight was suspended. The motion became perfectly uniform after a very little way; and the time of passing over 96 French feet with this uniform motion was very carefully noted. The resistance was measured by the weight employed, after deducting a certain quantity (properly estimated) for friction, and for the accumulation of the water against the anterior surface. The results of the many experiments are given in the following table; where column 1st contains the angle of the prow, column 2d contains the resistance as given by the preceding theory, column 3d contains the resistance exhibited in the experiments, and column 4th, contains the deviation of the experiment from the theory.

E.

nce de.

I.	II.	III.	IV.
180	10000	10000	0
168	9890	9893	+3
156	9568	9578	+10
144	9045	9084	+39
132	8346	8446	+100
120	7500	7710	+210
108	6545	6925	+380
96	5523	6148	+625
84	4478	5433	+955
72	3455	4800	+1345
60	2500	4404	+1904
48	1654	4240	+2586
36	955	4142	+3187
24	432	4063	+3631
12	109	3999	+3890

The resistance to 1 square foot, French measure, moving with the velocity of 2,56 feet per second, was very nearly 7,625 pounds French.

Reducing these to English measures, we have the surface = 1,1363 feet, the velocity of the motion equal to 2,7263 feet per second, and the resistance equal to 8,234 pounds avoirdupois. The weight of a column of fresh water of this base, and having for its height the fall necessary for communicating this velocity, is 8,264 pounds avoirdupois. The resistances to other velocities were accurately proportional to the squares of the velocities.

There is great diversity in the value which different authors have deduced for the absolute resistance of water from their experiments. In the value now given nothing is taken into account but the inertia of the water. The accumulation against the forepart of the box was carefully noted, and the statical pressure backwards, arising from this cause, was subtracted from the whole resistance to the drag. There had not been a sufficient variety of experiments for discovering the share which tenacity and friction produced; so that the number of pounds set down here may be considered as somewhat superior to the mere effects of the inertia of the water. We think, upon the whole, that it is the most accurate determination yet given of the resistance to a body in motion: but we shall afterwards see reason for believing, that the impulse of a running stream having the same velocity is somewhat greater; and this is the form in which most of the experiments have been made.

Also observe, that the resistance here given is that to a vessel two feet broad and deep and four feet long. The resistance to a plane of two feet broad and deep would probably have exceeded this in the proportion of 15,22 to 14,54, for reasons we shall see afterwards.

rs. From the experiments of Chevalier Buat, it appears that a body of one foot square, French measure, and two feet long, having its centre 15 inches under water, moving three French feet per second, sustained a pressure of 1454 French pounds, or 15,63 English. This reduced in the proportion of 3^2 to $2,56^2$ gives 11,43 pounds, considerably exceeding the 8,24.

Mr Bouguer, in his *Manœuvre des Vaisseaux*, says, that he found the resistance of sea-water to a velocity of one foot to be 23 ounces *poids de Marc*.

The chevalier Borda found the resistance of sea-water to the face of a cubic foot, moving against the water one foot per second, to be 21 ounces nearly. But this experiment is complicated: the wave was not deducted; and it was not a plane, but a cube. Resistance of Fluids.

Don George d'Ulloa found the impulse of a stream of sea-water, running two feet per second, on a foot square, to be $15\frac{1}{4}$ pounds English measure. This greatly exceeds all the values given by others.

From these experiments we learn, in the first place, that the direct resistance to a motion of a plane surface through water, is very nearly equal to the weight of a column of water having that surface for its base, and for its height the fall producing the velocity of the motion. This is but one half of the resistance determined by the preceding theory. It agrees, however, very well with the best experiments made by other philosophers on bodies totally immersed or surrounded by the fluid; and sufficiently shows, that there must be some fallacy in the principles or reasoning by which this result of the theory is supposed to be deduced. We shall have occasion to return to this again. 35 Consequences from them.

But we see that the effects of the obliquity of incidence deviate enormously from the theory, and that this deviation increases rapidly as the acuteness of the prow increases. In the prow of 60° the deviation is nearly equal to the whole resistance pointed out by the theory, and in the prow of 12° it is nearly 40 times greater than the theoretical resistance.

The resistance of the prow of 90° should be one-half the resistance of the base. We have not such a prow; but the medium between the resistance of the prow of 96 and 84 is 5790, instead of 500.

These experiments are very conform to those of other authors on plane surfaces. Mr Robins found the resistance of the air to a pyramid of 45°, with its apex foremost, was to that of its base as 1000 to 1411, instead of one to two. Chevalier Borda found the resistance of a cube, moving in water in the direction of the side, was to the oblique resistance, when it was moved in the direction of the diagonal, in the proportion of $5\frac{1}{3}$ to 7; whereas it should have been that of $\sqrt{2}$ to 1, or of 10 to 7 nearly. He also found, that a wedge whose angle was 90°, moving in air, gave for the proportion of the resistances of the edge and base 7281 : 10000, instead of 5000 : 10000. Also, when the angle of the wedge was 60°, the resistances of the edge and base were 52 and 100, instead of 25 and 100.

In short, in all the cases of oblique plane surfaces, the resistances were greater than those which are assigned by the theory. The theoretical law agrees tolerably with observation in large angles of incidence, that is, in incidences not differing very far from the perpendicular; but in more acute prows the resistances are more nearly proportional to the sines of incidence than to their squares.

The academicians deduced from these experiments an expression of the general value of the resistance, which corresponds tolerably well with observation. Thus let x be the complement of the half angle of the prow, and let P be the direct pressure or resistance, with an incidence of 90°, and p the effective oblique pressure: then $p = P \times \text{cosine}^2\, x + 3,153 \left(\frac{x^0}{6^0}\right)^{3,25}$. This gives for a prow of 12° an error in defect about $\frac{1}{100}$, and in larger angles it is much nearer the truth; and this is exact enough for any practice.

This is an abundantly simple formula; but if we introduce

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troduce it in our calculations of the resistances of curvilineal prows, it renders them so complicated as to be almost useless; and what is worse, when the calculation is completed for a curvilineal prow, the resistance which results is found to differ widely from experiment. This shows that the motion of the fluid is so modified by the action of the most prominent part of the prow, that its impulse on what succeeds is greatly affected, so that we are not allowed to consider the prow as composed of a number of parts, each of which is affected as if it were detached from all the rest.

As the very nature of naval architecture seems to require curvilineal forms, in order to give the necessary strength, it seemed of importance to examine more particularly the deviations of the resistances of such prows from the resistances assigned by the theory. The academicians therefore made vessels with prows of a cylindrical shape; one of these was a half cylinder, and the other was one-third of a cylinder, both having the same breadth, viz. two feet, the same depth, also two feet, and the same length, four feet. The resistance of the half cylinder was to the resistance of the perpendicular prow in the proportion of 13 to 25, instead of being as 13 to 19.5. The chevalier Borda found nearly the same ratio of the resistances of the half cylinder, and its diametrical plane when moved in air. He also compared the resistances of two prisms or wedges, of the same breadth and height. The first had its sides plane, inclined to the base in angles of 60°: the second had its sides portions of cylinders, of which the planes were the chords, that is, their sections were arches of circles of 60°. Their resistances were as 133 to 100, instead of being as 133 to 220, as required by the theory; and as the resistance of the first was greater in proportion to that of the base than the theory allows, the resistance of the last was less.

Mr Robins found the resistance of a sphere moving in air to be to the resistance of its great circle as 1 to 2.27; whereas theory requires them to be as 1 to 2. He found, at the same time, that the absolute resistance was greater than the weight of a cylinder of air of the same diameter, and having the height necessary for acquiring the velocity. It was greater in the proportion of 49 to 40 nearly.

Borda found the resistance of the sphere moving in water to be to that of its great circle as 1000 to 2508, and it was one-ninth greater than the weight of the column of water whose height was that necessary for producing the velocity. He also found the resistance of air to the sphere was to its resistance to its great circle as 1 to 2.45.

36
The theory gives some resistances too small and others too great.

It appears, on the whole, that the theory gives the resistance of oblique plane surfaces too small, and that of curved surfaces too great; and that it is quite unfit for ascertaining the modifications of resistance arising from the figure of the body. The most prominent part of the prow changes the action of the fluid on the succeeding parts, rendering it totally different from what it would be were that part detached from the rest, and exposed to the stream with the same obliquity. It is of no consequence, therefore, to deduce any formula from the valuable experiments of the French academy. The experiments themselves are of great importance, because they give us the impulses on plane surfaces with every obliquity. They therefore put it in our power to select the most proper obliquity in a thousand important cases. By appealing to them, we can tell what is the proper angle of the sail for producing the greatest impulse in the direction of the ship's course; or the best inclination of the sail of a wind-mill, or the best inclination of the float of a water-wheel, &c. &c. These deductions will be made in their proper places in the course of this work. We see also, that the deviation from the simple theory is not very considerable till the obliquity is great; and that, in the inclinations which other circumstances would induce us to give to the floats of water-wheels, the sails of wind-mills, and the like, the results of the theory are sufficiently agreeable to experiment, for rendering this theory of very great use in the construction of machines. Its great defect is in the impulsions on curved surfaces, which puts a stop to our improvement of the science of naval architecture, and the working of ships.

But it is not enough to detect the faults of the theory: we should try to amend it, or to substitute another. It is a pity that so much ingenuity should have been thrown away in the application of a theory so defective. Mathematicians were seduced, as has been already observed, by the opportunity which it gave for exercising their calculus, which was a new thing at the time of publishing this theory. Newton saw clearly the defects of it, and makes no use of any part of it in his subsequent discussions, and plainly has used it merely as an introduction, in order to give some general notions in a subject quite new, and to give a demonstration of one leading truth, viz. the proportionality of the impulsions to the squares of the velocities. While we profess the highest respect for the talents and labours of the great mathematicians who have followed Newton in this most difficult research, we cannot help being sorry that some of the greatest of them continued to attach themselves to a theory which he neglected, merely because it afforded an opportunity of displaying their profound knowledge of the new calculus, of which they were willing to ascribe the discovery to Leibnitz. It has been in a great measure owing to this that we have been so late in discovering our ignorance of the subject. Newton had himself pointed out all the defects of this theory; and he set himself to work to discover another which should be more conformable to the nature of things, retaining only such deductions from the other as his great sagacity assured him would stand the test of experiment. Even in this he seems to have been mistaken by his followers. He retained the proportionality of the resistance to the square of the velocity. This they have endeavoured to demonstrate in a manner conformable to Newton's determination of the oblique impulses of fluids; and under the cover of the agreement of this proposition with experiment, they introduced into mechanics a mode of expression, and even of conception, which is inconsistent with all accurate notions of these subjects. Newton's proposition was, that the motions communicated to the fluid, and therefore the motions lost by the body, in equal times, were as the squares of the velocities; and he conceived these as proper measures of the resistances. It is a matter of experience, that the forces or pressures by which a body must be supported in opposition to the impulses of fluids, are in this very proportion. In determining the *proportion* of the direct and oblique resistances of plane surfaces,

37
Its defects pointed out by Newton.

surfaces, he considers the resistances to arise from mutual collisions of the surface and fluid, repeated at intervals of time too small to be perceived. But in making this comparison, he has no occasion whatever to consider this *repetition;* and when he assigns the proportion between the resistance of a cone and of its base, he, in fact, assigns the proportion between two *simultaneous* and instantaneous impulses. But the mathematicians who followed him have considered this repetition as equivalent to an augmentation of the initial or first impulse; and in this way have attempted to demonstrate that the resistances are as the squares of the velocities. When the velocity is double, each impulse is double, and the number in a given time is double; therefore, say they, the resistance, and the force which will withstand it, is quadruple; and observation confirms their deduction: yet nothing is more gratuitous and illogical. It is very true that the resistance, conceived as Newton conceives it, the loss of motion sustained by a body moving in the fluid, is quadruple; but the instantaneous impulse, and the force which can withstand it, is, by all the laws of mechanics, only double. What is the force which can withstand a double impulse? Nothing but a double impulse. Nothing but impulse can be opposed to impulse; and it is a gross misconception to think of stating any kind of comparison between impulse and pressure. It is this which has given rise to much jargon and false reasoning about the force of percussion. This is stated as infinitely greater than any pressure, and as equivalent to a pressure infinitely repeated. It forced the abettors of these doctrines at last to deny the existence of all pressure whatever, and to assert that all motion, and tendency to motion, was the result of impulse. The celebrated Euler, perhaps the first mathematician, and the lowest philosopher, of this century, says, "since motion and impulse are seen to exist, and since we see that by means of motion pressure may be produced, as when a body in motion strikes another, or as when a body moved in a curved channel presses upon it, merely in consequence of its curvilineal motion, and the exertion of a centrifugal force; and since Nature is most wisely economical in all her operations; it is absurd to suppose that pressure, or tendency to motion, has any other origin; and it is the business of a philosopher to discover by what motion any observed pressure is produced." Whenever any pressure is observed, such as the pressure of gravity, of magnetism, of electricity, condensed air, nay, of a spring, and of elasticity and cohesion themselves, however disparate, nay, opposite, the philosopher must immediately cast about, and contrive a set of motions (creating *pro re natâ* the movers) which will produce a pressure like the one observed. Having pleased his fancy with this, he cries out εὕρηκα "this *will produce* the pressure;" *et frustra fit per plura quod fieri potest per pauciora,* "therefore in this way the pressure *is* produced." Thus the vortices of Descartes are brought back in triumph, and have produced vortices without number, which fill the universe with motion and pressure.

38 No comparison between impulse and pressure.

Such bold attempts to overturn long-received doctrines in mechanics, could not be received without much criticism and opposition; and many able dissertations appeared from time to time in defence of the common doctrines. In consequence of the many objections to the comparison of pure pressure with pure percussion or impulse, John Bernoulli and others were at last obliged to assert that there were no perfectly hard bodies in nature, nor could be, but that all bodies were elastic; and that in the communication of motion by percussion, the velocities of both bodies were *gradually* changed by their mutual elasticity acting during the finite but imperceptible time of the collision. This was, in fact, giving up the whole argument, and banishing percussion, while their aim was to get rid of pressure. For what is elasticity but a pressure? and how shall *it* be produced? To act in this instance, must it arise from a still smaller impulse? But this will require another elasticity, and so on without end.

These are all legitimate consequences of this attempt to state a comparison between percussion and pressure. Numberless experiments have been made to confirm the statement; and there is hardly an itinerant lecturing showman who does not exhibit among his apparatus Gravesande's machine (Vol. I. plate xxxv. fig. 4.). But nothing affords so specious an argument as the experimented proportionality of the impulse of fluids to the square of the velocity. Here is every appearance of the accumulation of an infinity of minute impulses, in the known ratio of the velocity, each to each, producing pressures which are in the ratio of the squares of the velocities.

The pressures are observed; but the impulses or percussions, whose accumulation produces these pressures, are only supposed. The rare fluid, introduced by Newton for the purpose already mentioned, either does not exist in nature, or does not act in the manner we have said, the particles making their impulse, and then escaping through among the rest without affecting their motion. We cannot indeed say what may be the proportion between the diameter and the distance of the particles. The first may be incomparably smaller than the second, even in mercury, the densest fluid which we are familiarly acquainted with: but although they do not touch each other, they act nearly as if they did, in consequence of their mutual attractions and repulsions. We have seen air a thousand times rarer in some experiments than in others, and therefore the distance of the particles at least ten times greater than their diameters; and yet, in this rare state, it propagates all pressures or impulses made on any part of it to a great distance, almost in an instant. It cannot be, therefore, that fluids act on bodies by impulse. It is very possible to conceive a fluid advancing with a flat surface against the flat surface of a solid. The very first and superficial particles may make an impulse; and if they were annihilated, the next might do the same: and if the velocity were double, these impulses would be double, and would be withstood by a double force, and not a quadruple, as is observed: and this very circumstance that a quadruple force is necessary, should have made us conclude that it was not to impulse that this force was opposed. The first particles having made their stroke, and not being annihilated, must escape laterally. In their escaping they effectually prevent every farther impulse, because they come in the way of those filaments which would have struck the body. The whole process seems to be somewhat as follows:

39 But a very small part of a fluid can make any impulse on a surface.

When the flat surface of the fluid has come into contact with the plane surface AD (fig. 7.) perpendicular to the direction DC of their motion, they must deflect to

Fig 7.

to both sides equally, and in equal portions, because no reason can be assigned why more should go to either side. By this means the filament EF, which would have struck the surface in G, is deflected *before it arrives at* the surface, and describes a curved path EFIHK, continuing its rectilineal motion to I, where it is intercepted by a filament immediately adjoining to EF, on the side of the middle filament DC. The different particles of DC may be supposed to impinge in succession at C, and to be deflected at right angles; and gliding along CB, to escape at B. Each filament in succession, outwards from DC, is deflected in its turn; and being hindered from even touching the surface CB, it glides off in a direction parallel to it; and thus EF is deflected in I, moves parallel to CB from I to H, and is again deflected at right angles, and describes HK parallel to DC. The same thing may be supposed to happen on the other side of DC.

And thus it would appear, that except two filaments immediately adjoining to the line DC, which bisects the surface at right angles, no part of the fluid makes any impulse on the surface AB. All the other filaments are merely pressed against it by the lateral filaments without them, which they turn aside, and prevent from striking the surface.

40
No impulse on the edge of a prism.
Fig. 8.

In like manner, when the fluid strikes the edge of a prism or wedge ACB (fig. 8.), it cannot be said that any real impulse is made. Nothing hinders us from supposing C a mathematical angle or indivisible point, not susceptible of any impulse, and serving merely to divide the stream. Each filament EF is effectually prevented from impinging at G in the line of its direction, and with the obliquity of incidence EGC, by the filaments between EF and DC, which glide along the surface CA; and it may be supposed to be deflected when it comes to the line CF which bisects the angle DCA, and again deflected and rendered parallel to DC at I. The same thing happens on the other side of DC; and we cannot in that case assert that there is any impulse.

41
The ordinary theory of no use in naval architecture.

We now see plainly how the ordinary theory must be totally unfit for furnishing principles of naval architecture, even although a formula could be deduced from such a series of experiments as those of the French Academy. Although we should know precisely the impulse, or, to speak now more cautiously, the action, of the fluid on a surface GL (fig. 9.) of any obliquity, when it is alone, detached from all others, we cannot in the smallest degree tell what will be the action of *part* of a stream or fluid advancing towards it, with the same obliquity, when it is preceded by an adjoining surface CG, having a different inclination; for the fluid will not glide along GL in the same manner as if it made part of a more extensive surface having the same inclination. The previous deflections are extremely different in these two cases; and the previous deflections are the only changes which we can observe in the motions of the fluid, and the only causes of that pressure which we observe the body to sustain, and which we call the impulse on it. This theory must, therefore, be quite unfit for ascertaining the action on a curved surface, which may be considered as made up of an indefinite number of successive planes.

Fig. 9.

We now see with equal evidence how it happens that the action of fluids on solid bodies may and must be opposed by pressures, and may be compared with and measured by the pressure of gravity. We are not comparing forces of different kinds, percussions with pressures, but pressures with each other. Let us see whether this view of the subject will afford us any method of comparison or absolute measurement.

Fig. 7.

When a filament of fluid, that is, a row of corpuscles, are turned out of their course EF (fig. 7.), and forced to take another course IH, force is required to produce this change of direction. The filament is prevented from proceeding by other filaments which lie between it and the body, and which deflect it in the same manner as if it were contained in a bended tube, and it will press on the concave filament next to it as it would press on the concave side of the tube. Suppose such a bended tube ABE (fig. 10.), and that a ball A is projected along it with any velocity, and moves in it without friction: it is demonstrated, in elementary mechanics, that the ball will move with undiminished velocity, and will press on every point, such as B, of the concave side of the tube, in a direction BF perpendicular to the plane CBD, which touches the tube in the point B. This pressure on the adjoining filament, on the concave side of its path, must be withstood by that filament which deflects it; and it must be propagated across that filament to the next, and thus augment the pressure upon that next filament already pressed by the deflection of the intermediate filament; and thus there is a pressure towards the middle filament, and towards the body, arising from the deflection of all the outer filaments; and their accumulated sum must be conceived as immediately exerted on the middle filaments and on the body, because a perfect fluid transmits every pressure undiminished.

Fig. 10.

42
Pressure the action of fluids.

The pressure BF is equivalent to the two BH, BG, one of which is perpendicular, and the other parallel, to the direction of the original motion. By the first (taken in any point of the curvilineal motion of any filament), the two halves of the stream are pressed together; and in the case of fig. 7. and 8. exactly balance each other. But the pressures, such as BG, must be ultimately withstood by the surface ACB; and it is by these accumulated pressures that the solid body is urged down the stream; and it is these accumulated pressures which we observe and measure in our experiments. We shall anticipate a little, and say that it is most easily demonstrated, that when a ball A (fig. 10.) moves with undiminished velocity in a tube so incurvated that its axis at E is at right angles to its axis at A, the accumulated action of the pressures, such as BG, taken for every point of the path, is precisely equal to the force which would produce or extinguish the original motion.

43
Whether they be for elastic or not.

This being the case, it follows most obviously, that if the two motions of the filaments are such as we have described and represented by fig. 7. the whole pressure in the direction of the stream, that is, the whole pressure which can be observed on the surface, is equal to the weight of a column of fluid having the surface for its base, and twice the fall productive of the velocity for its height, precisely as Newton deduced it from other considerations; and it seems to make no odds whether the fluid be elastic or unelastic, if the deflections and velocities are the same. Now it is a fact, that no difference in this respect can be observed in the actions of air and water; and this had always appeared a great defect in Newton's theory: but it was only a defect of the

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the theory attributed to him. But it is also true, that the observed action is but one-half of what is just now deduced from this improved view of the subject. Whence arises this difference? The reason is this: We have given a very erroneous account of the motions of the filaments. A filament EF does not move as represented in fig. 7. with two rectangular inflections at I and at H, and a path IH between them parallel to CB. The process of nature is more like what is represented in fig. 11.

Fig. 11.

It is observed, that at the anterior part of the body AB, there remains a quantity of fluid ADB, almost, if not altogether stagnant, of a singular shape, having two curved concave sides A *a* D, B *b* D, along which the middle filaments glide. This fluid is very slowly changed.—

44 Important experiments by Sir Charles Knowles.

The late Sir Charles Knowles, an officer of the British navy, equally eminent for his scientific professional knowledge and for his military talents, made many beautiful experiments for ascertaining the paths of the filaments of water. At a distance up the stream, he allowed small jets of a coloured fluid, which did not mix with water, to make part of the stream; and the experiments were made in troughs with sides and bottom of plate-glass. A small taper was placed at a considerable height above, by which the shadows of the coloured filaments were most distinctly projected on a white plane held below the trough, so that they were accurately drawn with a pencil. A few important particulars may be here mentioned.

The still water ADC, fig. 11. lasted for a long while before it was renewed; and it seemed to be gradually wasted by abrasion, by the adhesion of the surrounding water, which gradually licked away the outer parts from D to A and B; and it seemed to renew itself in the direction CD, opposite to the motion of the stream. There was, however, a considerable intricacy and eddy in this motion. Some (seemingly superficial) water was continually, but slowly, flowing outward from the line DC, while other water was seen within and below it, coming inwards and going backwards.

The coloured lateral filaments were most constant in their form, while the body was the same, although the velocity was in some cases quadrupled. Any change which this produced seemed confined to the superficial filaments.

As the filaments were deflected, they were also constipated, that is, the curved parts of the filaments were nearer each other than the parallel straight filaments up the stream; and this constipation was more considerable as the prow was more obtuse and the deflexion greater.

The inner filaments were ultimately more deflected than those without them; that is, if a line be drawn touching the curve EFIH in the point H of contrary flexure, where the concavity begins to be on the side next the body, the angle HKC, contained between the axis and the tangent line, is so much the greater as the filament is nearer the axis.

When the body exposed to the stream was a box of upright sides, flat bottom, and angular prow, like a wedge, having its edge also upright, the filaments were not all deflected laterally, as theory would make us expect; but the filaments near the bottom were also deflected downwards as well as laterally, and glided along at some distance under the bottom, forming lines of double curvature.

The breadth of the stream that was deflected was much greater than that of the body; and the sensible deflection began at a considerable distance up the stream, especially in the outer filaments.

Lastly, the form of the curves was greatly influenced by the proportion between the width of the trough and that of the body. The curvature was always less when the trough was very wide in proportion to the body.

Great varieties were also observed in the motion or velocity of the filaments. In general, the filaments increased in velocity outwards from the body to a certain small distance, which was nearly the same in all cases, and then diminished all the way outward. This was observed by inequalities in the colour of the filaments, by which one could be observed to outstrip another. The retardation of those next the body seemed to proceed from friction; and it was imagined that without this the velocity there would always have been greatest.

45 With inferences from them.

These observations give us considerable information respecting the mechanism of these motions, and the action of fluids upon solids. The pressure in the duplicate ratio of the velocities comes here again into view. We found, that although the velocities were very different, the curves were precisely the same. Now the observed pressures arise from the transverse forces by which each particle of a filament is retained in its curvilineal path; and we know that the force by which a body is retained in any curve is directly as the square of the velocity, and inversely as the radius of curvature. The curvature, therefore, remaining the same, the transverse forces, and consequently the pressure on the body, must be as the square of the velocity: and, on the other hand, we can see pretty clearly (indeed it is rigorously demonstrated by D'Alembert), that whatever be the velocities, the curves *will* be the same. For it is known in hydraulics, that it requires a fourfold or ninefold pressure to produce a double or triple velocity. And as all pressures are propagated through a perfect fluid without diminution, this fourfold pressure, while it produces a double velocity, produces also fourfold transverse pressures, which will retain the particles, moving twice as fast, in the same curvilineal paths. And thus we see that the impulses, as they are called, and resistances of fluids, have a certain relation to the weight of a column of fluid, whose height is the height necessary for producing the velocity. How it happens that a plane surface, immersed in an extended fluid, sustains just half the pressure which it would have sustained had the motions been such as are sketched in fig. 7th, is a matter of more curious and difficult investigation. But we see evidently that the pressure must be less than what is there assigned; for the stagnant water a-head of the body greatly diminishes the ultimate deflections of the filaments: And it may be demonstrated, that when the part BE of the canal, fig. 10. is inclined to the part AB in an angle less than 90°, the pressures BG along the whole canal are as the versed sine of the ultimate angle of deflection, or the versed sine of the angle which the part BE makes with the part AB. Therefore, since the deflections resemble more the sketch given in fig. 11. the accumulated sum of all these forces BG of fig. 10. must be less than the similar sum corresponding to fig. 7. that is, less than the weight of the column of fluid, having twice the productive height for its height. How it is just one half, shall be our next inquiry.

And

And here we must return to the labours of Sir Isaac Newton. After many beautiful observations on the nature and mechanism of continued fluids, he says, that the resistance which they occasion is but one half of that occasioned by the rare fluid which had been the subject of his former proposition; "which truth," (says he, with his usual caution and modesty), "I shall endeavour to show."

46 Investigations of Newton

He then enters into another, as novel and as difficult an investigation, viz. the laws of hydraulics, and endeavours to ascertain the motion of fluids through orifices when urged by pressures of any kind. He endeavours to ascertain the velocity with which a fluid escapes through a horizontal orifice in the bottom of a vessel, by the action of its weight, and the pressure which this vein of fluid will exert on a little circle which occupies part of the orifice. To obtain this, he employs a kind of approximation and trial, of which it would be extremely difficult to give an extract; and then, by increasing the diameter of the vessel and of the hole to infinity, he accommodates his reasoning to the case of a plane surface exposed to an indefinitely extended stream of fluid; and, lastly, giving to the little circular surface the motion which he had before ascribed to the fluid, he says, that the resistance to a plane surface moving through an unelastic continuous fluid, is equal to the weight of a column of the fluid whose height is one-half of that necessary for acquiring the velocity; and he says, that the resistance of a globe is, in this case, the same with that of a cylinder of the same diameter. The resistance, therefore, of the cylinder or circle is four times less, and that of the globe is twice less than their resistance on a rare elastic medium.

47 liable to great objections,

But this determination, though founded on principles or assumptions, which are much nearer to the real state of things, is liable to great objections. It depends on his method for ascertaining the velocity of the issuing fluid; a method extremely ingenious, but defective. The cataract, which he supposes, cannot exist as he supposes, descending by the full action of gravity, and surrounded by a funnel of stagnant fluid. For, in such circumstances, there is nothing to balance the hydrostatical pressure of this surrounding fluid; because the whole pressure of the central cataract is employed in producing its own descent. In the next place, the pressure which he determines is beyond all doubt one half of what is observed on a plane surface in all our experiments. And, in the third place, it is repugnant to all our experience, that the resistance of a globe or of a pointed body is as great as that of its circular base. His reasons are by no means convincing. He supposes them placed in a tube or canal; and since they are supposed of the same diameter, and therefore leave equal spaces at their sides, he concludes, that because the water escapes by their sides with the same velocity, they will have the same resistance. But this is by no means a necessary consequence. Even if the water should be allowed to exert equal pressures on them, the pressures being perpendicular to their surfaces, and these surfaces being inclined to the axis, while in the case of the base of a cylinder, it is in the direction of the axis, there must be a difference in the accumulated or compound pressure in the direction of the axis. He indeed says, that in the case of the cylinder or the circle obstructing the canal, a quantity of water remains stagnant on its upper surface; viz. all the water whose motion would not contribute to the most ready passage of the fluid between the cylinder and the sides of the canal or tube; and that this water may be considered as frozen. If this be the case, it is indifferent what is the form of the body that is covered with this mass of frozen or stagnant water. It may be a hemisphere or a cone; the resistance will be the same.—But Newton by no means, assigns, either with precision or with distinct evidence, the form and magnitude of this stagnant water, so as to give confidence in the results. He contents himself with saying, that it is that water whose motion is not necessary or cannot contribute to the most easy passage of the water.

48 though displaying great sagacity.

There remains, therefore, many imperfections in this theory. But notwithstanding these defects, we cannot but admire the efforts and sagacity of this great philosopher, who, after having discovered so many sublime truths of mechanical nature, ventured to trace out a path for the solution of a problem which no person had yet attempted to bring within the range of mathematical investigation. And his solution, though inaccurate, shines throughout with that inventive genius and that fertility of resource, which no man ever possessed in so eminent a degree.

Those who have attacked the solution of Sir Isaac Newton have not been more successful. Most of them, instead of principles, have given a great deal of calculus; and the chief merit which any of them can claim, is that of having deduced some single proposition which happens to quadrate with some single case of experiment, while their general theories are either inapplicable, from difficulty and obscurity, or are discordant with more general observation.

We must, however, except from this number Daniel Bernoulli, who was not only a great geometer, but one of the first philosophers of the age. He possessed all the talents, and was free from the faults of that celebrated family; and while he was the mathematician of Europe who penetrated farthest in the investigation of this great problem, he was the only person who felt, or at least who acknowledged, its great difficulty.

49 Bernoulli's general formula founded on hypothesis.

In the 2d volume of the *Comment. Petropol.* 1727, he proposes a formula for the resistance of fluids, deduced from considerations quite different from those on which Newton founded his solution. But he delivers it with modest diffidence; because he found that it gave a resistance four times greater than experiment. In the same dissertation he determines the resistance of a sphere to be one half of that of its great circle. But in his subsequent theory of Hydrodynamics (a work which must ever rank among the first productions of the age, and is equally eminent for refined and elegant mathematics, and ingenious and original thoughts in dynamics), he calls this determination in question. It is indeed founded on the same hypothetical principles which have been unskilfully detached from the rest of Newton's physics, and made the groundwork of all the subsequent theories on this subject.

50 He treats the subject in a particular case with great precision.

In 1741, Mr Daniel Bernoulli published another dissertation (in the 8th volume of the *Com. Petropol.*) on the action and resistance of fluids, limited to a very particular case; namely, to the impulse of a vein of fluid

Resistance of Fluids.

fluid falling perpendicularly on an infinitely extended plane surface. This he demonstrates to be equal to the weight of a column of the fluid whose base is the area of the vein, and whose height is twice the fall producing the velocity. This demonstration is drawn from the true principles of mechanics and the acknowledged laws of hydraulics, and may be received as a strict physical demonstration. As it is the only proposition in the whole theory that has as yet received a demonstration accessible to readers not versant in all the refinements of modern analysis; and as the principles on which it proceeds will undoubtedly lead to a solution of every problem which can be proposed, once that our mathematical knowledge shall enable us to apply them—we think it our duty to give it in this place, although we must acknowledge, that this problem is so very limited, that it will hardly bear an application to any case that differs but a little from the express conditions of the problem. There do occur cases however in practice, where it may be applied to very great advantage.

Daniel Bernoulli gives two demonstrations; one of which may be called a popular one, and the other is more scientific and introductory to further investigation. We shall give both.

51
Determines the action exerted in the efflux of a vein of fluid.

Bernoulli first determines the whole action, exerted in the efflux of the vein of fluid. Suppose the velocity of efflux v is that which would be acquired by falling through the height h. It is well known that a body moving during the time of this fall with the velocity v would describe a space $2h$. The effect, therefore, of the hydraulic action is, that in the time t of the fall h, there issues a cylinder or prism of water whose base is the cross section s or area of the vein, and whose length is $2h$. And this quantity of matter is now moving with the velocity v. The quantity of motion, therefore, which is thus produced is $2shv$; and this quantity of motion is produced in the time t. And this is the accumulated effect of all the expelling forces, estimated in the direction of the efflux. Now, to compare this with the exertion of some pressing power with which we are familiarly acquainted, let us suppose this pillar $2sh$ to be frozen, and, being held in the hand, to be dropped. It is well known, that in the time t it will fall through the height h, and will acquire the velocity v, and now possesses the quantity of motion $2shv$—and all this is the effect of its weight. The weight, therefore, of the pillar $2sh$ produces the same effect, and in the same time, and (as may easily be seen) in the same gradual manner, with the expelling forces of the fluid in the vessel, which expelling forces arise from the pressure of all the fluid in the vessel. Therefore the accumulated hydraulic pressure, by which a vein of a heavy fluid is forced out through an orifice in the bottom or side of a vessel, is equal (when estimated in the direction of the efflux) to the weight of a column of the fluid, having for its base the section of the vein, and twice the fall productive of the velocity of efflux for its height.

Fig. 12.

Now let ADBC (fig. 12.) be a quadrangular vessel with upright plane sides, in one of which is an orifice EF. From every point of the circumference of this orifice, suppose horizontal lines E e, F f, &c. which will mark a similar surface on the opposite side of the vessel. Suppose the orifice EF to be shut. There can be no doubt but that the surfaces EF and ef will be equally pressed in opposite directions. Now open the orifice EF; the water will rush out, and the pressure on EF is now removed. There will therefore be a tendency in the vessel to move back in the direction E e. And this tendency must be precisely equal and opposite to the whole effort of the expelling forces. This is a conclusion as evident as any proposition in mechanics. It is thus that a gun recoils and a rocket rises in the air; and on this is founded the operation of Mr Parents or Dr Barker's mill, described in all treatises of mechanics, and most learnedly treated by Euler in the Berlin Memoirs.

Now, let this stream of water be received on a circular plane MN, perpendicular to its axis, and let this circular plane be of such extent, that the vein escapes from its sides in an infinitely thin sheet, the water flowing off in a direction parallel to the plane. The vein by this means will expand into a trumpet-like shape, having curved sides, EKG, FLH, fig. 13. We abstract at present the action of gravity which would cause the vein to bend downwards, and occasion a greater velocity at H than at G; and we suppose the velocity equal in every point of the circumference. It is plain, that if the action of gravity be neglected after the water has issued through the orifice EF, the velocity in every point of the circumference of the plane MN will be that of the efflux through EF. Fig. 13.

Now, because EKG is the natural shape assumed by the vein, it is plain, that if the whole vein were covered by a tube or mouth-piece, fitted to its shape, and perfectly polished, so that the water shall glide along it, without any friction (a thing which we may always suppose), the water will exert no pressure whatever on this trumpet mouth-piece. Lastly, let us suppose that the plane MN is attached to the mouth-piece by some bits of wire, so as to allow the water to escape all round by the narrow chink between the mouth-piece and the plane: We have now a vessel consisting of the upright part ABDC, the trumpet GKEFLH, and the plane MN; and the water is escaping from every point of the circumference of the chink GHNM with the velocity v. If any part of this chink were shut up, there would be a pressure on that part equivalent to the force of efflux from the opposite part. Therefore, when all is open, these efforts of efflux balance each other all round. There is not therefore any tendency in this compound vessel to move to any side. But take away the plane MN, and there would immediately arise a pressure in the direction E e equal to the weight of the column $2sh$. This is therefore balanced by the pressure on the circular plane MN, which is therefore equal to this weight, and the proposition is demonstrated.

A number of experiments were made by Professor Kraft at St Petersburgh, by receiving the vein on a plane MN (fig. 12.) which was fastened to the arm of a balance OPQ, having a scale R hanging on the opposite arm. The resistance or pressure on the plane was measured by weights put into the scale R; and the velocity of the jet was measured by means of the distance KH, to which it spouted on a horizontal plane.

52
Difference between this theory and experiments accounted for.

The results of these experiments were as conformable to the theory as could be wished. The resistance was always a little less than what the theory required, but greatly exceeded its half; the result of the generally received theories. This defect should be expected; for the

the demonstration supposes the plane MN to be infinitely extended, so that the film of water which issues through the chink may be accurately parallel to the plane. This never can be completely effected. Also it was supposed, that the velocity was justly measured by the amplitude of the parabola EGK. But it is well known that the very putting the plane MN in the way of the jet, though at the distance of an inch from the orifice, will diminish the velocity of the efflux through this orifice. This is easily verified by experiment. Observe the time in which the vessel will be emptied when there is no plane in the way. Repeat the experiment with the plane in its place; and more time will be necessary. The following is a note of a course of experiments, taken as they stand, without any selection.

	N° 1	2	3	4	5	6
Resist. by theory	1701	1720	1651	1602	1528	1072
Resist. by experiment	1403	1463	1456	1401	1403	1021
Difference	298	257	105	201	125	51

In order to demonstrate this proposition in such a manner as to furnish the means of investigating the whole mechanism and action of moving fluids, it is necessary to premise an elementary theorem of curvilineal motions.

