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BOTANIC GARDEN;

THE

A Poem, in Two Parts.

PART I.

CONTAINING

THE ECONOMY OF VEGETATION.

PART II.

.....

THE LOVES OF THE PLANTS.

WITH

Philofophical Notes.

LONDON, PRINTED FOR J. JOHNSON, ST. PAUL'S CHURCH-YARD. MDCCXCI. Cntered at Stationers Ball.

ADVERTISEMENT.

THE general defign of the following fheets is to inlift Imagination under the banner of Science; and to lead her votaries from the loofer analogies, which drefs out the imagery of poetry, to the ftricter, ones which form the ratiocination of philofophy. While their particular defign is to induce the ingenious to cultivate the knowledge of Botany, by introducing them to the veftibule of that delightful fcience, and recommending to their attention the immortal works of the celebrated Swedifh Naturalift, LINNEUS.

In the firft Poem, or Economy of Vegetation, the phyfiology of Plants is delivered; and the operation of the Elements, as far as they may be fuppofed to affect the growth of Vegetables. In the fecond Poem, or Loves of the Plants, the Sexual Syftem of Linneus is explained, with the remarkable properties of many particular plants.

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APOLOGY.

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IT may be proper here to apologize for many of the fubfequent conjectures on fome articles of natural philofophy, as not being fupported by accurate inveftigation or conclusive experiments. Extravagant theories however in those parts of philofophy, where our knowledge is yet imperfect, are not without their use; as they encourage the execution of laborious experiments, or the investigation of ingenious deductions, to confirm or refute them. And fince natural objects are allied to each other by many affinities, every kind of theoretic distribution of them adds to our knowledge by developing fome of their analogies.

The Roficrucian doctrine of Gnomes, Sylphs, Nymphs, and Salamanders, was thought to afford a proper machinery for a Botanic poem; as it is probable, that they were originally the names of hieroglyphic figures reprefenting the elements.

Many of the important operations of Nature were fhadowed or allegorized in the heathen mythology, as the first Cupid springing from the Egg of Night, the marriage of Cupid and Psyche, the Rape of Proserpine, the Congress of Jupiter and Juno, Death and Resufcitation of Adonis, &c. many of which are ingeniously explained in the works of Bacon, Vol. V. p. 47. 4th Edit. London, 1778. The

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Egyptians were poffeffed of many difcoveries in philosophy and chemistry before the invention of letters; these were then expressed in hieroglyphic paintings of men and animals; which after the difcovery of the alphabet were described and animated by the poets, and became first the deities of Egypt, and afterwards of Greece and Rome. Allusions to those fables were therefore thought proper ornaments to a philosophical poem, and are occasionally introduced either as represented by the poets, or preserved on the numerous gems and medallions of antiquity.

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by developing for their analogies.

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TO

THE AUTHOR

OF THE

POEM ON THE LOVES OF THE PLANTS.

BY THE REV. W. B. STEPHENS.

OFT tho' thy genius, D——! amply fraught With native wealth, explore new worlds of mind; Whence the bright ores of drofslefs wifdom brought, Stampt by the Mufe's hand, enrich mankind;

Tho' willing Nature to thy curious eye, Involved in night, her mazy depths betray; Till at their fource thy piercing fearch defcry The ftreams, that bathe with Life our mortal clay;

Tho', boldly foaring in fublimer mood Through trackless skies on metaphysic wings, Thou darest to scan the approachless Cause of Good, And weigh with steadfast hand the Sum of Things;

b

[x]

OFT the' thy youtus, D-----! amply franght

Yet wilt thou, charm'd amid his whifpering bowers, Oft with lone ftep by glittering Derwent ftray, Mark his green foliage, count his musky flowers, That blush or tremble to the rifing ray;

While FANCY, feated in her rock-roof'd dell, Liftening the fecrets of the vernal grove, Breathes fweeteft ftrains to thy fymphonious fhell, And gives new echoes to the throne of Love.

Repton, Nov. 28, 1788.

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Argument of the First Canto.

by the Fire, arr. XI. Siriu Inpiter and Semele. Northern

 \mathbf{T}_{HE} Genius of the place invites the Goddels of Botany. 1. She defcends, is received by Spring, and the Elements, 59. Addreffes the Nymphs of Fire. Star-light Night feen in the Camera Obfcura, 81. I. Love created the Univerfe. Chaos explodes. All the Stars revolve. God. 97. II. Shooting Stars. Lightning. Rainbow. Colours of the Morning and Evening Skies. Exterior Atmosphere of inflammable Air. Twilight. Fire-balls. Aurora Borealis. Planets. Comets. Fixed Stars. Sun's Orb, 115. III. 1. Fires at the Earth's Centre. Animal Incubation, 137. 2. Volcanic Mountains. Venus vifits the Cyclops, 149. IV. Heat confined on the Earth by the Air. Phofphoric lights in the Evening. Bolognian Stone. Calcined Shells. Memnon's Harp, 173. Ignis fatuus. Luminous Flowers. Glow-worm. Fire-fly. Luminous Sea-infects. Electric Eel. Eagle armed with Lightning, 180. V. I. Difcovery of Fire. Medufa, 200. 2. The chemical Properties of Fire. Phofphorus. Lady in Love, 223. 3. Gunpowder, 237. VI. Steam-engine applied to Pumps, Bellows, Water-engines, Corn-mills, Coining, Barges, Waggons, Flyingchariots, 253. Labours of Hercules. Abyla and Calpe, 297. VII. 1. Electric Machine. Hesperian Dragon. Electric kifs. Halo round the heads of Saints. Electric Shock. Fairy-rings, 335. 2. Death of Professor Richman, 371. 3. Franklin draws Lightning

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Unmark'd by you, light Graces fwim the gree And hovering Cupids aim their fhafts, unfeen.

So the fair flower expands it's lucid form

Sinboths his fine down, to charm thy curic

THE

ECONOMY OF VEGETATION.

CANTO I.