Fig. 14.

If a particle of matter describes a curve line ABCE (fig. 14.) by the continual action of deflecting forces, which vary in any manner, both with respect to intensity and direction, and if the action of these forces, in every point of the curve, be resolved into two directions, perpendicular and parallel to the initial direction AK; then,

1. The accumulated effect of the deflecting forces, estimated in a direction AD perpendicular to AK, is to the final quantity of motion as the sine of the final change of direction is to radius.

53
His proposition demonstrated.

Let us first suppose that the accelerating forces act by starts, at equal intervals of time, when the body is in the points A, B, C, E. And let AN be the deflecting force, which, acting at A, changes the original direction AK to AB. Produce AB till BH = AB, and complete the parallelogram BFCH. Then FB is the force which, by acting at B, changed the motion BH (the continuation of AB) to BC. In like manner make C*h* (in BC produced) equal to BC, and complete the parallelogram C*f*E*h*. C*f* is the deflecting force at C, &c. Draw BO parallel to AN, and GBK perpendicular to AK. Also draw lines through C and E perpendicular to AK, and draw through B and C lines parallel to AK. Draw also HL, *hl* perpendicular, and FG, HI, *hi*, parallel to AK.

It is plain that BK is BO or AN estimated in the direction perpendicular to AK, and that BG is BF estimated in the same way. And since BH=AB, HL or IM is equal to BK. Also CI is equal to BG. Therefore CM is equal to AP+BG. By similar reasoning it appears that E*m*=E*i*+*hl*, =C*g*+CM, = C*g*+BG, +AP.

Therefore if CE be taken for the measure of the final velocity or quantity of motion, E*m* will be the accumulated effect of the deflecting forces estimated in the direction AD perpendicular to AK. But E*m* is to CE as the sine of *m*CE is to radius; and the angle *m*CE is the angle contained between the initial and final directions, because C*m* is parallel to AK. Now let the intervals of time diminish continually and the frequency of the impulses increase. The deflection becomes ultimately continuous, and the motion curvilineal, and the proposition is demonstrated.

We see that the initial velocity and its subsequent changes do not affect the conclusion, which depends entirely on the final quantity of motion.

2. The accumulated effect of the accelerating forces, when estimated in the direction AK of the original motion, or in the opposite direction, is equal to the difference between the initial quantity of motion and the product of the final quantity of motion by the cosine of the change of direction.

$$\begin{aligned} \text{For } Cm &= Cl - ml, = BM - fq \\ BM &= BL - ML, = AK - FG \\ AK &= AO - OK, = AO - PN. \end{aligned}$$

Therefore PN+FG+*f*Q (the accumulated impulse in the direction OA)=AO—CM,=AO—$\overline{\text{CE}}$ × cosine of ECM.

Cor. 1. The same action, in the direction opposite to that of the original motion, is necessary for causing a body to move at right angles to its former direction as for stopping its motion. For in this case, the cosine of the change of direction is = *o*, and AO—CE × cosine ECM=AO—*o*, = AO, = the original motion.

Cor. 2. If the initial and final velocities are the same, the accumulated action of the accelerating forces, estimated in the direction OA, is equal to the product of the original quantity of motion by the versed sine of the change of direction.

The application of these theorems, particularly the second, to our present purpose is very obvious. All the filaments of the jet were originally moving in the direction of its axis, and they are finally moving along the resisting plane, or perpendicular to their former motion. Therefore their transverse forces in the direction of the axis are (*in cumulo*) equal to the force which would stop the motion. For the aggregate of the simultaneous forces of every particle in the whole filament is the same with that of the successive forces of one particle, as it arrives at different points of its curvilineal path. All the tranverse forces, estimated in a direction perpendicular to the axis of the vein, precisely balance and sustain each other; and the only forces which can produce a sensible effect are those in a direction parallel to the axis. By these all the inner filaments are pressed towards the plane MN, and must be withstood by it. It is highly probable, nay certain, that there is a quantity of stagnant water in the middle of the vein which sustains the pressures of the moving filaments without it, and transmits it to the solid plane. But this does not alter the case. And, fortunately, it is of no consequence what changes happen in the velocities of the particles while each is describing its own curve. And it is from this circumstance, peculiar to this particular case of perpendicular impulse, that we are able to draw the conclusion. It is by no means difficult to demonstrate that the velocity of the external surface of this jet is constant, and indeed of every jet which is not acted on by external forces after it has quitted the orifice: but this discussion is quite unnecessary here. It is however extremely difficult to ascertain, even in this most simple case, what is the velocity of the internal filaments in the different points of their progress.

Such

Such is the demonstration which Mr Bernoulli has given of this proposition. Limited as it is, it is highly valuable, because derived from the true principles of hydraulics.

He hoped to render it more extensive and applicable to oblique impulses, when the axis AC of the vein (fig. 15.) is inclined to the plane in an angle ACN.

Fig. 15.

But here all the simplicity of the case is gone, and we are now obliged to ascertain the motion of each filament.

54 His theory attempted in vain to be rendered general.

It might not perhaps be impossible to determine what must happen in the plane of the figure, that is, in a plane passing through the axis of the vein, and perpendicular to the plane MN. But even in this case it would be extremely difficult to determine how much of the fluid will go in the direction EKG, and what will go in the path FLH, and to ascertain the form of each filament, and the velocity in its different points. But in the real state of the case, the water will dissipate from the centre C on every side; and we cannot tell in what proportions. Let us however consider a little what happens in the plane of the figure, and suppose that all the water goes either in the course EKG or in the course FLH. Let the quantities of water which take these two courses have the proportions of p and Π. Let $\sqrt{2a}$ be the velocity at A, $\sqrt{2b}$ be the velocity at G, and $\sqrt{2\beta}$ be the velocity at H. ACG and ACH are the two changes of direction, of which let c and $-c$ be the cosines. Then, adopting the former reasoning, we have the pressure of the watery plate GKEACM on the plane in the direction AC$=\frac{p}{p+\Pi}\times\overline{2a-2cb}$, and the pressure of the plate HLFACN $=\frac{p}{p+\Pi}\times\overline{2a+2c\beta}$, and their sum $=\frac{p\times\overline{2a-2cb}+\Pi\times\overline{2a+2c\beta}}{p\times\Pi}$; which being multiplied by the sine of ACM, or $\sqrt{1-c^2}$, gives the pressure perpendicular to the plane MN$=\frac{p\times\overline{2a-2cb}+\Pi\times\overline{2a+2c\beta}}{p+\Pi}\sqrt{1-c^2}$.

But there remains a pressure in the direction perpendicular to the axis of the vein, which is not balanced, as in the former case, by the equality on opposite sides of the axis. The pressure arising from the water which escapes at G has an effect opposite to that produced by the water which escapes at H. When this is taken into account, we shall find that their joint efforts perpendicular to AC are $\frac{p-\Pi}{p+\Pi}\times 2a\sqrt{1-c^2}$, which, being multiplied by the cosine of ACM, gives the action perpendicular to MN $=\frac{p-\Pi}{p+\Pi}\times 2ac\sqrt{1-c^2}$.

The sum or joint effort of all these pressures is

$$\frac{p\times\overline{2a-2cb}+\Pi\times\overline{2a+2c\beta}}{p+\Pi}\sqrt{1-c^2}+\frac{p-\Pi}{p+\Pi}\times 2ac\sqrt{1-c^2}.$$

Thus, from this case, which is much simpler than can happen in nature, seeing that there will always be a lateral efflux, the determination of the impulse is as uncertain and vague as it was sure and precise in the former case.

It is therefore without proper authority that the absolute impulse of a vein of fluid on a plane which receives it wholly, is asserted to be proportional to the sine of incidence. If indeed we suppose the velocity in G and H are equal to that at A, then $b=\beta$, $=a$, and the whole impulse is $2a\sqrt{1-c^2}$, as is commonly supposed. But this cannot be. Both the velocity and quantity at H are less than those at G. Nay, frequently there is no efflux on the side H when the obliquity is very great. We may conclude in general, that the oblique impulse will always bear to the direct impulse a greater proportion than that of the sine of incidence to radius. If the whole water escapes at G, and none goes off laterally, the pressure will be $\overline{2a+2ac-2bc}\times\sqrt{1-c^2}$. The experiments of the Abbé Bossut show in the plainest manner that the pressure of a vein, striking obliquely on a plane which receives it wholly, diminishes faster than in the ratio of the square of the sine of incidence; whereas, when the oblique plane is wholly immersed in the stream, the impulse is much greater than in this proportion, and in great obliquities is nearly as the sine.

Nor will this proposition determine the impulse of a fluid on a plane wholly immersed in it, even when the impulse is perpendicular to the plane. The circumstance is now wanting on which we can establish a calculation, namely, the angle of final deflection. Could this be ascertained for each filament, and the velocity of the filament, the principles are completely adequate to an accurate solution of the problem. In the experiments which we mentioned to have been made under the inspection of Sir Charles Knowles, a cylinder of six inches diameter was exposed to the action of a stream moving precisely one foot per second; and when certain deductions were made for the water which was held adhering to the posterior base (as will be noticed afterwards), the impulse was found equal to $3\frac{1}{8}$ ounces avoirdupois. There were 36 coloured filaments distributed on the stream, in such situations as to give the most useful indications of their curvature. It was found necessary to have some which passed under the body and some above it; for the form of these filaments, at the same distance from the axis of the cylinder, was considerably different: and those filaments which were situated in planes neither horizontal nor vertical took a double curvature. In short, the curves were all traced with great care, and the deflecting forces were computed for each and reduced to the direction of the axis; and they were summed up in such a manner as to give the impulse of the whole stream. The deflections were marked as far a-head of the cylinder as they could be assuredly observed. By this method the impulse was computed to be $2\frac{15}{16}$ ounces, differing from observation $\frac{3}{16}$ of an ounce, or about $\frac{1}{16}$ of the whole; a difference which may most reasonably be ascribed to the adhesion of the water, which must be most sensible in such small velocities. These experiments may therefore be considered as giving all the confirmation that can be desired of the justness of the principles. This indeed hardly admits of a doubt: but, alas! it gives but small assistance; for all this is empirical, in as far as it leaves us in every case the task of observing the form of the curves and

and the velocities in their different points. To derive service from this most judicious method of Daniel Bernoulli, we must discover some method of determining, *à priori*, what will be the motion of the fluid whose course is obstructed by a body of any form. And here we cannot omit taking notice of the casual observations of Sir Isaac Newton when attempting to determine the resistance of the plane surface or cylinder, or sphere exposed to a stream moving in a canal. He says, that the form of the resisting surface is of less consequence, because there is always a quantity of water stagnant upon it, and which may therefore be considered as frozen; and he therefore considers that water only whose motion is necessary for the most expeditious discharge of the water in the vessel. He endeavours to discriminate that water from the rest; and although it must be acknowledged that the principle which he assumes for this purpose is very gratuitous, because it only shows, that *if certain portions of the water*, which he determines very ingeniously, were really frozen, the rest will issue, as he says, and will exert the pressure which he assigns; still we must admire his fertility of resource, and his sagacity in thus foreseeing what subsequent observation has completely confirmed. We are even disposed to think, that in this casual observation Sir Isaac Newton has pointed out the only method of arriving at a solution of the problem; and that, if we could discover *what motions are not necessary for the most expeditious passage of the water*, and could thus determine the form and magnitude of the stagnant water which adheres to the body, we should much more easily ascertain the real motions which occasion the observed resistance. We are here disposed to have recourse to the economy of nature, the improper use of which we have sometimes taken the liberty of reprehending. Mr Maupertuis published as a great discovery his principle of smallest action, where he showed that in all the mutual actions of bodies the quantity of action was a minimum; and he applied this to the solution of many difficult problems with great success, imagining that he was really reasoning from a contingent law of nature, selected by its infinitely wise Author, viz. that on all occasions there is the smallest possible exertion of natural powers. Mr D'Alembert has, however, shown (vid. *Encyclopedié Françoise*, ACTION) that this was but a whim, and that the minimum observed by Maupertuis is merely a minimum of calculus, peculiar to a formula which happens to express a combination of mathematical quantities which frequently occurs in our way of considering the phenomena of nature, but which is no natural measure of action.

55 A method recommended for obtaining a general theory.

But the chevalier D'Arcy has shown, that in the trains of natural operations which terminate in the production of motion in a particular direction, the intermediate communications of motion are such that the smallest possible quantity of motion is produced. We seem obliged to conclude, that this law will be observed in the present instance; and it seems a problem not above our reach to determine the motions which result from it. We would recommend the problem to the eminent mathematicians in some simple case, such as the proposition already demonstrated by Daniel Bernoulli, or the perpendicular impulse on a cylinder included in a tubular canal; and if they succeed in this, great things may be expected. We think that experience gives great encouragement. We see that the resistance to a plane surface is a very small matter greater than the weight of a column of the fluid having the fall productive of the velocity for its height, and the small excess is most probably owing to adhesion, and the measure of the real resistance is probably precisely this weight. The velocity of a spouting fluid was found, in fact, to be that acquired by falling from the surface of the fluid; and it was by looking at this, as at a pole star, that Newton, Bernoulli, and others, have with great sagacity and ingenuity discovered much of the laws of hydraulics, by searching for principles which would give this result. We may hope for similar success.

In the mean time, we may receive this as a physical truth, that the perpendicular impulse or resistance of a plane surface, wholly immersed in the fluid, is equal to the weight of the column having the surface for its base, and the fall producing the velocity for its height.

This is the medium result of all experiments made in these precise circumstances. And it is confirmed by a set of experiments of a kind wholly different, and which seem to point it out more certainly as an immediate consequence of hydraulic principles.

56 Experiment by Mr Pitot's tube. Fig. 16.

If Mr Pitot's tube be exposed to a stream of fluid issuing from a reservoir or vessel, as represented in fig. 16. with the open mouth I pointed directly against this stream, the fluid is observed to stand at K in the upright tube, precisely on a level with the fluid AB in the reservoir. Here is a most unexceptionable experiment, in which the impulse of the stream is actually opposed to the hydrostatical pressure of the fluid on the tube. Pressure is in this case opposed to pressure, because the issuing fluid is deflected by what stays in the mouth of the tube, in the same way in which it would be deflected by a firm surface. We shall have occasion by and by to mention some most valuable and instructive experiments made with this tube.

57 Euler's theory.

It was this which suggested to the great mathematician Euler another theory of the impulse and resistance of fluids, which must not be omitted, as it is applied in his elaborate performance On the Theory of the Construction and Working of Ships, in two volumes 4to, which was afterwards abridged and used as a text book in some marine academies. He supposes a stream of fluid ABCD (fig. 17.), moving with any velocity, to strike the plane BD perpendicularly, and that part of it goes through a hole EF, forming a jet EGHF. Mr Euler says, that the velocity of this jet will be the same with the velocity of the stream. Now compare this with an equal stream issuing from a hole in the side of a vessel with the same velocity. The one stream is urged out by the pressure occasioned by the impulse of the fluid; the other is urged out by the pressure of gravity. The effects are equal, and the modifying circumstances are the same. The causes are therefore equal, and the pressure occasioned by the impulse of a stream of fluid, moving with any velocity, is equal to the weight of a column of fluid whose height is productive of this velocity, &c. He then determines the oblique impulse by the resolution of motion, and deduces the common rules of resistance, &c.

Fig. 17.

But all this is without just grounds. This gentleman was always satisfied with the slightest analogies which would give him an opportunity of exhibiting his great

great dexterity in algebraic analysis, and was not afterwards startled by any discordancy with observation. *Analysi magis fidendum* is a frequent assertion with him. Though he wrote a large volume, containing a theory of light and colours totally opposite to Newton's, he has published many dissertations on optical phenomena on the Newtonian principles, expressly because his own principles *non ideo facile ansam præbebat analysi instruendæ*.

Not a shadow of argument is given for the leading principle in this theory, viz. that the velocity of the jet is the same with the velocity of the stream. None can be given, but saying, that the pressure is equivalent to its production; and this is assuming the very thing he labours to prove. The matter of fact is, that the velocity of the jet is greater than that of the stream, and may be greater almost in any proportion. Which curious circumstance was discovered and ingeniously explained long ago by Daniel Bernoulli in his *Hydrodynamica*. It is evident that the velocity must be greater. Were a stream of sand to come against the plane, what goes through would indeed preserve its velocity unchanged: but when a real fluid strikes the plane, all that does not pass through is deflected on all sides; and by these deflections forces are excited, by which the filaments which surround the cylinder immediately fronting the hole are made to press this cylinder on all sides, and as it were squeeze it between them: and thus the particles at the hole must of necessity be accelerated, and the velocity of the jet must be greater than that of the stream. We are disposed to think that, in a fluid perfectly incompressible, the velocity will be double, or at lest increased in the proportion of 1 to $\sqrt{2}$. If the fluid is in the smallest degree compressible, even in the very small degree that water is, the velocity at the first impulse may be much greater. D. Bernoulli found that a column of water moving 5 feet per second, in a tube some hundred feet long, produced a velocity of 136 feet per second in the first moment.

There being this radical defect in the theory of Mr Euler, it is needless to take notice of its total insufficiency for explaining oblique impulses and the resistance of curvilineal prows.

We are extremely sorry that our readers are deriving so little advantage from all that we have said; and that having taken them by the hand, we are thus obliged to grope about, with only a few scattered rays of light to direct our steps. Let us see what assistance we can get from Mr d'Alembert, who has attempted a solution of that problem in a method entirely new and extremely ingenious. He saw clearly, that all the followers of Newton had forsaken the path which he had marked out for them in the second part of his investigation, and had merely amused themselves with the mathematical discussion with which his introductory hypothesis gave them an opportunity of occupying themselves. He paid the deserved tribute of applause to Daniel Bernoulli for having introduced the notion of pure pressure as the chief agent in this business; and he saw that he was in the right road, and that it was from hydrostatical principles alone that we had any chance of explaining the phenomena of hydraulics. Bernoulli had only considered the pressures which were excited in consequence of the curvilineal motions of the particles. Mr d'Alembert even thought that these pressures were not the consequences, but the causes, of these curvilineal motions. No internal motion can happen in a fluid but in consequence of an unbalanced pressure; and every such motion will produce an inequality of pressure, which will determine the succeeding motions. He therefore endeavoured to reduce all to the discovery of those disturbing pressures, and thus to the laws of hydrostatics. He had long before this hit on a very refined and ingenious view of the action of bodies on each other, which had enabled him to solve many of the most difficult problems concerning the motions of bodies, such as the centre of oscillation, of spontaneous conversion, the precession of the equinoxes, &c. &c. with great facility and elegance. He saw that the same principle would apply to the action of fluid bodies. The principle is this.

"*In whatever manner any number of bodies are supposed to act on each other, and by these actions come to change their present motions, if we conceive that the motion which each body would have in the following instant (if it became free), is resolved into two other motions; one of which is the motion which it really takes in the following instant; the other will be such, that if each body had no other motion but this second, the whole bodies would have remained in equilibrio.*" We here observe, "that the motion which each body would have in the following instant, if it became free," is a continuation of the motion which it has in the first instant. It may therefore perhaps be better expressed thus:

If the motions of bodies, anyhow acting on each other, be considered in two consecutive instants, and if we conceive the motion which it has in the first instant as compounded of two others, one of which is the motion which it actually takes in the second instant, the other is such, that if each body had only those second motions, the whole system would have remained in equilibrio.

The proposition itself is evident. For if these second motions be not such as that an equilibrium of the whole system would result from them, the other component motions would not be those which the bodies really have after the change; for they would necessarily be altered by these unbalanced motions. See D'Alembert *Essai de Dynamique*.

Assisted by this incontestable principle, M. d'Alembert demonstrates, in a manner equally new and simple, those propositions which Newton had so cautiously deduced from his hypothetical fluid, showing that they were not limited to this hypothesis, viz. that the motions produced by similar bodies, similarly projected in them, would be similar; that whatever were the pressures, the curves described by the particles would be the same; and that the resistances would be proportional to the squares of the velocities. He then comes to consider the fluid as having its motions constrained by the form of the canal or by solid obstacles interposed.

We shall here give a summary account of his fundamental proposition.

60
Summary account of his fundamental proposition.
Fig. 18.

It is evident, that if the body ADCE (fig. 18.) did not form an obstruction to the motion of the water, the particles would describe parallel lines TF, OK, PS, &c. But while yet at a distance from the body in F, K, S, they gradually change their directions, and describe the curves FM, Km, Sn, so much more incurvated as they are nearer to the body. At a certain distance ZY this curvature,

curvature will be insensible, and the fluid included in the space ZYHQ will move uniformly as if the solid body were not there. The motions on the other side of the axis AC will be the same; and we need only attend to one-half, and we shall consider these as in a state of permanency.

No body changes either its direction or velocity otherwise than by insensible degrees: therefore the particle which is moving in the axis will not reach the vertex A of the body, where it behoved to deflect instantaneously at right angles. It will therefore begin to be deflected at some point F a-head of the body, and will describe a curve FM, touching the axis in F, and the body in M; and then, gliding along the body, will quit it at some point L, describing a tangent curve, which will join the axis again (touching it) in R; and thus there will be a quantity of stagnant water FAM before or a head of the body, and another LCR behind or astern of it.

Let a be the velocity of a particle of the fluid in any instant, and a' its velocity in the next instant. The velocity a may be considered as compounded of a' and a''. If the particles tended to move with the velocities a'' only, the whole fluid would be in equilibrio (general principle), and the pressure of the fluid would be the same as if all were stagnant, and each particle were urged by a force $\frac{a''}{\dot{t}}$, $\dot{t}$ expressing an indefinitely small moment of time. (N. B. $\frac{a''}{\dot{t}}$ is the proper expression of the accelerating force, which, by acting during the moment $\dot{t}$, would generate the velocity a''; and a'' is supposed an indeterminate quantity, different perhaps for each particle). Now let a be supposed constant, or $a=a'$. In this case $a''=o$. That is to say, no pressure whatever will be exerted on the solid body unless there happen changes in the velocities or directions of the particles.

Let a and a' then be the motions of the particles in two consecutive instants. They would be in equilibrio if urged only by the forces $\frac{a''}{\dot{t}}$. Therefore if γ be the point where the particles which describe the curve FM begin to change their velocity, the pressure in D would be equal to the pressure which the fluid contained in the canal γ FMD would exert, if each particle were solicited by its force $\frac{a''}{\dot{t}}$. The question is therefore reduced to the finding the curvature in the canal γ FMD, and the accelerating forces $\frac{a''}{\dot{t}}$ in its different parts.

It appears, in the first place, that no pressure is exerted by any of the particles along the curve FM: for suppose that the particle a (fig. 19. describes the indefinitely small straight line $a\,b$ in the first instant, and $b\,c$ in the second instant; produce $a\,b$ till $b\,d=a\,b$, and joining dc, the motion ab or bd may be considered as composed of $b\,c$, which the particle really takes in the next instant, and a motion $d\,c$ which should be destroyed. Draw $b\,i$ parallel to dc, and ic perpendicular to bc. It is plain that the particle b, solicited by the forces $b\,e$, ei (equivalent to dc) should be in equilibrio. This being established, $b\,c$ must be $=o$, that is, there will be no accelerating or retarding force at b; for if there

Fig. 19.

be, draw $b\,m$ (fig. 20.) perpendicular to bF, and the parallel $n\,q$ infinitely near it. The part $b\,n$ of the fluid contained in the canal $b\,n\,q\,m$ would sustain some pressure from b towards n, or from n towards b. Therefore since the fluid in this stagnant canal should be in equilibrio, there must also be some action, at least in one of the parts $b\,m$, $m\,q$, $q\,n$, to counterbalance the action on the part $b\,n$. But the fluid is stagnant in the space FAM (in consequence of the law of continuity). Therefore there is no force which can act on $b\,m$, $m\,q$, $q\,n$; and the pressure in the canal in the direction $b\,n$ or $n\,b$ is nothing, or the force $b\,c=o$, and the force ie is perpendicular to the canal; and there is therefore no pressure in the canal FM, except what proceeds from the part γ F, or from the force $e\,i$; which last being perpendicular to the canal, there can be no force exerted on the point M, but what is propagated from the part γ F.

The velocity therefore in the canal FM is constant if finite, or infinitely small if variable: for, in the first case, the force $b\,e$ would be absolutely nothing; and in the second case, it would be an infinitesimal of the second order, and may be considered as nothing in comparison with the velocity, which is of the first order. We shall see by and by that the last is the real state of the case. Therefore the fluid, before it begins to change its direction in F, begins to change its velocity in some point γ a-head of F, and by the time that it reaches F its velocity is as it were annihilated.

Cor. 1. Therefore the pressure in any point D arises both from the retardations in the part γ F, and from the particles which are in the canal MD: as these last move along the surface of the body, the force $\frac{a''}{\dot{t}}$, destroyed in every particle, is compounded of two others, one in the direction of the surface, and the other perpendicular to it; call these p and p'. The point D is pressed perpendicularly to the surface MD; 1st, by all the forces p in the curve MD; 2d, by the force p' acting on the single point D. This may be neglected in comparison of the indefinite number of the others: therefore taking in the arch MD, an infinitely small portion N m, $=\dot{s}$, the pressure on D, perpendicular to the surface of the body, will be $=\int p\dot{s}$; and this fluent must be so taken as to be $=o$ in the point M.

Cor. 2. Therefore, to find the pressure on D, we must find the force p on any point N. Let u be the velocity of the particle N, in the direction N m in any instant, and $u+\dot{u}$ its velocity in the following instant; we must have $p=\frac{-\dot{u}}{\dot{t}}$. Therefore the whole question is reduced to finding the velocity u in every point N, in the direction N m.

And this is the aim of a series of propositions which follow, in which the author displays the most accurate and precise conception of the subject, and great address and elegance in his mathematical analysis. He at length brings out an equation which expresses the pressure on the body in the most general and unexceptionable manner. We cannot give an abstract, because the train of reasoning is already concise in the extreme: nor can we even exhibit the final equation; for it is conceived in the

His final equation truly solves the problem, but the most refined and abstruse form of indeterminate functions, in order to embrace every possible circumstance. But we can assure our readers, that it truly expresses the solution of the problem. But, alas! it is of no use. So imperfect is our mathematical knowledge, that even Mr d'Alembert has not been able to exemplify the application of the equation to the simplest case which can be proposed, such as the direct impulse on a plane surface wholly immersed in the fluid. All that he is enabled to do, is to apply it (by some modifications and substitutions which take it out of its state of extreme generality) to the direct impulse of a vein of fluid on a plane which deflects it wholly, and thus to show its conformity to the solution given by Daniel Bernoulli, and to observation and experience. He shows, that this impulse (independent of the deficiency arising from the plane's not being of infinite extent) is somewhat less than the weight of a column whose base is the section of the vein, and whose height is twice the fall necessary for communicating the velocity. This great philosopher and geometer concludes by saying, that he does not believe that any method can be found for solving this problem that is more direct and simple; and imagines, that if the deductions from it shall be found not to agree with experiment, we must give up all hopes of determining the resistance of fluids by theory and analytical calculus. He says *analytical calculus*; for all the physical principles on which the calculus proceeds are rigorously demonstrated, and will not admit of a doubt. There is only one hypothesis introduced in this investigation, and this is not a physical hypothesis, but a hypothesis of calculation. It is, that the quantities which determine the ratios of the second fluxions of the velocities, estimated in the directions parallel and perpendicular to the axis AC (fig. 18.) are functions of the abscissa AP, and ordinate PM of the curve. Any person, in the least acquainted with mathematical analysis, will see, that without this supposition no analysis or calculus whatever can be instituted. But let us see what is the *physical* meaning of this hypothesis. It is simply this, that the motion of the particle M depends on its situation only. It appears impossible to form any other opinion; and if we could form such an opinion, it is as clear as day light that the case is desperate, and that we must renounce all hopes.

We are sorry to bring our labours to this conclusion; but we are of opinion, that the only thing that remains is, for mathematicians to attach themselves with firmness and vigour to some simple cases; and, without aiming at generality, to apply M. d'Alembert's or Bernoulli's mode of procedure to the particular circumstances of the case. It is not improbable but that, in the solutions which may be obtained of these particular cases, circumstances may occur which are of a more general nature. These will be so many laws of hydraulics to be added to our present very scanty stock; and these may have points of resemblance, which will give birth to laws of still greater generality. And we repeat our expression of hopes of some success, by endeavouring to determine, in some simple cases, the *minimum possibile* of motion. The attempts of the Jesuit commentators on the *Principia* to ascertain this on the Newtonian hypothesis do them honour, and have really given us great assistance in the particular case which came through their hands.

Resistance of Fluids. 64 and multiply experiments.

And we should multiply experiments on the resistance of bodies. Those of the French academy are undoubtedly of inestimable value, and will always be appealed to. But there are circumstances in those experiments which render them more complicated than is proper for a general theory, and which therefore limit the conclusions which we wish to draw from them. The bodies were floating on the surface. This greatly modifies the deflections of the filaments of water, causing some to deflect laterally, which would otherwise have remained in one vertical plane; and this circumstance also necessarily produced what the academicians called the *remou*, or accumulation on the anterior part of the body, and depression behind it. This produced an additional resistance, which was measured with great difficulty and uncertainty. The effect of adhesion must also have been very considerable, and very different in the different cases; and it is of difficult calculation. It cannot perhaps be totally removed in any experiment, and it is necessary to consider it as making part of the resistance in the most important practical cases, viz. the motion of ships. Here we see that its effect is very great. Every seaman knows that the speed, even of a copper-sheathed ship, is *greatly* increased by greasing her bottom. The difference is too remarkable to admit of a doubt: nor should we be surprised at this, when we attend to the diminution of the motion of water in long pipes. A smooth pipe four and a half inches diameter, and 500 yards long, yields but one-fifth of the quantity which it ought to do independent of friction. But adhesion does a great deal which cannot be compared with friction. We see that water flowing through a hole in a thin plate will be increased in quantity fully one-third, by adding a little tube whose length is about twice the diameter of the hole. The adhesion therefore will greatly modify the action of the filaments both on the solid body and on each other, and will change both the forms of the curves and the velocities in different points; and this is a sort of objection to the only hypothesis introduced by d'Alembert. Yet it is only a sort of objection; for the effect of this adhesion, too, must undoubtedly depend on the situation of the particle.

65 The experiments of Robins and Borda susceptible of considerable accuracy.

The form of these experiments of the academy is ill-suited to the examination of the resistance of bodies wholly immersed in the fluid. The form of experiment adopted by Robins for the resistance of air, and afterwards by the chevalier Borda for water, is free from these inconveniences, and is susceptible of equal accuracy. The great advantage of both is the exact knowledge which they give us of the velocity of the motion; a circumstance essentially necessary, and but imperfectly known in the experiments of Mariotte and others, who examined quiescent bodies exposed to the action of a stream. It is extremely difficult to measure the velocity of a stream. It is very different in its different parts. It is swiftest of all in the middle superficial filament, and diminishes as we recede from this towards the sides or bottom, and the rate of diminution is not precisely known. Could this be ascertained with the necessary precision, we should recommend the following form of experiment as the most simple, easy, economical, and accurate.

Let a, b, c, d, (fig, 21.) be four hooks placed in a horizontal plane at the corners of a rectangular parallelogram, Fig 21.

Resistance of Fluids.

lelogram, the sides $a\,b$, $c\,d$ being parallel to the direction of the stream ABCD, and the sides $a\,b$, $c\,d$ being perpendicular to it. Let the body G be fastened to an axis $e\,f$ of stiff-tempered steel-wire, so that the surface on which the fluid is to act may be inclined to the stream in the precise angle we desire. Let this axis have hooks at its extremities, which are hitched into the loops of four equal threads, suspended from the hooks a, b, c, d; and let H e be a fifth thread, suspended from the middle of the line joining the points of suspension a, b. Let HIK be a graduated arch, whose centre is H, and whose plane is in the direction of the stream. It is evident that the impulse on the body G will be measured (by a process well known to every mathematician) by the deviation of the thread H e from the vertical line HI; and this will be done without any intricacy of calculation, or any attention to the centres of gravity, of oscillation, or of percussion. These must be accurately ascertained with respect to that form in which the pendulum has always been employed for measuring the impulse or velocity of a stream. These advantages arise from the circumstance, that the axis $e\,f$ remains always parallel to the horizon. We may be allowed to observe, by the bye, that this would have been a great improvement of the beautiful experiments of Mr Robins and Dr Hutton on the velocities of cannon-shot, and would have saved much intricate calculation, and been attended with many important advantages.

66 Simple experiment for measuring the velocity of a stream.

The great difficulty is, as we have observed, to measure the velocity of the stream. Even this may be done in this way with some precision. Let two floating bodies be dragged along the surface, as in the experiments of the academy, at some distance from each other laterally, so that the water between them may not be sensibly disturbed. Let a horizontal bar be attached to them, transverse to the direction of their motion, at a proper height above the surface, and let a spherical pendulum be suspended from this, or let it be suspended from four points, as here described. Now let the deviation of this pendulum be noted in a variety of velocities. This will give us the law of relation between the velocity and the deviation of the pendulum. Now, in making experiments on the resistance of bodies, let the velocity of the stream, in the very filament in which the resistance is measured, be determined by the deviation of this pendulum.

It were greatly to be wished that some more palpable argument could be found for the existence of a quantity of stagnant fluid at the anterior and posterior parts of the body. The one already given, derived from the consideration that no motion changes either its velocity or direction by finite quantities in an instant, is unexceptionable. But it gives us little information. The smallest conceivable extent of the curve FM in fig. 18. will answer this condition, provided only that it touches the axis in some point F, and the body in some point M, so as not to make a finite angle with either. But surely there are circumstances which rigorously determine the extent of this stagnant fluid. And it appears without doubt, that if there were no cohesion or friction, this space will have a determined ratio to the size of the body (the figures of the bodies being supposed similar). Suppose a plane surface AB, as in fig. 11. there can be no doubt but that the figure A a D b B

Fig. 18.

Fig. 11.

will in every case be similar. But if we suppose an adhesion or tenacity which is constant, this may make a change both in its extent and its form: for its constancy of form depends on the disturbing forces being always as the squares of the velocity; and this ratio of the disturbing forces is preserved, while the inertia of the fluid is the only agent and patient in the process. But when we add to this the constant (that is, invariable) disturbing force of tenacity, a change of form and dimensions must happen. In like manner, the friction, or something analogous to friction, which produces an effect proportional to the velocity, must alter this necessary ratio of the whole disturbing forces. We may conclude, that the effect of both these circumstances will be to diminish the quantity of this stagnant fluid, by licking it away externally; and to this we must ascribe the fact, that the part FAM is never perfectly stagnant, but is generally disturbed with a whirling motion. We may also conclude, that this stagnant fluid will be more incurvated between F and M than it would have been, independent of tenacity and friction; and that the arch LR will, on the contrary, be less incurvated.—And, lastly, we may conclude, that there will be something opposite to pressure, or something which we may call *abstraction*, exerted on the posterior part of the body which moves in a tenacious fluid, or is exposed to the stream of such a fluid; for the stagnant fluid LCR adheres to the surface LC, and the passing fluid tends to draw it away both by its tenacity and by its friction. This must augment the apparent impulse of the stream on such a body; and it must greatly augment the resistance, that is, the motion lost by this body in its progress through the tenacious fluid: for the body must drag along with it this stagnant fluid, and drag it in opposition to the tenacity and friction of the surrounding fluid. The effect of this is most remarkably seen in the resistances to the motion of pendulums; and the chevalier Buat, in his examination of Newton's experiments, clearly shows that this constitutes the greatest part of the resistance.

Resistance of Fluids.

This most ingenious writer has paid great attention to this part of the process of nature, and has laid the foundation of a theory of resistance entirely different from all the preceding. We cannot abridge it; and it is too imperfect in its present condition to be offered as a body of doctrine: but we hope that the ingenious author will prosecute the subject.

67 Account of the chevalier Buat's experiments.

WE cannot conclude this dissertation (which we acknowledge to be very unsatisfactory and imperfect) better, than by giving an account of some experiments of the chevalier Buat, which seem of immense consequence, and tend to give us very new views of the subject. Mr Buat observed the motion of water issuing from a glass cylinder through a narrow ring formed by a bottom of smaller diameter; that is, the cylinder was open at both ends, and there was placed at its lower end a circle of smaller diameter, by way of bottom, which left a ring all around. He threw some powdered sealing wax into the water, and observed with great attention the motion of its small particles. He saw those which happened to be in the very axis of the cylinder descend along the axis with a motion pretty uniform,

uniform, till they came very near the bottom; from this they continued to descend very slowly, till they were almost in contact with the bottom; they then deviated from the centre, and approached the orifice in straight lines and with an accelerated motion, and at last darted into the orifice with great rapidity. He had observed a thing similar to this in a horizontal canal, in which he had set up a small board like a dam or bar, over which the water flowed. He had thrown a gooseberry into the water, in order to measure the velocity at the bottom, the gooseberry being a small matter heavier than water. It approached the dam uniformly till about three inches from it. Here it almost stood still, but it continued to advance till almost in contact. It then rose from the bottom along the inside of the dam with an accelerated motion, and quickly escaped over the top.

Hence he concluded, that the water which covers the anterior part of the body exposed to the stream is not perfectly stagnant, and that the filaments recede from the axis in curves, which converge to the surface of the body as different hyperbolas converge to the same assymptote, and that they move with a velocity continually increasing till they escape round the sides of the body.

He had established (by a pretty reasonable theory, confirmed by experiment) a proposition concerning the pressure which water in motion exerts on the surface along which it glides, viz. *that the pressure is equal to that which it would exert if at rest* minus *the weight of the column whose height would produce the velocity of the passing stream.* Consequently the pressure which the stream exerts on the surface perpendicularly exposed to it will depend on the velocity with which it glides along it, and will diminish from the centre to the circumference. This, says he, may be the reason why the impulse on a plane wholly immersed is but one half of that on a plane which deflects the whole stream.

.he ent ri- exa- his

He contrived a very ingenious instrument for examining this theory. A square brass plate ABGF (fig. 22.) was pierced with a great number of holes, and fixed in the front of a shallow box represented edgewise in fig. 23. The back of this box was pierced with a hole *c*, in which was inserted the tube of glass CDE, bent square at D. This instrument was exposed to a stream of water, which beat on the brass plate. The water having filled the box through the holes, stood at an equal height in the glass tube when the surrounding water was stagnant; but when it was in motion, it always stood in the tube above the level of the smooth water without, and thus indicated the pressure occasioned by the action of the stream.

When the instrument was not wholly immersed, there was always a considerable accumulation against the front of the box, and a depression behind it. The water before it was by no means stagnant: indeed it should not be, as Mr Buat observes; for it consists of the water which was escaping on all sides, and therefore upwards from the axis of the stream, which meets the plate perpendicularly in *c* considerably under the surface. It escapes upwards; and if the body were sufficiently immersed, it would escape in this direction almost as easily as laterally. But in the present circumstances, it heaps up, till the elevation occasions it to fall off sidewise as fast as it is renewed. When the instrument was immersed more than its semidiameter under the surface, the water still rose above the level, and there was a great depression immediately behind this elevation. In consequence of this difficulty of escaping upwards, the water flows off laterally; and if the horizontal dimensions of the surface is great, this lateral efflux becomes more difficult, and requires a greater accumulation. From this it happens, that the resistance of broad surfaces equally immersed is greater than in the proportion of the breadth. A plane of two feet wide and one foot deep, when it is not completely immersed, will be more resisted than a plane two feet deep and one foot wide; for there will be an accumulation against both: and even if these were equal in height, the additional surface will be greatest in the widest body; and the elevation will be greater, because the lateral escape is more difficult.

69 Circumstances chiefly to be attended to in using this instrument.

The circumstances chiefly to be attended to are these. The pressure on the centre was much greater than towards the border, and, in general, the height of the water in the tube DE was more than $\frac{4}{3}$ of the height necessary for producing the velocity when only the central hole was open. When various holes were opened at different distances from the centre, the height of the water in DH continually diminished as the hole was nearer the border. At a certain distance from the border the water at E was level with the surrounding water, so that no pressure was exerted on that hole. But the most unexpected and remarkable circumstance was, that, in great velocities, the holes at the very border, and even to a small distance from it, not only sustained no pressure, but even gave out water; for the water in the tube was lower than the surrounding water. Mr Buat calls this a *non-pression.* In a case in which the velocity of the stream was three feet, and the pressure on the central hole caused the water in the vertical tube to stand 33 lines or $\frac{11}{4}$ of an inch above the level of the surrounding smooth water, the action on a hole at the lower corner of the square caused it to stand 12 lines lower than the surrounding water. Now the velocity of the stream in this experiment was 36 inches per second. This requires $21\frac{1}{2}$ lines for its productive fall; whereas the pressure on the central hole was 33. This approaches to the pressure on a surface which deflects it wholly. The intermediate holes gave every variation of pressure, and the diminution was more rapid as the holes were nearer the edge; but the law of diminution could not be observed.

70 Remarkable circumstance,

71 not inconsistent with the principles of hydrostatics or hydraulics.

This is quite a new and most unexpected circumstance in the action of fluids on solid bodies, and renders the subject more intricate than ever; yet it is by no means inconsistent with the genuine principles of hydrostatics or hydraulics. In as far as M. Buat's proposition concerning the pressure of moving fluids is true, it is very reasonable to say, that when the lateral velocity with which the fluid tends to escape exceeds the velocity of percussion, the height necessary for producing this velocity must exceed that which would produce the other, and a non-pression must be observed. And if we consider the forms of the lateral filaments near the edge of the body, we see that the concavity of the curve is turned towards the body, and that the centrifugal forces tend to diminish their pressure on the body. If the middle alone were struck with a considerable velocity, the water might even

even rebound, as if frequently observed. This *actual* rebounding is here prevented by the surrounding water, which is moving with the same velocity: but the pressure may be almost annihilated by the *tendency* to rebound of the inner filaments.

Part (and perhaps a considerable part) of this apparent non-pression is undoubtedly produced by the tenacity of the water, which licks off with it the water lying in the hole. But at any rate, this is an important fact, and gives great value to these experiments. It gives a key to many curious phenomena in the resistance of fluids; and the theory of M. Buat deserves a very serious consideration. It is all contained in the two following propositions.

72 Substance of Buat's theory.

1. "*If, by any cause whatever, a column of fluid, whether making part of an indefinite fluid, or contained in solid canals, come to move with a given velocity, the pressure which it exerted laterally before its motion, either on the adjoining fluid or on the sides of the canal, is diminished by the weight of a column having the height necessary for communicating the velocity of the motion.*

2. "*The pressure on the centre of a plane surface perpendicular to the stream, and wholly immersed in it, is* $\frac{1}{3}$ *of the weight of a column having the height necessary for communicating the velocity. For 33 is* $\frac{1}{3}$ *of* $21\frac{1}{4}$."

73 Experiments by which it is confirmed.

He attempted to ascertain the medium pressure on the whole surface, by opening 625 holes dispersed all over it. With the same velocity of current, he found the height in the tube to be 29 lines, or $7\frac{1}{4}$ more than the height necessary for producing the velocity. But he justly concluded this to be too great a measure, because the holes were $\frac{1}{2}$ of an inch from the edge: had there been holes at the very edge, they would have sustained a non-pression, which would have diminished the height in the tube very considerably. He exposed to the same stream a conical funnel, which raised the water to 34 lines. But this could not be considered as a measure of the pressure on a plane solid surface; for the central water was undoubtedly scooped out, as it were, and the filaments much more deflected than they would have been by a plane surface. Perhaps something of this happened even in every small hole in the former experiments. And this suggests some doubt as to the accuracy of the measurement of the pressure and of the velocity of a current by Mr Pitot's tube. It surely renders some corrections absolutely necessary. It is a fact, that when exposed to a vein of fluid coming through a short passage, the water in the tube stands on a level with that in the reservoir. Now we know that the velocity of this stream *does not* exceed what would be produced by a fall equal to $\frac{82}{100}$ of the head of water in the reservoir. Mr Buat made many valuable observations and improvements on this most useful instrument, which will be taken notice of in the articles RIVERS and *WATER-WORKS*.

Mr Buat, by a scrupulous attention to all the circumstances, concludes that the medium of pressure on the whole surface is equal to $\frac{25.5}{21.5}$ of the weight of a column, having the surface for its base, and the productive fall for its height. But we think that there is an uncertainty in this conclusion; because the height of the water in the vertical tube was undoubtedly augmented by an hydrostatical pressure arising from the accumulation of water above the body which was exposed to the stream.

Since the pressures are as the squares of the velocities, or as the heights h which produce the velocities, we may express this pressure by the symbol $\frac{25.5}{21.5}h$, or $1.186\,h$, or $m\,h$, the value of m being 1.186. This exceeds considerably the result of the experiments of the French academy. In these it does not appear that m sensibly exceeds unity. Note, that in these experiments the body was moved through still water; here it is exposed to a stream. These are generally supposed to be equivalent, on the authority of the third law of motion, which makes every action depend on the relative motions. We shall by and by see some cases of difference.

The writers on this subject seem to think their task completed when they have considered the action of the fluid on the anterior part of the body, or that part of it which is before the broadest section, and have paid little or no attention to the hinder part. Yet those who are most interested in the subject, the naval architects, seem convinced that it is of no less importance to attend to the form of the hinder part of a ship. And the universal practice of all nations has been to make the hinder part more acute than the fore-part. This has undoubtedly been deduced from experience; for it is in direct opposition to any notions which a person would naturally form on this subject. Mr Buat therefore thought it very necessary to examine the action of the water on the hinder part of the body by the same method. And, previous to this examination, in order to acquire some scientific notions of the subject, he made the following very curious and instructive experiment.

Two little conical pipes AB (fig. 24.) were inserted into the upright side of a prismatic vessel. They were an inch long, and their diameters at the inner and outer ends were five and four lines. A was 57 lines under the surface, and B was 73. A glass syphon was made of the shape represented in the figure, and its internal diameter was $1\frac{1}{2}$ lines. It was placed with its mouth in the axis, and even with the base of the conical pipe. The pipes being shut, the vessel was filled with water, and it was made to stand on a level in the two legs of the syphon, the upper part being full of air. When this syphon was applied to the pipe A, and the water running freely, it rose 32 lines in the short leg, and sunk as much in the other. When it was applied to the pipe B, the water rose 41 lines in the one leg of the syphon, and sunk as much in the other.

He reasons in this manner from the experiment. The ring comprehended between the end of the syphon and the sides of the conical tube being the narrowest part of the orifice, the water issued with the velocity corresponding to the height of the water in the vessel above the orifice, diminished for the contraction. If therefore the cylinder of water immediately before the mouth of the syphon issued with the same velocity, the tube would be emptied through a height equal to the HEAD OF WATER (*charge*). If, on the contrary, the cylinder of water, immediately before the mouth of the syphon, were stagnant, the water in it would exert its full pressure on the mouth of the syphon, and the water in the syphon would be level with the water in the vessel.

Between

Between these extremes we must find the real state of the case, and we must measure the force of non-pressure by the rise of the water in the syphon.

We see that in both experiments it bears an accurate proportion to the depth under the surface. For 57 : 73=32 : 41 very nearly. He therefore estimates the non-pressure to be $\frac{56}{100}$ of the height of the water above the orifice.

We are disposed to think that the ingenious author has not reasoned accurately from the experiment. In the first place, the force indicated by the experiment, whatever be its origin, is certainly double of what he supposes; for it must be measured by the sum of the rise of the water in one leg, and its depression in the other, the weight of the air in the bend of the syphon being neglected. It is precisely analogous to the force acting on the water oscillating in a syphon, which is acknowledged to be the sum of the elevation and depression. The force indicated by the experiment therefore is $\frac{112}{100}$ of the height of the water above the orifice. The force exhibited in this experiment bears a still greater proportion to the productive height; for it is certain that the water *did not* issue with the velocity acquired by the fall from the surface, and probably did not exceed $\frac{2}{3}$ of it. The effect of contraction must have been considerable and uncertain. The velocity should have been measured both by the amplitude of the jet and by the quantity of water discharged. In the next place, we apprehend that much of the effect is produced by the tenacity of the water, which drags along with it the water which would have slowly issued from the syphon, had the other end not dipped into the water of the vessel. We know, that if the horizontal part of the syphon had been continued far enough, and if no retardation were occasioned by friction, the column of water in the upright leg would have accelerated like any heavy body; and when the last of it had arrived at the bottom of that leg, the whole in the horizontal part would be moving with the velocity acquired by falling from the surface. The water of the vessel which issues through the surrounding ring very quickly acquires a much greater velocity than what the water descending in the syphon would acquire in the same time, and it drags this last water along with it both by tenacity and friction, and it drags it out till its action is opposed by the want of equilibrium produced in the syphon, by the elevation in the one leg and the depression in the other. We imagine that little can be concluded from the experiment with respect to the real non-pressure. Nay, if the sides of the syphon be supposed infinitely thin, so that there would be no curvature of the filaments of the surrounding water at the mouth of the syphon, we do not very distinctly see any source of non-pressure: For we are not altogether satisfied with the proof which Mr Buat offers for this measure of the pressure of a stream of fluid gliding along a surface, *and obstructed by friction or any other cause*. We imagine that passing water in the present experiment would be a little retarded by accelerating continually the water descending in the syphon, and renewed a-top, supposing the upper end open; because this water would not of itself acquire more than half this velocity. It however drags it out, till it not only resists with a force equal to the weight of the whole vertical column, but even exceeds it by $\frac{12}{100}$. This it is able to do, because the whole pressure by which the water issues from an orifice has been shown (by Daniel Bernoulli) to be equal to twice this weight. We therefore consider this beautiful experiment as chiefly valuable, by giving us a measure of the tenacity of the water; and we wish that it were repeated in a variety of depths, in order to discover what relation the force exerted bears to the depth. It would seem that the tenacity, being a certain determinate thing, the proportion of 100 to 112 would not be constant; and that the observed ratio would be made up of two parts, one of them constant, and the other proportional to the depth under the surface.

But still this experiment is intimately connected with the matter in hand; and this apparent non-pressure on the hinder part of a body exposed to a stream, from whatever causes it proceeds, does operate in the action of water on this hinder part, and must be taken into the account.

78 Further discussions of De Buat.

We must therefore follow the chevalier de Buat in his discussions on this subject. A prismatic body, having its prow and poop equal and parallel surfaces, and plunged horizontally into a fluid, will require a force to keep it firm in the direction of its axis precisely equal to the difference between the real pressures exerted on its prow and poop. If the fluid is at rest, this difference will be nothing, because the opposite dead pressures of the fluid will be equal: but in a stream, there is superadded to the dead pressure on the prow the active pressure arising from the deflections of the filaments of this fluid.

If the dead pressure on the poop remained in its full intensity by the perfect stagnation of the water behind it, the whole sensible pressure on the body would be the active pressure only on the prow, represented by $m\,h$. If, on the other hand, we could suppose that the water behind the body moved continually away from it (being renewed laterally) with the velocity of the stream, the dead pressure would be entirely removed from its poop, and the whole sensible pressure, or what must be opposed by some external force, would be $m\,h+h$. Neither of these can happen; and the real state of the case must be between these extremes.

79 Experiments.

The following experiments were tried: The perforated box with its vertical tube was exposed to the stream, the brass plate being turned down the stream. The velocity was again 36 inches per second.

The central hole A alone being opened, gave a non-pressure of	13 lines.
A hole B, $\frac{5}{8}$ of an inch from the edge, gave	15
A hole C, near the surface	15.7
A hole D, at the lower angle	15.3

Here it appears that there is a very considerable non-pressure, increasing from the centre to the border. This increase undoubtedly proceeds from the greater lateral velocity with which the water is gliding in from the sides. The water behind was by no means stagnant, although moving off with a much smaller velocity than that of the passing stream, and it was visibly removed from the sides, and gradually licked away at its further extremity.

Another box, having a great number of holes, all open, indicated a medium of non-pressure equal to $13\frac{1}{2}$ lines.

Another

Another of larger dimensions, but having fewer holes, indicated a non-pressure of $12\frac{1}{8}$.

But the most remarkable, and the most important phenomena were the following.

The first box was fixed to the side of another box, so that, when all was made smooth, it made a perfect cube, of which the perforated brass plate made the poop.

The apparatus being now exposed on the stream, with the perforated plate looking down the stream,

The hole A indicated a non-pression	-	=7.2
B	- - - - - -	8
C	- - - - - -	6

Here was a great diminution of the non-pressions produced by the distance between the prow and the poop.

This box was then fitted in the same manner, so as to make the poop of a box three feet long. In this situation the non-pressures were as follows:

Hole A	- - - - - - -	1.5
B	- - - - - - -	3.2

The non-pressions were still farther diminished by this increase of length.

The box was then exposed with all the holes open, in three different situations:

1st, Single, giving a non-pressure	- -	13.1
2d, Making the poop of a cube	- -	5.3
3d, Making the poop of a box three feet long		3.0

Another larger box:

1st, Single	- - - - - - -	12.2
2d, Poop of a cube	- - - - -	5.
3d, Poop of the long box	- - -	3.2

80 Great utility of them in ship-building.

Those are most valuable experiments. They plainly show how important it is to consider the action on the binder part of the body. For the whole impulse or resistance, which must be withstood or overcome by the external force, is the sum of the active pressure on the fore-part, and of the non-pressure on the hinder-part; and they show that this does not depend solely on the form of the prow and poop, but also, and perhaps chiefly, on the length of the body. We see that the non-pressure on the hinder-part was prodigiously diminished (reduced to one-fourth) by making the length of the body triple of the breadth. And hence it appears, that merely lengthening a ship, without making any change in the form either of her prow or her poop, will greatly diminish the resistance to her motion through the water; and this increase of length may be made by continuing the form of the midship frame in several timbers along the keel, by which the capacity of the ship, and her power of carrying sail, will be greatly increased, and her other qualities improved, while her speed is augmented.

81 Physical cause of it explained.

It is surely of importance to consider a little the physical cause of this change. The motions are extremely complicated, and we must be contented if we can but perceive a few leading circumstances.

The water is turned aside by the anterior part of the body, and the velocity of the filaments is increased, and they acquire a divergent motion, by which they also push aside the surrounding water. On each side of the body, therefore, they are moving in a divergent direction, and with an increased velocity. But as they are on all sides pressed by the fluid without them, their motions gradually approach parallelism, and their velocities to an equality with the stream. The progressive velocity, or that in the direction of the stream, is checked, at least at first. But since we observe the filaments constipated round the body, and that they are not deflected at right angles to their former direction, it is plain that the real velocity of a filament in its oblique path is augmented. We always observe, that a stone lying in the sand, and exposed to the wash of the sea, is laid bare at the bottom, and the sand is generally washed away to some distance all round. This is owing to the increased velocity of the water which comes into contact with the stone. It takes up more sand than it can keep floating, and it deposits it at a little distance all around, forming a little bank, which surrounds the stone at a small distance. When the filaments of water have passed the body, they are pressed by the ambient fluid into the place which it has quitted, and they glide round its stern, and fill up the space behind. The more divergent and the more rapid they are, when about to fall in behind, the more of the circumambient pressure must be employed to turn them into the trough behind the body, and less of it will remain to press them to the body itself. The extreme of this must obtain when the stream is obstructed by a thin plane only. But when there is some distance between the prow and the poop, the divergency of the filaments which had been turned aside by the prow, is diminished by the time that they have come abreast of the stern, and should turn in behind it. They are therefore more readily made to converge behind the body, and a more considerable part of the surrounding pressure remains unexpended, and therefore presses the water against the stern; and it is evident that this advantage must be so much the greater as the body is longer. But the advantage will soon be susceptible of no very considerable increase: for the lateral and divergent, and accelerated filaments, will soon become so nearly parallel and equally rapid with the rest of the stream, that a great increase of length will not make any considerable change in these particulars; and it must be accompanied with an increase of friction.

These are very obvious reflections. And if we attend minutely to the way in which the almost stagnant fluid behind the body is expended and renewed, we shall see all these effects confirmed and augmented. But as we cannot say any thing on this subject that is precise, or that can be made the subject of computation, it is needless to enter into a more minute discussion. The diminution of the non-pressure towards the centre most probably arises from the smaller force which is necessary to be expended in the inflection of the lateral filaments, already inflected in some degree, and having their velocity diminished. But it is a subject highly deserving the attention of the mathematicians; and we presume to invite them to the study of the motions of these lateral filaments, passing the body, and pressed into its wake by forces which are susceptible of no difficult investigation. It seems highly probable, that if a prismatic box, with a square stern, were fitted with an addition precisely shaped like the water which would (abstracting tenacity and friction) have been stagnant behind it, the quantity of non-pression would be the smallest possible. The mathematician would surely discover circumstances which would ance uids. would furnish some maxims of construction for the hinder part as well as for the prow. And as his speculations on this last have not been wholly fruitless, we may expect advantages from his attention to this part, so much neglected.

de- as is In the mean time, let us attend to the deductions which Mr de Buat has made from his few experiments.

When the velocity is three feet per second, requiring the productive height 21.5 lines, the heights corresponding to the non-pressure on the poop of a thin plane is 14.41 lines (taking in several circumstances of judicious correction, which we have not mentioned), that of a foot cube is 5.83, and that of a box of triple length is 3.31.

Let q express the variable ratio of these to the height producing the velocity, so that $q\,h$ may express the non-pressure in every case; we have,

For a thin plane - -	$q = 0.67$
a cube - - - -	0.271
a box = 3 cubes - - -	0.153

It is evident that the value of q has a dependence on the proportion of the length, and the transverse section of the body. A series of experiments on prismatic bodies showed Mr de Buat that the deviation of the filaments was similar in similar bodies, and that this obtained even in dissimilar prisms, when the lengths were as the square-roots of the transverse sections. Although therefore the experiments were not sufficiently numerous for deducing the precise law, it seemed not impossible to derive from them a very useful approximation. By a dexterous comparison he found, that if l expresses the length of the prism, and s the area of the transverse section, and L expresses the common logarithm of the quantity to which it is prefixed, we shall express the non-pressure pretty accurately by the formula $\frac{1}{q} = \mathrm{L}\left(1.42\frac{l}{\sqrt{s}}\right)$.

Hence arises an important remark, that when the height corresponding to the non-pression is greater than $\sqrt{s}$, and the body is little immersed in the fluid, there will be a void behind it. Thus a surface of a square inch, just immersed in a current of three feet per second, will have a void behind it. A foot square will be in a similar condition when the velocity is 12 feet.

We must be careful to distinguish this non-pressure from the other causes of resistance, which are always necessarily combined with it. It is superadditive to the active impression on the prow, to the statical pressure of the accumulation a-head of the body, the statical pressure arising from the depression behind it, the effects of friction, and the effects of tenacity. It is indeed next to impossible to estimate them separately, and many of them are actually combined in the measures now given. Nothing can determine the pure non-pressures till we can ascertain the motions of the filaments.

ro- oi- M. de Buat here takes occasion to controvert the universally adopted maxim, that the pressure occasioned by a stream of fluid on a fixed body is the same with that on a body moving with equal velocity in a quiescent fluid. He repeated all these experiments with the perforated box in still water. The general distinction was, that both the pressures and the non-pressure in this case were less, and that the odds were chiefly to be observed near the edges of the surface. The general factor of the pressure of a stream on the anterior surface was $m = 1.186$; but that on a moving body through a still fluid is only $m = 1$. He observed no non-pressure even at the very edge of the prow, but even a sensible pressure. The pressure, therefore, or resistance is more equably diffused over the surface of the prow than the impulse is.—He also found that the resistances diminished in a less ratio than the squares of the velocities, especially in small velocities.

The non-pressures increased in a greater ratio than the squares of the velocities. The ratio of the velocities to a small velocity of $2\frac{1}{5}$ inches per second increased geometrically, the value of q increased arithmetically; and we may determine q for any velocity V by this proportion $\mathrm{L}\frac{55}{2.2} : \mathrm{L}\frac{\mathrm{V}}{22} = 0.5 : q$, and $q = \frac{\mathrm{L}\frac{\mathrm{V}}{2.2}}{2.8}$. That is, let the common logarithm of the velocity, divided by $2\frac{1}{5}$, be considered as a common number; divide this common number by $2\frac{8}{10}$, the quotient is q, which must be multiplied by the productive height. The product is the pressure.

When Pitot's tube was exposed to the stream, we had $m = 1$; but when it is carried through still water, m is $= 1.22$. When it was turned from the stream, we had $q = 0.157$; but when carried through still water, q is $= 0.138$. A remarkable experiment.

When the tube was moved laterally through the water, so that the motion was in the direction of the plane of its mouth, the non-pressure was $= 1$. This is one of his chief arguments for his theory of non-pression. He does not give the detail of the experiment, and only inserts the result in his table. 84 and supports his opinion by a remarkable experiment.

As a body exposed to a stream deflects the fluid, heaps it up, and increases its velocity; so a body moved through a still fluid turns it aside, causes it to swell up before it, and gives it a real motion alongside of it in the opposite direction. And as the body exposed to a stream has a quantity of fluid almost stagnant both before and behind; so a body moved through a still fluid carries before it and drags after it a quantity of fluid, which accompanies it with nearly an equal velocity. This addition to the quantity of matter in a motion must make a diminution of its velocity; and this forms a very considerable part of the observed resistance.

We cannot, however, help remarking that it would require very distinct and strong proof indeed to overturn the common opinion, which is founded on our most certain and simple conceptions of motion, and on a law of nature to which we have never observed an exception. M. de Buat's experiments, though most judiciously contrived, and executed with scrupulous care, are by no means of this kind. They were, of absolute necessity, very complicated; and many circumstances, impossible to avoid or to appreciate, rendered the observation, or at least the comparison, of the velocities, very uncertain. 85 The objection not well founded.

We can see but two circumstances which do not admit of an easy or immediate comparison in the two states of the problem. When a body is exposed to a stream *in our experiments*, in order to have an impulse made on it, there is a force tending to move the body backwards, independent of the real impulse or pressure occasioned by the deflection of the stream. We cannot have 86 Remarks and experiments on the motion of bodies in running or still water.

have a stream except in consequence of a sloping surface. Suppose a body floating on this stream. It will not only sail down *along with the stream*, but it will sail *down the stream*, and will therefore go faster along the canal than the stream does: for it is floating on an inclined plane; and if we examine it by the laws of hydrostatics, we shall find, that besides its own tendency to *slide* down this inclined plane, there is an odds of hydrostatical pressure, which *pushes* it down this plane. It will therefore go along the canal faster than the stream. For this acceleration depends on the difference of pressure at the two ends, and will be more remarkable as the body is larger, and especially as it is longer. This may be distinctly observed. All floating bodies go into the stream of the river, because there they find the smallest obstruction to the acquisition of this motion along the inclined plane; and when a number of bodies are thus floating down the stream, the largest and longest outstrip the rest. A log of wood floating down in this manner may be observed to make its way very fast among the chips and saw-dust which float alongside of it.

Now when, in the course of our experiments, a body is supported against the action of the stream, and the impulse is measured by the force employed to support it, it is plain that part of this force is employed to act against that tendency which the body has to outstrip the stream. This does not appear in our experiment, when we move a body with the velocity of this stream through still water having a horizontal surface.

The other distinguishing circumstance is, that the retardations of a stream arising from friction are found to be nearly as the velocities. When, therefore, a stream moving in a limited canal is checked by a body put in its way, the diminution of velocity occasioned by the friction of the stream having already produced its effect, the impulse is not affected by it; but when the body puts the still water in motion, the friction of the bottom produces some effect, by retarding the recess of the water. This, however, must be next to nothing.

The chief difference will arise from its being almost impossible to make an exact comparison of the velocities: for when a body is moved against the stream, the relative velocity is the same in all the filaments. But when we expose a body to a stream, the velocity of the different filaments is not the same; because it decreases from the middle of the stream to the sides.

57
Mr Buat's calculation of resistance,

M. Buat found the total sensible resistance of a plate 12 inches square, and measured, not by the height of water in the tube of the perforated box, but by weights acting on the arm of a balance, having its centre 15 inches under the surface of a stream moving three feet per second, to be 19.46 pounds; that of a cube of the same dimensions was 15.22; and that of a prism three feet long was 13.87; that of a prism six feet long was 14.27. The three first agree extremely well with the determination of m and q, by the experiments with the perforated box. The total resistance of the last was undoubtedly much increased by friction, and by the retrograde force of so long a prism floating in an inclined stream. This last by computation is 0.223 pounds; this added to $h\,(m+q)$, which is 13.39, gives 13.81, leaving 0.46 for the effect of friction.

If the same resistances be computed on the supposition that the body moves in still water, in which case we have $m=1$, and q for a thin plate $=0.433$; and if q be computed for the lengths of the other two bodies by the formula $\frac{1}{q} = L\,1.42 + \frac{l}{\sqrt{s}}$; we shall get for the resistances 14.94; 12.22; and 11.49.

58
and of the quantity of water adhering to a body moving in still water, &c.

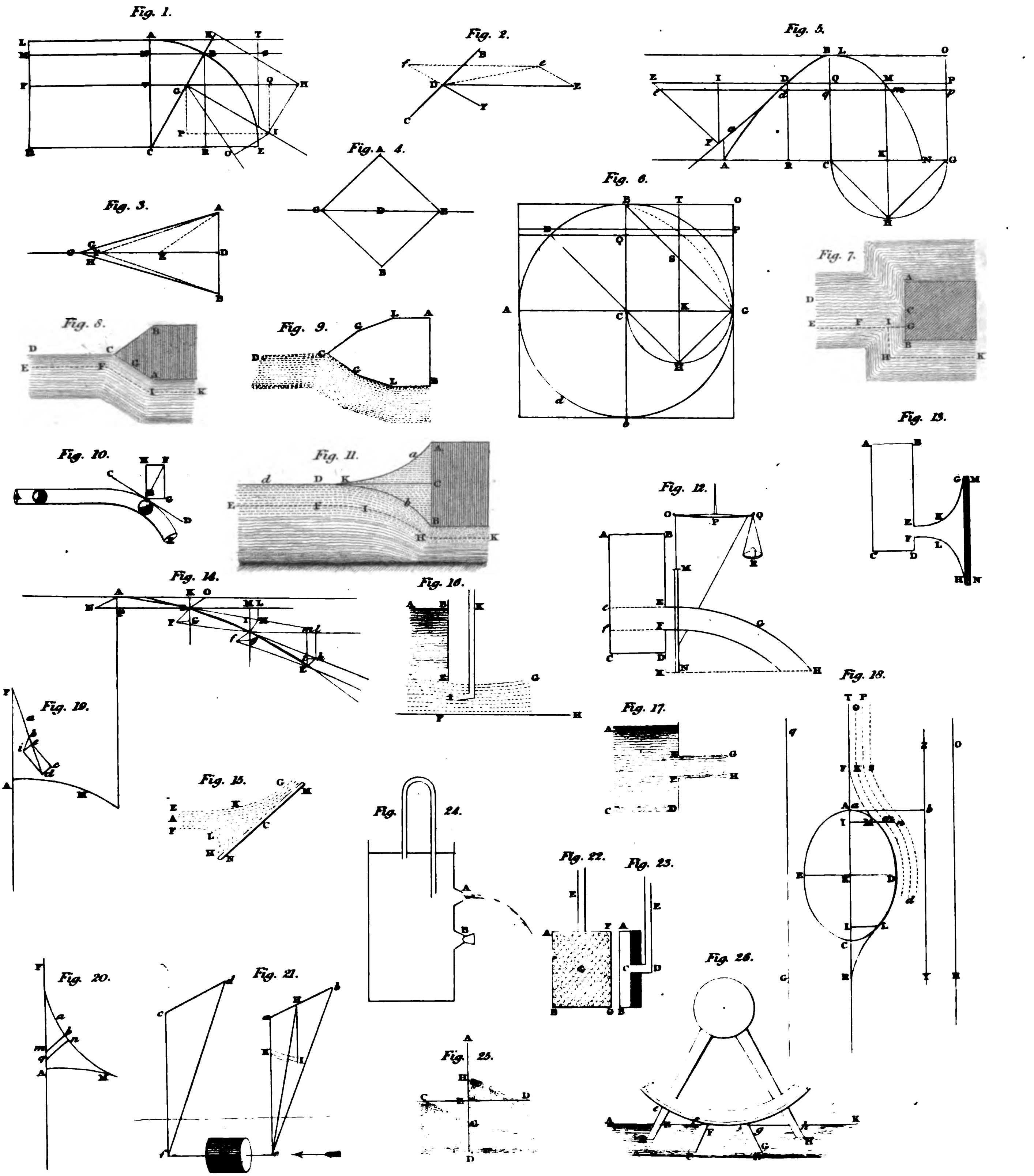
Hence M. Buat concludes, that the resistances in these two states are nearly in the ratio of 13 to 10. This, he thinks, will account for the difference observed in the experiments of different authors.

M. Buat next endeavours to ascertain the quantity of water which is made to adhere in some degree to a body which is carried along through still water, or which remains nearly stagnant in the midst of a stream. He takes the sum of the motions in the direction of the stream, viz. the sum of the actual motions of all those particles which have lost part of their motion, and he divides this sum by the general velocity of the stream. The quotient is equivalent to a certain quantity of water perfectly stagnant round the body. Without being able to determine this with precision, he observes, that it augments as the resistance diminishes; for in the case of a longer body, the filaments are observed to converge to a greater distance behind the body. The stagnant mass a-head of the body is more constant; for the deflection and resistance at the prow are observed not to be affected at the length of the body. M. Buat, by a very nice analysis of many circumstances, comes to this conclusion, that the whole quantity of fluid, which in this manner accompanies the solid body, remains the same, whatever is the velocity. He might have deduced it at once, from the consideration that the curves described by the filaments are the same in all velocities.

He then relates a number of experiments made to ascertain the absolute quantity thus made to accompany the body. These were made by causing pendulums to oscillate in fluids. Newton had determined the resistances to such oscillation by the diminution of the arches of vibration. M. Buat determines the quantity of dragged fluid by the increase of their duration; for the stagnation or dragging is in fact adding a quantity of matter to be moved, without any addition to the moving force. It was ingeniously observed by Newton, that the time of oscillation was not sensibly affected by the resistance of the fluid: a compensation, almost complete, being made by the diminution of the arches of vibration; and experiment confirmed this. If, therefore, a great augmentation of the time of vibration be observed, it must be ascribed to the additional quantity of matter which is thus dragged into motion, and it may be employed for its measurement. Thus, let a be the length of a pendulum swinging seconds in vacuo, and l the length of a second's pendulum swinging in a fluid. Let p be the weight of the body in the fluid, and P the weight of the body displaced by it; $P+p$ will express its weight in vacuo, and $\frac{P+p}{p}$ will be the ratio of these weights. We shall therefore have $\frac{P+p}{p} = \frac{a}{l}$ and $l = \frac{ap}{P+p}$.

Let n express the sum of the fluid displaced, and the fluid dragged along, n being a greater number than unity,

RESISTANCE OF FLUIDS. PLATE CCCCLXI.



unity, to be determined by experiment. The mass in motion is no longer $P+p$, but $P+np$, while its weight in the fluid is still p. Therefore we must have

$$l=\frac{ap}{nP+p}=\frac{a}{\frac{nP}{p}+1}, \text{ and } n=\frac{p}{P}\left(\frac{a}{l}-1\right).$$

A prodigious number of experiments made by M. Buat on spheres vibrating in water gave values of n, which were very constant, namely, from 1.5 to 1.7; and by considering the circumstances which accompanied the variations of n (which he found to arise chiefly from the curvature of the path described by the ball), he states the mean value of the number n at 1.583. So that a sphere in motion drags along with it about $\frac{6}{10}$ of its own bulk of fluid with a velocity equal to its own.

He made similar experiments with prisms, pyramids, and other bodies, and found a complete confirmation of his assertion, that prisms of equal lengths and sections, though dissimilar, dragged equal quantities of fluid; that similar prisms and prisms not similar, but whose lengths were as the square root of their sections, dragged quantities proportional to their bulks.

He found a general value of n for prismatic bodies, which alone may be considered as a valuable truth; namely, that $n=0.705\frac{\sqrt{s}}{l}+1.13$.

From all these circumstances, we see an intimate connection between the pressures, non-pressures, and the fluid dragged along with the body. Indeed this is immediately deducible from the first principles; for what Mr Buat calls the *dragged fluid* is in fact a certain portion of the whole change of motion produced in the direction of the bodies motion.

It was found, that with respect to thin planes, spheres, and pyramidal bodies of equal bases, the resistances were inversely as the quantities of fluid dragged along.

The intelligent reader will readily observe, that these views of the Chevalier Buat are not so much discoveries of new principles as they are classifications of consequences, which may all be deduced from the general principles employed by D'Alembert and other mathematicians. But they greatly assist us in forming notions of different parts of the procedure of nature in the mutual action of fluids and solids on each other. This must be very acceptable in a subject which it is by no means probable that we shall be able to investigate with mathematical precision. We have given an account of these last observations, that we may omit nothing of consequence that has been written on the subject; and we take this opportunity of recommending the *Hydraulique* of Mr Buat as a most ingenious work, containing more original, ingenious, and practically useful thoughts, than all the performances we have met with. His doctrine of *the principle of uniform motion of fluids in pipes and open canals*, will be of immense service to all engineers, and enable them to determine with sufficient precision the most important questions in their profession; questions which at present they are hardly able to guess at. See RIVERS and *WATER-Works*.

The only circumstance which we have not noticed in detail, is the change of resistance produced by the void, or tendency to a void, which obtains behind the body; and we omitted a particular discussion, merely because we could say nothing sufficiently precise on the subject. Persons not accustomed to the discussions in the physico-mathematical sciences, are apt to entertain doubts or false notions connected with this circumstance, which we shall attempt to remove; and with this we shall conclude this dissertation.

Explained.

If a fluid were perfectly incompressible, and were contained in a vessel incapable of extension, it is impossible that any void could be formed behind the body; and in this case it is not very easy to see how motion could be performed in it. A sphere moved in such a medium could not advance the smallest distance, unless *some* particles of the fluid, in filling up the space left by it, moved with a velocity next to infinite. Some degree of compressibility, however small, seems necessary. If this be insensible, it may be rigidly demonstrated, that an external force of compression will make no *sensible* change in the internal motions, or in the resistances. This indeed is not obvious, but is an immediate consequence of the *quaquaversum* pressure of fluids. As much as the pressure is augmented by the external compressions in one side of a body, so much is it augmented on the other side; and the same must be said of every particle. Nothing more is necessary for securing the same motions by the same partial and internal forces; and this is fully verified by experiment. Water remains equally fluid under any compressions. In some of Sir Isaac Newton's experiments balls of four inches diameter were made so light as to preponderate in water only three grains. These balls descended in the same manner as they would have descended in a fluid where the resistance was equal in every part; yet, when they were near the bottom of a vessel nine feet deep, the compression round them was at least 2400 times the moving force; whereas, when near the top of the vessel, it was not above 50 or 60 times.