"STAY YOUR RUDE STEPS! whofe throbbing breafts infold The legion-fiends of Glory, or of Gold! STAY! whofe falfe lips feductive fimpers part, While Cunning neftles in the harlot-heart!— For you no Dryads drefs the rofeate bower, 5 For you no Nymphs their fparkling vafes pour; PART L B Unmark'd by you, light Graces fwim the green, And hovering Cupids aim their fhafts, unfeen.

"But THOU ! whofe mind the well-attemper'd ray Of Tafte and Virtue lights with purer day; IO Whofe finer fenfe each foft vibration owns With fweet refponfive fympathy of tones; So the fair flower expands it's lucid form To meet the fun, and fhuts it to the ftorm ;-For thee my borders nurfe the fragrant wreath, 15 My fountains murmur, and my zephyrs breathe; Slow flides the painted fnail, the gilded fly Smooths his fine down, to charm thy curious eye; On twinkling fins my pearly nations play, Or win with finuous train their trackless way; 20 My plumy pairs in gay embroidery drefs'd Form with ingenious bill the penfile neft,

For you no Dryads drefs the roleate bower,

[2]

So the fair flower. l. 13. It feems to have been the original defign of the philosophy of Epicurus to render the mind exquisitely sensible to agreeable sensitions, and equally infensible to disagreeable ones.

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To Love's fweet notes attune the liftening dell, And Echo founds her foft fymphonious fhell.

"And, if with Thee fome haplefs Maid fhould ftray, Difafterous Love companion of her way, 26 Oh, lead her timid fteps to yonder glade, Whofe arching cliffs depending alders fhade; There, as meek Evening wakes her temperate breeze, And moon-beams glimmer through the trembling trees, The rills, that gurgle round, fhall foothe her ear, 31 The weeping rocks fhall number tear for tear; There as fad Philomel, alike forlorn, Sings to the Night from her accuftomed thorn; While at fweet intervals each falling note 35 Sighs in the gale, and whifpers round the grot;

Difasterous Love. 1. 26. The fcenery is taken from a botanic garden about a mile from Lichfield, where a cold bath was erected by Sir John Floyer. There is a grotto furrounded by projecting rocks, from the edges of which trickles a perpetual flower of water; and it is here reprefented as adapted to love-fcenes, as being thence a proper refidence for the modern goddefs of Botany, and the eafier to introduce the next poem on the Loves of the Plants according to the fyftem of Linneus.

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The fifter-woe shall calm her aching breaft, And fofter flumbers steal her cares to reft.---

"Winds of the North! reftrain your icy gales, Nor chill the bofom of these happy vales! 40 Hence in dark heaps, ye gathering Clouds, revolve! Difperfe, ye Lightnings ! and, ye Mifts, diffolve ! -Hither, emerging from yon orient fkies, BOTANIC GODDESS ! bend thy radiant eyes; O'er these fost scenes assume thy gentle reign, 45 Pomona, Ceres, Flora in thy train; O'er the still dawn thy placid fmile effuse, And with thy filver fandals print the dews; In noon's bright blaze thy vermil veft unfold, And wave thy emerald banner ftar'd with gold." 50

Thus fpoke the GENIUS, as He ftept along, And bade thefe lawns to Peace and Truth belong; Down the fteep flopes He led with modeft skill The willing pathway, and the truant rill,

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Stretch'd o'er the marfhy vale yon willowy mound, 55 Where fhines the lake amid the tufted ground, Raifed the young woodland, fmooth'd the wavy green, And gave to Beauty all the quiet fcene.—

Blue NYMPHS craceging leavestheir foa

70

She comes!—the GODDESS!—through the whifpering air, Bright as the morn, defcends her blufhing car; 60 Each circling wheel a wreath of flowers intwines, And gem'd with flowers the filken harnefs fhines; The golden bits with flowery fluds are deck'd, And knots of flowers the crimfon reins connect.— And now on earth the filver axle rings, 65 And the fhell finks upon its flender fprings; Light from her airy feat the Goddefs bounds, And fleps celeftial prefs the panfied grounds.

Fair Spring advancing calls her feather'd quire, And tunes to fofter notes her laughing lyre; Bids her gay hours on purple pinions move, And arms her Zephyrs with the fhafts of Love, Pleafed GNOMES, afcending from their earthy beds, Play round her graceful footfteps, as fhe treads; Gay SYLPHS attendant beat the fragrant air 75 On winnowing wings, and waft her golden hair; Blue NYMPHS emerging leave their fparkling ftreams, And FIERY FORMS alight from orient beams; Mufk'd in the rofe's lap frefh dews they fhed, Or breathe celeftial luftres round her head. 80

Firft the fine Forms her dulcet voice requires, Which bathe or bafk in elemental fires; From each bright gem of Day's refulgent car, From the pale fphere of every twinkling ftar, From each nice pore of ocean, earth, and air, 85 With eye of flame the fparkling hofts repair,

And gen'd with flowers the filters harnefs thines ;

Pleafed Gnomes. 1. 73. The Roficrucian doctrine of Gnomes, Sylphs, Nymphs, and Salamanders affords proper machinery for a philosophic poem; as it is probable that they were originally the names of hieroglyphic figures of the Elements, or of Genii prefiding over their operations. The Faries of more modern days feem to have been derived from them, and to have inherited their powers. The Gnomes and Sylphs, as being more nearly allied to modern Fairies are represented as either male or female, which distinguishes the latter from the Auræ of the Latin Poets, which were only female; except the winds, as Zephyrus and Auster, may be supposed to have been their husbands.

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Mix their gay hues, in changeful circles play, Like motes, that tenant the meridian ray.— So the clear Lens collects with magic power The countlefs glories of the midnight hour ; 90 Stars after ftars with quivering luftre fall, And twinkling glide along the whiten'd wall.— Pleafed, as they pafs, fhe counts the glittering bands, And ftills their murmur with her waving hands ; Each liftening tribe with fond expectance burns, 95 And now to thefe, and now to thofe, fhe turns.