But in a fluid sensibly compressible, or which is not confined, a void may be left behind the body. Its motion may be so swift that the surrounding pressure may not suffice for filling up the deserted space; and, in this case, a statical pressure will be added to the resistance. This may be the case in a vessel or pond of water having an open surface exposed to the finite or limited pressure of the atmosphere. The question now is, whether the resistance will be increased by an increase of external pressure? Supposing a sphere moving near the surface of water, and another moving equally fast at four times the depth. If the motion be so swift that a void is formed in both cases, there is no doubt but that the sphere which moves at the greatest depth is most resisted by the pressure of the water. If there is no void in either case, then, because the quadruple depth would cause the water to flow in with only a double velocity, it would seem that the resistance would be greater; and indeed the water flowing in laterally with a double velocity produces a quadruple non-pressure.—But, on the other hand, the pressure at a small depth may be insufficient for preventing a void, while that below effectually prevents it; and this was observed in some experiments of Chevalier de Borda. The effect, therefore, of greater immersion, or of greater compression, in an elastic fluid, does not follow a precise ratio of the pressure, but depends partly on absolute quantities. It cannot, therefore, be stated by any very simple formula what increase or diminution of resistance will result

result from a greater depth; and it is chiefly on this account that experiments made with models of ships and mills are not conclusive with respect to the performance of a large machine of the same proportions, without corrections, sometimes pretty intricate. We assert, however, with great confidence, that this is of all methods the most exact, and infinitely more certain than any thing that can be deduced from the most elaborate calculation from theory. If the resistances at all depths be equal, the proportionality of the total resistance to the body is exact, and perfectly conformable to observation. It is only in great velocities where the depth has any material influence, and the influence is not near so considerable as we should, at first sight, suppose; for, in estimating the effect of immersion, which has a relation to the difference of pressure, we must always take in the pressure of the atmosphere; and thus the pressure at 33 feet deep is not 33 times the pressure at one foot deep, but only double, or twice as great. The atmospheric pressure is omitted only when the resisted plane is at the very surface. D'Ulloa, in his *Examino Maritimo*, has introduced an equation expressing this relation; but, except with very limited conditions, it will mislead us prodigiously. To give a general notion of its foundation, let AB (fig. 25.) be the section of a plane moving through a fluid in the direction CD, with a known velocity. The fluid will be heaped up before it above its natural level CD, because the water will not be pushed before it like a solid body, but will be pushed aside. And it cannot acquire a lateral motion any other way than by an accumulation, which will diffuse itself in all directions by the law of undulatory motion. The water will also be left lower behind the plane, because time *must* elapse before the pressure of the water behind can make it fill the space. We may acquire some notion of the extent of both the accumulation and depression in this way. There is a certain depth CF ($=\frac{v^2}{2\varphi}$, where v is the velocity, and φ the accelerating power of gravity) under the surface, such that water would flow through a hole at F with the velocity of the plane's motion. Draw a horizontal line FG. The water will certainly touch the plane in G, and we may suppose that it touches it no higher up. Therefore there will be a hollow, such as CGE. The elevation HE will be regulated by considerations nearly similar. ED must be equal to the velocity of the plane, and HE must be its productive height. Thus, if the velocity of the plane be one foot per second, HE and EG will be $\frac{1}{10}$ of an inch. This is sufficient (though not exact) for giving us a notion of the thing. We see that from this must arise a pressure in the direction DC, viz. the pressure of the whole column HG.

Fig. 25.

Something of the same kind will happen although the plane AB be wholly immerged, and this even to some depth. We see such elevations in a swift running stream, where there are large stones at the bottom.—This occasions an excess of pressure in the direction opposite to the plane's motion; and we see that there must, in every case, be a relation between the velocity and this excess of pressure. This D'Ulloa expresses by an equation. But it is very exceptionable, not taking properly into the account the comparative facility with which the water can heap up and diffuse itself. It must always heap up till it acquires a sufficient head of water to produce a lateral and progressive diffusion sufficient for the purpose. It is evident, that a smaller elevation will suffice when the body is more immersed, because the check or impulse given by the body below is propagated, not vertically only, but in every direction; and therefore the elevation is not confined to that part of the surface which is immediately above the moving body, but extends so much further laterally as the centre of agitation is deeper: Thus, the elevation necessary for the passage of the body is so much smaller; and it is the *height* only of this accumulation or wave which determines the backward pressure on the body. D'Ulloa's equation may happen to quadrate with two experiments at different depths, without being nearly just; for *any two* points may be in a curve, without exhibiting its equation. Three points will do it with some approach to precision; but four, at least, are necessary for giving any notion of its nature. D'Ulloa has only given two experiments, which we mentioned in another place.

We may here observe, that it is this circumstance which immediately produces the great resistance to the motion of a body through a fluid in a narrow canal.—The fluid cannot pass the body, unless the area of the section be sufficiently extensive. A narrow canal prevents the extension sidewise. The water must therefore heap up, till the section and velocity of diffusion are sufficiently enlarged, and thus a great backward pressure is produced. (See the second series of Experiments by the French Academicians; see also Franklin's Essays). It is important, and will be considered in another place.

Thus have we attempted to give our readers some account of one of the most interesting problems in the whole of mechanical philosophy. We are sorry that so little advantage can be derived from the united efforts of the first mathematicians of Europe, and that there is so little hope of greatly improving our scientific knowledge of the subject. What we have delivered will, however, enable our readers to peruse the writings of those who have applied the theories to practical purposes. Such, for instance, are the treatises of John Bernoulli, of Bouguer, and of Euler, on the construction and working of ships, and the occasional dissertations of different authors on water-mills. In this last application the ordinary theory is not without its value, for the impulses are nearly perpendicular; in which case they do not materially deviate from the duplicate proportion of the sign of incidence. But even here this theory, applied as it commonly is, misleads us exceedingly. The impulse on one float may be accurately enough stated by it; but the authors have not been attentive to the motion of the water after it has made its impulse; and the impulse on the next float is stated the same as if the parallel filaments of water, which were not stopped by the preceding float, did impinge on the opposite part of the second, in the same manner, and with the same obliquity and energy, as if it were detached from the rest. But this does not in the least resemble the real process of nature.

91 Impulse of water on water mills.

Suppose the floats B, C, D, H (fig. 26.) of a wheel immersed in a stream whose surface moves in the direction AK, and that this surface meets the float B in E. The part BE alone is supposed to be impelled; whereas the water, checked by the float, heaps up on it to e.—Then drawing the horizontal line BF, the part CF of the

Fig. 26.

the next float is supposed to be all that is impelled by the parallel filaments of the stream; whereas the water bends round the lower edge of the float B by the surrounding pressure, and rises on the float *c* all the way to *f*. In like manner, the float D, instead of receiving an impulse on the very small portion DG, is impelled all the way from D to *g*, not much below the surface of the stream. The surfaces impelled at once, therefore, greatly exceed what this slovenly application of the theory supposes, and the whole impulse is much greater; but this is a fault in the application, and not in the theory. It will not be a very difficult thing to acquire a knowledge of the motion of the water which has passed the preceding float, which, though not accurate, will yet approximate considerably to the truth; and then the ordinary theory will furnish maxims of construction which will be very serviceable. This will be attempted in its proper place; and we shall endeavour, in our treatment of all the practical questions, to derive useful information from all that has been delivered on the present occasion.

RES

RESOLUTION *of* IDEAS. See LOGIC, Part I. chap. iii.

RESOLUTION, in *Music*. To *resolve* a discord or dissonance, says Rousseau, is to carry it according to rule into a consonance in the subsequent chord. There is for that purpose a procedure prescribed, both for the fundamental bass of the dissonant chord, and for the part by which the dissonance is formed.

There is no possible manner of resolving a dissonance which is not derived from an operation of cadence: it is then by the kind of cadence which we wish to form, that the motion of the fundamental bass is determined, (see CADENCE). With respect to the part by which the dissonance is formed, it ought neither to continue in its place, nor to move by disjointed gradations; but to rise or descend diatonically, according to the nature of the dissonance. Theorists say, that major dissonances ought to rise, and minor to descend; which is not however without exception, since in particular chords of harmony, a seventh, although major, ought not to rise but to descend, unless in that chord, which is, very incorrectly, called *the chord of the seventh redundant*. It is better then to say, that the seventh and all its derivative dissonances ought to descend; and that the sixth superadded, and all its derivative dissonances, should rise. This is a rule truly general, and without any exception. It is the same case with the rule of resolving dissonances. There are some dissonances which cannot be prepared; but there is by no means one which ought not to be resolved.

With respect to the sensible note improperly called a *major dissonance*, if it ought to ascend, this is less on account of the rule for resolving dissonances, than on account of that which prescribes a diatonic procedure, and prefers the shortest road; and in reality, there are cases, as that of the interrupted cadence, in which this sensible note does not ascend.

RESOLUTION, in *Chemistry*, the reduction of a mixed body into its component parts or first principles, as far as can be done by a proper analysis.

RESOLUTION, in *Medicine*, the disappearing of any tumor without coming to suppuration or forming an abscess.

RESOLVENTS, in *Medicine*, such as are proper for dissipating tumors, without allowing them to come to suppuration.

RESONANCE, RESOUNDING, in *Music*, &c. a sound returned by the air inclosed in the bodies of stringed instruments, such as lutes, &c. or even in the bodies of wind-instruments, as flutes, &c.

RESPIRATION, the act of respiring or breathing the air. See ANATOMY, N° 118. BLOOD, N° 29. MEDICINE, N° 104. and PHYSIOLOGY.

RESPIRATION of Fishes. See ICHTHYOLOGY.

RESPITE, in *Law*, signifies a delay, forbearance, or prolongation of time, granted to any one for the payment of a debt or the like. See REPRIEVE.

RESPONDENT, in the schools, one who maintains a thesis in any art or science; who is thus called from his being to answer all the objections proposed by the opponent.

RESPONDENTIA. See BOTTOMRY.

RESPONSE, an answer or reply. A word chiefly used in speaking of the answers made by the people to the priest, in the litany, the psalms, &c.

RESORT, a French word, sometimes used by English authors to signify the jurisdiction of a court, and particularly one from which there is no appeal.—Thus it is said, that the house of lords judge *en dernier ressort*, or in the last ressort.

REST, the continuance of a body in the same place, or its continual application or contiguity to the same parts of the ambient or contiguous bodies; and therefore is opposed to motion. See the article MOTION.

REST, in *Poetry*, is a short pause of the voice in reading, being the same with the cæsura, which, in Alexandrine verses, falls on the sixth syllable; but in verses of 10 or 11 syllables, on the fourth. See POETRY, Part III.

REST-HARROW, or CAMMOCK, the *Ononis Arvensis*. A decoction of this plant has been much recommended to horses labouring under a stoppage of urine. It is the pest of some corn-fields; but in its younger state, before the plant has acquired its thorns, it is a most acceptable food to sheep.

RESTAURATION, the act of re-establishing or setting a thing or person in its former good state.

RESTIO, a genus of plants belonging to the diœcia class. See BOTANY *Index*.

RESTITUTION, in a moral and legal sense, is restoring a person to his right, or returning something unjustly taken or detained from him.

RESTITUTION of Medals, or *Restituted Medals*, is a term used by antiquaries for such medals as were struck by the emperors, to retrieve the memory of their predecessors.

Hence, in several medals, we find the letters REST. This practice was first begun by Claudius, by his striking afresh several medals of Augustus. Nero did the same; and Titus, after his father's example, struck restitutions of most of his predecessors. Gallienus struck

Restitution || Resurrection.

a general restitution of all the preceding emperors on two medals; the one bearing an altar, the other an eagle without the REST.

RESTIVE, or RESTY, in the menege, a stubborn, unruly, ill-broken horse, that stops, or runs back, instead of advancing forward.

RESTORATION, the same with restauration. See RESTAURATION.

In England, the return of King Charles II. in 1660, is, by way of eminence, called the *Restoration;* and the 29th of May is kept as an anniversary festival, in commemoration of that event, by which the legal and episcopal government was restored.

RESTORATIVE, in *Medicine*, a remedy proper for restoring and retrieving the strength and vigour both of the body and animal spirits.

All under this class, says Quincy, are rather nutrimental than medicinal; and are more administered to repair the wastes of the constitution, than to alter and rectify its disorders.

RESTRICTION, among logicians, is limiting a term, so as to make it signify less than it usually does.

RESTRINGENT, in *Medicine*, the same with astringent. See ASTRINGENTS.

RESULT, what is gathered from a conference, inquiry, meditation, or the like; or the conclusion and effects thereof.

1
Definition.

RESURRECTION, in *Theology*, is a rising again from the state of the dead; and is that event, the belief of which constitutes one of the principal articles in the Christian creed.

2
Plan of the article.

In treating of this object of our faith, it has been usual to mention, first, the resurrection of our Blessed Lord, with the character of the witnesses, and the authenticity of the gospel history by which it has been proved, and from which, as a consequence, ours is inferred. But as most of the arguments for this resurrection are contained in the gospels, and as merely to repeat them would afford, we hope, but little information to most of our readers, we mean here to take a view of the several grounds on which the belief of a future existence is supposed to be founded; to collect together some of the sentiments of authors and nations concerning the place where departed spirits reside; concerning the nature of their present state; concerning the kinds of their future destination; that we may afterwards see how far their notions differ and agree with what we consider as the doctrines of Scripture.

3
The notion of a future state unknown to some obscure tribes.

Of a future state, there have sometimes been found a few wandering and obscure tribes who seemed to entertain no notion at all; though it should be remarked, that some of these were likewise observed in so low a degree of savage barbarity as not to be acquainted with the use of the bow, the dart, or the sling, and as not knowing how to wield a club, or to throw a stone, as a weapon of defence *.

* See *Robertson's Hist. of America.*

4
Has been almost universal.

Wherever the human mind has been cultivated, or, properly speaking, begun to be cultivated, the opinion has likewise generally prevailed that human existence is not confined to the present scene; nay, so very general has this notion been found among mankind, that many are puzzled how to account for what they suppose to be almost next to its universality.

5
The origin of this notion derived by some from primeval revelation.

To explain the phenomenon, some have imagined that it is a notion derived by tradition from primeval revelation. They suppose that the first parent of mankind, as a moral agent accountable for his conduct, was informed by his Maker of every thing which it was of importance for him to know; that he must have been acquainted with this doctrine of a future state in particular; and that he could hardly fail to communicate a matter so interesting to his posterity. They suppose, too, that the history of the translation of Enoch must have made a great noise in the world, and that the remembrance of it must have been long retained and widely diffused; and they find in the book of Job plain intimations of a resurrection from the dead, which, from the manner in which they are introduced, they think that very ancient patriarch must have received through this channel.

6
The usual objections to this opinion of no force.

It is not thought to be any objection to these suppositions, that the Most High, when delivering his laws from the top of Mount Sinai, did not enforce them by the awful sanctions of a future state. The intelligent reader of the Scriptures knows that the sanctions of a future state belong to a different and more universal dispensation than was that of Moses; that the primeval revelation related to that dispensation; and that the Jewish law, with its temporal sanctions, was introduced only to preserve the knowledge and worship of the true God among a people too gross in their conceptions to have been properly influenced by the view of future rewards and punishments, of such a nature as eye hath not seen, nor ear heard, neither hath it entered into the heart of man to conceive. He sees at the same time, everywhere scattered through the Old Testament, plain indications of the Mosaic economy being no more than preparatory to the bringing in of a better hope; and he thinks it evident, that such Jews as understood any thing of the nature of that better hope, must have been convinced, that, however the *ceremonial rites* of *their* religion might be sufficiently guarded by temporal sanctions, the *fundamental principles* of *all* religion and virtue are supported by rewards and punishments to be dispensed in a state beyond the grave. See PROPHECY and THEOLOGY.

7
Reasons in support of the opinion.

That the progenitors of the human race must have been inspired by their Creator with the knowledge of their immortality, and of every thing necessary to their everlasting welfare, cannot, we should think, be questioned by any one who believes that the world had a beginning, and that it is under the government of goodness and justice. The progress from sense to science is so slow, that however capable we may suppose the earliest inhabitants of this earth to have been of making philosophical discoveries, we cannot believe that the Father of mercies left his helpless creature to discover for himself his future existence. Death, when first presented to him, must have been a ghastly object; and had he been left without any hope of redemption from it, he would undoubtedly have sunk into listless despondency.

But a prospect of immortality is so pleasing to the human mind, that if it was communicated to the first man, it would of course be cherished by his posterity; and there is no difficulty in conceiving how it might be handed down by tradition to very remote ages, among such of his descendants as were not scattered over the face of the earth in small and savage tribes.—In the course of its progress, it would frequently be new-

new-modelled by the ever active imagination; and at last many absurd and fantastic circumstances would doubtless be combined with the original truth, that death puts not an end to human existence.

But though we are firmly convinced that the first principles of useful knowledge, and among them the doctrine of a future state, were communicated to man by his Maker; and though this doctrine, in large and permanent societies, might certainly be conveyed more or less pure to late posterity through the channel of tradition—we are far from attributing so much to tradition as some writers are disposed to do, or thinking it the only source from which mankind could derive the belief of their existence beyond the grave. In small tribes of savages such a tradition could hardly be preserved; and yet some indistinct notions of a future state have been found among tribes who are said to have lost all traditionary notions even of the being of a God.

8
Others imagine the notion might be conjectured from natural phenomena;

9
as from dreaming, &c.

Others, therefore, are inclined to believe that, independent of any traditions, mankind might be led by certain phenomena to form some conjectures of a future state. They observe, that although a few individuals perhaps may, yet it seldom happens that the whole individuals of any nation are exempted from dreaming: They observe, too, and this observation is founded on experience, that the images of the dead are from the remaining impressions of memory frequently summoned up in the fancy: and that it appears from all the languages of rude nations, who pay the greatest attention to their dreams, and who speak of seeing the dead in their visions, that these images (A) have always been taken by them for realities; nay, some of the learned, and the celebrated Baxter is of the number, are disposed to doubt whether these appearances be not something more than illusions of the brain: But whether they really be so or not, one thing is certain, that all nations in all countries, in the darkest ages and the rudest periods, are accustomed to dream; and whether sleeping or waking, in the stillness of the night, in the gloom of solitude, in the fondness of friendship, in the rovings of love, the delirium of fever, and the anguish of remorse, to see and converse with the shades of the departed; and Lucretius* has remarked, that even the inferior animals are not exempted from such illusions of a restless fancy.

* *Lucret.* lib. iv.

For often sleeping racers pant and sweat,
Breathe short, as if they ran their second heat;
As if the barrier down with eager pace
They stretch'd, as when contending for the race.
And often hounds, when sleep hath clos'd their eyes,
They toss, and tumble, and attempt to rise;
They open often, often snuff the air,
As if they prest the footsteps of the deer;
And sometimes wak'd, pursue their fancy'd prey,
The fancy'd deer, that seem to run away,
Till quite awak'd, the follow'd shapes decay.
And softer curs, that lie and sleep at home,
Do often rouse, and walk about the room,
And bark, as if they saw some strangers come.
And birds will start, and seek the woods, by night,
Whene'er the fancy'd hawk appears in sight,
Whene'er they see his wing or hear him fight.

CREECH.

These powers of fancy extend wide over animal creation; and it is on this general principle that necromancers and dreamers have in all ages established their trade, that the stories of goblins have at all times so very easily procured belief, and that

The village matron, round the blazing hearth,
Suspends the infant audience with her tales,
Breathing astonishment! Of witching rhymes
And evil spirits; of the deathbed call
Of him who robb'd the widow and devour'd
The orphan's portion; of unquiet souls
Ris'n from the grave to ease the heavy guilt
Of deeds in life conceal'd; of shapes that walk
At dead of night, and clank their chains and wave
The torch of hell around the murderer's head.

AIKENSIDE.

Mankind in general would willingly dispense with these troublesome visits of the dead. To prevent the return of the *zumbi* or the ghost, some nations of Africa use many superstitious rites*; and Kolben tells us, that the frightened Hottentots leave in the hut where a person has died all the utensils and furniture, lest the angry ghost, incensed at their avarice, should haunt them in their dreams, and infest them in the night. Divines and moralists have laboured to show that these are merely imaginary terrors: but God and nature seem to have determined that they shall produce the same effects upon certain minds as if they were real; and that while there is any sensibility in the heart, while there is any remembrance of the past, and any conjuring power in the fancy; the ignorant, the benighted, the timid, shall often meet with the goblins of darkness, the spectres of the tomb, the apparitions that hover round the grave, and the forms of the dead in the middle dream. See SPECTRE.

* *Voyage to Congo and Angola, Churchill's Voyages.*

10
Probable inferences from dreams, &c.

From these phenomena, which have been so common in all countries and in all ages, what would mankind naturally infer? Would they not infer, that there is something in the nature of man that survives death, and that there is a future state of existence beyond the grave? Are not still many specimens of this reasoning preserved in the ancient poets? and is it not thus that Achilles† reasons after imagining that he saw the ghost of his friend Patroclus?

† *Hom. Iliad* lib. xxiii. l. 103.

'Tis true, 'tis certain, man, though dead, retains
Part of himself; th' immortal mind remains:
The form subsists without the body's aid,
Aerial semblance, and an empty shade.

This

(A) These images were called by the Greeks Ειδωλα Θανοντων; and among the Romans they had various names, as *umbræ*, *lemures*, *manes*, *larvæ*, and were sometimes called *occursacula noctium*, *bustorum formidamina*, *sepulchrorum terriculamenta*, *animæ errantes*, which are all comprehended under the *species mortuorum*.

Resurrection.

This night my friend, so late in battle lost,
Stood at my side a pensive plaintive ghost;
Ev'n now familiar as in life he came,
Alas! how diff'rent, yet how like the same. POPE.

* Lib. iii.

Lucretius *, a studious observer of nature, though no friend to the soul's immortality, acknowledges frankly that these phantoms often terrify the mind, haunt us in our sleep, and meet us while awake. He confesses, too, that by such appearances mankind have been led to believe the future existence of the soul; but aware of the consequence,

——*Ne forte animas Acherunte reamur*
Effugere, aut umbras inter vivos volitare,

he endeavours to explain these curious phenomena on some of the odd and fantastic principles of the Epicureans. In doing this, however, he pretends not to deny that these images appear to be real; but candidly acknowledges that

————They strike and shake
The airy soul, as when we are awake,
With stroke so lively, that we think we view
The absent dead, and think the image true.
CREECH.

We here see how the belief of the soul's immortality came to be general among mankind. But for this information we are much more indebted to the poets, who have given us faithful transcripts of nature, than to the philosophers who have wished to entertain us with their own theories, or to those laborious men of erudition, who have dreaded as much to examine the source of an ancient report as the friends of Ulysses to approach the coast of Cimmerian darkness. With them tradition is the ultimate boundary of research: and as gorgons, chimeras, and hydras, have come down to us by tradition; so they, with great sagacity, suspect that tradition must likewise be at the bottom of the soul's immortality, and occasion the visions and phantoms of the dead.

11 Folly of allowing too much to tradition.

To tradition we have allowed all that it can justly claim; but we cannot allow it to be the only source of this opinion: and we have felt the highest indignation upon hearing men of learning and genius affirm, from a false zeal for the honour of revelation, that mankind, without this instruction, could never have acquired the art of building huts to screen them from the cold, or have learned the method of propagating their species! The reader must not here suppose that we allude to Polydore Virgil (B). We have in our eye persons now alive, with whom we have conversed on the subject, and who (terrified at the length to which some philosophers have carried the doctrine of instincts, and others the reasoning powers of the mind) have contended, with the utmost earnestness, that we know nothing—not even the functions of our animal nature—but by tradition or written revelation.

12 Opinion of philosophers.

Having now seen the source of the opinion concerning the future existence of the soul, and pointed out the natural phenomena by which mankind were led to embrace it, we come next to review the arguments by which the philosophers attempted to confirm it.

13 Pythagoras's notion of transmigration.

Pythagoras believed, with the rest of his country, that annihilation was never the end, and that nonentity was never the beginning of any thing that is. His general doctrine upon this subject was shortly expressed in very few words, *Omnia mutantur, nihil interit.* He afterwards learned from Egyptian priests that the soul migrates into new bodies; and being, it seems, a person of a most extraordinary and astonishing memory, he found there was some truth in the story; for after musing, he began to remember that he was Euphorbus, the son of Pantheus, that was slain by Menelaus in the Trojan war; and upon a jaunt to Peloponnesus, recollected the shield which he had worn at the time of the siege, in one of the temples of Juno at Argos! That none might question the truth of his assertion, his followers presently removed all doubts by the famous argument, the IPSE DIXIT of Egyptian origin.

14 Plato's doctrine of pre-existence.

As Pythagoras taught that human souls are frequently thrust into brute shapes, and, as some imagined, by way of punishment; it occurred to Plato, that all bodies, even the human, are a sort of prisons; and that, in consequence of this confinement, the soul was subjected to the rage of desire, appetite, and passion, and to all the wretched miseries of a jail. To explain this mystery, he supposed that desires and appetites belong to a soul that is purely animal residing in the body. But he was perplexed with another difficulty; for as he thought highly of the goodness of Deity, he could not imagine how he should imprison us without a crime. He supposed, therefore, that prior to its union with the present body the soul had existed in one of ether, which it still retains; but that even in this etherial body it had felt something of impure desire; and happening to indulge the vicious appetite, had contracted some stains of pollution, for which it was confined in its present body as a house of correction to do penance and improve its morals.

15 And mode of proving it.

To prove this ideal pre-existence of the soul, Plato availed himself of an opinion that was general in his time, that coincided with the doctrines of Pythagoras, and that was partly founded on a sort of reasoning and observation. He thought that matter and intelligence are coeternal (see PLATONISM); that there are various orders of souls; that those of both the man and the brute are parts or emanations (C) of the *anima mundi*, or soul of the world; that all are ultimately parts or emanations of Deity itself; and that all their faculties are

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(B) This writer allots part of a chapter to show, "Quis primum instituerit artem meretriciam," as being in his opinion a traditionary practice. See Lib. iii. cap. 17. *De Rerum Inventoribus.*

(C) The Deity was conceived by the ancients sometimes as a solid, when inferior souls were called αποσπασματα, i. e. fragments or parts broken off from him; and sometimes as a fluid, when they were considered as απορροιαι or, emanations: but from none of these hypotheses did they reason consequentially. Their αποσπασματα were often after death reunited to the Deity; and their απορροιαι often remained separate and distinct for a long while, without flowing back as they ought to have done, and mingling with the great ocean of spirit.

are more or less restricted and confined, according to those organised systems with which they are connected. Know first (says one delivering his doctrines),

Know first, that heav'n and earth's compacted frame,
And flowing waters, and the starry flame,
And both the radiant lights, one common soul
Inspires, and feeds, and animates the whole.
This active mind, infus'd through all the space,
Unites and mingles with the mighty mass:
Hence men and beasts the breath of life obtain,
And birds of air, and monsters of the main;
The ethereal vigour is in all the same,
And every soul is fill'd with equal flame;
As much as earthy limbs, and gross allay
Of mortal members, subject to decay,
Blunt not the beams of heav'n and edge of day (D).
DRYDEN.

Besides this hypothesis, that in some measure was common to others, Plato had an argument peculiarly his own. Happening to peep into the region of metaphysics, he was somewhat surprised on observing the ideas which we derive from reflection and consciousness; and supposing that they could not have entered by the senses, he naturally, though not very justly, concluded that we must have received them in some state of prior existence.

As, according to him, the soul was eternal, as well as the matter which composed the body, and as their union was only temporary and accidental, he might have been satisfied that the death of the soul was not to be the consequence of their separation, But, some how or other, satisfied he was not. He had recourse to a new argument. As the soul, he said, was an active principle, and a self-moving, it did not depend for its life on another; and therefore would always continue to exist, though the body were reduced to the general mass out of which it was formed. See METAPHYSICS, Part III. chap. iv.

Whether Plato had borrowed any of his doctrines from the eastern magi, we pretend not to say. We only observe a striking similarity, in some respects, between his and theirs. In Plato's philosophy, the sun, moon, and stars, were animated beings, and a sort of divinities that originally had sprung from the great fountain of heat and light, and our earthly bodies a sort of dungeons in which our miserable souls are benighted and debased by desires, appetites, and passions. In the magian philosophy, the Supreme Being was called *Oromasdes;* was the god of light, or was light itself, and represented by Mithras, a subordinate divinity, and the same with the sun. Another deity of very great power was Arimanes, the god of darkness, who presided over matter, and was the origin of all evil (see POLYTHEISM). The ancient Gnostics, who derived their tenets from this source, believed, with Pythagoras and Plato, in a great number of subordinate genii; and said, that Demiurgus, the god of matter and the soul or spirit of this world, had contrived the bodies of men and brutes; and in the former particularly, as in so many prisons, had confined a number of celestial spirits, that by exposing them to the low desires of appetite and passion, he might seduce them from their allegiance to the God of light, and render them more submissive to himself. From these prisons the Supreme Being was continually making attempts to rescue them; and in the mean time was frequently sending divine messengers to enlighten and instruct them, and to render them capable of returning to the regions of life and happiness, to which they had belonged (E).

The Stoics attempted to simplify this system, which appears anciently to have pervaded Egypt and the east, and which would seem to be no more than variously modified by Orpheus, Pythagoras, Plato, and others of the more northerly and western nations. None of them allowed a creation out of nothing; and the shaping and modelling of matter into forms was variously explained, according as they happened to be most addicted to superstition, to morals, or to physics. Some ascribed these operations to ancient Time, Chaos, and Darkness, and explained the future changes in nature by the genealogies of these deities; some observing attraction and repulsion, or at least a sort of agreement and discordance among bodies, were inclined to ascribe them to Friendship and Hatred, or Love and Antipathy; some observing, that while one body rose another descended, made Levity and Gravity primary agents; and some taking notice that living bodies sprung from corruption, were

(D) The general doctrine, as delivered here in these verses of Virgil, is the same with that not only of Pythagoras, but of the Stoics.

(E) Plato made the stars the native residence of inferior souls; and when these were thoroughly purified below, returned them home again: and therefore, says Virgil, alluding to his doctrine,

————————Some have taught
That bees have portions of ethereal thought,
Endu'd with particles of heav'nly fires;
For God the whole created mass inspires:
Thro' heav'n and earth, and ocean's depth, he throws
His influence round, and kindles as he goes.
Hence flocks, and herds, and men, and beasts, and fowls,
With breath are quicken'd, and attract their souls:
Hence take the forms his prescience did ordain,
And into him at length resolve again.
No room is left for death, they mount the sky,
AND TO THEIR OWN CONGENIAL PLANETS FLY. *Dryden.*

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were disposed to confer the same powers on Moisture and Heat.

17 Of the Stoics. The physical hypotheses were what had most charms for the Stoics. From their system immaterial beings were openly excluded; all things were regulated by physical laws or inexorable fate; and all things originated in the Το Ἑν or the *First One*, which was probably suggested by the Μονας of Pythagoras. This Το Ἑν appears to have been a *materia prima* devoid of all the qualities of body. In their language it was an Αρχη or *first principle*, not subject to change. When it was invested with the properties of body, it then became a Στοιχειον or an *element;* and then, so far as respected its qualities, especially its forms, it was subject to changes almost perpetual. The gods themselves and the souls of men were in this system only modifications of matter (F). Man was composed of their four elements, Fire, Air, Water, and Earth; and upon dissolution, every part returned to the element from which it had come, as the water of a vessel swimming in the sea unites with the ocean when the vessel is broken. This system, it is plain, cannot possibly admit of any separate consciousness of existence (G). The same may be said of the systems of Democritus and Epicurus, and all those who undertook to explain things upon physical principles (H). The chief merit of the physical systems appears to be this: Absurd as they were, it would seem from the whimsical and the almost childish reasoning of Lucretius, that they had a tendency to lead mankind from extravagant hypotheses to something that was similar to observation.

18 Of Aristotle. What Aristotle thought of the separate existence of the soul after death is not very certain. The soul he calls an Εντελεχεια; and if the reader can divine the meaning of the word, he perhaps can divine the meaning of the *Stagyrite*, and will then be a better diviner than we. At other times he says, that the soul is something divine; that it resembles the element of the stars; that it is something of a fiery nature; that it is the vicegerent of God in the body; and that the acuteness of the senses, the powers of the intellect, with the various kinds of appetites and passions, depend entirely on the qualities of the blood (I).

19 Of Critias and others. Another opinion of very old date was that of the late ingenious Mr Hunter. According to him, the living principle resides in the blood. This opinion, which is mentioned by Moses, was adopted by Critias and others of the ancients. Harvey likewise embraced it. But Mr Hunter, who always wished to be thought an original, inclines to stand at the head of the opinion, and supports it by experiments similar to those of the famed Taliacotius in mending noses. Should any of our readers wish to extract the soul's immortality from such an opinion, we must refer them to the many resources of ingenuity, sophistry, and logic.

Of the Jews. Among the Jews, the belief of a future and separate existence for a long time was deemed no essential article of their creed. Some thought that the soul was a spark in the moving of the heart; some imagined that it was the breath, and that upon the dissolution of the body it naturally vanished into soft air. The Sadducees denied the existence of either angel or spirit. Many believed the doctrine of ghosts, and were accustomed to invoke them at the grave. It is hence that we hear the prophets complaining that they were seeking from the living God unto dead men. Some imagined that there was a pre-existence of souls; and, in the case of a blind man, asked our Saviour, whether the man or his parents had sinned that he was born blind? Others inclined to a revolution of soul and body, and thought that our Saviour was either Elias or one of the old prophets returned; and a great many new-modelled their opinion of the soul's immortality according to certain passages in Scripture. The inspired mother of Samuel had said, "The Lord killeth and maketh alive: he bringeth down to the grave, and bringeth up." Isaiah had exclaimed, "Thy dead shall live; together with my dead body shall they arise: Awake, and sing, ye that dwell in the dust; for thy dew is as the dew of herbs, and the earth shall cast out the dead." Daniel had declared, that many of them that sleep in the dust of the earth shall awake to everlasting life, and some to shame and everlasting contempt. In the vision of the valley of dry bones, Ezekiel had seen that "at the word of the Lord" the bones came together, bone to his bone, the sinews and the flesh came upon them, and the skin covered them above, and the breath came into the bodies, and they lived and stood upon their feet. And a passage of Job led them to suppose, that at some distant and future period a particular time, which was called *the last* or the *latter day*, was appointed by heaven for the general resurrection of all those who are sleeping in their graves. "I know (says Job) my Redeemer liveth, and that he shall stand at the latter day upon the earth; and though after my skin worms destroy this body, yet in my flesh shall I see God.

Whether these passages were fairly interpreted agreeably to their true and original meaning, it is not here our business to inquire. It is sufficient for us to observe, that from them many of the Jews inferred the reality of a general resurrection (K). In this persuasion, Martha, speaking of her brother Lazarus, says to our Lord, "I know that he shall rise again in the resurrection at the last day." This resurrection appears to

(F) The Αρχη of the Stoics appears to be the same with the *Li* of the Chinese.

(G) Yet without regarding the inconsistency, many of the Stoics believed, that the soul continued separate long after death; though all in general seemed to deny a future state of rewards and punishments.

(H) In his *Physical Cosmogony*, Plato differed but little from the Stoics; but he had another sort of cosmogony, in which all things appear to have sprung from, and to be almost wholly composed of metaphysical entities, as ideas of forms, numbers, and mathematical figures. These kinds of notions were common both to him and Pythagoras; and were originally borrowed from Egypt, where calculation and geometry were half deified. See Platonism.

(I) The immortal Harvey has collected these different opinions of the Stagyrite in Exercit. 52. *De Generatione Animalium.*

(K) At present some are for allowing only those of their own nation to share in the benefits of this resurrection;

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to have been a general opinion among the Pharisees; for although it was a notion of the sect of the Sadducees that there was no resurrection, neither angel nor spirit, yet the Pharisees, we are told, confessed both. And this assertion is plainly confirmed by St Paul himself when his countrymen accused him before Felix. "I confess unto thee (says this eminent apostle), that after the way which they call heresy, so worship I the God of my fathers, believing all things which are written in the law and in the prophets, and having hope toward God, which they themselves also allow, that there shall be a resurrection of the dead, both of the just and unjust."

21
Of the Christians.

This resurrection of the dead to judgment, though not perhaps in the same sense in which the old Pharisees conceived it, is now generally and almost universally (L) maintained by Christians (M). Yet the Christians differ considerably with respect to the nature of the human soul. Some imagine that this spirit is naturally mortal, and that it is propagated along with the body from the loins of the parent. In support of this opinion, it has been observed that a great number of insects and plants transfer their lives to their posterity, and die soon after the act of propagation; that after this act the vital principle is in the most vigorous of plants and animals always found to be much exhausted; and that Tertullian a father of the church, in attempting some experiments of the kind, became subject to a momentary blindness, and felt a portion of his soul going out of him (N).

These imagine that immortality was only conditionally promised to man; that Adam forfeited this immortality by his disobedience; and that Christ has restored us to the hopes of it again by his sufferings and death: for as in Adam we have all died, so in Christ, they say, we shall all be made alive; and that now the sting is taken from death, and the victory over our souls from the grave.

Others have conceived the human soul as naturally immortal, and as setting death and the grave at defiance. Adam, they say, died only in a figure; and only from the consequences of this figure, which means sin, has our Lord saved us. In this sense Adam died on the very day in which he had sinned; or he died literally in 1000 years, which with the Lord are as one day. To these arguments their opponents reply, What then is the victory over death and the grave? You must still have recourse to a new figure, and betake yourselves to the second death; though, after all, where is your grave? To this it is answered, that the soul of itself is naturally immortal, and that it depends not either for its existence or the exercise of its faculties upon the body; that the properties of matter, as figure, magnitude, and motion, can produce nothing that is like to perception, memory, and consciousness. This is true, rejoin their opponents; but besides these few properties of matter, which are only the objects of that philosophy which has lately and properly been termed *mechanical*, the chemical philosophy has discovered other properties of matter; has found that matter is of various kinds; that it very often does not act mechanically; that it acquires many new properties by combination; and that no man, till farther experiment and observation, should venture to assert how far the soul is or is not dependent on its present organised system. The others, proceeding on their hypothesis, maintain that the soul, as being immaterial, is not divisible; and though the body of a frog may live without the head for a whole day; though the body of a tortoise may live without the head for a whole month: though a human limb may for some minutes after amputation continue to perform a vital motion, independent of a brain, a stomach, or a heart; and

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tion; and some are not even for allowing them, except they be men of piety and virtue. To render this resurrection probable, the rabbins say, with some of the Mahometans, that there is a certain bone in the body which resists putrefaction, and serves as a seed for the next body *. What that bone is, is of no great moment, as any bone, we believe, in the skeleton will answer the purpose equally well. With respect to the manner of this resurrection, the learned Hody has quoted several opinions of the Jews, and among others, that of the Chaldee paraphrast of the Canticles, asserting that the prophet Solomon had said, "When the dead shall revive, it shall come to pass that the Mount of Olives shall be cleft, and all the dead of Israel shall come out from thence; and the just too that died in captivity shall come through the way of the caverns under the earth, and shall come forth out of the Mount of Olives." He has likewise quoted Saunderson's Voyage to the Holy Land, in which, we are told that many of the Jews, by their own account, are to rise up in the valley of Jehoshaphat; and that in the *rowling* or *devolution* of the caverns, those at a distance must scrape their way thither with their nails.

* See *Pharisees*.

(L) The sect of the Quakers explain it figuratively.

(M) The last quoted author † (*Resurrection of the same Body, asserted from the traditions of the Heathens, the ancient Jews, and the primitive Church*) has endeavoured to show that this doctrine, in the same sense as we understand it, has been asserted by the ancient Magi, and by the present heathen Gaurs of Persia, the relics of the ancient Magi; by some of the ancient Arabians; by some of the Banians of India; by the present inhabitants of the island of Ceylon, of Java, of Pegu, of Transiana; by some amongst the Chinese; by the Arderians in Guinea; and by the ancient Prussians. The proofs which he brings, it must be confessed, are not however always very satisfactory. It appears, even from his own account, that some of these had derived their notions from certain Christians, Mahometans, or Jews. But the reader may judge of the great accuracy of his ideas from his bringing old Pythagoras and the Stoics, and even Democritus and Epicurus, in support of the same or a similar opinion.

† *Hody*.

(N) In illo ipso voluptatis ultimæ æstu quo genitale virus expellitur, nonne aliquid de anima quoque sentimus exire, utque adeo marcescimus et devigescimus cum lucis detrimento.

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and though the parts of a plant, a polype, or a worm, may survive their separation and become living wholes*, yet the soul, they observe, is not to be compared with the vital principles of plants and animals, nor ought to be divided on reasons so slender as those of analogy. Even granting, they say, that the soul were not naturally immortal of itself; yet the justice of God, which is not remarkable for its equal distribution of rewards and punishments in the present world, is bound to make some amends in the next. And to this again their opponents answer, as to the equal distribution of justice in a future world, of that we are assured on much better grounds than any of your's: our Lord has declared it in express terms; and whether the soul be immortal or not, we can easily believe what he said is true, as we know him whom we have trusted.

* See Polypus and Reproduction.

These, with Plato, suppose, that the soul is here as in prison; though how or at what time it should first have come into this dungeon they have not determined. They have only agreed, that upon its enlargement all its faculties are to receive an increase of power; and "having already equipped it so exquisitely with consciousness, activity, and perception in and of itself, and put it into so complete a capacity for happiness and misery in a separate state," their hypothesis does not require them to admit the least occasion for a resurrection; which accordingly is said to have been an article of Baxter's creed (O).

A third opinion, which extends likewise to every species of plant and animal, is, that all souls were created at once with bodies of ether; that these bodies, occupying only a very small space, were packed up in their first progenitors, and there left to be afterwards evolved and clothed with matter of a grosser kind by acts of generation and consequent nutrition. For the proof of this theory we are referred to the small animals seen through the microscope, and likewise to those which are supposed to escape even microscopic observation; but, above all, to the eggs of insects, which, though scarcely perceptible, yet contain in embryo a future caterpillar and all its coats, and within these a future butterfly with its legs and wings. These philosophers can perhaps account for the general taint of original sin in some other way than has hitherto been done. We have only to add, that on their scheme the resurrection is not a matter that seems to be indifferent.

22 Place of the dead near to the grave.

The next thing that falls to be considered is the place of the dead. From a natural enough association of ideas, an opinion had very early prevailed, that the spirit continued near to the body; and the offerings therefore intended for the dead were by most nations presented at the grave; and that on which the departed spirit is supposed to rest is always placed near the grave in China.

23 In darkness.

From the dreams of the night and the natural tendency of the fancy to work and to summon up spectres when the world around us is involved in darkness, it has also been imagined, that these spirits delight in the night and shadow of death (P), or have been prohibited from enjoying the exhilarating beams of day. And hence we are told,

> That in the dismal regions of the dead
> Th' infernal king once rais'd his horrid head;
> Leap'd from his throne, lest Neptune's arm should lay
> His dark dominions open to the day,
> And pour in light.

The nations, therefore, who have fancied a general receptacle for the dead, have thus been induced to place it in the west (Q), where the night begins and the day ends. That part of the world which, in the division of his father's dominions, fell to Pluto the infernal god, and where, according to Lactantius, Satan holds the empire of darkness, the Friendly Islanders have placed to the westward of a certain island which they call Tonga-*jee*; some tribes of American Indians, in a country beyond the western mountains; and Homer, somewhere to the westward of Greece at the boundaries of the ocean,

> Where in a lonely land and gloomy cells
> The dusky nation of Cimmeria dwells;
> The sun ne'er views th' uncomfortable seats
> When radiant he advances nor retreats.
> Unhappy race! whom endless night invades,
> Clouds the dull air, and wraps them round in shades.

Another opinion entertained by the Greeks and many other nations was, that the place of departed spirits is under the earth. This opinion is frequently mentioned in Homer, in Virgil, and alluded to by the Jewish prophets. As for the prophets, we know the circumstance from which they borrowed it: it was borrowed from those subterraneous vaults where their chiefs were buried, and which have been described by modern travellers. In the sides of these caverns there is ranged a great number of cells; and in these cells the mighty lay in a sort of state, with their weapons of war and their swords at their head. To these kinds of Egyptian cemeteries Ezekiel alludes, when he says, "that they shall not lie with the mighty that are fallen of the uncircumcised, who are gone down to hell with their weapons of war, and they have laid their swords under their heads." And Isaiah, when thus speaking of the prince of Babylon, "Thou shalt be brought down to hell, *to the sides of the pit*. Hell from beneath is moved for thee to meet thee at thy coming; it stirreth up the dead for thee, even all the chief ones of the earth; it hath raised up from their thrones all the kings of the nations. All the kings of the nations, even all of them, lie in glory, every one in his own house."

Mr

(O) *An Historical View of the Controversy concerning an Intermediate State, and the Separate Existence of the Soul.*

(P) Some Turkish ghosts are an exception, who use lamps or candles in their tombs, when their friends chuse to supply them with these luxuries.

(Q) The *west* and *darkness* are synonymous in Homer. Ω φιλοι, ου γαρ τ' ιδμεν όπη ζοφος, ουδ' όπη ηως. (Od. "O my friends! which is the west, or which is the east, the place of darkness, or that of the morning, we do not learn."

Many of the ancient fathers of the church asserted only, that the dead are now in *abditis receptaculis*, or in certain hidden and concealed places.

26 In hidden receptacles. Orpheus, Origen, and some others of the fathers, with the ancient Caledonian bard Ossian, and the learned Dodwell among the moderns, imagined that the soul,

27 In the air. when it left the body, went into the air, and resided somewhere between the surface of the earth and the moon.

28 In new bodies. Those who believed in a transmigration caused the soul at death only to enter a new body, and kept the departed always with the living. This creed has been found in India, in Egypt, in Mexico, and in all those countries where picture-writing has been much used. In this species of writing, the same picture is on fancied analogy transferred by metaphor to signify either a god or a man, a brute or a plant; and in those countries where it was practised, men had usually their names from animals, and were represented by their figure in writing (R). From this last stage of the process, a transmigration was easily supposed: and hence we hear of the gods of Egypt wandering about like so many vagrants in brute shapes, and of princes being translated into stars, because a star was their emblem in hieroglyphic, or stood for their name in figurative language. And, in like manner, we see, from the specimen of this character which is still preserved on celestial globes, how the heavens at first came to be filled with bears, scorpions, and dragons, and with a variety of other animals.

29 State of the dead according to some rude nations. The opinions concerning the state of the dead are still more numerous than those concerning the place where they reside. Rude nations have generally thought that the future state is similar to the present; that plants, animals, and inanimate things there, have their shades: and that these contribute as much to the pleasures and conveniences of the dead as their realities do to the living; that husbands have their wives (S), lovers their mistresses, warriors their battles, huntsmen their sport; and that all their passions, amusements, and business, are the same as formerly. For this reason, that the dead may not appear unprovided in the next world, like the ancient Gauls, some tribes of India, America, and Africa, bury with them in the same grave their wives, their arms, their favourite animals, and their necessary utensils.

30 According to the Egyptians. The ancient Egyptians, who believed in transmigration, supposed that the soul was after death obliged to animate every species of bird and quadruped, of reptile and insect and was not to return to a human form till after a period of 3500 years. Others have confined their transmigrations to particular animals, as the soul of man to the human form, and the soul of the brute to the bodies of the species to which it belonged. Some have changed the brute into man, and man into the brute, that man might suffer injuries similar to what he had inflicted, and the brute retaliate what he had suffered. Others have confined the human soul in plants and in stones; and Bell of Antermony mentions an Indian, who supposed that his ancestors might be in fishes.

31 According to Homer. The notions of Homer were probably those of many of his time. But these notions were dismal indeed. When his hero Ulysses visited the shades, many of the ghosts seemed to retain the mangled and ghastly appearance which they had at death; and, what is worse, seemed to be all starving with hunger, innumerable multitudes, with loud shrieks, flocking to the steams of his slain victim as to a most sumptuous and delicious banquet.

For scarcely had the purple torrent flow'd,
And all the caverns smok'd with streaming blood,
When, lo! appear'd along the dusky coasts
Thin airy shoals of visionary ghosts;
Fair pensive youths, and soft enamour'd maids,
And wither'd elders, pale and wrinkl'd shades.
Ghastly with wounds, the forms of warriors slain,
Stalk'd with majestic port, a martial train.
These, and a thousand more, swarm'd o'er the ground,
And all the dire assembly shriek'd around.
Ulysses saw, as ghost by ghost arose,
All wailing with unutterable woes.
Alone, apart, in discontented mood,
A gloomy shade, the sullen Ajax stood;
For ever sad, with proud disdain he pin'd,
And the lost arms for ever stung his mind.

Upon Ulysses saying to Achilles,

Alive, we hail'd thee with our guardian gods;
And, dead, thou rul'st a king in these abodes;

The shade replied:

Talk not of ruling in this dol'rous gloom,
Nor think vain words (he cry'd) can ease my doom;
Rather I choose laboriously to bear
A weight of woes, and breathe the vital air,
A SLAVE TO SOME POOR HIND THAT TOILS FOR BREAD,
THAN LIVE A SCEPTER'D MONARCH OF THE DEAD.

In this gloomy region no one is rewarded for his virtue, nor is punished for his crimes, unless committed, like those of Sisyphus, Tantalus, and Ixion, against the gods. All indeed are classed into groups, from a certain analogy of age, sex, fate, and disposition; but all appear to be equally unhappy, having their whole heart and affections concentrated in a world to which they are fated never to return.

The Elysium of Homer is alloted only for the relations and descendants of the gods; and Menelaus goes to this country of perpetual spring (T), not as a person of

(R) A military gentleman who resided at Penobscot during the late American war, assured us that the Indians, when desired to subscribe a written agreement, drew always the picture of the object or animal whose name they bore. But for fuller information on this subject, see Clavigero's History of Mexico.

(S) The question which the Sadducees put to our Saviour about the wife of the seven brothers, is a proof that the Pharisees thought there was a marriage and giving in marriage in the future state, and that it was somewhat similar to the present.

(T) Homer sends the ghost of Hercules to the shades, while Hercules himself is quaffing nectar with Hebe in in

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of superior merit, but because he had married the daughter of Jove.

32 Becomes a place of rewards and punishments.

Even long after a future state had become the scene of rewards and punishments, these for the most part were distributed, not according to moral, but physical distinctions. With the Greeks and Romans, the soul was condemned to many calamities for a number of years, if the body was not honoured with funeral rites. Among the Scandinavians, a natural death was attended with infamy, while a violent death, particularly in battle, gave a title to sit in the halls of Odin, and to quaff beer from the skulls of enemies. Among the Tlascalans, it was only the great that were permitted to animate birds and the nobler quadrupeds; the lower ranks were transformed into weasels, into paultry beetles, and such mean animals. Among the Mexicans, those who were drowned, who died of a dropsy, tumors, or wounds, or such like diseases, went along with the children that had been sacrificed to the god of water, and in a cool and delightful place were allowed to indulge in delicious repasts and varieties of pleasures: those who died of other diseases, were sent to the north or centre of the earth, and were under the dominion of the gods of darkness. "The soldiers, who died in battle, or in captivity among their enemies, and the women who died in labour, went to the house of the sun, who was considered as the prince of glory. In his mansions they led a life of endless delight. Every day the soldiers, on the first appearance of his rays, hailed his birth with rejoicings and with dancings, and the music of instruments and voices. At his meridian they met with the women, and in like festivity accompanied him to his setting. After four years of this glorious life, they went to animate clouds, and birds of beautiful feathers and of sweet song; but always at liberty to rise again, if they pleased, to heaven, or descend to the earth, to warble their songs, and to suck flowers *."

33 These at first distributed according to physical distinctions;

34 and afterwards according to moral distinctions.

These sentiments of a future state, conceived in a savage and a rude period, could not long prevail among an enlightened and civilized people. When the times of rapine and violence therefore began to cease; when societies regulated by certain laws began to be established; when martial prowess was less requisite, and the qualities of the heart had begun to give an importance to the character, the future state was also modelled on a different plan. In the Æneid of Virgil, an author of a highly cultivated mind, and of polished manners, it becomes a place of the most impartial and unerring justice; every one now receives a sentence suited to the actions of his past life, and a god is made to preside in judgment;

* *Clavigero's Hist. of Mexico*, vol. vi. p. 136.

> Who hears and judges each committed crime,
> Inquires into the manner, place and time.
> The conscious wretch must all his acts reveal,
> Loth to confess, unable to conceal,
> From the first moment of his vital breath,
> To the last hour of unrepenting death.

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The spirits of the dead no longer mingle together as in the less enlightened period of Homer; the vicious are dismissed to a place of torments, the virtuous sent to regions of bliss: indifferent characters are confined to a limbus *; and those who are too virtuous for hell, but too much polluted with the stains of vice to enter heaven without preparation, are for some time detained in a purgatory.

* Or paradise of fools.

35 Virgil's purgatory.

> For there are various penances enjoin'd,
> And some are hung to bleach upon the wind;
> Some plung'd in waters, others purg'd in fires,
> Till all the dregs are drain'd, and rust expires;
> Till nothing's left of their habitual stains,
> But the pure ether of the soul remains.

When thus purified, they become fitted to receive the rewards of their past virtues, and now enter into those regions of happiness and joy.

36 His heaven.

> With ether vested, and a purple sky,
> The blissful seats of happy souls below,
> Stars of their own, and their own suns they know;
> Where patriots live, who, for their country's good,
> In fighting fields were prodigal of blood.
> Priests of unblemish'd lives here make abode,
> And poets worthy their inspiring god;
> And searching wits, of more mechanic parts,
> Who grac'd their age with new-invented arts:
> Those who to worth their bounty did extend;
> And those who knew that bounty to commend.

These good men are engaged in various amusements, according to the taste and genius of each. Orpheus is still playing on his harp, and the warriors are still delighted with their chariots, their horses, and their arms.

The place of torment is at some distance.

37 His hell.

> A gaping gulf, which to the centre lies,
> And twice as deep as earth is distant from the skies;
> From hence are heard the groans of ghosts, the pains
> Of sounding lashes, and of dragging chains.
> Here, those who brother's better claim disown,
> Expel their parents, and usurp the throne;
> Defraud their clients, and, to lucre sold,
> Sit brooding on unprofitable gold.
> Who dare not give, and even refuse to lend,
> To their poor kindred, or a wanting friend.
> Vast is the throng of these; nor less the train
> Of lustful youths for foul adult'ry slain.

Hosts

in the skies. One soul of the hero is therefore repining with the ghosts of mortals in the regions below, while the other is enjoying all the happiness of the gods above. (See *Odyssey*, book ii. near the end). Philosophers since have improved on this hint of the poet; and men have now got rational, animal, and vegetable souls, to which sometimes a fourth one is added, as properly belonging to matter in general. Homer insinuates, that Menelaus was to be translated to Elysium without tasting death. This Elysium is the habitation of men, and not of ghosts, and is described as being similar to the seat of the gods. Compare *Odyss.* iv. l. 563. and *Odyss.* vi. l. 43. in the Greek.

Hosts of deserters, who their honour sold,
And basely broke their faith for bribes of gold:
All these within the dungeon's depth remain,
Despairing pardon, and expecting pain.

The souls of babes, of unhappy lovers, and some others, seem to be placed in a paradise of fools residing in a quarter distinct from Elysium, Tartarus, and Purgatory.

It is curious to observe, how much these ideas of a future state differ from the vague and simple conjectures of rude nations; and yet from their simple and rude conjectures, we can easily trace the successive changes in the writings of Homer, Plato, and Virgil; and may easily show, that those laws which different nations have prescribed for their dead, have always borne the strongest analogy to their state of improvement, their system of opinions, and their moral attainments. Some nations, as those of India, have fancied a number of heavens and hells, corresponding to some of the principal shades in virtue and vice; and have filled each of these places respectively with all the scenes of happiness and misery, which friendship and hatred, admiration, contempt, or rancour, could suggest. But having already observed the progress of the human mind in forming the grand and leading ideas of a future state, we mean not to descend to the modifications which may have occurred to particular nations, sects, or individuals.

The belief of Christians respecting futurity demands our attention, as being founded on a different principle, namely, on express revelations from heaven. From many express declarations in Scripture, all Christians seem to be agreed, that there is a heaven appointed for the good and a hell for the wicked. In this heaven the saints dwell in the presence of God and the uninterrupted splendours of day. Those who have been wise shine as the firmament, and those who have converted many to righteousness as the stars. Their bodies are glorious, immortal, incorruptible, not subject to disease, to pain, or to death. Their minds are strangers to sorrow, to crying, to disappointment; all their desires are presently satisfied; while they are calling, they are answered; while they are speaking, they are heard. Their mental faculties are also enlarged; they no more see things obscurely, aud as through a cloud, but continually beholding new wonders and beauties in creation, are constantly exclaiming, "Holy, holy, holy! is the Lord of hosts; worthy is he to receive glory, and honour, and thanksgiving; and to him be ascribed wisdom, and power, and might; for great and marvellous are his works, and the whole universe is filled with his glory."

Their notions of hell differ considerably. Some understanding the Scriptures literally, have plunged the wicked into an abyss without any bottom; have made this gulf darker than night; have filled it with rancorous and malignant spirits, that are worse than furies; and have described it as full of sulphur, burning for ever. This frightful gulf has by some been placed in the bowels of the earth; by some in the sun; by some in the moon; and by some in a comet: but as the Scriptures have determined nothing on the subject, all such conjectures are idle and groundless.

Others imagine, that the fire and sulphur are here to be taken in a figurative sense. These suppose the torments of hell to be troubles of mind and remorses of conscience; and support their opinion by observing, that matter cannot act upon spirit; forgetting, perhaps, that at the resurrection the spirit is to be clothed with a body, and, at any rate, that it is not for man vainly to prescribe bounds to Omnipotence.

Resurrection.

42 Of the middle state, and different opinions about it.

What seems to have tortured the genius of divines much more than heaven or hell, is a middle state. On this subject there being little revealed in Scripture, many have thought it incumbent upon them to supply the defect; which they seem to have done in different ways. From the Scriptures speaking frequently of the dead as sleeping in their graves, those who imagine that the powers of the mind are dependent on the body, suppose that they sleep till the resurrection, when they are to be awakened by the trump of God, reunited to their bodies, have their faculties restored, and their sentence awarded.

43 According to some a state of sleep;

This opinion they support by what St Peter says in the Acts, that David is not ascended into heaven; and that this patriarch could not possibly be speaking of himself when he said, "Thou will not leave my soul in hell, i. e. the place of the dead." They observe, too, that the victory of Christ over death and the grave seems to imply, that our souls are subject to their power; and accordingly the Scripture speaks frequently of the soul's drawing near to, of its being redeemed from, and of its descending into, the grave; that the Psalmist, however, declares, plainly, that when the breath of man goeth forth, he returneth to his earth, and that very day his thoughts perish. And should any one choose to consult Ecclesiastes, he will find, that the living know that they shall die, but that the dead know not any thing: that their love, and their hatred, and their envy, are perished; and that there is no work, nor device, nor wisdom, nor knowledge, in the grave, whither they are gone.

44 According to others, a state of conscious existence.

Those who believe that the soul is not for the exercise of its faculties dependent on the body, are upon its separation at death obliged to dispose of it some other way. In establishing this theory, they usually begin with attempting to prove, from Scripture or tradition, both its active and separate existence; but with proofs from tradition we intend not to middle. Their arguments from Scripture being of more value, deserve our serious consideration; and are nearly as follow.

Abraham, they say, Isaac, and Jacob, are still living, because Jehovah is their God, and he, it is allowed, is not the God of the dead, but of the living. But their opponents reply, That this is the argument which our Saviour brought from the writings of Moses to prove a future resurrection of the dead; and that any person, who looks into the context, will see it was not meant of a middle state. From the dead living unto God, our Saviour infers nothing more than that they shall live at the resurrection; and that these gentlemen would do well in future to make a distinction between simply living and living unto God: For though Abraham, Isaac, and Jacob, be living unto God, our Saviour has assured us that Abraham is dead, and the prophets dead.

A second argument is that glimpse which St Paul had of Paradise about 14 years before he had written his Second Epistle to the Corinthians. To this argument their opponents reply, That as St Paul could not tell whether, on that occasion, he was out of the body or in the body, it is more than probable that the whole was

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was a vision; and, at any rate, it is no proof of a separate existence.

A third argument is, St Paul's wishing to be absent from the body, and present with the Lord. But, say their opponents, St Paul desired not to be unclothed, but to be clothed upon: and as some of those who maintain a separate existence, bring Scripture to prove that the body * continues united to Christ till the resurrection; in that case, St Paul, if he wished to be present with the Lord, should have rather remained with his body than left it.

* *Shorter Catechism.*

A fourth argument is, the appearance of Moses and Elias upon the mount of transfiguration. To which their opponents reply, that these saints appeared in their bodies; that Elias was never divested of his body; and that the account which we have of the burial of Moses, has led some of the ablest critics and soundest divines to conclude, that he was likewise translated to heaven without tasting death. At any rate, say they, he might have been raised from the dead for the very purpose of being present at the transfiguration, as the bodies of other saints certainly were, to bear testimony to our Lord's resurrection and victory over the grave.

A fifth argument is, what our Saviour said to the thief, "Verily I say unto thee, to-day thou shalt be with me in paradise." The objection usually made here is, that the expression is evidently ambiguous, and that the sense depends entirely on the punctuation; for if the point be placed after *to-day*, the meaning will be "Verily, even now, I tell thee, thou shalt be with me in paradise." But the import of paradise in this place, say the opponents, is likewise doubtful. We learn from St Peter's explanation of the 16th Psalm, that our Saviour's soul was not to be left in hell; and we know that on the day of his crucifixion he went not to heaven: for after he had risen from the place of the dead, he forbade one of the women to touch him, as he had not yet ascended to the Father. Hell, therefore, and paradise, continue they, seem to be in this passage the very same thing, the place of the dead; and our Saviour's intention, they add, was not to go to heaven at that time, but to show his victory over death and the grave, to whose power all mankind had become subject by the disobedience of their first parents.

45 The soul is by some supposed to reside in the air till the resurrection.

Without pretending to enter into the merits of this dispute, the ingenious Burnet, in his Theory of the Earth, endeavours to prove, upon the authority of the ancient fathers, that paradise lies between the earth and the moon; and the learned Dodwell, on the same authority, has made it the common receptacle of souls till the resurrection; but has not told us whether or not they are to be accountable for the actions of this separate existence at the latter day, or are only to be judged according to the deeds that were done in their bodies.

46 The church of Rome supposes a purgatory.

This notion of a common receptacle has displeased many. The state of purgation, obscurely hinted in the doctrines of Pythagoras, and openly avowed by Plato and Virgil, has been adopted by the Romish divines, who support their opinion on certain obscure passages of Scripture, which are always of a yielding and a [illegible] nature, may easily be twisted to any hypothesis, and like general lovers espouse rather from interest than merit.

It has displeased others, because they are anxious that the righteous should have a fore-taste of their joys, and the wicked of their torments, immediately after death; which they infer to be certainly the case from the parable of the rich man and Lazarus (U). But to this it is objected, that the rich man is supposed to be in hell, the place of torments, and that this punishment ought not to take place on their own hypothesis till after the sentence at the resurrection.

Another argument used for the intermediate state is the vision of St John in the Apocalypse. In this vision the Evangelist saw under the altar the souls of them that were slain for the word of God and for the testimony which they held. Their opponents doubt whether these visible souls were immaterial, as St John heard them cry with a loud voice, and saw white robes given unto every one of them. If they had bodies, that circumstance might chance to prove a resurrection immediately after death, and so supersede the general resurrection at the last day.

While such conclusions as are here drawn from the parable and vision, say the opposers of an intermediate conscious existence, imply that the dead are already raised, and are now receiving the respective rewards of their virtues and their crimes; those who maintain an intermediate separate existence, who speak of the body as a prison, and of the soul as receiving an increase of power when freed from the body, are certainly not more than consistent with themselves, when they think that this soul would derive an advantage from its after union with either a new system of matter or the old one, however much altered. Baxter, they say, who saw the inconsistency, was disposed to reason somewhat like Æneas,

> O, Father! can it be that souls sublime
> Return to visit our terrestrial clime?
> Or, that the gen'rous mind, releas'd at death,
> Should covet lazy limbs and mortal breath?

In no one instance, they continue, have Christians perhaps more apparently than in this argument wrested the Scriptures to their own hurt; by thus rashly attempting to accommodate the sacred doctrines of religion to a preconceived philosophical hypothesis, they have laid themselves open to the ridicule of deists, and have been obliged, for the sake of consistency, either to deny or to speak slightingly of the resurrection; which is certainly the surest foundation of their hope, seeing St Paul hath assured us, that if there be no resurrection of the dead, then they which are fallen asleep in Christ are perished, and those who survive may eat and drink, and act as they please, for to-morrow they die; and die, [illegible] never to live again.

Though this reproof may be rather severe, [illegible]

[illegible]

(U) Whitby shows that this parable was conformable to the notions of the Jews at that time; and even the Mahometans, who believe in the resurrection of the dead, suppose likewise a state of rewards and punishments in the grave.

Resurrection. sorry to observe that there seems to have been sometimes too much reason for it. A certain divine†, whose piety was eminent, and whose memory we respect, having written "An Essay towards the proof of a separate State of Souls between Death and the Resurrection, and the Commencement of the Rewards of Virtue and Vice immediately after death," has taken this motto, "Because sentence against an evil work is not executed speedily, therefore the heart of the sons of men is fully set in them to do evil." "The doctrine, he says, of the resurrection of the body and the consequent states of heaven and of hell, is a guard and motive of divine force, but it is renounced by the enemies of our holy Christianity; and should we give up the recompenses of separate souls, while the deist denies the resurrection of the body, I fear, between both we should sadly enfeeble and expose the cause of virtue, and leave it too naked and defenceless."

This author, who wishes much that the punishment of crimes should follow immediately after death, is of opinion, that if heaven intended to check vice and impiety in the world, it has acted unwisely, if it really has deferred the punishment of the wicked to so late a period as the resurrection. "For such, he observes, is the weakness and folly of our natures, that men will not be so much influenced and alarmed by distant prospects, nor so solicitous to prepare for an event which they suppose to be so very far off, as they would for the same event, if it commences as soon as ever this mortal life expires. The vicious man will indulge his sensualities, and lie down to sleep in death with this comfort, I shall take my rest here for 100 or 1000 years, and perhaps in all that space my offences may be forgotten; or let the worst come that can come, I shall have a long sweet nap before my sorrows begin: and thus the force of divine terrors is greatly enervated by this delay of punishment."

Thus far our author, who thinks that his hypothesis, if not true, is at least expedient, and that from motives of expediency it ought to be inculcated as a doctrine of Scripture: but how far his reasons can be here justified we mean not to determine; we shall leave that to be settled by others, reminding them only that the distance of future rewards and punishments is not greater on the supposition of the sleep of the soul than on the contrary hypothesis. Every man who has but dipt into the science of metaphysics knows, and no man ever knew better than he who is believed to have been the author of the work before us, that time unperceived passes away as if in an instant; and that if the soul be in a state void of consciousness between death and the resurrection, the man who has lain in his grave a thousand years will appear to himself to have died in one moment and been raised in the next. We would likewise recommend to those who may henceforth be inclined to inculcate any thing as a doctrine of scripture merely on account of its supposed expediency, always to remember that God is above, that they are below, that he is omniscient, that they are of yesterday and know little, that their words therefore should be wary and few, and that they should always speak with respect of whatever concerns the Sovereign of the universe, or relates to his government either in the natural or moral world. For wilt thou, says the Highest, disannul my judgment; Wilt thou condemn me that thou mayest be righteous? Shall he that contendeth with the Almighty instruct him? He that reproveth God let him answer it.

If, in stating these opposite opinions, we may seem to have favoured what has been called the sleep of the soul, it is not from any conviction of its truth, for there are particular texts of Scripture which appear to us to militate against it. We are satisfied, however, that it is a very harmless opinion, neither injurious to the rest of the articles of the Christian faith nor to virtuous practice; and that those who have poured forth torrents of obloquy upon such as may have held it in simplicity and godly sincerity, have either mistaken the doctrine which they condemned, or been possessed by a spirit less mild than that of the gospel (x).

48 The resurrection repeatedly asserted in Scripture.

Whatever be the fate of the middle state, the resurrection stands on a different basis. It is repeatedly asserted in Scripture; and those grounds on which we believe it are authenticated facts, which the affectation, the ingenuity, and the hatred of sceptics, have numberless times attempted in vain to disprove. These facts we are now to consider, referring our readers for the character of the witnesses, the authenticity of the gospel-history, and the possibility of miracles, to the parts of this work where these subjects are treated (see MIRACLE, METAPHYSICS, Part I. chap. vii. and RELIGION); or, should more particular information be required, to the writings of Ditton, Sherlock, and West.

49 The possibility of it shown by our Saviour's raising several persons from the dead;

Our Lord, after proving his divine mission by the miracles which he wrought, and by the completion of ancient predictions in which he was described, declared that the doctrine of a resurrection was one of those truths which he came to announce. To show that such an event was possible, he restored to life the daughter of Jairus, a ruler of the synagogue, a young man of Nain, who was carried out on his bier to be buried, and his friend Lazarus, whose body at the time was thought to have become the prey of corruption. Though the two first of these miracles were wrought in the presence of a number of witnesses, yet the last, owing to particular circumstances, produced a much greater noise among the Jews. It was performed on a person seemingly of some note, in the village of Bethany, not far from Jerusalem, and in the presence of a great many persons who from the metropolis had come to condole with Mary and Martha. No doubts were entertained of the reality of Lazarus's death. Our Lord was at a distance when

† Watts.

(x) Perhaps no man has been more culpable in this respect than the celebrated Warburton, who seems at first to have himself denied an intermediate state of conscious existence. He afterwards imagined that such a state is supposed, though not expressly asserted, in Scripture; and at last he maintained it with all the zeal and warmth of a proselyte. To prove the sincerity of his conversion, he treated his adversaries with scurrilous nicknames, banter, and abuse; a species of reasoning which seldom succeeds in recommending a bad cause, and which never confers credit on one that is good.

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when he expired, and his body had already been lying for some days in the grave. When he came forth at the voice of our Lord, all were astonished. Those from Jerusalem, on returning home, are impatient to relate what they had seen; those who heard of so memorable an event cannot conceal it; the report reaches the ears of the Pharisees and chief priests. They are soon made acquainted with every circumstance; and dreading the issue, they think it necessary to call a council upon the occasion, and concert the measures that ought to be pursued in a matter which was likely to be attended with so many and important consequences. In this council, it seems to be agreed, that our Lord had performed, and was still continuing to perform, many miracles: that this last miracle, as being of an extraordinary kind, would make many converts; and that if measures were not speedily taken to prevent these uncommon displays of his powers, all would believe on him; the jealousy of the Romans would be excited, the rulers deposed, and the nation of the Jews deprived of its few remaining privileges. Yet notwithstanding these private concessions made in the council, the members who dreaded to let their sentiments be known to the people, affect in public to treat our Saviour as an impostor. But he who had already demonstrated the absurdity of their opinions, who supposed that his miracles were wrought by Beelzebub prince of the devils, is again ready to confute the ridiculous assertion of those who pretended to say that they were a deception. His friend Lazarus was still living at the distance of only a few miles, and many of the Jews who had gone to see him were ready to attest the truth of the report. If the rulers, apprehending the consequences of the truth, be afraid to know it, and if they are unwilling to go to Bethany, or to send for Lazarus and those who were present at his resurrection, our Lord gives them a fair opportunity of detecting his fraud, if there was any such to be found in him. To preserve their power, and remove the jealous suspicions of the Romans, it had been already determined in council to put him to death; and our Lord foretels that the third day after his death he shall rise from the grave. Here no place was reserved for deception. The sect of the Pharisees and the chief priests are openly warned and put upon their guard; and very fortunately for the cause of Christianity, this singular prediction was not heard with scorn, or indeed, if with scorn, it was only affected. We know from the sentiments expressed in the council, that our Lord was secretly dreaded by the rulers; and that his predictions, in their private opinion, were not to be slighted. The means accordingly which they employed to prevent, even in the very appearance, the completion of his prophecy, were admirably calculated to remove the scruples of the most wary and sceptical inquirers, if their object was only to search after truth. At the next festival of the passover, when the scheme of Caiaphas was put in execution, and when it was deemed expedient by the council that he should die, to save the nation from the jealousy of the Romans; as a proof of their steady loyalty to Rome he was apprehended, was tried as an enemy to her government, was at last condemned upon false evidence, and suspended on a cross until they were fully satisfied of his death. Even after his death, the spear of a soldier was thrust into his side: and the water that gushed out with the blood is a proof to those who are acquainted with the structure and economy of living bodies, that he must have been some time dead.

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After he was taken down from the cross, a seal was put on the door of the sepulchre in which he was laid, as the best check against secret fraud; and a guard of soldiers was stationed around it, as the best security against open violence. In spite, however, of all these precautions, the prediction was accomplished; the angel of God, descending from heaven with a countenance like lightning, and with raiment white as snow; the watch shake, and become as dead men; the earth quakes; the stone is rolled from the mouth of the sepulchre; the angel sits on it, and our Lord comes forth.

And above all by his own resurrection.

It was in vain for the Jews to allege that his disciples came in the night, and stole him away, while the watch were asleep. One must smile at these puerile assertions. How came the disciples to know that the watch were asleep; or what excuse had the watch for sleeping, and incurring a punishment which they knew to be capital in the Roman law; and how came they, in the name of wonder, to be brought as an evidence for those transactions that happened at the time when they were asleep?

Whatever credit may be given by modern infidels to this ill-framed story, it is past dispute that it had none among the Jewish rulers at the time that it was current. Not long after our Saviour's resurrection, the apostles were called before the council, and threatened with death for teaching in the name of Jesus. Their boldness upon that occasion was so provoking to the rulers, that the threat would have been instantly put in execution, had not Gamaliel, a doctor of the law, of high reputation, put them in mind of other impostors who had perished in their attempts to mislead the people; and concluded a very sensible speech with these remarkable words: "And now, I say unto you, refrain from those men, and let them alone; for if this counsel, or this work, be of men, it will come to nought; but *if it be of God*, ye cannot overthrow it, lest haply ye be found even to fight against God." This advice the council followed. But is it possible that Gamaliel could have given it, or the council paid the least regard to it, had the story of the disciples stealing the body been then credited? Surely some among them would have observed, that a work or counsel, founded on imposture and fraud, could not be *supposed to be of God*, and they would unquestionably have slain the apostles.

The story of stealing the body is indeed one of the most senseless fictions that ever was invented in support of a bad cause. Our Lord was on the earth 40 days after he arose. He appeared frequently to his disciples. He ate and drank in their presence; and when some of them doubted, he bade them handle him and see that he was not a spectre, showed the mark of the spear in his side, and the prints of the nails in his feet and hands. Besides thus appearing to his disciples, he was seen by more than 500 brethren at one time; all of whom, as well as his disciples, must necessarily have known him previous to his suffering, and could therefore attest that he was the person who was once dead, but was then alive. Yet for strangers in general, who had not seen him previous to his death, and could not therefore identify his person after he arose, our Lord reserved many other proofs that were equally convincing. Before his ascension, he bade his disciples wait till they received power, by the Holy

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Ghost descending upon them: That then they should be witnesses with him, both in Jerusalem, and in all Judea, and in Samaria, and unto the uttermost ends of the earth; in order that the people of all these nations, observing the miracles wrought in his name, might themselves become ocular witnesses that those who preached his resurrection were warranted to do so by his authority; and that this authority, on which so numerous miracles attended, must be divine.

51 Minute objections and trifling cavils.

We intend not here to examine the minute objections and cavils that have been advanced respecting the truth of this important fact. The kinds, however, we shall mention in general. Some have doubted of our Lord's resurrection, as being an event which is not confirmed by general experience, because they imagine that what happens once should happen again, and even repeatedly, in order to be true. Some, taking their own to be preferable schemes, have objected to the way in which it happened, and to the manner in which it is narrated.—Some have imagined, that possibly the gospel history may be false; that possibly the disciples were very ignorant, and might be deceived; that possibly, too, they were deep politicians, and a set of impostors; and that possibly the writings which detected their falsehoods may have been destroyed. It is difficult to reason, and worse to convince, against this evidence of possibilities: but we flatter ourselves, that to the candid reader it will appear sufficiently overturned in our article MIRACLE; where it is shown that neither clowns nor politicians could have acted the part that was acted by the apostles, had not the resurrection been an undoubted fact.

Some of the objectors to it have also maintained, that possibly there is nothing material without us, that there is nothing mental within us, and that possibly the whole world is ideas. This mode of arguing we pretend not to explain; it is thought by some to proceed entirely from a perverseness of mind or disposition, while in books of medicine it is always considered as a symptom of disease, and the patient recommended to be treated in the hospital, and not in the academy.

52 Importance of the doctrine of a resurrection.

By his raising others, and particularly by rising himself, from the dead, our Saviour demonstrated that a resurrection from the dead is possible. And on that authority, which by his miracles he proved to be divine, he declared to his followers, that there is to be a general resurrection both of the just and of the unjust, instructing his disciples to propagate this doctrine through all nations; St Paul confessing, that if there be no resurrection of the dead, preaching is vain, and our faith is vain.