I. "NYMPHS OF PRIMEVAL FIRE! YOUR veftal train Hung with gold-treffes o'er the vaft inane,

Nymphs of primeval fire. 1.97. The fluid matter of heat is perhaps the moft extenfive element in nature; all other bodies are immerfed in it, and are preferved in their prefent flate of folidity or fluidity by the attraction of their particles to the matter of heat. Since all known bodies are contractible into lefs fpace by depriving them of fome portion of their heat, and as there is no part of nature totally deprived of heat, there is reafon to believe that the particles of bodies do not touch, but are held towards each other by their felf-attraction, and recede from each other by their attraction to the mafs of heat which furrounds them; and thus exift in an equilibrium between thefe two powers. If more of the matter of heat be applied to them, they recede further from each other, and become fluid; if ftill more be applied, they take an aerial form, and are termed Gaffes by the modern chemifts. Thus when water is heated to a certain degree, it would inftantly affume the form of fteam, but for the preffure of the atmofphere, which prevents this change from taking place fo eafily; the fame is true of Pierced with your filver fhafts the throne of Night, And charm'd young Nature's opening eyes with light; 100 When LOVE DIVINE, with brooding wings unfurl'd, Call'd from the rude abyfs the living world.

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quickfilver, diamonds, and of perhaps all other bodies in Nature; they would first become fluid, and then aeriform by appropriated degrees of heat. On the contrary, this elastic matter of heat, termed Calorique in the new nomenclature of the French Academicians, is liable to become confolidated itself in its combinations with fome bodies, as perhaps in nitre, and probably in combustible bodies as fulphur and charcoal. See note on l. 232, of this Canto. Modern philosophers have not yet been able to decide whether light and heat be different fluids, or modifications of the fame fluid, as they have many properties in common. See note on l. 468 of this Canto.

When Love Divine. 1. 101. From having obferved the gradual evolution of the young animal or plant from its egg or feed; and afterwards its fucceffive advances to its more perfect flate, or maturity; philosophers of all ages feem to have imagined, that the great world itself had likewise its infancy and its gradual progress to maturity; this feems to have given origin to the very antient and fublime allegory of Eros, or Divine Love, producing the world from the egg of Night, as it floated in Chaos. See 1. 419. of this Canto.

The external cruft of the earth, as far as it has been expoled to our view in mines or mountains, countenances this opinion; fince thefe have evidently for the moft part had their origin from the fhells of fifhes, the decomposition of vegetables, and the recrements of other animal materials, and must therefore have been formed progreflively from finall beginnings. There are likewife fome apparently ufelefs or incomplete appendages to plants and animals, which feem to fhew they have gradually undergone changes from their original ftate; fuch as the ftamens without anthers, and ftyles without ftigmas of feveral plants, as mentioned in the note on Curcuma, Vol. II. of this work. Such as the halteres, or rudiments of wings of fome two-winged infects; and the paps of male animals; thus fwine have four toes, but two of them are imperfectly formed, and not long enough for ufe. The allantoide in fome animals feems to have become extinct; in others is above tenfold the fize, which would feem neceffary for its purpofe. Buffon du Cochon. T. 6. p. 257. Perhaps all the fuppofed monftrous births of Nature are remains of their habits of production in their former lefs perfect ftate, or attempts towards greater perfection.

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"-LET THERE BE LIGHT !" proclaim'd the ALMIGHTY LORD, Aftonifh'd Chaos heard the potent word ;-Through all his realms the kindling Ether runs, 105 And the mafs ftarts into a million funs; Earths round each fun with quick explosions burft, And fecond planets iffue from the firft;

Through all his realms. 1. 105. Mr. Herschel has given a very sublime and curious account of the conftruction of the heavens with his difcovery of fome thouland nebulæ, or clouds of ftars; many of which are much larger collections of ftars, than all those put together, which are visible to our naked eyes, added to those which form the galaxy, or milky zone, which furrounds us. He observes that in the vicinity of these clusters of ftars there are proportionally fewer ftars than in other parts of the heavens; and hence he concludes, that they have attracted each other, on the fuppofition that infinite fpace was at first equally sprinkled with them; as if it had at the beginning been filled with a fluid mafs, which had coagulated. Mr. Herfchel has further fhewn, that the whole fidereal fystem is gradually moving round fome centre, which may be an opake mass of matter, Philof. Tranf. V. LXXIV. If all thefe Suns are moving round fome great central body; they must have had a projectile force, as well as a centripetal one; and may thence be fuppofed to have emerged or been projected from the material, where they were produced. We can have no idea of a natural power, which could project a Sun out of Chaos, except by comparing it to the explosions or earthquakes owing to the fudden evolution of aqueous or of other more elaftic vapours; of the power of which under immeasurable degrees of heat, and compreffion, we are yet ignorant.

It may be objected, that if the ftars had been projected from a Chaos by explosions, that they muft have returned again into it from the known laws of gravitation; this however would not happen, if the whole of Chaos, like grains of gunpowder, was exploded at the fame time, and dispersed through infinite space at once, or in quick successfion, in every possible direction. The fame objection may be stated against the possibility of the planets having been thrown from the fun by explosions; and the second ary planets from the primary ones; which will be spoken of more at large in the second Canto, but if the planets are supposed to have been projected from their supposed to have been projected from the second canto.

PART I.

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Bend, as they journey with projectile force, In bright ellipfes their reluctant courfe; 110 Orbs wheel in orbs, round centres centres roll, And form, felf-balanced, one revolving Whole. —Onward they move amid their bright abode, Space without bound, THE BOSOM OF THEIR GOD !

II. "ETHEREAL POWERS ! YOU chafe the fhooting ftars, Or yoke the vollied lightenings to your cars, 116 Cling round the aërial bow with prifms bright, And pleafed untwift the fevenfold threads of light;

primary ones, at the beginning of their courfe; they might be fo influenced or diverted by the attractions of the funs, or fun, in their vicinity, as to prevent their tendency to return into the body, from which they were projected.

If these innumerable and immense funs thus rising out of Chaos are supposed to have thrown out their attendant planets by new explosions, as they ascended; and those their respective fatellites, filling in a moment the immensity of space with light and motion, a grander idea cannot be conceived by the mind of man.

Chafe the flooting flars. 1. 115. The meteors called flooting flars, the lightening, the rainbow, and the clouds, are phenomena of the lower regions of the atmosphere. The twilight, the meteors call'd fire-balls, or flying dragons, and the northern lights, inhabit the higher regions of the atmosphere. See additional notes, No. I.

Cling round the aerial bow. 1. 117. See additional notes, No. II

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Eve's filken couch with gorgeous tints adorn, And fire the arrowy throne of rifing Morn. —OR, plum'd with flame, in gay battalion's fpring To brighter regions borne on broader wing; Where lighter gafes, circumfufed on high, Form the vaft concave of exterior fky;

Eve's filken couch. 1. 119. See additional notes, No. III.

Where lighter gafes. 1. 123. Mr. Cavendifh has fhewn, that the gas called inflammable air, is at leaft ten times lighter than common air; Mr. Lavoifier contends, that it is one of the component parts of water, and is by him called hydrogene. It is fuppofed to afford their principal nourifhment to vegetables and thence to animals, and is perpetually rifing from their decomposition; this fource of it in hot climates, and in fummer months, is fo great as to exceed estimation. Now if this light gas passes through the atmosphere, without combining with it, it must compose another atmosphere over the aerial one; which must expand, when the prefiure above it is thus taken away, to inconceivable tenuity.

If this fupernatural gaffeous atmosphere floats upon the aerial one, like ether upon water, what must happen? I. it will flow from the line, where it will be produced in the greatest quantities, and become much accumulated over the poles of the earth; 2. the common air, or lower stratum of the atmosphere, will be much thinner over the poles than at the line; because if a glass globe be filled with oil and water, and whirled upon its axis, the centrifugal power will carry the heavier fluid to the circumference, and the lighter will in confequence be found round the axis. 3. There may be a place at some certain latitude between the poles and the line on each fide the equator, where the inflammable strate atmosphere. 4. Between the termination of the aerial and the beginning of the gaffeous atmosphere, the airs will occasionally be intermixed, and thus become inflammable by the electric stratest, these circumfances will affish in explaining the phenomena of fire-balls, northern lights, and of some variable winds, and long continued rains.

Since the above note was first written, Mr. Volta I am informed has applied the supposition of a supernatant atmosphere of inflammable air, to explain some phenomena in

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With airy lens the fcatter'd rays affault,
I 25
And bend the twilight round the dufky vault;
Ride, with broad eye and fcintillating hair,
The rapid Fire-ball through the midnight air;
Dart from the North on pale electric ftreams,
Fringing Night's fable robe with transfient beams.
I 30
—OR rein the Planets in their fwift careers,
Gilding with borrow'd light their twinkling fpheres;
Alarm with comet-blaze the fapphire plain,
The wan ftars glimmering through its filver train;

meteorology. And Mr. Lavoifier has announced his defign to write on this fubject. Traitè de Chimie, Tom. I. I am happy to find these opinions supported by such respectable authority.

And bend the twilight. 1. 126. The crepufcular atmosphere, or the region where the light of the fun ceafes to be refracted to us, is estimated by philosophers to be between 40 and 50 miles high, at which time the fun is about 18 degrees below the horizon; and the rarity of the air is supposed to be from 4,000 to 10,000 times greater than at the furface of the earth. Cotes's Hydroft. p. 123. The duration of twilight differs in different feafons and in different latitudes; in England the shortess where the fun never finks more than 18 degrees, below the horizon, the twilight continues the whole night. The time of its duration may also be occasionally affected by the varying height of the atmosphere. A number of observations on the duration of twilight in different latitudes might afford confiderable information concerning the aerial ftrata in the higher regions of the atmosphere, and might affiss over the aerial one.

Alarm with Comet-blaze. 1. 133. See additional notes, No. IV.

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Gem the bright Zodiac, ftud the glowing pole, 135 Or give the Sun's phlogiftic orb to roll.

III. NYMPHS! YOUR fine forms with fteps impaffive mock

Earth's vaulted roofs of adamantine rock ; Round her ftill centre tread the burning foil, And watch the billowy Lavas, as they boil ; 140 Where, in bafaltic caves imprifon'd deep, Reluctant fires in dread fufpenfion fleep ; Or fphere on fphere in widening waves expand, And glad with genial warmth the incumbent land. So when the Mother-bird felects their food 145 With curious bill, and feeds her callow brood ;

The Sun's phlogiflic orb. 1. 136. See additional notes, No. V.

Round the fiill centre. 1. 139. Many philosophers have believed that the central parts of the earth confist of a fluid mass of burning lava, which they have called a subterraneous fun; and have supposed, that it contributes to the production of metals, and to the growth of vegetables. See additional notes, No. VI.

Or sphere on sphere. 1. 143. See additional notes, No. VII.

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Warmth from her tender heart eternal fprings, And pleafed fhe clafps them with extended wings.

"You from deep cauldrons and unmeafured caves Blow flaming airs, or pour vitrefcent waves; 150 O'er fhining oceans ray volcanic light, Or hurl innocuous embers to the night.— While with loud fhouts to Etna Heccla calls, And Andes anfwers from his beacon'd walls;

Hurl innocuous embers. 1. 152. The immediate caufe of volcanic eruptions is believed to be owing to the water of the fea, or from lakes, or inundations, finding itfelf a paffage into the fubterraneous fires, which may lie at great depths. This muft firft produce by its coldnefs a condenfation of the vapour there exifting, or a vacuum, and thus occasion parts of the earth's cruft or shell to be forced down by the preffure of the incumbent atmosphere. Afterwards the water being fuddenly raifed into steam produces all the explosive effects of earthquakes. And by new accessions of water during the intervals of the explosions the repetition of the stocks is caufed. These circumstances were hourly illustrated by the fountains of boiling water in Iceland, in which the furface of the water in the boiling wells funk down low before every new ebullition.