53 Of the order in which the dead are to be raised.

As to the order of succession in which the dead are to be raised, the Scriptures are almost silent. St Paul says, that every man is to rise in his own order, and that the dead in Christ are to rise first: and St John observed in his vision, that the souls of them which were beheaded for the witness of Jesus, and for the word of God, and which had not worshipped the beast, neither his image, neither had received his mark upon their foreheads, or in their hands, lived and reigned with Christ a thousand years; but the rest of the dead lived not again until the thousand years (Y) were finished.

54 With what bodies they shall rise.

A question that has much oftener agitated the minds of men is, with what sort of bodies are the dead to be raised? St Paul has answered, with incorruptible and immortal bodies (Z). And to silence the disputatious caviller of his day, he illustrated his doctrine by the growth of grain. "Thou fool (said he), that which thou sowest, thou sowest not that body that shall be, but bare grain, it may chance of wheat or of some other grain." To us it appears very surprising, that any one who reads this passage with the slightest attention, should perplex himself, or disturb the church with idle attempts to prove the identity of the bodies with which we shall die and rise again at the last day. The apostle expressly affirms, that "flesh and blood cannot inherit the kingdom of God; that we shall all be changed, in a moment, in the twinkling of an eye, at the last trump; that there are celestial bodies and bodies terrestrial; and that the glory of the celestial is one, and the glory of the terrestrial another."

That this implies a total change of qualities, will admit of no dispute; but still it has been considered as an article of the Christian faith, that we are to rise with the same bodies in respect of substance. What is meant by the identity of substance, with qualities wholly different, it is not very easy to conceive. Perhaps the meaning may be, that our incorruptible bodies shall consist of the same material particles with our mortal bodies, though these particles will be differently arranged to produce the different qualities. But as the particles of our present bodies are constantly changing, and as different particles compose the body at different times, a question has been put, With what set of particles shall we rise? Here a singular variety of opinions have been held. Some * contend, that we shall rise with the original stamina of our bodies derived from our parents; some are for rising with that set of particles which they had at birth; some with the set which they are to have at death; and some with the particles which remain after maceration in water †; though, God knows, that if this maceration be continued long, these may arise with few or no particles at all. Another query has given much alarm. What if any of these particles should enter a vegetable, compose its fruit, and be eaten by a man, woman, or a child? Will not a dispute, similar to that apprehended by the Sadducees about the wife of the seven brothers, necessarily follow, whose particles are they to be at the resurrection? Against this confusion, they trust that the goodness and wisdom of heaven will take all the proper and necessary measures; and they even venture to point out a way in which that may be done. A foot deep of earth, they observe, in two or three of the counties of England, supposing each person to weigh on an average about seven stones and a few pounds, would amply supply with material

* *Leibnitz.*

† *Hody.*

(Y) These thousand years formed the happy millenium so often mentioned in the ancient fathers; and the learned Burnet, in his Theory of the Earth, has endeavoured to prove, that a similar notion prevailed among the Jews. See MILLENIUM.

(Z) Our Saviour rose with the same body, both as to substance and qualities; because it was necessary that his person should be known and identified after his resurrection.

Resurrection.

terial bodies 600,000,000 of souls for no less a space than 20,000 years *; and therefore there seems to be no necessity for the vamping up of their old materials to lodge and accommodate new souls.

* See Hody's Resurrection of the same body asserted.

But unluckily here, the question is not about the possibility of keeping the particles of different bodies separate and distinct. The question is rather, What have the Scriptures determined on the subject? Now the Scriptures say, that the spirit returns unto God who gave it. And should it be asked, in what place does he reserve it till the resurrection? the Scriptures reply, in the place of the dead; because the soul descends into the pit, is redeemed from the grave; and the sting of death, the last enemy that is to be destroyed, shall be taken away when the trumpet of God shall sound: at which time the dead that sleep in their graves shall awake, shall hear the voice, and shall come forth. There is not here so much as a word concerning the body; and therefore it was asked with what bodies are the dead to be raised? To which it was answered, the vile body is to be changed. The body which is, is not the body which shall be; for the incorruptible must put on incorruption, and that which is mortal, put on immortality.

This curious discovery of the sentiments of Scripture we owe to a layman, the celebrated Locke; who, in one of his controversies with the bishop of Worcester, came to understand what he knew not before, namely, that nowhere have the Scriptures spoken of the resurrection of the same body in the sense in which it is usually conceived. The resurrection of the same person is indeed promised; and how that promise may be fulfilled, notwithstanding the constant change of the particles of the body, has been shown in another place. See METAPHYSICS, Part III. Chap. iii.

The advocates, therefore, for the resurrection of the mortal body, have again been obliged to betake themselves to the shifts of reasoning. It is proper, say they, that the same bodies which have been accomplices in our vices and virtues, should also share in our rewards and punishments. Now, granting they will, shall one set of particles be bound for the crimes, or be entitled to receive the rewards, of the animal system, from its first commencement to its dissolution? or shall every particle rise up successively, and receive its dividend of rewards and punishments for the vices and virtues that belonged to the system during the time that they were in union with the sentient principle? and is the hand that fell in defending a father to be (as is supposed in some of the eastern countries) rewarded in heaven; while the other that struck him when the son became vicious, is dismissed into torments;

Finding this hypothesis supported by neither Scripture nor reason, they next appeal to the ancient fathers. And they, it is confessed, are for the resurrection of the very same flesh. But this notion is directly contrary to the Scriptures, which have said, that flesh and blood are not to inherit the kingdom of God.

55
State after the resurrection.

But whatever be the bodies with which the dead are to be raised at the general resurrection, all mankind must appear in judgment, and receive sentence according to the deeds done in the body, without regard, so far as we know, to their actions and conduct in the middle state. After this sentence, the righteous are to enter into celestial and eternal joys, and the wicked to suffer the punishments of hell. These punishments some have supposed to be everlasting; others think, that after some temporary punishment, the souls of the wicked are to be annihilated; and others imagine, that after doing purgatorial penance for a while in hell, they are to be again received into favour; inclining to explain the denunciation of the Almighty as a child would do the threatenings of his mother, or a lover the affected chidings of his mistress.

Resurrection
|
Reticula.

RESUSCITATION, the same with resurrection and revivification. See the preceding article and REANIMATION.

The term *resuscitation*, however, is more particularly used by chemists for the reproducing a mixed body from its ashes; an art to which many have pretended, as to reproduce plants, &c. from their ashes.

RETAIL, in *Commerce*, is the selling of goods in small parcels, in opposition to wholesale. See COMMERCE.

RETAINER, a servant who does not continually dwell in the house of his master, but only attends upon special occasions.

RETAINING FEE, the first fee given to a serjeant or counsellor at law, in order to make him sure, and prevent his pleading on the contrary side.

RETALIATION, among civilians, the act of returning like for like.

RETARDATION, in *Physics*, the act of diminishing the velocity of a moving body. See GUNNERY, MECHANICS, PNEUMATICS, and PROJECTILES.

RETE MIRABILE, in *Anatomy*, a small plexus or network of vessels in the brain, surrounding the pituitary gland.

RETENTION is defined by Mr Locke to be, a faculty of the mind, whereby it keeps or retains those simple ideas it has once received, by sensation or reflection. See METAPHYSICS, Part I. Chap. ii.

RETENTION, is also used, in medicine, &c. for the state of contraction in the solids or vascular parts of the body, which makes them hold fast their proper contents. In this sense, retention is opposed to evacuation and excretion.

RETICULA, or RETICULE, in *Astronomy*, a contrivance for measuring very nicely the quantity of eclipses, &c. This instrument, which was introduced by the Academy of Sciences at Paris, is a little frame composed of 13 fine silken threads, parallel to, and at equal distances from each other, placed in the focus of object glasses of telescopes; that is, in the place where the image of the luminary is painted in its full extent. The diameter of the sun or moon is of consequence thus seen divided into 12 equal parts or digits; so that, in order to ascertain the quantity of the eclipse, there is nothing more to do than to number the parts that are dark, or that are luminous.

As a square Reticule is only proper for the diameter of the luminary, not for the circumference of it, it is sometimes made circular, by drawing six concentric, equidistant circles, which perfectly represents the phases of the eclipse.

But it is obvious that whether the Reticule be square or circular, it should be perfectly equal to the diameter or circumference of the sun or star, such as it appears in the focus of the glass; otherwise the division cannot be just. Another imperfection in the Reticule is, that its

its magnitude is determined by that of the image in the focus, and of course it will only fit one particular magnitude.

But a remedy for these inconveniences has been found out by M. de la Hire, who contrived that the same Reticule may serve for all telescopes, and all magnitudes of the luminary in the same eclipse. Two object glasses applied against each other, having a common focus, and these forming an image of a certain magnitude, this image will increase in proportion as the distance between the two glasses is increased, as far as to a certain limit. If therefore a Reticule be taken of such a magnitude, as just to comprehend the greatest diameter the sun or moon can ever have in the common focus of two object glasses applied to each other, it is only necessary to remove them from each other, as the star comes to have a less diameter, to have the image still exactly comprehended in the same Reticule.

As the silken threads are apt to deviate from the parallelism, &c. by the different temperature of the air, another improvement is, to make the Reticule of a thin looking glass, by drawing lines or circles upon it with the fine point of a diamond.

RETICULAR BODY *(corpus reticulare)*, in *Anatomy*, a very fine membrane, perforated, in the manner of a net, with a multitude of foramina. It is placed immediately under the cuticle; and when that is separated from the cutis, whether by art or accident, this adheres firmly to it, and is scarce possible to be parted from it, seeming rather to be its inner superficies than a distinct substance. In regard to this, we are to observe, first, the places in which it is found, being all those in which the sense of feeling is most acute, as in the palm of the hands, the extremities of the fingers, and on the soles of the feet. The tongue, however, is the part where it is most accurately to be observed: it is more easily distinguishable there than anywhere else, and its nature and structure are most evidently seen there.

Its colour in the Europeans is white; but in the negroes and other black nations it is black; in the tawney it is yellowish; the skin itself in both is white; and the blackness and yellowness depend altogether on the colour of this membrane.

The uses of the corpus reticulare are to preserve the structure of the other parts of the integuments, and keep them in their determinate form and situation. Its apertures give passage to the hairs and sweat through the papillæ and excretory ducts of the skin: it retains these in a certain and determinate order, that they cannot be removed out of their places, and has some share in preserving the softness of the papillæ, which renders them fit for the sense of feeling. See ANATOMY, N° 83.

RETICULUM, is a Latin word, signifying a *little* or *casting net*. It was applied by the Romans to a particular mode of constructing their buildings. In the city of Salino (see SALINO) are still to be seen remains of some walls, evidently of Roman origin from the *reticulum*. This structure consists of small pieces of baked earth cut lozengewise, and disposed with great regularity on the angles, so as to exhibit to the eye the appearance of cut diamonds; and was called *reticular*, from its resemblance to fishing-nets. The Romans always concealed it under a regular coating of other matter; and Mr Houel informs us, that this was the only specimen of it which he saw in all his travels through Sicily, Malta, and Lipari. It appears to be the remains of some baths, which have been built for the convenience of sea-bathing.

Reticulum || Retirement.

RETIMO, the ancient *Rhitymnia* of Stephen the geographer, and called by Ptolemy *Rhitymna*, is a fine city, lying at one end of a rich and fertile plain, on the north coast of the island of Candia. It is but a small place, containing scarce 6000 inhabitants; but it is a bishop's see, and the harbour is defended by a citadel, where a bashaw resides. It was taken by the Turks in 1647, and has been in their hands ever since. It is about 45 miles from Candia. E. Long. 24. 45. N. Lat. 35. 22.

The citadel, which stands on a rock jutting out into the sea, would be sufficient for the defence of the city, were it not situated at the foot of a high hill, from which it might be cannonaded with great advantage. The harbour is now almost filled with sand, and is no longer accessible to shipping; nor do the Turks in any measure oppose the ravages of time, but behold with a careless eye the most valuable works in a state of ruin. The French had formerly a vice-consul at Retimo, to which ships used to repair for cargoes of oil; but they have been long unable to get into the harbour: to repair which, however, and to revive the commerce of Retimo, would be a most useful attempt. The plains around the city abound in a variety of productions. Great quantities of oil, cotton, saffron, and wax, are produced here; and they would be produced in still greater quantities if the inhabitants could export their commodities. The gardens of Retimo bear the best fruits in the island; excellent pomegranates, almonds, pistachio nuts, and oranges. The apricot-tree, bearing the michmich, the juice of which is so delicious, and its flavour so exquisite, is found here. It is a kind of early peach, but smaller and more juicy than those of France.

RETINA, in *Anatomy*, the expansion of the optic nerves over the bottom of the eye, where the sense of vision is first received. See ANATOMY, N° 142. and OPTICS *(Index)* at *Eye* and *Vision*.

RETINUE, the attendants or followers of a prince or person of quality, chiefly in a journey.

RETIRADE, in fortification, a kind of retrenchment made in the body of a bastion, or other work, which is to be disputed, inch by inch, after the defences are dismantled. It usually consists of two faces, which make a re-entering angle. When a breach is made in a bastion, the enemy may also make a retirade or new fortification behind it.

RETIREMENT, means a private way of life or a secret habitation, "Few (says an elegant writer) are able to bear solitude; and though retirement is the ostensible object of the greater part, yet, when they are enabled by success to retire, they feel themselves unhappy. Peculiar powers and elegance of mind are necessary to enable us to draw all our resources from ourselves. In a remote and solitary village the mind must be internally active in a great degree, or it will be miserable for want of employment. But in great and populous cities, even while it is passive, it will be constantly amused. It is impossible to walk the streets without finding the attention powerfully solicited on every Dr Knox.

every side. No exertion is necessary. Objects pour themselves into the senses, and it would be difficult to prevent their admittance. But, in retirement, there must be a spirit of philosophy and a store of learning, or else the fancied scenes of bliss will vanish like the colours of the rainbow. Poor Cowley might be said to be melancholy mad. He languished for solitude, and wished to hide himself in the wilds of America. But, alas! he was not able to support the solitude of a country village within a few miles of the metropolis!

"With a virtuous and cheerful family, with a few faithful and good-humoured friends, with a well-selected collection of elegant books, and with a competency, one may enjoy comforts even in the deserted village, which the city, with all its diversions, cannot supply."

RETORT, in *Chemistry*, an oblong or globular vessel of glass or porcelain, with its neck bent, proper for distillation.

In the fifth volume of the Transactions of the London Society for the Encouragement of Arts, p. 96. we find a paper containing a method for preventing stone retorts from breaking; or stopping them when cracked, during any chemical operation without losing any of the contained subject. "I have always found it necessary (says the writer) to use a previous coating for filling up the interstices of the earth or stone, which is made by dissolving two ounces of borax in a pint of boiling water, and adding to the solution as much slaked lime as will make it into a thin paste; this, with a common painter's brush, may be spread over several retorts, which when dry are then ready for the proper preserving coating. The intention of this first coating is, that the substances thus spread over, readily vitrifying in the fire, prevent any of the distilling matters from pervading the retort, but do in nowise prevent it from cracking.

"Whenever I want to use any of the above coated retorts; after I have charged them with the substance to be distilled, I prepare a thin paste, made with common linseed oil and slaked lime well mixed, and perfectly plastic, that it may be easily spread: with this let the retorts be covered all over except that part of the neck which is to be inserted into the receiver; this is readily done with a painter's brush: the coating will be sufficiently dry in a day or two, and they will then be fit for use. With this coating I have for several years worked my stone retorts, without any danger of their breaking, and have frequently used the same retort four or five times; observing particularly to coat it over with the last-mentioned composition every time it is charged with fresh materials: Before I made use of this expedient, it was an even chance, in conducting operations in stone and earthen retorts, whether they did not crack every time; by which means great loss has been sustained. If at any time during the operation the retorts should crack, spread some of the oil composition thick on the part, and sprinkle some powder of slaked lime on it, and it immediately stops the fissure, and prevents any of the distilling matter from pervading; even that subtile penetrating substance the solid phosphorus will not penetrate through it. It may be applied without any danger, even when the retort is red hot; and when it is made a little stiffer, is more proper for luting vessels than any other I ever have tried: because if properly mixed it will never crack, nor will it indurate so as to endanger the breaking the necks of the vessels when taken off."

RETRACTS, among horsemen, pricks in a horse's feet, arising from the fault of the farrier in driving nails that are weak, or in driving them ill-pointed, or otherwise amiss.

RETREAT, in a military sense. An army or body of men are said to retreat when they turn their backs upon the enemy, or are retiring from the ground they occupied: hence every march in withdrawing from the enemy is called a *retreat*.

That which is done in sight of an active enemy, who pursues with a superior force, is the most important part of the subject; and is, with reason, looked upon as the glory of the profession. It is a manœuvre the most delicate, and the properest to display the prudence, genius, courage, and address, of an officer who commands: the historians of all ages testify it; and historians have never been so lavish of eulogiums as on the subject of the brilliant retreats of our heroes. If it is important, it is no less difficult to regulate, on account of the variety of circumstances, each of which demands different principles, and an almost endless detail. Hence a good retreat is esteemed, by experienced officers, the masterpiece of a general. He should therefore be well acquainted with the situation of the country through which he intends to make it, and careful that nothing is omitted to make it safe and honourable. See WAR.

RETREAT, is also a beat of the drum, at the firing of the evening gun; at which the drum-major, with all the drums of the battalion, except such as are upon duty, beats from the camp-colours on the right to those on the left, on the parade of encampment: the drums of all the guards beat also; the trumpets at the same time sounding at the head of their respective troops. This is to warn the soldiers to forbear firing, and the centinels to challenge, till the break of day that the reveille is beat. The retreat is likewise called *setting the watch*.

RETRENCHMENT literally signifies something cut off or taken from a thing; in which sense it is the same with subtraction, diminution, &c.

RETRENCHMENT, in the art of war, any kind of work raised to cover a post, and fortify it against the enemy, such as fascines loaded with earth, gabions, barrels of earth, sand-bags, and generally all things that can cover the men and stop the enemy. See FORTIFICATION and WAR.

RETRIBUTION, a handsome present, gratuity, or acknowledgement, given instead of a formal salary or hire, to persons employed in affairs that do not so immediately fall under estimation, nor within the ordinary commerce in money.

RETROMINGENTS, in *Natural History*, a class or division of animals, whose characteristic is, that they stale or make water backwards, both male and female.

RETURN (*returna* or *retorna*), in *Law*, is used in divers senses. 1. Return of writs by sheriffs and bailiffs is a certificate made by them to the court, of what they have done in relation to the execution of the writ directed to them. This is wrote on the back of the writ by the officer, who thus sends the writ back to the court from whence it issued, in order that it may be filed. 2. Return of a commission, is a certificate or answer

swer sent to the court from whence the commission issues, concerning what has been done by the commissioners. 3. Returns, or days in bank, are certain days in each term, appointed for the return of writs, &c. Thus Hillary term has four returns, viz. in the king's-bench, on the day next after the octave, or eighth day after Hillary day; on the day next after the fifteenth day from St Hillary; on the day after purification; and on the next after the octave of the purification. In the common pleas, in eight days of St Hillary: from the day of St Hillary, in fifteen days: on the day after the purification: in eight days of the purification. Easter term has five returns, viz. in the king's bench, on the day next after the fifteenth day from Easter: on the day next after the three weeks from Easter: on the day next after one month from Easter: on the day next after five weeks from Easter: and on the day next after the day following ascension-day. In the common pleas, in fifteen days from the feast of Easter: in three weeks from the feast of Easter: in one month from Easter day: in five weeks from Easter day: on the day after the ascension-day. Trinity term has four returns, viz. on the day following the second day after Trinity: on the day following the eighth day after Trinity: on the day next after the fifteenth day from Trinity: on the day next after three weeks from Trinity. In the common pleas, on the day after Trinity: in eight days of Trinity: in fifteen days from Trinity: in three weeks from Trinity. Michaelmas term has six returns, viz. on the day next after three weeks from St Michael: on the day next after one month of St Michael: on the day following the second day after All-souls: on the day next after the second day after St Martin: on the day following the octave of St Martin: on the day next after fifteen days of St Martin. In the common pleas, in three weeks from St Michael: in one month from St Michael: on the day after All-souls: on the day after St Martin: on the octave of St Martin: in fifteen days from St Martin. It is to be observed, that, as in the king's-bench, all returns are to be made on some particular day of the week in each term, care must be taken not to make the writs out of that court returnable on a non-judicial day; such as Sunday, and All-saints, in Michaelmas term, the purification in Hillary, the ascension in Easter, and Midsummer-day, except it should fall on the first day of Trinity term.

Returns, in a military sense, are of various sorts, but all tending to explain the state of the army, regiment, or company; namely, how many capable of doing duty, on duty, sick in quarters, barracks, infirmary, or hospital; prisoners, absent with or without leave; total effective; wanting to complete the establishment, &c.

RETUSARI, an island in Russia, is a long slip of land, or rather sand, through the middle of which runs a ridge of granite. It is 20 miles from Petersburg by water, four from the shore of Ingria, and nine from the coast of Carelia. It is about 10 miles in circumference, and was overspread with firs and pines when Peter first conquered it from the Swedes. It contains at present about 30,000 inhabitants, including the sailors and garrison, the former of whom amount to about 12,000, the latter to 1500 men. The island affords a small quantity of pasture, produces vegetables, and a few fruits, such as apples, currants, gooseberries, and strawberries, which thrive in this northern climate.

RETZ, Cardinal de. See Gondi.

RETZIA, a genus of plants belonging to the pentandria class, and to the 29th natural order, *Campanaceæ*. See Botany *Index*.

RETULINGEN, a handsome, and formerly a free and imperial town of Germany, in the kingdom of Wirtemberg; seated in a plain on the river Eschez, near the Neckar, adorned with handsome public buildings, and has a well frequented college. E. Long. 9. 10. N. Lat. 48. 31.

REVE, Reeve, or *Greve*, the bailiff of a franchise, or manor, thus called, especially in the west of England. Hence shire-reeve, sheriff, port-greve, &c.

REVEILLE, a beat of drum about break of day, to give notice that it is time for the soldiers to arise, and that the sentries are to forbear challenging.

REVEL, a port town of Livonia, situated at the south entrance of the gulf of Finland, partly in a plain and partly on a mountain; 133 miles south-west of Petersburg. It is a place of great trade, and holds two fairs yearly, which are visited by merchants from all countries, but particularly by those of England and Holland. It is a strong place, with a capital harbour, and had 10,600 inhabitants about 1796. It is surrounded with high walls and deep ditches, and defended by a castle. It was confirmed to the Swedes at the peace of Oliva, conquered by Peter the Great in 1710, and ceded to Russia in 1721. The conquest of it was again attempted by the Swedes in 1790. The duke of Sudermania, with the Swedish fleet, attempted to carry the harbour; but after an obstinate engagement with the Russian fleet, he was obliged to give it up; but it was but for a very short while. He retired about 10 leagues from the harbour, to repair the damage his fleet had sustained, and to prepare for a second attack before any relief could be afforded to the Russian fleet. As soon as he had refitted, he sailed for the harbour, at a league distant from which the Russian fleet was discovered, ready to dispute with the Swedes the entrance. Upon a council being held by the duke, it was resolved to attack the Russians; and the signals being given, the fleet bore down for the attack, which was maintained for near six hours with the utmost fury: at length the Swedes broke the Russian line, which threw them into much confusion; when the Swedes, taking the advantage of the general confusion into which the Russians were thrown, followed them with their whole force into the harbour, where the conflict and carnage were dreadful on both sides, though the Swedes certainly had the worst of it; but at the same time their skill and bravery are indisputable.

This valuable place was again confirmed to Russia by the peace. The government of Revel or Esthonia is one of the divisions of the Russian empire, containing five districts. 1. Revel, on the Baltic sea. 2. Baltic-port, about 40 versts westward from Revel. 3. Habsal, or Hapsal, a maritime town. 4. Weissenstein, on the rivulet Saida, about 80 versts from Revel. 5. Wesenberg, about 100 versts from Revel, at about an equal distance from that town and Narva.

REVELATION, the act of revealing, or making a thing public that was before unknown; it is also used for,

for the discoveries made by God to his prophets, and by them to the world; and more particularly for the books of the Old and New Testament. See BIBLE, CHRISTIANITY, MIRACLE, RELIGION, and THEOLOGY.

The principal tests of the truth of any revelation, are the tendency of its practical doctrines; its consistency with itself, and with the known attributes of God; and some satisfactory evidence that it cannot have been derived from a human source.

Before any man can receive a written book as a revelation from God, he must be convinced that God exists, and that he is possessed of almighty power, infinite wisdom, and perfect justice. Now should a book teaching absurd or immoral doctrines (as many chapters of the Koran do, and as all the traditionary systems of Paganism did), pretend to be revealed by a God of wisdom and justice, we may safely reject its pretensions without farther examination than what is necessary to satisfy us that we have not misunderstood its doctrine. Should a book claiming this high origin, enjoin in one part of it, and forbid in another, the same thing to be done under the same circumstances, we may reject it with contempt and indignation; because a being of infinite wisdom can never act capriciously or absurdly. Still, however, as it is impossible for us to know how far the powers of men may reach in the investigation or discovery of useful truth, some farther evidence is necessary to prove a doctrine of divine origin, than its mere consistency with itself, and with the principles of morality; and this evidence can be nothing but the power of working miracles exhibited by him by whom it was originally revealed. In every revelation confirmed by this evidence, many doctrines are to be looked for which human reason cannot full comprehend; and these are to be believed on the testimony of God, and suffered to produce their practical consequences. At this kind of belief the shallow infidel may smile contemptuously; but it has place in arts and sciences as well as in religion. Whoever avails himself of the demonstrations of Newton, Bernoulli, and others, respecting the resistance of fluids, and applies their conclusions to the art of ship-building, is as implicit a believer, if he understand not the principles of fluxions, as any Christian; and yet no man will say that his faith is not productive of important practical consequences. He believes, however, in man, while the Christian believes in God; and therefore he cannot pretend that his faith rests on a surer foundation.

Mr Locke, in laying down the distinct provinces of reason and faith, observes, 1. That the same truths may be discovered by revelation which are discoverable to us by reason. 2. That no revelation can be admitted against the clear evidence of reason. 3. That there are many things of which we have but imperfect notions, or none at all; and others, of whose past, present, or future existence, by the natural use of our faculties we cannot have the least knowledge: and these, being beyond the discovery of our faculties, and above reason, when revealed, become the proper object of our faith. He then adds, that our reason is not injured or disturbed, but assisted and improved, by new discoveries of truth coming from the fountain of knowledge. Whatever God has revealed is certainly true; but whether it be a divine revelation or not, reason must judge, which can never permit the mind to reject a greater evidence to embrace what is less evident. There can be no evidence that any traditional revelation is of divine original, in the words we receive it, and the sense we understand it, so clear and so certain as that of the principles of reason: and, therefore, nothing that is contrary to the clear and self-evident dictates of reason, has a right to be urged or assented to as a matter of faith, wherein reason has nothing to do.

REVELATION *of St John*. See APOCALYPSE.

REVELS, entertainments of dancing, masking, acting comedies, farces, &c. anciently very frequent in the inns of court and in noblemen's houses, but now much disused. The officer who has the direction of the revels at court is called the *MASTER of the Revels*.

REVENGE, means the return of injury for injury, and differs materially from that sudden resentment which rises in the mind immediately on being injured; which, so far from being culpable when restrained within due bounds, is absolutely necessary for self-preservation. Revenge, on the contrary, is a cool and deliberate wickedness, and is often executed years after the offence was given; and the desire of it is generally the effect of littleness, weakness, and vice; while, to do right, and to suffer wrong, is an argument of a great soul, that scorns to stoop to suggested revenges.

Revenge is but a frailty incident
To craz'd and sickly minds; the poor content
Of little souls, unable to surmount
An injury, too weak to bear affront. DRYDEN.

Revenge is generally the concomitant of savage minds, of minds implacable, and capable of the most horrid barbarities; unable to set any limits to their displeasure, they can confine their anger within no bounds of reason.

Cruel revenge, which still we find
The weakest frailty of a feeble mind.
Degenerous passion, and for man too base,
It seats its empire in the savage race.
JUVENAL.

The institution of law prevents the execution of private revenge, and the growth of civilization shows its impropriety. Though in modern times a species of revenge is sanctioned by what is called the law of honour, which evades the law of the land indeed, but which is equally mean and disgraceful as the other kinds, and is of consequences equally baneful. See ANGER, DUELLING, and RESENTMENT.

REVENUE, the annual income a person receives from the rent of his lands, houses, interest of money in the stocks, &c.

Royal REVENUE, that which the British constitution hath vested in the royal person, in order to support his dignity and maintain his power; being a portion which each subject contributes of his property, in order to secure the remainder. This revenue is either *ordinary* or *extraordinary*.

I. The king's *ordinary* revenue is such as has either subsisted time out of mind in the crown; or else has been granted by parliament, by way of purchase or exchange for such of the king's inherent hereditary revenues as were found inconvenient to the subject.—In saying that it has subsisted time out of mind in the crown, we do not mean that the king is at present in the actual possession of the whole of his revenue. Much (nay the greatest

greatest part) of it is at this day in the hands of subjects; to whom it has been granted out from time to time by the kings of England; which has rendered the crown in some measure dependent on the people for its ordinary support and subsistence. So that we must be obliged to recount, as part of the royal revenue, what lords of manors and other subjects frequently look upon to be their own absolute rights; because they and their ancestors are and have been vested in them for ages, though in reality originally derived from the grants of our ancient princes.

1. The first of the king's ordinary revenues, which may be taken notice of, is of an ecclesiastical kind, (as are also the three succeeding ones), viz. the custody of the temporalities of bishops. See TEMPORALITIES.

2. The king is entitled to a CORODY, as the law calls it, out of every bishopric; that is, to send one of his chaplains to be maintained by the bishop, or to have a pension allowed him till the bishop promotes him to a benefice. This is also in the nature of an acknowledgement to the king, as founder of the see, since he had formerly the same corody or pension from every abbey or priory of royal foundation. It is supposed to be now fallen into total disuse; though Sir Matthew Hale says, that it is due of common right, and that no prescription will discharge it.

3. The king also is entitled to all the tithes arising in extraparochial places; though perhaps it may be doubted how far this article, as well as the last, can be properly reckoned a part of the king's own royal revenue; since a corody supports only his chaplains, and these extraparochial tithes are held under an implied trust that the king will distribute them for the good of the clergy in general.

4. The next branch consists in the first-fruits and tenths of all spiritual preferments in the kingdom. See TENTHS.

5. The next branch of the king's ordinary revenue (which, as well as the subsequent branches, is of a lay or temporal nature) consists in the rents and profits of the demesne lands of the crown. These demesne lands, *terræ dominicales regis*, being either the share reserved to the crown at the original distribution of landed property, or such as came to it afterwards by forfeitures or other means, were anciently very large and extensive; comprising divers manors, honours, and lordships; the tenants of which had very peculiar privileges, when we speak of the tenure in ancient demesne. At present they are contracted within a very narrow compass, having been almost entirely granted away to private subjects. This has occasioned the parliament frequently to interpose; and particularly after King William III. had greatly impoverished the crown, an act passed, whereby all future grants or leases from the crown for any longer term than 31 years or three lives, are declared to be void; except with regard to houses, which may be granted for 50 years. And no reversionary lease can be made, so as to exceed, together with the estate in being, the same term of three lives or 31 years; that is, when there is a subsisting lease, of which there are 20 years still to come, the king cannot grant a future interest, to commence after the expiration of the former, for any longer term than 11 years. The tenant must also be made liable to be punished for committing waste; and the usual rent must be reserved, or, where there has usually been no rent, one-third of the clear yearly value. The misfortune is, that this act was made too late, after almost every valuable possession of the crown had been granted away for ever, or else upon very long leases; but may be of benefit to posterity, when those leases come to expire.

6. Hither might have been referred the advantages which were used to arise to the king from the profits of his military tenures, to which most lands in the kingdom were subject, till the statute 12 Car. II. c. 24. which in great measure abolished them all. Hither also might have been referred the profitable prerogative of purveyance and pre-emption: which was a right enjoyed by the crown of buying up provisions and other necessaries, by the intervention of the king's purveyors, for the use of his royal household, at an apprised valuation, in preference to all others, and even without consent of the owner: and also of forcibly impressing the carriages and horses of the subject, to do the king's business on the public roads, in the conveyance of timber, baggage, and the like, however inconvenient to the proprietor, upon paying him a settled price. A prerogative which prevailed pretty generally throughout Europe during the scarcity of gold and silver, and the high valuation of money consequential thereupon. In those early times, the king's household (as well as those inferior lords) were supported by specific renders of corn, and other victuals, from the tenants of the respective demesnes; and there was also a continual market kept at the palace-gate to furnish viands for the royal use. And this answered all purposes, in those ages of simplicity, so long as the king's court continued in any certain place. But when it removed from one part of the kingdom to another (as was formerly very frequently done), it was found necessary to send purveyors before hand, to get together a sufficient quantity of provisions and other necessaries for the household: and, lest the unusual demand should raise them to an exorbitant price, the powers before-mentioned were vested in these purveyors; who in process of time very greatly abused their authority, and became a great oppression to the subject though of little advantage to the crown; ready money in open market (when the royal residence was more permanent, and specie began to be plenty) being found upon experience to be the best proveditor of any. Wherefore, by degrees, the powers of purveyance have declined, in foreign countries as well as our own; and particularly were abolished in Sweden by Gustavus Adolphus, towards the beginning of the last century. And, with us in England, having fallen into disuse during the suspension of monarchy, King Charles, at his restoration, consented, by the same statute, to resign entirely those branches of his revenue and power: and the parliament, in part of recompense, settled on him; his heirs, and successors, for ever, the hereditary excise of 15d. per barrel on all beer and ale sold in the kingdom, and a proportionable sum for certain other liquors. So that this hereditary excise now forms the sixth branch of his majesty's ordinary revenue.

7. A seventh branch might also be computed to have arisen from wine licences; or the rents payable to the crown by such persons as are licensed to sell wine by retail throughout Britain, except in a few privileged places. These were first settled on the crown by the statute 12 Car. II. c. 25. and, together with the hereditary

Revenue. ditary exercise, made up the equivalent in value for the loss sustained by the prerogative in the abolition of the military tenures, and the right of pre-emption and purveyance: but this revenue was abolished by the statute 30 Geo. II. c. 19. and an annual sum of upwards of 7000l. per annum, issuing out of the new stamp duties imposed on wine-licences, was settled on the crown in its stead.

8. An eighth branch of the king's ordinary revenue is usually reckoned to consist in the profits arising from his forests. See FOREST. These consist principally in the amercements or fines levied for offences against the forest-laws. But as few, if any, courts of this kind for levying amercements have been held since 1632, 8 Char. I. and as, from the accounts given of the proceedings in that court by our histories and law-books, nobody would wish to see them again revived, it is needless to pursue this inquiry any farther.

9. The profits arising from the king's ordinary courts of justice make a ninth branch of his revenue. And these consist not only in fines imposed upon offenders, forfeitures of recognizances, and amercements levied upon defaulters; but also in certain fees due to the crown in a variety of legal matters, as, for setting the great seal to charters, original writs, and other forensic proceedings, and for permitting fines to be levied of lands in order to bar entails, or otherwise to insure their title. As none of these can be done without the immediate intervention of the king, by himself or his officers, the law allows him certain perquisites and profits, as a recompense for the trouble he undertakes for the public. These, in process of time, have been almost all granted out to private persons, or else appropriated to certain particular uses: so that though our law proceedings are still loaded with their payment, very little of them is is now returned into the king's exchequer: for a part of whose royal maintenance they were originally intended. All future grants of them, however, by the statute 1 Ann. stat. 2. c. 7. are to endure for no longer time than the prince's life who grants them.

10. A tenth branch of the king's ordinary revenue, said to be grounded on the consideration of his guarding and protecting the seas from pirates and robbers, is the right to *royal fish*, which are whale and sturgeon: and these, when either thrown ashore, or caught near the coasts, are the property of the king, on account of their superior excellence. Indeed, our ancestors seem to have entertained a very high notion of the importance of this right; it being the prerogative of the kings of Denmark and the dukes of Normandy; and from one of these it was probably derived to our princes.

11. Another maritime revenue, and founded partly upon the same reason, is that of SHIPWRECKS. See WRECK.

12. A twelfth branch of the royal revenue, the right to mines, has its original from the king's prerogative of coinage, in order to supply him with materials; and therefore those mines which are properly royal, and to which the king is entitled when found, are only those of silver and gold. See MINE.

13. To the same original may in part be referred the revenue of a treasure-trove. See *TREASURE-Trove.*

14. Waifs. See WAIF.

15. Estrays. See ESTRAY.

Besides the particular reasons, given in the different articles, why the king should have the several revenues of royal fish, shipwrecks, treasure-trove, waifs, and estrays, there is also one general reason which holds for them all; and that is, because they are *bona vacantia*, or goods in which no one else can claim a property. And, therefore, by the law of nature, they belonged to the first occupant or finder; and so continued under the imperial law. But in settling the modern constitutions of most of the governments in Europe, it was thought proper (to prevent that strife and contention which the mere title of occupancy is apt to create and continue, and to provide for the support of public authority in a manner the least burdensome to individuals) that these rights should be annexed to the supreme power by the positive laws of the state. And so it came to pass, that, as Bracton express it, "hæc, quæ nullius in bonis sunt, "et olim fuerunt inventoris de jure naturali, jam efficiuntur principis de jure gentium,"

16. The next branch of the king's ordinary revenue consists in forfeitures of lands and goods for offences; *bona confiscata*, as they are called by the civilians, because they belonged to the *fiscus* or imperial treasury; or, as our lawyers term them, *foris facta*, that is, such whereof the property is gone away or departed from the owner. The true reason and only substantial ground of any forfeiture for crimes, consist in this; that all property is derived from society, being one of those civil rights which are conferred upon individuals, in exchange for that degree of natural freedom which every man must sacrifice when he enters into social communities. If therefore, a member of any national community violates the fundamental contract of his association, by transgressing the municipal law, he forfeits his right to such privileges as he claims by that contract; and the state may very justly resume that portion of property, or any part of it, which the laws have before assigned him. Hence, in every offence of an atrocious kind, the laws of England have exacted a total confiscation of the moveables or personal estate; and, in many cases, a perpetual, in others only a temporary, loss of the offender's immoveables or landed property; and have vested them both in the king, who is the person supposed to be offended, being the one visible magistrate in whom the majesty of the public resides. See FORFEITURE and DEODAND.