Befides thefe eruptions occafioned by the fteam of water, there feems to be a perpetual effufion of other vapours, more noxious and (as far as it is yet known) perhaps greatly more expansile than water from the Volcanos in various parts of the world. As thefe Volcanos are fuppofed to be fpiracula or breathing holes to the great fubterraneous fires, it is probable that the efcape of elastic vapours from them is the caufe, that the earthquakes of modern days are of fuch fmall extent compared to those of antient times, of which vestiges remain in every part of the world, and on this account may be faid not only to be innocuous, but useful.

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Sea-wilder'd crews the mountain-ftars admire, And Beauty beams amid tremendous fire.

" Thus when of old, as mystic bards prefume, Huge Cyclops dwelt in Etna's rocky womb, On thundering anvils rung their loud alarms, And leagued with VUCLAN forged immortal arms; 160 Defcending VENUS fought the dark abode, And footh'd the labours of the grifly God .---While frowning Loves the threatening falchion wield, And tittering Graces peep behind the fhield, With jointed mail their fairy limbs o'erwhelm, 165 Or nod with paufing step the plumed helm; With radiant eye She view'd the boiling ore, Heard undifmay'd the breathing bellows roar, Admired their finewy arms, and fhoulders bare, And ponderous hammers lifted high in air, 170 With fmiles celeftial blefs'd their dazzled fight, And Beauty blazed amid infernal night.

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IV. "EFFULGENT MAIDS! YOU round deciduous day,
Treffed with foft beams, your glittering bands array;
On Earth's cold bofom, as the Sun retires, 175
Confine with folds of air the lingering fires;
O'er Eve's pale forms diffuse phosphoric light,
And deck with lambent flames the fhrine of Night.

Confine with folds of air. 1. 174. The air, like all other bad conductors of electricity, is known to be a bad conductor of heat; and thence prevents the heat acquired from the fun's rays by the earth's furface from being fo foon diffipated, in the fame manner as a blanket, which may be confidered as a fponge filled with air, prevents the efcape of heat from the perfon wrapped in it. This feems to be one caufe of the great degree of cold on the tops of mountains, where the rarity of the air is greater, and it therefore becomes a better conductor both of heat and electricity. See note on Barometz, Vol. II. of this work.

There is however another caufe to which the great coldnefs of mountains and of the higher regions of the atmosphere is more immediately to be afcribed, explained by Dr. Darwin in the Philof. Tranf. Vol. LXXVIII. who has there proved by experiments with the air-gun and air-pump, that when any portion of the atmosphere becomes mechanically expanded, it abforbs heat from the bodies in its vicinity. And as the air which creeps along the plains, expands itself by a part of the preffure being taken off when it afcends the fides of mountains; it at the fame time attracts heat from the fummits of those mountains, or other bodies which happen to be immersed in it, and thus produces cold. Hence he concludes that the hot air at the bottom of the Andes becomes temperate by its own rarefaction when it afcends to the city of Quito; and by its further rarefaction becomes cooled to the freezing point when it afcends to the finowy regions on the fummits of those mountains. To this also he attributes the great degree of cold experienced by the aeronauts in their balloons; and which produces hail in fummer at the height of only two or three miles in the atmosphere.

Diffuse phosphoric light. 1. 177. I have often been induced to believe from observation, that the twilight of the evenings is lighter than that of the mornings at the same distance

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So, warm'd and kindled by meridian fkies, And view'd in darknefs with dilated eyes, BOLOGNA's chalks with faint ignition blaze, BECCARI's fhells emit prifmatic rays.

from noon. Some may afcribe this to the greater height of the atmosphere in the evenings having been rarefied by the fun during the day; but as its density must at the fame time be diminished, its power of refraction would continue the fame. I should rather fuppose that it may be owing to the phosphorescent quality (as it is called) of almost all bodies; that is, when they have been exposed to the fun they continue to emit light for a confiderable time afterwards. This is generally believed to arise either from such bodies giving out the light which they had previously absorbed; or to the continuance of a flow combustion which the light they had been previously exposed to had excited. See the next note.

Beccari's fhells. 1. 182. Beccari made made many curious experiments on the phofphoric light, as it is called, which becomes visible on bodies brought into a dark room, after having been previoufly exposed to the funfhine. It appears from these experiments, that almost all inflammable bodies posses this quality in a greater or lefs degree; white paper or linen thus examined after having been exposed to the funfhine, is luminous to an extraordinary degree; and if a perfon fhut up in a dark room, puts one of his hands out into the fun's light for a fhort time and then retracts it, he will be able to fee that hand diffinctly, and not the other. These experiments feem to countenance the idea of light being abforbed and again emitted from bodies when they are removed into darknefs. But Beccari further pretended, that fome calcareous compositions when exposed to red, yellow, or blue light, through coloured glaffes, would on their being brought into a dark room emit coloured lights. This miftaken fact of Beccari's, Mr. Wilfon decidedly refutes; and among many other curious experiments difcovered, that if oyfter-fhells were thrown into a common fire and calcined for about half an hour, and then brought to a perfon who had previoufly been fome minutes in a dark room, that many of them would exhibit beautiful irifes of prifmatic colours, from whence probably arofe Beccari's miftake. Mr. Wilfon from hence contends, that thefe kinds of phofphori do not emit the light they had previoufly received, but that they are fet on fire by the fun's rays, and continue for fome time a flow combuftion after they are withdrawn from the light. Wilfon's Experiments on Phofphori. Dodíley, 1775.

The Bolognian ftone is a felenite, or gypfum, and has been long celebrated for its phofphorefcent quality after having been burnt in a fulphurous fire; and exposed when

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So to the facred Sun in MEMNON's fane, Spontaneous concords quired the matin ftrain; —Touch'd by his orient beam, refponfive rings The living lyre, and vibrates all it's ftrings; Accordant ailes the tender tones prolong, And holy echoes fwell the adoring fong.