17. Another branch of the king's ordinary revenue arises from escheats of lands, which happen upon the defect of heirs to succeed to the inheritance; whereupon they in general revert to and vest in the king, who is esteemed, in the eye of the law, the original proprietor of all lands in the kingdom.

18. The last branch of the king's ordinary revenue, consists in the custody of idiots, from whence we shall be naturally led to consider also the custody of lunatics. See IDIOT and LUNATIC.

This may suffice for a short view of the king's *ordinary* revenue, or the proper patrimony of the crown; which was very large formerly, and capable of being increased to a magnitude truly formidable: for there are very few estates in the kingdom that have not, at some period or other since the Norman conquest, been vested in the hands of the king, by forfeiture, escheat, or otherwise. But, fortunately for the liberty of the subject, this hereditary landed revenue, by a series of improvident

Revenue. improvident management, is sunk almost to nothing; and the casual profits, arising from the other branches of the *census regalis*, are likewise almost all of them alienated from the crown. In order to supply the deficiencies of which, we are now obliged to have recourse to new methods of raising money, unknown to our early ancestors; which methods constitute,

II. The king's *extraordinary* revenue. For, the public patrimony being got into the hands of private subjects, it is but reasonable that private contributions should supply the public service. Which, though it may perhaps fall harder upon some individuals, whose ancestors have had no share in the general plunder, than upon others, yet, taking the nation throughout, it amounts to nearly the same; provided the gain by the extraordinary should appear to be no greater than the loss by the ordinary revenue. And perhaps, if every gentleman in the kingdom was to be stripped of such of his lands as were formerly the property of the crown; was to be again subject to the inconveniences of purveyance and pre-emption, the oppression of forest-laws, and the slavery of feodal tenures; and was to resign into the king's hands all his royal franchises of waifs, wrecks, estrays, treasure-trove, mines, deodands, forfeitures, and the like; he would find himself a greater loser than by paying his *quota* to such taxes as are necessary to the support of government. The thing, therefore, to be wished and aimed at in a land of liberty, is by no means the total abolition of taxes, which would draw after it very pernicious consequences, and the very supposition of which is the height of political absurdity. For as the true idea of government and magistracy will be found to consist in this, that some few men are deputed by many others to preside over public affairs, so that individuals may the better be enabled to attend their private concerns; it is necessary that those individuals should be bound to contribute a portion of their private gains, in order to support that government, and reward that magistracy, which protects them in the enjoyment of their respective properties. But the things to be aimed at are wisdom and moderation, not only in granting, but also in the method of raising, the necessary supplies; by contriving to do both in such a manner as may be most conducive to the national welfare, and at the same time most consistent with economy and the liberty of the subject; who, when properly taxed, contributes only, as was before observed, some part of his property in order to enjoy the rest.

These extraordinary grants are usually called by the synonymous names of *aids*, *subsidies*, and *supplies*; and are granted by the commons of Great Britain, in parliament assembled. See PARLIAMENT and TAX.

The clear nett produce of the several branches of the revenue, after all charges of collecting and management paid, amounted in the year 1786 to about 15,397,000l. sterling, and in 1813 they amounted to 64,972,987l. of which England furnished 55,995,123l. Scotland 4,155,199l. and Ireland 4,822,264l. See *NATIONAL Debt* and FUNDS.

The respective produces of the several taxes were originally separate and distinct funds; being securities for the sums advanced on each several tax, and for them only. But at last it became necessary, in order to avoid confusion, as they multiplied yearly, to reduce the number of these separate funds, by uniting and blending them together; superadding the faith of parliament for the general security of the whole. So that there are now only three capital funds of any account, the *aggregate* fund, and the *general* fund, so called from such union and addition; and the *South-sea* fund, being the produce of the taxes appropriated to pay the interest of such part of the national debt as was advanced by that company and its annuitants. Whereby the separate funds, which were thus united, are become mutual securities for each other; and the whole produce of them, thus aggregated, liable to pay such interest or annuities as were formerly charged upon each distinct fund: the faith of the legislature being moreover engaged to supply any casual deficiencies.

The customs, excises and other taxes, which are to support these funds, depending on contingencies, upon exports, imports, and consumptions, must necessarily be of a very uncertain amount; but they have always been considerably more than was sufficient to answer the charge upon them. The surplusses, therefore, of the three great national funds, the aggregate, general, and South-sea funds, over and above the interest and annuities charged upon them, are directed by statute 3 Geo. I. c. 7. to be carried together, and to attend the disposition of parliament; and are usually denominated the *sinking fund*, because originally destined to sink and lower the national debt. To this have been since added many other entire duties, granted in subsequent years; and the annual interest of the sums borrowed on their respective credits is charged on, and payable out of the produce of the sinking fund. However, the nett surplusses and savings, after all deductions paid, amount annually to a very considerable sum. For as the interest on the national debt has been at several times reduced (by the consent of the proprietors, who had their option either to lower their interest or be paid their principal), the savings from the appropriated revenues must needs be extremely large.

But, before any part of the aggregate fund (the surplusses whereof are one of the chief ingredients that form the sinking fund) can be applied to diminish the principal of the public debt, it stands mortgaged by parliament to raise an annual sum for the maintenance of the king's household and the civil list. For this purpose, in the late reigns, the produce of certain branches of the excise and customs, the post-office, the duty on wine-licences, the revenues of the remaining crown-lands, the profits arising from courts of justice, (which articles include all the hereditary revenues of the crown), and also a clear annuity of 120,000l. in money, were settled on the king for life, for the support of his majesty's household, and the honour and dignity of the crown. And, as the amount of these several branches was uncertain, (though in the last reign they were computed to have sometimes raised almost a million), if they did not rise annually to 800,000l. the parliament engaged to make up the deficiency. But his present majesty having, soon after his accession, spontaneously signified his consent that his own hereditary revenues might be so disposed of as might best conduce to the utility and satisfaction of the public, and having graciously accepted a limited sum, the said hereditary and other revenues are now carried into, and made a part of, the aggregate fund; and the aggregate fund is charged with the payment of the whole annuity to the crown. The limited annuity accepted by his present majesty was at first 800,000l. but it has been since augmented to 900,000l. The expences themselves, being put under the same care and management as the other branches of the public patrimony, produce more, and are better collected than heretofore; and the public is a gainer of upwards of 100,000l. per annum by this disinterested bounty of his majesty.

The sinking fund, though long talked of as the last resource of the nation, proved very inadequate to the purpose for which it was established. Ministers found pretences for diverting it into other channels; and the diminution of the national debt proceeded slowly during the intervals of peace, whilst each succeeding war increased it with great rapidity. To remedy this evil, and restore the public credit, to which the late war had given a considerable shock, Mr Pitt conceived a plan for diminishing the debt by a fund, which should be rendered unalienable to any other purpose. In the session 1786, he moved that the annual surplus of the revenue above the expenditure should be raised, by additional taxes, from 900,000l. to one million sterling, and that certain commissioners should be vested with the full power of disposing of this sum in the purchase of stock (see FUNDS), for the public, in their own names. These commissioners should receive the annual million by quarterly payments of 250,000l. to be issued out of the exchequer before any other money, except the interest of the national debt itself; by these provisions, the fund would be secured, and no deficiencies in the national revenues could affect it, but such must be separately provided for by parliament.

The accumulated compound interest on a million yearly, together with the annuities that would fall into that fund, would, he said, in 28 years amount to such a sum as would leave a surplus of four millions annually, to be applied, if necessary, to the exigencies of the state. In appointing the commissioners, he should, he said, endeavour to choose persons of such weight and character as corresponded with the importance of the commission they were to execute. The speaker of the house of commons, the chancellor of the exchequer, the master of the rolls, the governor and deputy governor of the bank of England, and the accountant-general of the high court of chancery, were persons who, from their several situations, he should think highly proper to be of the number.

To the principle of this bill no objection was made, though several specious but ill-founded ones were urged against the sufficiency of the mode which the chancellor of the exchequer had adopted for the accomplishment of so great and so desirable an end. He had made it a clause in his bill, that the accumulating million should never be applied but to the purchase of stock. To this clause Mr Fox objected, and moved that the commissioners therein named should be impowered to accept so much of any future loan as they should have cash belonging to the public to pay for. This, he said, would relieve that distress the country would otherwise be under, when, on account of a war, it might be necessary to raise a new loan: whenever that should be the case, his opinion was, that the minister should not only raise taxes sufficiently productive to pay the interest of the loan, but also sufficient to make good to the sinking fund whatsoever had been taken from it.

If, therefore, for instance, at any future period a loan of six millions was proposed, and there was at that time one million in the hands of the commissioners, in such case they should take a million of the loan, and the *bonus* or *douceur* thereupon should be received by them for the public. Thus government would only have five millions to borrow of six; and from such a mode of proceeding, he said, it was evident great benefit would arise to the public.

This clause was received by Mr Pitt with the strongest marks of approbation, as was likewise another, moved by Mr Pulteney, enabling the commissioners named in the bill to continue purchasing stock for the public when it is above par, unless otherwise directed by parliament. With these additional clauses the bill was read a third time on the 15th of May, and passed.

The sinking fund continued to be applied to the reduction of the debt till 1819, when twelve millions, out of the fourteen to which it amounted, were applied to the services of the year, and taxes to the amount of three millions were imposed to make up the fund to five millions. The establishment of the sinking fund was really beneficial, by introducing the practice of providing a fund for the discharge of each new loan, as it was contracted; but this was the whole of its value. The idea of advantage being reaped from placing money at compound interest, instead of applying it directly to pay off debt, has been completely explained by Dr Hamilton, and is one of the most extraordinary delusions ever countenanced by public men.

The clear produce of the taxes raised on the people of this country was, in the year 1792, very near 17,000,000l.; and in the year ending 5th Jan. 1813, it amounted to the enormous sum of 64,972,987l.

REVENUE, in hunting, a fleshy lump formed chiefly by a cluster of whitish worms on the head of the deer, supposed to occasion the casting of the horns by gnawing them at the root.

REVERBERATION, in *Physics*, the act of a body repelling or reflecting another after its impinging thereon.

REVERBERATION, in *Chemistry*, denotes a kind of circulation of the flame by means of a reverberatory furnace.

REVERBERATORY, or *Reverberating Furnace*. See FURNACE.

REVEREND, a title of respect given to ecclesiastics.—The religious abroad are called *reverend fathers*, and abbesses, prioresses, &c. *reverend mothers*. In England, bishops are *right reverend*, and archbishops *most reverend*. In France, before the Revolution, their bishops, archbishops, and abbots, were all alike *most reverend*. In Scotland, the clergy individually are *reverend*, a synod is *very reverend*, and the general assembly is *venerable*.

REVERIE, the same with delirium, raving, or distraction. It is used also for any ridiculous, extravagant imagination, action, or proposition, a chimera, or vision. But the most ordinary use of the word among English writers, is for a deep disorderly musing or meditation.

REVERSAL *of* JUDGEMENT, in *Law*. A judgement may be falsified, reversed, or voided, in the first place,

place, *without a writ of error*, for matters foreign to or *dehors* the record, that is, not apparent upon the face of it; so that they cannot be assigned for error in the superior court, which can only judge from what appears in the record itself; and therefore, if the whole record be not certified, or not truly certified, by the inferior court, the party injured thereby (in both civil and criminal cases) may allege a diminution of the record, and cause it to be rectified. Thus, if any judgment whatever be given by persons who had no good commission to proceed against the person condemned, it is void; and may be falsified by shewing the special matter, without writ of error. As, where a commission issues to A and B, and twelve others, or any two of them, of which A or B shall be one, to take and try indictments; and any of the other twelve proceed without the interposition or presence of either A or B: in this case all proceedings, trials, convictions, and judgments, are void for want of a proper authority in the commissioners, and may be falsified upon bare inspection, without the trouble of a writ of error; it being a high misdemeanour in the judges so proceeding, and little (if any thing) short of murder in them all, in case the person so attainted be executed and suffer death. So likewise if a man purchases land of another; and afterwards the vender is, either by outlawry, or his own confession, convicted and attainted of treason or felony previous to the sale or alienation; whereby such land becomes liable to forfeiture or escheat; now, upon any trial, the purchaser is at liberty, without bringing any writ of error, to falsify not only the time of the felony or treason supposed, but the very point of the felony or treason itself; and is not concluded by the confession or the outlawry of the vender, though the vender himself is concluded, and not suffered now to deny the fact, which he has by confession or flight acknowledged. But if such attainder of the vender was by verdict, on the oath of his peers, the alienee cannot be received to falsify or contradict the *fact* of the crime committed; though he is at liberty to prove a mistake in time, or that the offence was committed after the alienation, and not before.

Secondly, a judgment may be reversed, *by writ of error*, which lies from all inferior criminal jurisdictions to the court of king's bench, and from the king's bench to the house of peers; and may be brought for notorious mistakes in the judgment or other parts of the record: as where a man is found guilty of perjury, and receives the judgment of felony, or for other less palpable errors; such as any irregularity, omission, or want of form in the process of outlawry, or proclamations; the want of a proper addition to the defendant's name, according to the statute of additions; for not properly naming the sheriff or other officer of the court, or not duly describing where his county-court was held: for laying an offence, committed in the time of the late king, to be done against the peace of the present; and for many other similar causes, which (though allowed out of tenderness to life and liberty) are not much to the credit or advancement of the national justice.—These writs of error, to reverse judgments in case of misdemeanours, are not to be allowed of course, but on sufficient probable cause shown to the attorney-general; and then they are understood to be grantable of common right, and *ex debito justitiæ*. But writs of error to reverse attainders in capital cases are only allowed *ex gratia*; and not without express warrant under the king's sign-manual, or at least by the consent of the attorney-general. These therefore can rarely be brought by the party himself, especially where he is attainted for an offence against the state: but they may be brought by his heir or executor after his death, in more favourable times; which may be some consolation to his family. But the easier and more effectual way is,

Lastly, to reverse the attainder by act of parliament. This may be and hath been frequently done upon motives of compassion, or perhaps the zeal of the times, after a sudden revolution in the government, without examining too closely into the truth or validity of the errors assigned. And sometimes, though the crime be universally acknowledged and confessed, yet the merits of the criminal's family shall after his death obtain a restitution in blood, honours, and estate, or some or one of them, by act of parliament; which (so far as it extends) has all the effect of reversing the attainder, without casting any reflections upon the justice of the preceding sentence. See ATTAINDER.

The effect of falsifying or reversing an outlawry is, that the party shall be in the same plight as if he had appeared upon the *capias*: and, if it be before plea pleaded, he shall be put to plead to the indictment; if, after conviction, he shall receive the sentence of the law; for all the other proceedings, except only the process of outlawry for his non-appearance, remain good and effectual as before. But when judgment, pronounced upon conviction, is falsified or reversed, all former proceedings are absolutely set aside, and the party stands as if he had never been at all accused; restored in his credit, his capacity, his blood, and his estates: with regard to which last, though they be granted away by the crown, yet the owner may enter upon the grantee, with as little ceremony as he might enter upon a disseisor.—But he still remains liable to another prosecution for the same offence: for, the first being erroneous, he never was in jeopardy thereby.

REVERSE of a medal, coin, &c. denotes the second or back side, in opposition to the head or principal figure.

REVERSION, in *Scots Law*. See LAW, N° clxix 1—3.

REVERSION, in the law of England, has two significations; the one of which is, an estate left, which continues during a particular state in being; and the other is the returning of the land, &c. after the particular estate is ended; and it is further said to be an interest in lands, when the possession of it fails, or where the estate which was for a time parted with, returns to the granters, or their heirs. But, according to the usual definition of a reversion, it is the residue of an estate left in the granter, after a particular estate granted away ceases, continuing in the granter of such an estate.

The difference between a remainder and a reversion consists in this, that the remainder may belong to any man except the granter; whereas the reversion returns to him who conveyed the lands, &c.

In order to render the doctrine of reversions easy, we shall give the following table; which shows the present value of one pound, to be received at the end of any

Reversion. number of years not exceeding 40; discounting at the rate of 5, 4, and 3 per cent. compound interest.

Years	Value at 5 per ct.	Value at 4 per ct	Value at 3 per ct.
1	.9524	.9615	.9709
2	.9070	.9245	.9426
3	.8638	.8898	.9151
4	.8227	.8548	.8885
5	.7835	.8219	.8626
6	.7462	.7903	.8375
7	.7107	.7599	.8131
8	.6768	.7307	.7894
9	.6446	.7026	.7664
10	.6139	.6756	.7441
11	.5847	.6496	.7224
12	.5568	.6246	.7014
13	.5303	.6006	.6809
14	.5051	.5775	.6611
15	.4810	.5553	.6419
16	.4581	.5339	.6232
17	.4363	.5134	.6050
18	.4155	.4936	.5874
19	.3957	.4746	.5703
20	.3769	.4564	.5537
21	.3589	.4388	.5375
22	.3418	.4219	.5219
23	.3255	.4057	.5067
24	.3100	.3901	.4919
25	.2953	.3757	.4776
26	.2812	.3607	.4637
27	.2678	.3468	.4502
28	.2551	.3335	.4371
29	.2229	.3206	.4243
30	.2314	.3003	.4120
31	.2204	.2965	.4000
32	.2099	.2851	.3883
33	.1999	.2741	.3770
34	.1903	.2636	.3660
35	.1813	.2534	.3554
36	.1726	.2437	.3450
37	.1644	.2343	.3350
38	.1566	.2253	.3252
39	.1491	.2166	.3158
40	.1420	.2083	.3066

The use of the preceding table.—To find the present value of any sum to be received at the end of a given term of years, discounting at the rate of 3, 4, or 5 per cent. compound interest. Find by the above table the present value of 1l. to be received at the end of the given term; which multiply by the number of pounds proposed, (cutting off four figures from the product on account of the decimals), then the result will be the value sought: For example, the present value of 10,000l. to be received 10 years hence, and the rate of interest 5 per cent. is equal to 6139 × 10,000 = 6139,0000l. or 6139l. The present value of 10,000l. due in ten years, the rate of interest being 3 per cent. is .7441 × 10,000=7441. See ANNUITIES, SUPPLEMENT.

Reversion || Revivification.

REVERSION of Series, in *Algebra*, a kind of reversed operation of an infinite series. See SERIES.

REVETEMENT, in *Fortification*, a strong wall built on the outside of the rampart and parapet to support the earth, and prevent its rolling into the ditch.

REVIVIFICATION, in *Chemistry*, a term generally applied to the distillation of quicksilver from cinnabar.

REVIVIFICATION, in *Physiology*, the recalling of animals apparently dead, to life. There are many kinds of insects which may be revivified, after all the powers of animation have been suspended for a considerable time. Common flies, small beetles, spiders, moths, bugs, &c. after being drowned in spirit of wine, and continuing apparently dead for upwards of 15 minutes, have been restored to life merely by being thrown among wood-ashes slightly warm.

While Dr Franklin was in France, he received a quantity of Madeira wine from America, which had been bottled in Virginia. He found a few dead flies in some of the bottles, which he exposed to the sun in the month of July; and in less than three hours these seemingly dead animals recovered life which had been so long suspended. At first they appeared as if convulsed; they then raised themselves on their legs, washed their eyes with their fore feet, dressed their wings with those behind, and in a short time began to fly about.

But the most remarkable instance of revivification we have heard of, is the following. In the warmer parts of France there is an insect very pernicious to the rye, apparently beginning its operations at the foot of the plant, and gradually proceeding towards the ear. If the plant be thoroughly dried while the insect is in the root or stem, the animal is irrecoverably killed; but after it has reached the grain, the case is very different. There have been instances of these insects being brought to life in 15 minutes, by a little warm water, after the grains in which they were lodged, had been kept dry for 30 years.

What is the metaphysician to think of these phenomena, or what conclusion is he to draw from them respecting the mind? If he be a sober man he will draw no conclusion, for this reason, that he knows nothing of the sentient principle of insects, or of any animal but man. He is conscious that it is the same individual being which in himself, thinks, and wills, and feels; he knows that part of his thought is not in one place, and part of it in another; and therefore he concludes that this thinking being is not matter, while experience teaches him that it quits the material system, when that becomes unfit to discharge its functions, and cannot be recalled. Experience teaches him, on the other hand, that the sentient principle of these insects does not quit the system when unfit for its functions; and hence he ought to infer, that the minds of men and of insects are very different, and that the bond which unites the material and immaterial parts of an insect, is certainly different from that which unites the mind and body of man. This is the only inference which can be fairly drawn from

from these phenomena; and he who makes them the basis of materialism, must have his judgment warped by some passion or prejudice.

COMMISSION OF REVIEW, is a commission sometimes granted, in extraordinary cases, to revise the sentence of the court of delegates, when it is apprehended they have been led into a material error. This commission the king may grant, although the statutes 24 and 25 Hen. VIII. declare the sentence of the delegates definitive: because the pope, as supreme head by the canon law, used to grant such commission of review; and such authority as the pope heretofore exerted is now annexed to the crown by statutes 26 Henry VIII. c. 1. and 1 Eliz. c. 1. But it is not matter of right, which the subject may demand *ex debito justitiæ;* but merely a matter of favour, and which therefore is often denied.

REVIEW, is the drawing out all or part of the army in line of battle, to be viewed by the king, or a general, that they may know the condition of the troops.

At all reviews, the officers should be properly armed, ready in their exercise, salute well, in good time, and with a good air; their uniform genteel, &c. The men should be clean and well dressed; their accoutrements well put on; very well sized in their ranks; the serjeants expert in their duty, drummers perfect in their beatings, and the fifers play correct. The manual exercise must be performed in good time, and with life; and the men carry their arms well; march, wheel, and form with exactness. All manœuvres must be performed with the utmost regularity, both in quick and slow time. The firings are generally 36 rounds; viz. by companies; by grand divisions; by sub-divisions; obliquely, advancing, retreating; by files; in the square; street firings, advancing and retreating; and lastly, a volley. The intention of a review is, to know the condition of the troops, see that they are complete and perform their exercise and evolutions well.

REVIEW is also applied to literary journals, which give a periodical view of the state of literature;—as the Monthly Review, the Critical Review, the British Critic, &c. The number of works of this description in Britain has increased greatly of late years, and some of them have a very extensive circulation.

RE-UNION ISLAND, an island in the South sea, discovered by the French on the 16th December 1773; lying, according to M. de Pages, in latitude 48° 21″, and longitude 66° 47″, the variation of the needle being 30° always towards north-west. The road and harbour are extremely good, and the latter from 16 to 8 fathoms deep at the very shore. The coast on each side is lofty, but green, with an abrupt descent, and swarms with a species of bustards. The penguins and sea-lions which swarmed on the sands, were nowise alarmed at the approach of those who landed; from whence M. de Pages concluded that the country was wholly uninhabited. The soil produces a kind of grass about five inches long, with a broad black leaf, and seemingly of a rich quality; but there was no vestige of a tree or human habitation. See *Travels round the World*, by M. de Pages, vol. iii. chaps. 8. and 9.

REVOLUTION, in politics, signifies a change in the constitution of a state; and is a word of different import from *revolt*, with which it is sometimes confounded. When a people withdraw their obedience from their governors for any particular reason, without overturning the government, or waging an offensive war against it, they are in a state of revolt; when they overturn the government, and form a new one for themselves, they effect a *revolution*.

That which is termed *the revolution* in Britain is the change which, in 1688, took place in consequence of the forced abdication of King James II. when the Protestant succession was established, and the constitution restored to its primitive purity. Of this important transaction, which confirmed the rights and liberties of Britons, we have endeavoured to give an impartial account under another article (see BRITAIN, N° 281, &c.) Of the rise and progress of the American revolution, which is still fresh in the memory of some of our readers, a large detail is given under the article AMERICA. By the revolution which took place in Poland about the end of the 18th century, that kingdom was dismembered and seized by Austria, Prussia and Russia. For an account of this revolution, see POLAND; and for the history and progress of the French revolution, the most extraordinary of all, whether considered with regard to the events which accompanied, or the consequences which followed it, see FRANCE.

REVOLUTION, in *Geometry*, the motion of rotation of a line about a fixed point or centre, or of any figure about a fixed axis, or upon any line or surface. Thus, the revolution of a given line about a fixed centre, generates a circle; and that of a right-angled triangle about one side, as an axis, generates a cone; and that of a semicircle, about its diameter, generates a sphere or globe, &c.

REVOLUTION, in *Astronomy*, is the period of a star, planet, or comet, &c. or its course from any point of its orbit, till it return to the same again.

REVULSION, in *Medicine*, turning a flux of humours from one part to another, by bleeding, cupping, friction, sinapisms, blisters, fomentations, bathings, issues, setons, strong purging of the bowels, &c.

REYN, JAN DE, an eminent history and portrait painter, born at Dunkirk in 1610. He had the good fortune to be a disciple of Vandyke, was the first performer in his school, and was so attached to his maste that he followed him to London, where it is thought he continued as long as he lived. In these kingdoms he is mostly known by the name of *Lang Jan*. He died in 1678: and it is imagined that the scarcity of his works is occasioned by so many of them being imputed to Vandyke; a circumstance which, if true, is beyond any thing that could be said in his praise.

REYNEAU, CHEARLS-RENE, commonly known by the name of Father Reyneau, a celebrated mathematician of France, was born in the year 1656, at Brissac in the province of Anjou. When 20 years of age, he connected himself with the *Oratorians*, a sort of religious order, the members of which lived in community without binding themselves to the observance of any vows, and turned their chief attention to the instruction of youth. He afterwards taught philosophy at Pezenos, and next at Toulon, which requiring some degree of geometrical knowledge, he became extremely fond of that science, and cultivated and improved it to a great extent. He was, in consequence of his knowledge, invited to fill the mathematical chair at Angers in 1683, and he was also elected a member of the academy, in 1694.

He

Reyneau, Reynolds.

He undertook to reduce into a body, for the benefit of his pupils, the chief theories which were scattered through the works of Newton, Des Cartes, Leibnitz, Bernoulli, the Leipsic Acts, the Memoirs of the Paris Academy, and several other works, to which he gave the name of *Analyse Demontrée*, or Analysis Demonstrated, which was published in 1708, in 2 vols. 4to.

He gave to this work the name of Analysis Demonstrated, because he therein demonstrates various methods which had not been demonstrated by their authors, or at least not with sufficient accuracy and perspicuity. This work of Reyneau was very much applauded, and it became a general maxim in France, that to follow him was the best, if not the only way, to make any extraordinary progress in the study of mathematics.

Such was his ambition to be useful, that in 1714 he published his *Science du Calcul des Grandeurs*, intended for the benefit of such as were wholly unacquainted with the science of geometry. Of this work a very able judge was pleased to observe, that "though several books had already appeared upon the same subject, such a treatise as that before him was still wanting, as in it every thing was handled in a manner sufficiently extensive, and at the same time with all possible exactness and perspicuity." Although many branches of the mathematics had been well discussed prior to his time, no good elements were to be met with, even of practical geometry.

When the Royal Academy of Sciences at Paris gave admission to other learned and eminent men, Father Reyneau was received into the number. The works already mentioned are all he ever published, or perhaps ever composed, with the exception of a little piece upon logic; and materials for a second volume of his *Science du Calcul* were left behind him in manuscript. Towards the close of life he was too much afflicted with sickness to give much application to study; and he died in 1728, at 72 years of age. His many virtues and extensive erudition made this event much regretted by all who had the pleasure of being acquainted with him. It was regarded as an honour and a happiness by the first men in France, to number him among their friends, such as the chancellor of the kingdom and Malebranche, of the latter of whom Reyneau was a faithful and zealous disciple.

REYNOLDS, Sir Joshua, the celebrated painter, was, on July the 16th 1723, born at Plympton, a small town in Devonshire. His father was minister of the parish, and also master of the grammar-shool; and being a man of learning and philanthropy, he was beloved and respected by all to whom he was known.—Such a man, it will naturally be supposed, was assiduous in the cultivation of the minds of his children, among whom his son Joshua shone conspicuous, by displaying at a very early period a superiority of genius, and the rudiments of a correct taste. Unlike other boys, who generally content themselves with giving a literal explanation of their author, regardless of his beauties or his faults, young Reynolds attended to both these, displaying a happy knowledge of what he read, and entering with ardour into the spirit of his author. He discovered likewise talents for composition, and a natural propensity to drawing, in which his friends and intimates thought him qualified to excel. Emulation was a distinguishing feature in his mind, which his father perceived with the delight natural to a parent; and designing him for the church, in which he hoped that his talents might raise him to eminence, he sent him to one of the universities.

Reynolds.

Soon after this period he grew passionately fond of painting; and, by the perusal of Richardson's theory of that art, was determined to make it his profession through life. At his own earnest request, therefore, he was removed to London; and about the year 1742 became a pupil to Mr Hudson, who, though not himself an eminent painter, was preceptor to severals who afterwards excelled in the art. One of the first advices which he gave to Mr Reynolds was to copy carefully Guercino's drawings. This was done with such skill, that many of the copies are said to be now preserved in the cabinets of the curious as the originals of that very great master.

About the year 1749, Mr Reynolds went to Italy under the auspices, and in the company, of the late Lord (then Commodore) Keppel, who was appointed to the command of the British squadron in the Mediterranean. In this garden of the world, this magic seat of the arts, he failed not to visit the schools of the great masters, to study the productions of different ages, and to contemplate with unwearied attention the various beauties which are characteristic of each. His labour here, as has been observed of another painter, was "the labour of love, not the task of the hireling;" and how much he profited by it is known to all Europe.

Having remained about two years in Italy, and studied the language as well as the arts of the country with great success, he returned to England, improved by travel and refined by education. On the road to London from the port where he landed, he accidentally found in the inn where he lodged Johnson's life of Savage; and was so taken with the charms of composition, and the masterly delineation of character displayed in that performance, that, having begun to read it while leaning with his arm on the chimney-piece, he continued in that attitude insensible of pain till he was hardly able to raise his hand to his head. The admiration of the work naturally led him to seek the acquaintance of its author, who continued one of his sincerest admirers and warmest friends, till 1784, when they were separated by the stroke of death.

The first thing that distinguished him after his return to his native country, was a full length portrait of Commodore Keppel; which in the polite circles was spoken of in terms of the highest encomium, and testified to what a degree of eminence he had arrived in his profession. This was followed by a portrait of Lord Edgecumbe, and a few others, which at once introduced him to the first business in portrait painting; and that branch of the art he cultivated with such success as will for ever establish his fame with all descriptions of refined society. Having painted some of the first-rate beauties of the age, the polite world flocked to see the graces and the charms of his pencil; and he soon became the most fashionable painter, not only in England, but in all Europe. He has indeed preserved the resemblance of so many illustrious characters, that we feel the less regret for his having left behind him so few historical

Reynolds. historical paintings; though what he has done in that way shows (A) him to have been qualified to excel in both departments. The only landscape, perhaps, which he ever painted, except those beautiful and chaste ones which compose the back grounds of many of his portraits, is "A View on the Thames from Richmond," which in 1784 was exhibited by the Society for Promoting Painting and Design in Liverpool.

In 1764 Mr Reynolds had the merit of being the first promoter of that club, which, having long existed without a name, became at last distinguished by the appellation of the *Literary Club*. Upon the foundation of the Royal Academy of Painting, Sculpture, and Architecture, he was appointed president; and his acknowledged excellence in his profession made the appointment acceptable to all the lovers of art. To add to the dignity of this new institution, his majesty conferred on the president the honour of knighthood; and Sir Joshua delivered his first discourse at the opening of the Academy on January 2. 1769. The merit of that discourse has been universally admitted among painters; but it contains some directions respecting the proper mode of prosecuting their studies, to which every student of every art would do well to pay attention. "I would chiefly recommend (says he), that an implicit obedience to the *rules of art*, as established by the practice of the great masters, should be exacted from the young students. That those models, which have passed through the approbation of ages, should be considered by them as perfect and infallible guides; as subjects for their imitation, not their criticism. I am confident, that this is the only efficacious method of making a progress in the arts; and that he who sets out with doubting, will find life finished before he becomes master of the rudiments. For it may be laid down as a maxim, that he who begins by presuming on his own sense, has ended his studies as soon as he has commenced them. Every opportunity, therefore, should be taken to discountenance that false and vulgar opinion, that rules are the fetters of genius. They are fetters only to men of no genius; as that armour which, upon the strong, becomes an ornament and a defence, upon the weak and mishapen turns into a load, and cripples the body which it was made to protect."

Reynolds. Each succeeding year, on the distribution of the prizes, Sir Joshua delivered to the students a discourse of equal merit with this: and perhaps we do not hazard too much when we say, that, from the whole collected, the lover of belles lettres and the fine arts will acquire juster notions of what is meant by taste in general, and better rules for acquiring a correct taste, than from multitudes of those volumes which have been professedly written on the subject.

In the autumn of 1785 he went to Brussels, where he expended about 1000l. on the purchase of paintings, which, having been taken from the different monasteries and religious houses in Flanders and Germany, were then exposed to sale by the command of the emperor Joseph II. Gainsborough and he had engaged to paint each other's portrait; and the canvas for both being actually stretched, Sir Joshua gave one sitting to his distinguished rival; but, to the regret of every admirer of the art, the unexpected death of the latter prevented all further progress.

In 1790 he was anxiously desirous to procure the vacant professorship of perspective in the academy for Mr Bononi, an Italian achitect; but that artist not having been yet elected an associate, was of course no academician, and it became necessary to raise him to those situations, in order to qualify him for being a professor. Mr Gilpin being his competitor for the associateship; the numbers on the ballot proved equal, when the president by his casting vote decided the election in favour of his friend, who was thereby advanced so far towards the professorship. Soon after this, an academic seat being vacant, Sir Joshua exerted all his influence to obtain it for Mr Bononi; but finding himself outvoted by a majority of two to one, he quitted the chair with great dissatisfaction, and next day sent to the secretary of the academy a formal resignation of the office, which for twenty-one years he had filled with honour to himself and his country. His indignation, however, subsiding

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(A) As the lovers of painting may wish to have a catalogue of this great master's historical pieces, we subjoin the following from the European Magazine, which we have good reason to believe accurate, as the editors of that miscellany grudge neither trouble nor expence to procure authentic information. Sir Joshua's principal historical pieces, then, are the following: Hope nursing Love; Venus chastising Cupid for having learned to cast accounts; Count Ugolino in the dungeon; the calling of Samuel; Ariadne; a Captain of banditti; Beggar Boy; A Lady in the character of St Agnes; Thais; Dionysius the Areopagite; an infant Jupiter; Master Crewe in the character of Henry VIII.; the death of Dido; a Child asleep; Cupid sleeping; Covent Garden Cupid; Cupid in the Clouds; Cupids painting; Boy laughing; Master Herbert in the character of Bacchus; Hebe; Miss Meyer in the character of Hebe; Madona, a head; the Black-guard Mercury; a little boy (Samuel) praying; an old Man reading; Love loosing the zone of Beauty; the Children in the Wood; Cleopatra dissolving the Pearl; Garrick in the character of Kitely; Garrick between Tragedy and Comedy; Mrs Abingdon in the character of Comedy; a Child surrounded by Guardian Angels; Miss Beauclerc in the character of Spenser's Una; Resignation; the Duchess of Manchester in the character of Diana; Lady Blake in the character of Juno; Mrs Sheridan in the character of St Cecilia; Edwin, from Beattie's Ministrel; the Nativity, Four Cardinal Virtues, and Faith, Hope, and Charity, for the window of New College Chapel, Oxford; the Studious Boy; a Bacchante; a daughter of Lord W. Gordon as an Angel; the Holy Family; the Cottagers, from Thomson; the Vestal; the Careful Shepherdess; a Gypsey telling Fortunes; the infant Hercules strangling the Serpent; the Mouse-trap girl; Venus; Cornelia and her Children; the Bird; Melancholy; Mrs Siddons in Tragedy; Head of Lear; Mrs Talmash in the character of Miranda, with Prospero and Caliban; Robin Goodfellow; Death of Cardinal Beaufort; Macbeth, with the Caldron of the Witches.

ding, he suffered himself to be prevailed upon to return to the chair, which within a year and a half he was again desirous to quit for a better reason.

Finding a disease of languor, occasioned by an enlargement of the liver, to which he had for some time been subject, increase upon him, and daily expecting the total loss of sight, he wrote a letter to the academy, intimating his intention to resign the office of president on account of bodily infirmities, which disabled him from executing the duties of it to his own satisfaction. The academicians received this intelligence with the respectful concern due to the talents and virtues of their president; and either then did enter, or designed to enter, into a resolution, honourable to all parties, namely, that a deputation from the whole body of the academy should wait upon him, and inform him of their wish, that the authority and privileges of the office of president might be his during his life; declaring their willingness to permit the performance of any of its duties which might be irksome to him by a deputy.

From this period Sir Joshua never painted more. The last effort of his pencil was the portrait of the Honourable Charles James Fox, which was executed in his best style, and shows that his fancy, his imagination, and his other great powers in the art which he professed, remained unabated to the end of his life. When the last touches were given to this picture,

"The hand of Reynolds fell, to rise no more."

On Thursday February the 23d 1792, the world was deprived of this amiable man and excellent artist, at the age of 68 years; a man than whom no one, according to Johnson, had passed through life with more observation of men and manners. The following character of him is said to be the production of Mr Burke.

"His illness was long, but borne with a mild and cheerful fortitude, without the least mixture of any thing irritable or querulous, agreeably to the placid and even tenor of his whole life. He had from the beginning of his malady a distinct view of his dissolution, which he contemplated with that entire composure which nothing but the innocence, integrity, and usefulness of his life, and an unaffected submission to the will of Providence, could bestow. In this situation he had every consolation from family tenderness, which his tenderness to his family had always merited.