"You with light Gas the lamps nocturnal feed, Which dance and glimmer o'er the marshy mead; 190

cold to the fun's light. It may be thus well imitated: Calcine oyfter-fhells half an hour, pulverize them when cold, and add one third part of flowers of fulphur, prefs them clofe into a fmall crucible, and calcine them for an hour or longer, and keep the powder in a phial clofe flopped. A part of this powder is to be exposed for a minute or two to the funbeams, and then brought into a dark room. The calcined Bolognian flone becomes a calcareous hepar of fulphur; but the calcined fhells, as they contain the animal acid, may alfo contain fome of the phofphorus of Kunkel.

In Memnon's fane. 1. 183. See additional notes. No. VIII.

The lamps nocturnal. 1. 189. The ignis fatuus or Jack a lantern, fo frequently alluded to by poets, is fuppofed to originate from the inflammable air, or Hydrogene, given up from moraffes; which being of a heavier kind from its impurity than that obtained from iron and water, hovers near the furface of the earth, and uniting with common air gives out light by its flow ignition. Perhaps fuch lights have no exiftence, and the reflection of a ftar on watery ground may have deceived the travellers, who have been faid to be bewildered by them ? if the fact was eftablished it would much contribute to explain the phenomena of northern lights. I have travelled much in the night, in all feasons of the year, and over all kinds of foil, but never faw one of thefe Will o'wifps.

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Shine round Calendula at twilight hours, And tip with filver all her faffron flowers; Warm on her moffy couch the radiant Worm, Guard from cold dews her love-illumin'd form, From leaf to leaf conduct the virgin light, 195 Star of the earth, and diamond of the night. You bid in air the tropic Beetle burn, And fill with golden flame his winged urn; Or gild the furge with infect-fparks, that fwarm Round the bright oar, the kindling prow alarm; 200 Or arm in waves, electric in his ire, The dread Gymnotus with ethereal fire.-Onward his courfe with waving tail he helms, And mimic lightenings fcare the watery realms,

Sbine round Calendula. 1. 191. See note on Tropæolum in Vol. II. The radiant Worm. 1. 193. See additional notes, No. IX.

The dread Gymnotus. 1. 202. The Gymnotus electricus is a native of the river of Surinam in South America; those which were brought over to England about eight years ago were about three or four feet long, and gave an electric shock (as I experienced) by putting one finger on the back near its head, and another of the opposite hand into the water near its tail. In their native country they are faid to exceed twenty feet in length, So, when with briftling plumes the Bird of Jove 205 Vindictive leaves the argent fields above,

and kill any man who approaches them in an hoftile manner. It is not only to efcape its enemies that this furprizing power of the fifh is ufed, but alfo to take its prey; which it does by benumbing them and then devouring them before they have time to recover, or by perfectly killing them; for the quantity of the power feemed to be determined by the will or anger of the animal; as it fometimes flruck a fifh twice before it was fufficiently benumbed to be eafily fwallowed.

The organs productive of this wonderful accumulation of electric matter have been accurately diffected and defcribed by Mr. J. Hunter. Philof. Tranf. Vol. LXV. And are fo divided by membranes as to compose a very extensive furface, and are supplied with many pairs of nerves larger than any other nerves of the body; but how so large a quantity is fo quickly accumulated as to produce such amazing effects in a fluid ill adapted for the purpose is not yet fatisfactorily explained. The Torpedo possible a similar power in a less degree, as was shewn by Mr. Walch, and another fish lately described by Mr. Paterfon. Philo. Tranf. Vol. LXXVI.

In the conftruction of the Leyden-Phial, (as it is called) which is coated on both fides, it is known, that above one hundred times the quantity of politive electricity can be condenfed on every fquare inch of the coating on one fide, than could have been accumulated on the fame furface if there had been no oppolite coating communicating with the earth; becaufe the negative electricity, or that part of it which caufed its expanfion, is now drawn off through the glafs. It is alfo well known, that the thinner the glafs is (which is thus coated on both fides fo as to make a Leyden-phial, or plate) the more electricity can be condenfed on one of its furfaces, till it becomes fo thin as to break, and thence difcharge itfelf.

Now it is poffible, that the quantity of electricity condenfible on one fide of a coated phial may increafe in fome high ratio in refpect to the thinnefs of the glafs, fince the power of attraction is known to decreafe as the fquares of the diftances, to which this circumftance of electricity feems to bear fome analogy. Hence if an animal membrane, as thin as the filk-worm fpins its filk, could be fo fituated as to be charged like the Leyden bottle, without burfting, (as fuch thin glafs would be liable to do,) it would be difficult to calculate the immenfe quantity of electric fluid, which might be accumulated on its furface. No land animals are yet difcovered which poffefs this power, though the air would have been a much better medium for producing its effects; perhaps the fize of the neceffary apparatus would have been inconvenient to land animals.

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Borne on broad wings the guilty world he awes, And grafps the lightening in his fhining claws.

V. 1. "NYMPHS! YOUR foft fmiles uncultur'd man fubdued,

And charm'd the Savage from his native wood; 210 You, while amazed his hurrying Hords retire From the fell havoc of devouring FIRE,

In bis *fbining claws.* 1. 208. Alluding to an antique gem in the collection of the Grand Duke of Florence. Spence.

Of devouring fire. 1. 212. The first and most important discovery of mankind feems to have been that of fire. For many ages it is probable fire was efteemed a dangerous enemy, known only by its dreadful devastations; and that many lives must have been lost, and many dangerous burns and wounds must have afflicted those who first dared to fubject it to the uses of life. It is faid that the tall monkies of Borneo and Sumatra lie down with pleasure ruond any accidental fire in their woods; and are arrived to that degree of reason, that knowledge of causation, that they thrust into the remaining fire the half-burnt ends of the branches to prevent its going out. One of the nobles of the cultivated people of Otaheita, when Captain Cook treated them with tea, catched the boiling water in his hand from the cock of the tea-urn, and bellowed with pain, not conceiving that water could become hot, like red fire.

Tools of fteel conftitute another important difcovery in confequence of fire; and contributed perhaps principally to give the European nations fo great fuperiority over the American world. By thefe two agents, fire and tools of fteel, mankind became able to cope with the vegetable kingdom, and conquer provinces of forefts, which in uncultivated countries almost exclude the growth of other vegetables, and of those animals which are necessary to our existence. Add to this, that the quantity of our food is also increased by the use of fire, for fome vegetables become falutary food by means of the heat used in cookery, which are naturally either noxious or difficult of digestion; as Taught, the firft Art! with piny rods to raife By quick attrition the domeftic blaze, Fan with foft breath, with kindling leaves provide, 215 And lift the dread Deftroyer on his fide. So, with bright wreath of ferpent-treffes crown'd, Severe in beauty, young MEDUSA frown'd; Erewhile fubdued, round WISDOM'S Ægis roll'd 219 Hifs'd the dread fnakes, and flam'd in burnifh'd gold; Flafh'd on her brandifh'd arm the immortal fhield, And Terror lighten'd o'er the dazzled field.

2. NYMPHS! you disjoin, unite, condense, expand, And give new wonders to the Chemist's hand;

potatoes, kidney-beans, onions, cabbages. The caffava when made into bread, is perhaps rendered mild by the heat it undergoes, more than by expreffing its fuperfluous juice. The roots of white bryony and of arum, I am informed lofe much of their acrimony by boiling.

Young Medufa frowned. 1. 218. The Egyptian Medufa is reprefented on antient gems with wings on her head, fnaky hair, and a beautiful countenance, which appears intenfely thinking; and was fuppofed to reprefent divine wifdom. The Grecian Medufa, on Minerva's fhield, as appears on other gems, has a countenance difforted with rage or pain, and is fuppofed to reprefent divine vengeance. This Medufa was one of the Gorgons, at first very beautiful and terrible to her enemies; Minerva turned her hair into fnakes, and Perfeus having cut off her head fixed it on the fhield of that goddefs; the fight of which then petrified the beholders. Dannet. Dict.

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On tepid clouds of rifing fteam afpire, 225 Or fix in fulphur all it's folid fire; With boundlefs fpring elaftic airs unfold, Or fill the fine vacuities of gold; With fudden flafh vitrefcent fparks reveal, By fierce collifion from the flint and fteel; 230

Or fix in fulphur. 1. 226. The phenomena of chemical explosions cannot be accounted for without the fupposition, that fome of the bodies employed contain concentrated or folid heat combined with them, to which the French Chemist's have given the name of Calorique. When air is expanded in the air-pump, or water evaporated into fteam, they drink up or abforb a great quantity of heat; from this analogy, when gunpowder is exploded it ought to abforb much heat, that is, in popular language, it ought to produce a great quantity of cold. When vital air is united with phlogistic matter in refpiration, which feems to be a flow combustion, its volume is leffened; the carbonic acid, and perhaps phosphoric acid are produced; and heat is given out; which according to the experiments of Dr. Crawford would feem to be deposited from the vital air. But as the vital air in nitrous acid is condensed from a light elastic gas to that of a heavy fluid, it must possible for a great than before. And hence a great part of the heat, which is given out in firing gunpowder, I should fuppose, must reside in the fulphur or charcoal.

Mr. Lavoifier has fhewn, that vital air, or Oxygene, loofes lefs of its heat when it becomes one of the component parts of nitrous acid, than in any other of its combinations; and is hence capable of giving out a great quantity of heat in the explosion of gunpowder; but as there feems to be great analogy between the matter of heat, or Calorique, and the electric matter; and as the worft conductors of electricity are believed to contain the greatest quantity of that fluid; there is reason to suffect that the worft conductors of heat may contain the most of that fluid; as sufficient, wax, filk, air, glass. See note on 1. 174 of this Canto.

Vitrefcent fparks. 1. 229. When flints are ftruck against other flints they have the property of giving sparks of light; but it it seems to be an internal light, perhaps of electric origin, very different from the ignited sparks which are struck from flint and steel. The sparks produced by the collision of steel with flint appear to be globular particles of Or mark with fhining letters KUNKEL's name In the pale Phofphor's felf-confuming flame. So the chafte heart of fome enchanted Maid

Shines with infidious light, by Love betray'd; Round her pale bosom plays the young Defire, And flow the wastes by felf-confuming fire.

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3. "You taught myfterious BACON to explore Metallic veins, and part the drofs from ore; With fylvan coal in whirling mills combine The cryftal'd nitre, and the fulphurous mine; Through wiry nets the black diffufion ftrain, And clofe an airy ocean in a grain.—

iron, which have been fufed, and imperfectly fcorified or vitrified. They are kindled by the heat produced by the collifion; but their vivid light, and their fufion and vitrification are the effects of a combustion continued in these particles during their paffage through the air. This opinion is confirmed by an experiment of Mr. Hawksbee, who found that these fparks could not be produced in the exhausted receiver. See Keir's Chemical Dict. art. Iron, and art. Earth vitrifiable.

The pale Pholphor. 1. 232. See additionable notes, No. X.

And close an airy ocean. 1. 242. Gunpowder is plainly defcribed in the works of Roger Bacon before the year 1267. He defcribes it in a curious manner, mentioning Pent in dark chambers of cylindric brafs, Slumbers in grim repofe the footy mafs; Lit by the brilliant fpark, from grain to grain 245 Runs the quick fire along the kindling train; On the pain'd ear-drum burfts the fudden crafh, Starts the red flame, and Death purfues the flafh.—

the fulphur and nitre, but conceals the charcoal in an anagram. The words are, fed tamen falis petræ *lure mope can ubre*, et fulphuris; et fic facies tonitrum, et corrufcationem, fi fcias, artificium. The words lure mope can ubre are an anagram of carbonum pulvere. Biograph. Britan. Vol. I. Bacon de Secretis Operibus, Cap. XI. He adds, that he thinks by an artifice of this kind Gideon defeated the Midianites with only three hundred men. Judges, Chap. VII. Chamb. Dict. art. Gunpowder. As Bacon does not claim this as his own invention, it is thought by many to have been of much more antient difcovery.