"Sir Joshua Reynolds was, on very many accounts, one of the most memorable men of his time: He was the first Englishman who added the praise of the elegant arts to the other glories of his country. In taste, in grace, in facility, in happy invention, and in the richness and harmony of colouring, he was equal to the great masters of the renowned ages. In portrait he went beyond them; for he communicated to that description of the art in which English artists are the most engaged, a variety, a fancy, and a dignity, derived from the higher branches, which even those who professed them in a superior manner did not always preserve when they delineated individual nature. His portraits remind the spectator of the invention of history and the amenity of landscape. In painting portraits he appears not to be raised upon that platform, but to descend to it from a higher sphere. His paintings illustrate his lessons, and his lessons seem to be derived from his paintings.

"He possessed the theory as perfectly as the practice of his art. To be such a painter, he was a profound and penetrating philosopher.

"In full happiness of foreign and domestic fame, admired by the expert in art, and by the learned in science, courted by the great, caressed by sovereign powers, and celebrated by distinguished poets, his native humility, modesty, and candour, never forsook him, even on surprise or provocation; nor was the least degree of arrogance or assumption visible to the most scrutinizing eye in any part of his conduct or discourse.

"His talents of every kind—powerful from nature, and not meanly cultivated in letters—his social virtues in all the relations and all the habitudes of life, rendered him the centre of a very great and unparalleled variety of agreeable societies, which will be dissipated by his death. He had too much merit not to excite some jealousy, too much innocence to provoke any enmity. The loss of no man of his time can be felt with more sincere, general, and unmixed sorrow."

REZAN, or Rezanskoi, an ancient town of Russia, and capital of a duchy of the same name, with an archbishop's see. It was formerly considerable for its extent and riches; but it was almost ruined by the Tartars in 1568. The country is populous, and was formerly governed by its own princes. E. Long. 42. 37. N. Lat. 54. 54.

RHABDOLOGY, or Rabdology, in arithmetic, a name given by Napier to a method of performing some of the more difficult operations of numbers by means of square little rods. Upon these are inscribed the simple numbers; then by shifting them according to certain rules, those operations are performed by simply adding or subtracting the numbers as they stand upon the rods.

RHADAMANTHUS, a severe judge, and king of Lydia; the poets make him one of the three judges of hell.

RHAGADES in *Medicine*, denotes chaps or clefts in any part of the body. If seated in the anus, and recent, the patient must sit still, and sit over the steam of warm water. The epulotic cerate may also be applied. If the lips of these fissures are callous, they must be cut or otherwise treated as to become new ulcerations.

RHAMA, or Rama, an incarnate deity of the first rank, in Indian mythology. Sir William Jones believes he was the Dionysos (A) of the Greeks, whom they named *Bromius*, without knowing why; and *Bugenes*, when

(A) The learned president, whose death will be lamented by every scholar, by the orientalist and the divine especially, imagines, that this would fully appear from comparing, together the *Dionysiaca* of Nonnus and the *Ramayan* of Valmic, the first poet of the Hindoos. He adds, that, in his opinion, Rhama was the son of Cush, and that he might have established the first regular government in that part of Asia, in which his exploits are said to have been performed.

Rhama. Rhama ‖ Rhapsodi.

Asiatic Researches, vol. i. p. 221, &c.

when they represented him *horned*, as well as *Lyaois* and *Eleutherios* the deliverer, and *Tryambos* or *Dythyrambos* the triumphant. "Most of those titles (says Sir William) were adopted by the Romans, by whom he was called *Bruma*, *Tauriformis*, *Liber*, and *Triumphus*; and both nations had records or traditionary accounts of his giving laws to men and deciding their contests, of his improving navigation and commerce, and, what may appear yet more observable, of his conquering India and other countries with an army of satyrs, commanded by no less a personage than Pan; whom Lillius Gyraldus, on what authority I know not, asserts to have resided in Iberia 'when he had returned, says the learned mythologist, from the Indian war, in which he accompanied Bacchus.' It were superfluous in a mere essay to run any length in the parallel between this European god and the sovereign of Ayodhya, whom the Hindoos believe to have been an appearance on earth of the preserving power; to have been a conqueror of the highest renown, and the deliverer of nations from tyrants, as well as of his consort Sita from the giant Ravan king of Lanca; and to have commanded in chief a numerous and intrepid race of those large monkeys, which our naturalists, or some of them, have denominated Indian satyrs: his general, the prince of satyrs, was named *Hanumat*, or "with high cheek bones;" and, with workmen of such agility, he soon raised a bridge of rocks over the sea, part of which, say the Hindoos, yet remains; and it is probably the series of rocks to which the Mussulmans or Portuguese have given the foolish name of *Adam's* (it should be called *Rama's*) bridge. Might not this army of satyrs have been only a race of mountaineers, whom Rama, if such a monarch ever existed, had civilized? However that may be, the large breed of Indian apes is at this moment held in high veneration by the Hindoos, and fed with devotion by the Brahmans, who seem in two or three places on the banks of the Ganges to have a regular endowment for the support of them: they live in tribes of three or four hundred, are wonderfully gentle (I speak as an eye-witness), and appear to have some kind of order and subordination in their little sylvan polity." The festival of Rhama is held on the 9th day of the new moon of Chaitra, on which the war of Lanca is dramatically represented, concluding with an exhibition of the fire-ordeal, by which the victor's wife Sita gave proof of her connubial fidelity. Among the Hindoos there is a variety of very fine dramas of great antiquity on the story of Rhama.

There are three Rhamas mentioned in the Indian mythology, who, together with Crishna, the darling god of the Indian women, are described as youths of perfect beauty. The third Rhama is Crishna's elder brother, and is considered as the eighth Avatar (A), invested with an emanation of his divine radiance. Like all the Avatars, Rhama is painted with gemmed Ethiopian or Parthian coronets; with rays encircling his head, jewels in his ears, two necklaces, one straight and one pendant on his bosom, with dropping gems; garlands of well-disposed many-coloured flowers, or collars of pearls, hanging down below his waist; loose mantles of golden tissue or dyed silk, embroidered on the hems with flowers, elegantly thrown over one shoulder, and folded like ribbands across the breast: with bracelets, two on one arm and on each wrist: all the Avatars are naked to the waists, and uniformly with dark azure flesh, in allusion probably to the tint of that primordial fluid on which Narayan moved in the beginning of time; but their skirts are bright yellow, the colour of the curious pericarpium in the centre of the water-lily.

RHAMNUS, the BUCKTHORN, a genus of plants belonging to the pentandria class; and in the natural method ranking under the 43d order, *Dumosæ*. See BOTANY and MATERIA MEDICA *Index*.

The paliurus, or thorn of Christ, a deciduous shrub or tree, belongs to this genus, and is a native of Palestine, Spain, Portugal, and Italy. It grows to nearly the height of 14 feet, and is armed with sharp thorns, two of which are at each joint, one of which is about half an inch long, straight, and upright; the other is scarcely half that length, and bent backward; and between them is the bud for next year's shoot. June is the time of flowering, and the flowers are succeeded by a small fruit, surrounded by a membrane. "This plant (says Hanbury) is undoubtedly the sort of which the crown of thorns for our blessed Saviour was composed. The branches are very pliant, and the spines of it are at every joint strong and sharp. It grows naturally about Jerusalem, as well as in many parts of Judæa; and there is no doubt that the barbarous Jews would make choice of it for their cruel purpose. But what farther confirms the truth of these thorns being then used, are the ancient pictures of our blessed Saviour's crucifixion. The thorns on the crown of his head exactly answer to those of this tree; and there is great reason to suppose these were taken from the earliest paintings of the Lord of Life: and even now our moderate painters copy from them, and represent the crown as composed of these thorns. These plants, therefore, should principally have a share in those parts of the plantation that are more peculiarly designed for religious retirement; for they will prove excellent monitors, and conduce to due reflection on and gratitude to 'Him who hath loved us, and has washed us from our sins,' &c.

RHAMPHASTOS, a genus of birds belonging to the order of *Picæ*. See ORNITHOLOGY *Index*.

RHAPIS, a genus of plants belonging to the hexandria class; and in the natural method ranking under the first order *Palmæ*. See BOTANY *Index*.

RHAPSODI, RHAPSODISTS, in *Antiquity*, persons who made a business of singing pieces of Homer's poems.

(A) *Avatar* means the descent of the deity in his capacity of preserver. The three first of these descents relate to some stupendous convulsion of our globe from the fountains of the deep, and the fourth exhibits the miraculous punishment of pride and impiety, appearing to refer to the deluge. Three of the others were ordained for the overthrow of tyrants or giants. Of these Avatars, we have mentioned in the text that Rhama is the eighth; Buddha, who appears to have been a reformer of the doctrines contained in Vedas, is the ninth: the tenth Avatar, we are told, is yet to come, and is expected to appear mounted (like the crowned conqueror in the Apocalypse) on a white horse, with a scimitar blazing like a comet, to mow down all incorrigible and impenitent offenders who shall then be on the earth.

poems. It has been said, that the Rhapsodi were clothed in red when they sung the Iliad, and in blue when they sung the Odyssey. They performed on the theatres, and sometimes strove for prizes in contests of poetry, singing, &c. After the two antagonists had finished their parts, the two pieces or papers they were written in were soon joined together again: whence the name, *viz.* from ῥαπτω, *suo*, and ωδη, *canticum*: but there seem to have been other Rhapsodi of more antiquity than these people, who composed heroic poems or songs in praise of heroes and great men, and sung their own compositions from town to town for a livelihood; of which profession Homer himself is said to have been. See BARD.

RHAPSODOMANCY, an ancient kind of divination performed by pitching on a passage of a poet at hazard, and reckoning on it as a prediction of what was to come to pass. There were various ways of practising this rhapsodomancy. Sometimes they wrote several papers or sentences of a poet on so many pieces of wood, paper, or the like, shook them together in an urn, and drew out one which was accounted the lot: sometimes they cast dice on a table whereon verses were written, and that whereon the die lodged contained the prediction. A third manner was by opening a book, and pitching on some verse at first sight. This method they particularly called the *sortes Prænestinæ;* and afterwards, according to the poet, made use of *sortes Homericæ, sortes Virgilianæ*, &c. See SORTES.

RHAPSODY, in *Antiquity*, a discourse in verse sung or rehearsed by a rhapsodist. Others will have raphsody to signify a collection of verses, especially those of Homer, which having been a long time dispersed in pieces and fragments, were at length by Pisistratus's order digested into books called *rhapsodies*, from ῥαπτω, *suo*, and ωδη, *canticum*. Hence, among moderns, *rhapsody* is also used for an assemblage of passages, thoughts, and authorities, raked together from divers authors, to compose some new piece.

RHE, or REE, a little island in the bay of Biscay, near the coast of Aunis in France. It was taken during the war with France which ended in 1763, in the expedition commanded by Hawke and Mordaunt.

RHEA AMERICANA. The American ostrich of authors has been frequently mentioned, but till of late years very imperfectly known. See ORNITHOLOGY *Index*.

RHEEDIA, a genus of plants belonging to the polyandria class, and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

RHEGIUM, in *Ancient Geography*, so very ancient a city as to be supposed to take its name from the violent bursting of the coast of Italy from Sicily, thought to have been formerly conjoined (Mela, Virgil). A city of the Bruttii, a colony of Chalcidians from Eubœa: a strong barrier opposed to Sicily (Strabo); mentioned by Luke; surnamed *Julium* (Ptolemy), from a fresh supply of inhabitants sent hither by Augustus, after driving Sextus Pompeius out of Sicily (Strabo); and thus was in part a colony, retaining still the right of a municipium (Inscription). The city is now called *Reggio*, in the Farther Calabria.

RHEIMS, a city of France, in the department of Marne, which contained 31,295 inhabitants in 1800. It is one of the most ancient and celebrated places in the kingdom, had an archbishop's see, whose archbishop was a duke and peer of France. It is about four miles in circumference, and contains several fine squares, well-built houses, and magnificent churches. It had a mint, an university, and five abbeys, the most famous of which is that of St Remy. There are also several triumphal arches and other monuments of the Romans. It is seated on the river Vesie, surrounded by hills, which produce excellent wine. E. Long. 4. 8. N. Lat. 49. 14.

RHENISH WINE, that produced on the hills about Rheims. This wine is much used in medicine as a solvent of iron, for which it is well calculated on account of its acidity. Dr Percival observes, that it is the best solvent of Peruvian bark; in which, however, he thinks its acidity has no share, because an addition of vinegar to water does not augment its solvent power.

RHETORES, amongst the Athenians, were ten in number, elected by lot to plead public causes in the senate house or assembly. For every cause in which they were retained, they received a drachm out of the public money. They were sometimes called Συνηγοροι and their fee το Συνηγορικον. No man was admitted to this office before he was 40 years of age, though others say 30. Valour in war, piety to their parents, prudence in their affairs, frugality, and temperance, were necessary qualifications for this office, and every candidate underwent an examination concerning these virtues, previous to the election. The orators at Rome were not unlike the Athenian rhetores. See ORATOR.

RHETORIANS, a sect of heretics in Egypt, so denominated from Rhetorius their leader. The distinguishing tenet of this heresiarch, as represented by Philastrius, was, that he approved of all the heresies before him, and taught that they were all in the right.

RHETORIC, the art of speaking copiously on any subject, with all the advantages of beauty and force. See ORATORY.

RHEUM, a thin serous humour, occasionally oozing out of the glands about the mouth and throat.

RHEUM, *Rhubarb;* a genus of plants of the enneandria class, and in the natural method ranking under the 12th order, *Holoraceæ*. See BOTANY and MATERIA MEDICA *Index*. Here, after enumerating the species, we shall introduce what has been said on the cultivation of this valuable plant. There are five species, viz. 1. The rhaponticum, or common rhubarb, has a large, thick, fleshy, branching, deeply-striking root, yellowish within; crowned by very large, roundish, heart-shaped smooth leaves, on thick, slightly-furrowed foot-stalks; and an upright strong stem, two or three feet high, adorned with leaves singly, and terminated by thick close spikes of white flowers. It grows in Thrace and Scythia, but has been long in the English gardens. Its root affords a gentle purge. It is, however, of inferior quality to some of the following sorts; but the plant being astringent, its young stalks in spring, being cut and peeled, are used for tarts. 2. The palmatum, palmated-leaved true Chinese rhubarb, hath a thick fleshy root, yellow within; crowned with very large palmated leaves, being deeply divided into acuminated segments, expanded like an open hand; upright stems, five or six feet high or more, terminated by large spikes of flowers. This is now proved to be the true foreign rhubarb, the purgative quality of which is well known. 3. The compactum, or Tartarian rhubarb, hath a large, fleshy, branched root, yellow within; crowned by very large, heart-

heart-shaped somewhat lobated, sharply indented, smooth leaves, and an upright large stem, five or six feet high, garnished with leaves singly, and branching above; having all the branches terminated by nodding panicles of white flowers. This has been supposed to be the true rhubarb; which, however, though of superior quality to some sorts, is accounted inferior to the rheum palmatum. 4. The undulatum, undulated, or waved-leaved Chinese rhubarb, hath a thick, branchy, deep-striking root, yellow within; crowned with large, oblong, undulate, somewhat hairy leaves, having equal foot-stalks, and an upright firm stem, four feet high; garnished with leaves single, and terminated by long loose spikes of white flowers. 5. The Arabian ribes, or currant rhubarb of Mount Libanus, has a thick fleshy root, very broad leaves, full of granulated protuberances, and with equal foot-stalks, and upright firm stems, three or four feet high, terminated by spikes of flowers, succeeded by berry-like seeds, being surrounded by a purple pulp. All these plants are perennial in root, and the leaves and stalks are annual. The roots being thick, fleshy, generally divided, strike deep into the ground; of a brownish colour without and yellow within: the leaves rise in the spring, generally come up in a large head folded together, gradually expanding themselves, having thick foot-stalks; and grow from one to two feet high, or more in length and breadth, spreading all around: amidst them rise the flower-stems, which are garnished at each joint by one leaf, and are of strong and expeditious growth, attaining their full height in June, when they flower; and are succeeded by large triangular seeds, ripening in August. Some plants of each sort merit culture in gardens for variety; they will effect a singularity with their luxuriant foliage, spikes, and flowers; and as medical plants, they demand culture both for private and public use.

They are generally propagated by seeds sown in autumn soon after they are ripe, or early in the spring, in any open bed of light deep earth; remarking, those intended for medical use should generally be sowed where they are to remain, that the roots, being not disturbed by removal, may grow large. Scatter the seeds thinly, either by broad-cast all over the surface, and raked well in; or in shallow drills a foot and a half distance, covering them near an inch deep. The plants will rise in the spring, but not flower till the second or third year; when they, however, are come up two or three inches high, thin them to eight or ten inches, and clear out all weeds; though those designed always to stand should afterwards be hoed out to a foot and a half or two feet distance: observing, if any are required for the pleasure ground, &c. for variety, they should be transplanted where they are to remain in autmn, when their leaves decay, or early in spring, before they shoot: the others remaining where sowed, must have the ground kept clean between them; and in autumn, when the leaves and stalks decay, cut them down, and slightly dig the ground between the rows of plants, repeating the same work every year. The roots remaining, they increase in size annually: and in the second or third year many of them will shoot up stalks, flower, and perfect seeds; and in three or four years the roots will be arrived to a large size; though older roots are generally preferable for medical use.

In Mr Bell's Travels we have an account of some curious particulars relating to the culture of rhubarb. He tells us, that the best rhubarb grows in that part of Eastern Tartary called *Mongalia*, which now serves as a boundary between Russia and China. The marmots contribute greatly to the culture of the rhubarb. Wherever you see 10 or 20 plants growing, you are sure of finding several burrows under the shades of their broad-spreading leaves. Perhaps they may sometimes eat the leaves and roots of this plant; however, it is probable the manure they leave about the roots contributes not a little to its increase; and their casting up the earth, makes it shoot out young buds and multiply. This plant does not run, and spread itself, like docks and others of the same species; but grows in tufts, at uncertain distances, as if the seeds had been dropped with design. It appears that the Mongals never accounted it worth cultivating; but that the world is obliged to the marmots for the quantities scattered, at random, in many parts of this country: for whatever part of the ripe seed happens to be blown among the thick grass, can very seldom reach the ground, but must there wither and die; whereas, should it fall among the loose earth thrown up by the marmots, it immediately takes root and produces a new plant.

After digging and gathering the rhubarb, the Mongals cut the large roots into small pieces, in order to make them dry more readily. In the middle of every piece they scoop a hole, through which a cord is drawn, in order to suspend them in any convenient place. They hang them, for the most part, about their tents, and sometimes on the horns of their sheep. This is a most pernicious custom, as it destroys some of the best part of the root; for all about the hole is rotten and useless, whereas, were people rightly informed how to dig and dry this plant, there would not be one pound of refuse in an hundred; which would save a great deal of trouble and expence, that much diminish the profits on this commodity. At present, the dealers in this article think these improvements not worthy of their attention, as their gains are more considerable on this than on any other branch of trade. Perhaps the government may hereafter think it proper to make some regulations with regard to this matter.

Two sorts of rhubarb are met with in the shops. The first is imported from Turkey and Russia, in roundish pieces freed from the bark, with a hole through the middle of each; they are externally of a yellowish colour, and on cutting appear variegated with lively reddish streaks. The other, which is less esteemed, comes immediately from the East Indies in longish pieces, harder, heavier, and more compact than the foregoing. The first sort, unless kept very dry, is apt to grow mouldy and worm-eaten; the second is less subject to these inconveniences. Some of the more industrious artists are said to fill up the worm holes with certain mixtures, and to colour the outside of the damaged pieces with powder of the finer sorts of rhubarb, and sometimes with cheaper materials: this is often so nicely done, as effectually to impose upon the buyer, unless he very carefully examines each piece.

The Turkey rhubarb is, among us, universally preferred to the East India sort, though this last is for some purposes at least equal to the other; it is manifestly more astringent, but has somewhat less of an aromatic

Rheum. aromatic flavour. Tinctures drawn from both with rectified spirit have nearly the same taste: on distilling off the menstruum, the extract left from the tincture of the East India rhubarb proved considerably the strongest.

Rhubarb has been cultivated in Britain with considerable success, and for medical purposes is found to equal that of foreign growth, as is proved by the Transactions of the London Society for encouraging Arts, Manufactures, and Commerce, who have rewarded several persons both for cultivating and curing it. In the Transactions for 1792, the gold medal was adjudged to Sir William Fordyce, for raising from seed in the year 1791 upwards of 300 plants of the true rhubarb, or rheum palmatum of the London Pharmacopœia 1788, which in the second and third weeks of October were transplanted into a deep loam, at four feet distance from each other, according to rules laid down by the society. In 1793 it was adjudged to Mr Thomas Jones, from whose papers we derive the following information.

After giving an accurate account of his experiments and observations, he concludes, that the season for sowing is the spring about March or April, or in autumn about August and September; that those plants which are raised in the spring should be transplanted in autumn, and *vice versa;* that they cannot have too much room; that room and time are essentially necessary to their being large, of a good appearance, and perhaps to the increase of their purgative qualities; that to effect these purposes, the soil must be light, loamy, and rich, but not too much so, lest the roots should be too fibrous; that their situation can scarcely be too dry, as more evils are to be expected from a superabundancy of moisture than any actual want of it: and lastly, we may conclude, that in particular the injuries which they are subject to are principally during their infancy, and to be imputed to insects and inattention to the planting season: afterwards, from too great an exposure to frost: but that none can be dreaded from heat; and that in general they are hardy and easy of cultivation, when arrived beyond a certain term.

The method of curing rhubarb, as proposed by Dr Tirruogel of Stockholm, is as follows: "No roots should be taken up till they have been planted ten years: they should be taken out of the ground either in winter, before the frost set in, or in the beginning of spring, and immediately cut into pieces, and carefully barked; let them be spread upon a table for three or four days, and be frequently turned, that the juices may thicken or condense within the roots. After that process, make a hole in each piece, and put a thread through it; by which let them hang separately, either within doors, or in some sheltered shady shed. Some persons dry them in a different way; they inclose the roots in clay, and make a hole in the clay, about the thickness of a goose-quill, and in this manner hang up each piece to dry separately, that the moisture may not evaporate, nor the strength of the root be weakened. But the method which the Tartars follow is a bad one: they dig the roots out of the deserts where they grow, bark them, and immediately string them, and hang them round the necks of their camels, that they may dry as they travel; but this greatly lessens the medical virtue of the root."

In the year 1794 the Society adjudged the gold medal to Mr William Hayward of Hanbury, Oxfordshire, Rheum. for propagating rhubarb by offsets taken from the crowns of large plants, instead of seeds, for the purpose of bringing it to perfection in a shorter time, which fully answered his expectations. Mr Hayward was a candidate in the year 1789 for the gold medal; but having misunderstood their rules, he was not entitled to it, though with great propriety they voted to him the silver medal; in consequence of which he sent them his method of culture and cure. His method of cultivating Turkey rhubarb from seed is thus explained in the Society: "I have usually sown the seed about the beginning of February, on a bed of good soil (if rather sandy the better), exposed to an east or west aspect, in preference to the south; observing a full sun to be prejudicial to the vegetation of the seeds, and to the plants whilst young. The seeds are best sown moderately thick (broadcast), treading them regularly in, as is usual with parsneps and other light seeds, and then raking the ground smooth. I have sometimes, when the season has been wet, made a bed for sowing the rhubarb seeds upon, about two feet thick, with new dung from the stable, covering it near one foot thick with good soil. The intent of this bed is not for the sake of warmth, but solely to prevent the rising of earth-worms, which, in a moist season, will frequently destroy the young crop. If the seed is good, the plants often rise too thick; if so, when they have attained six leaves they should be taken carefully up (where too close), leaving the standing crop eight or ten inches apart: those taken up may be planted at the same distance, in a fresh spot of ground, in order to furnish other plantations. When the plants in general are grown to the size that cabbage plants are usually set out for a standing crop, they are best planted where they are to remain, in beds four feet wide, one row along the middle of the bed, leaving two yards distance betwixt the plants, allowing an alley between the beds about a foot wide, for conveniency of weeding the plants. In the autumn, when the decayed leaves are removed, if the shovelings of the alleys are thrown over the crowns of the plants, it will be found of service.

His mode of cultivating the same plant by offsets is thus given: "On taking up some plants the last spring, I slipped off several offsets from the heads of large plants: these I set with a dibble about a foot apart, in order, if I found them thrive, to remove them into other beds. On examining them in the autumn, I was surprised to see the progress they had made, and pleased to be able to furnish my beds with 40 plants in the most thriving state. Though this was my first experiment of its kind, I do not mean to arrogate the discovery to myself, having known it recently tried by others, but without being informed of their success. I have reason to think this valuable drug will, by this method, be brought much sooner to perfection than from seed."

His method of curing rhubarb is thus described: "The plants may be taken up either early in the spring, or in autumn, when the leaves are decayed, in dry weather if possible, when the roots are to be cleared from dirt (without washing): let them be cut into pieces, and with a sharp knife freed from the outer coat, and exposed to the sun and air for a few days, to render the outside a little dry. In order to accelerate the curing of the largest pieces, a hole may be scooped out with a penknife: these and the smaller parts are then to be strung on packthread, and hung up in a warm room (I have always had the conveniency of such a one over a baker's oven), where it is to remain till perfectly dry. Each piece may be rendered more sightly by a common file, fixing it in a small vice during that operation: afterwards rub over it a very fine powder, which the small roots furnish in beautiful perfection, for this and every other purpose where rhubarb is required."

In the year 1794, too, the society adjudged the gold medal to Mr Ball for his method of curing the true rhubarb, which is as follows: "I take the roots up when I find the stalks withering or dying away, clean them from the earth with a dry brush, cut them in small pieces of about four or five inches in breadth, and about two in depth, taking away all the bark, and make a hole in the middle, and string them on packthread, keeping every piece apart; and every morning, if the weather is clear and fine, I place them in the open part of the garden, on stages, erected by fixing small posts about six feet high in the ground, and six feet asunder, into which I fix horizontal pegs, about a foot apart, beginning at the top; and the rhubarb being stringed crosswise on small poles, I place them on these pegs; so that if it should rain, I could easily remove each pole with the suspended pieces, into any covered place. I never suffer them to be out at night, as the damps at this season would be apt to mould them; and if at any time I perceive the least mark of mould, I rub it off with a dry cloth. In some of the pieces of rhubarb which I have cured this year, I have made holes about half an inch diameter in the middle, for the free passage of air, and have found that every one of these pieces dried better than the others where no such holes were made; and have likewise hung several strings in the kitchen, and never exposed them in the open air, and found them to dry exceedingly well, and much better than those in the open air. Some years since I dried a quantity of rhubarb on a malt-kiln, keeping up the thermometer to 80 degrees, which answered well, but I think rather dried too quick: the roots which I have cured this year are a part of the plantation of 1789, and for which the Society was so kind as to give me a medal."

RHEXIA, a genus of plants belonging to the octandria class; and in the natural method ranking with those of the 17th order, *Calycanthemæ*. See BOTANY *Index*.

RHINANTHUS, a genus of plants belonging to the didynamia class; and in the natural method ranking under the 40th order, *Personatæ*. See BOTANY *Index*.

RHINE, a large river of Germany, famous both in ancient and modern history. It rises among the Alpes Lepontiæ, or Grisons; and first traversing the Lacus Acronius, divides the Rhæti and Vindelici from the Helvetii, and then the Germans from the Gauls and Belgæ; and running from south to north for the greatest part of its way, and at length bending its course west, it empties itself at several mouths (Cæsar); at three mouths into the German ocean, (Pliny); viz. the western, or Helius; the northern, or Fleuvus; and the middle between both these, which retains the original name, *Rhenus*; and in this Ptolemy agrees.—Mela and Tacitus mention two channels, and as many mouths, the right and left; the former running by Germany, and the latter by Gallia Belgica: and thus also Asinius Pollio, and Virgil; the cut or trench of Drusus not being made in their time, whereby the middle channel was much drained and reduced, and therefore overlooked by Tacitus and Mela; and which Pliny calls the *Scanty*. To account for Cæsar's several mouths, is a matter of no small difficulty with the commentators; and they do it no otherwise than by admitting that the Rhine naturally formed small drains or rivulets from itself; the cut of Drusus being long posterior to him; in whose time Asinius Pollio, quoted by Strabo, who agrees with him therein, affirmed that there were but two mouths, finding fault with those who made them more: and he must mean the larger mouths, which emitted larger streams. The Romans, especially the poets, used the term *Rhenus* for *Germany*, (Martial).—At present, the river, after entering the Netherlands at Schenkinhaus, is divided into several channels, the two largest of which obtain the names of the *Lech* and the *Waal*, which running through the United Provinces, falls into the German ocean below Rotterdam.

RHINE, *Lower*, a department in the east of France, consisting chiefly of the lower part of the ancient Alsace. It is extremely fertile, and produces corn of all kinds, maize, rapeseed, hemp, flax, tobacco, chesnuts, vines, excellent pasturage, and wood in abundance. Agriculture is more improved here than in most other parts of France. Fallows are now disused. Potatoes were introduced here earlier, and are cultivated more extensively, than in the other departments. The horses are good,—black cattle numerous,—but there are few sheep. There are mines of iron and coal, and quarries of building stone. The manufactures consist of fustians, tapestry, cutlery, &c. The extent of this department was 495,975 hectares, of which, about one-eighth part was cut off by the treaty of Paris in 1815. Its population in 1800 was 444,858; but in 1815, after the cessions, it was only 391,642. Its contributions in 1802 amounted to 3,609,442. Strasburg is the chief town.

RHINE, *Upper*, a department in the east of France, consisting of the higher part of the ancient Alsace. The soil is unequal, and in many places poor. It produces wheat, barley, rye, flax, madder, wine, and legumes. There are mines of silver, copper, lead, iron, and coal. The manufactures are woollen and cotton cloths, hosiery, ribbons, cotton-yarn, iron and steel ware, powder, and watches. The extent of this department in 1800 was 549,607 hectares, and the population 382,285; but about one-fifth of its surface having been disjoined from it and annexed to Switzerland in 1815, its population in 1817 was only 318,577. Its contributions in 1802 amounted to 2,837,963 francs. Colmar is the chief town.

Lower Circle of the RHINE, consisted of the palatinate of the Rhine, and the three ecclesiastical electorates, viz. those of Cologne, Mentz, and Triers, now belonging to Prussia.

Upper Circle of the RHINE, consisted of the landgraviates of Alsace and Hesse, comprehending the Weteraw; but now only Hesse can be acounted a part of Germany, Alsace being long ago united to France.

RHINEBERG, a town of Germany, in the circle of the Lower Rhine, and diocese of Cologne, now belonging to Prussia. It is seated on the Rhine, in E. Long. 6. 39. N. Lat. 51. 30.

RHINECK, a town of Germany, in the archbishopric of Cologne, seated on the Rhine, E. Long. 7. 53. N. Lat. 50. 27.—There is another town of the same name in Swisserland, capital of Rhinthal, seated on the Rhine, near the lake of Constance, with a good castle. E. Long. 9. 53. N. Lat. 47. 38.

RHINFELD, a small but strong town of Germany, formerly belonging to Austria, but now to the grand duchy of Baden. It has been often taken and retaken in the German wars; and is seated on the Rhine, over which there is a handsome bridge. E. Long. 7. 53. N. Lat. 47. 40.

RHINEGAU, a beautiful district of the electorate of Mentz, is situated on the Rhine, about three miles from the city of Mentz, and is so populous that it looks like one entire town intermixed with gardens and vineyards. The Rhine here grows astonishingly wide, and forms a kind of sea, near a mile broad, in which are several well wooded little islands. The Rhinegau forms an amphitheatre, the beauties of which are beyond all description. At Walluf, the very high hills come nearly down to the river side; from thence they recede again into the country, forming a kind of half circle, the other end of which is 15 miles on at Rudesheim, on the banks of the Rhine. The banks of the river, the hills which form the circles, and the slopes of the great mountains, are thick sown with villages and hamlets. The white appearance of the buildings, and the fine blue slated roofs of the houses playing amidst the various green of the landscape, have an admirable effect. In the space of every mile, as you sail down the river, you meet with a village which in any other place would pass for a town. Many of the villages contain from 300 to 400 families; and there are 36 of them in a space of 15 miles long and six miles broad, which is the width of this beautiful amphitheatre. The declivities of all the hills and mountains are planted thick with vineyards and fruit trees, and the thick wooded tops of the hills cast a gloomy horror over the otherwise cheerful landscape. Every now and then a row of rugged hills run directly down to the shore, and domineer majestically over the lesser hills under them. On one of these great mountains, just about the middle of the Rhinegau, you meet *Johannis-Berg*, a village which produces some of the best Rhenish. Before this village is a pretty little rising, and near the banks of the river there is a very fine old castle, which gives unspeakable majesty to the whole landscape. Indeed, in every village, you meet with some or other large building, which contributes very much to the decoration of the whole. This country is indebted for its riches to this semicircular hill, which protects it from the cold winds of the east and north, at the same time that it leaves room enough for the sun to exercise his benign influences. The groves and higher slopes of the hills make excellent pastures, and produce large quantities of dung, which, in a country of this sort, is of inestimable value.

Reisbach's Travels through Germany, iii. 226.

The bank of the Rhine, opposite to the Rhinegau, is exceedingly barren, and heightens the beauty of the prospect on the other side by the contrast it exhibits; on this side, you hardly meet above three or four villages, and these are far distant from each other. The great interval between them is occupied by heaths and meadows, only here and there a thick bush affords some shade, and a few corn fields among the villages enliven the gloomy landscape. The back ground of this country is the most picturesque part of it. It is formed by a narrow gullet of mountains, which diminish in perspective between Rudesheim and Bingen. Perpendicular mountains and rocks hang over the Rhine in this place, and seem to make it the dominion of eternal night. At a distance, the Rhine seems to come out of this landscape through a hole under ground; and it appears to run tediously, in order to enjoy its course through a pleasant country the longer. Amidst the darkness which covers this back ground, the celebrated Mouse tower seems to swim upon the river. In a word, there is not any thing in this whole tract that does not contribute something to the beauty and magnificence of the whole; or, if I may be permitted the expression, to make the paradise more welcome. As you sail along the Rhine, between Mentz and Bingen, the banks of the river form an oval amphitheatre, which makes one of the richest and most picturesque landscapes to be seen in Europe. The inhabitants of these regions are some of them extremely rich, and some extremely poor. The happy middle state is not for countries the chief product of which is wine; for, besides that the cultivation of the vineyard is infinitely more troublesome and expensive than agriculture, it is subjected to revolutions, which in an instant reduce the holder of land to the condition of a day-labourer. It is a great misfortune for this country, that, though restrained by law, the nobility are, through connivance of the elector, allowed to purchase as much land as they please. The peasant generally begins by running in debt for his vineyard; so that if it does not turn out well, he is reduced to day-labour, and the rich man extends his possessions to the great detriment of the country. There are several peasants here, who having incomes of 30,000 50,000 or 100,000 guilders a-year, have laid aside the peasant, and assumed the wine-merchant; but splendid as their situation is, it does not compensate, in the eyes of the humane man, for the sight of so many poor people with which the villages swarm. In order to render a country of this kind prosperous, the state should appropriate a fund to the purpose of maintaining the peasant in bad years, and giving him the assistance which his necessities, and his want of ready money, may from time to time make convenient.

The inhabitants of the Rhinegau are a handsome and uncommonly strong race of men. You see at the very first aspect that their wine gives them merry hearts and sound bodies. They have a great deal of natural wit, and a vivacity and jocoseness, which distinguishes them very much from their neighbours. You need only compare them with some of these, to be convinced that the drinker of wine excels the drinker of beer and water, both in body and mind, and that the inhabitant of the south is much stouter than he who lives in the north; for though the wine-drinker may not have quite as much flesh as he who drings only beer, he has better blood,

blood, and can bear much more work. Tacitus had already observed this, in his treatise *De moribus Germanorum*. "The large and corpulent bodies of the Germans (says he) have a great appearance, but are not made to last." At that time almost all the Germans drank only water; but the mere drinking of wine has effected a revolution in several parts of Germany, which makes the present inhabitants of these countries very different from those described by Tacitus. Black and brown hair is much commoner here than the white, which made the Germans so famous in old Rome. "It will be easily imagined (says Baron Reisbeck), that the monks fare particularly well in so rich a country. We made a visit to the prelate of Erbach. These lordly monks, for so in every respect they are, have an excellent hunt, rooms magnificently furnished, billiard tables, half a dozen beautiful singing women, and a stupendous wine cellar, the well ranged batteries of which made me shudder. A monk, who saw my astonishment at the number of the casks, assured me, that, without the benign influence which flowed from them, it would be totally impossible for the cloister to subsist in so damp a situation."

RHINFELD, a castle of Germany, in the circle of the Lower Rhine, now in the dominions of Prussia. It is looked upon as one of the most important places seated on the Rhine, as well in regard to its strength as situation. It is near St Goar, and built on a craggy rock. This fortress commands the whole breadth of the Rhine, and those who pass are always obliged to pay a considerable toll. In the time of war it is of great importance to be masters of this place. It was taken by the French in 1794. E. Long. 7. 43. N. Lat. 50. 3.

RHINLAND, a name given to a part of South Holland, which lies on both sides of the Rhine, and of which Leyden is the capital town.

RHINOCEROS, a genus of quadrupeds belonging to the order of belluæ. See MAMMALIA *Index*.

RHINOCEROS-Bird. See BUCEROS, ORNITHOLOGY *Index*.

RHITYMNA See RETIMO.

RHIZOBALUS, a genus of plants, belonging to the polyandria class; and in the natural method ranking under the 23d order, *Trihilatæ*. Of this there is only one species, viz. *Pekia*. The nuts are sold in the shops as American nuts; they are flat, tuberculated, and kidney-shaped, containing a kernel of the same shape, which is sweet and agreeable. Clusius gives a good figure of the nut, and Aublet has one of the whole plant.

END OF THE SEVENTEENTH VOLUME.

DIRECTIONS FOR PLACING THE PLATES OF VOL. XVII.

PART I.

PART II.