The permanently elastic fluid generated in the firing of gunpowder is calculated by Mr. Robins to be about 244 if the bulk of the powder be 1. And that the heat generated at the time of the explosion occasions the rarefied air thus produced to occupy about 1000 times the space of the gunpowder. This prefiure may therefore be called equal to 1000 atmospheres or fix tons upon a square inch. As the suddenness of this explosion must contribute much to its power, it would seem that the chamber of powder, to produce its greatest effect, should be lighted in the centre of it; which I believe is not attended to in the manufacture of muskets or pistols.

From the cheapnels with which a very powerful gunpowder is likely foon to be manufactured from aerated marine acid, or from a new method of forming nitrous acid by means of mangonele or other calciform ores, it may probably in time be applied to move machinery, and fuperfede the use of fteam.

There is a bitter invective in Don Quixot against the inventors of gun-powder, as it levels the strong with the weak, the knight cased in steel with the naked shepherd, those who have been trained to the sword, with those who are totally unskilful in the use of it; and throws down all the splendid distinctions of mankind. These very reafons ought to have been urged to shew that the discovery of gunpowder has been of public utility by weakening the tyranny of the few over the many.

PART I.

E

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Fear's feeble hand directs the fiery darts,

And Strength and Courage yield to chemic arts; 250 Guilt with pale brow the mimic thunder owns, And Tyrants tremble on their blood-ftain'd thrones.

the pain deer-down built the hidden could at the

VI. NYMPHS! you erewhile on fimmering cauldrons

play'd,

And call'd delighted SAVERY to your aid;

Delighted Savery. 1. 254. The invention of the fleam-engine for raifing water by the preffure of the air in confequence of the condenfation of fleam, is properly afcribed to Capt. Savery; a plate and defcription of this machine is given in Harris's Lexicon Technicum, art. Engine. Though the Marquis of Worcefter in his Century of Inventions printed in the year 1663 had defcribed an engine for raifing water by the explosive power of fleam long before Savery's. Mr. Defegulier affirms, that Savery bought up all he could procure of the books of the Marquis of Worcefter, and deftroyed them, profeffing himfelf then to have difcovered the power of fleam by accident, which feems to have been an unfounded flander. Savery applied it to the raifing of water to fupply houfes and gardens, but could not accomplifh the draining of mines by it. Which was afterwards done by Mr. Newcomen and Mr. John Cowley at Dartmouth, in the year 1712, who added the pifton.

A few years ago Mr. Watt of Glafgow much improved this machine, and with Mr. Boulton of Birmingham has applied it to variety of purpofes, fuch as raifing water from mines, blowing bellows to fufe the ore, fupplying towns with water, grinding corn and many other purpofes. There is reafon to believe it may in time be applied to the rowing of barges, and the moving of carriages along the road. As the fpecific levity of air is too great for the fupport of great burthens by balloons, there feems no probable method of flying conveniently but by the power of fteam, or fome other explosive material; which another half century may probable difcover. See additional notes, No. XI.
Bade round the youth exploitve STEAM afpire255In gathering clouds, and wing'd the wave with fire;Bade with cold ftreams the quick expansion ftop,And funk the immense of vapour to a drop.Prefs'd by the ponderous air the Piston fallsRefiftles, fliding through it's iron walls;260Quick moves the balanced beam, of giant-birth,Wields his large limbs, and nodding fhakes the earth.

"The Giant-Power from earth's remoteft caves Lifts with ftrong arm her dark reluctant waves; Each cavern'd rock, and hidden den explores, 265 Drags her dark coals, and digs her fhining ores.— Next, in clofe cells of ribbed oak confined, Gale after gale, He crowds the ftruggling wind; The imprifon'd ftorms through brazen noftrils roar, Fan the white flame, and fufe the fparkling ore. 270 Here high in air the rifing ftream He pours To clay-built cifterns, or to lead-lined towers; Fresh through a thousand pipes the wave distils, And thirsty cities drink the exuberant rills.— There the vast mill-stone with inebriate whirl On trembling floors his forceful singers twirl. Whose flinty teeth the golden harvests grind, Feast without blood ! and nourish human-kind.

"Now his hard hands on Mona's rifted creft, Bofom'd in rock, her azure ores arreft;

Feast without blood ! 1. 278. The benevolence of the great Author of all things is greatly manifeft in the fum of his works, as Dr. Balguy has well evinced in his pamphlet on Divine Benevolence afferted, printed for Davis, 1781. Yet if we may compare the parts of nature with each other, there are fome circumstances of her economy which feem to contribute more to the general fcale of happiness than others. Thus the nourishment of animal bodies is derived from three fources: I. the milk given from the mother to the offspring; in this excellent contrivance the mother has pleafure in affording the fuftenance to the child, and the child has pleafure in receiving it. 2. Another fource of the food of animals includes feeds or eggs; in thefe the embryon is in a torpid or infenfible ftate, and there is along with it laid up for its early nourifhment a ftore of provision, as the fruit belonging to fome feeds, and the oil and ftarch belonging to others; when thefe are confumed by animals the unfeeling feed or egg receives no pain, but the animal receives pleafure which confumes it. Under this article may be included the bodies of animals which die naturally. 3. But the laft method of fupporting animal bodies by the deftruction of other living animals, as lions preying upon lambs, these upon living vegetables, and mankind upon them all, would appear to be a lefs perfect part of the economy of nature than those before mentioned, as contributing less to the fum of general happinels.

Mona's rifted creft. 279. Alluding to the very valuable copper-mines in the ifle of Anglefey, the property of the Earl of Uxbridge.

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With iron lips his rapid rollers feize

The lengthening bars, in thin expansion fqueeze; Defeending ferews with ponderous fly-wheels wound The tawny plates, the new medallions round; Hard dyes of fteel the cupreous circles cramp, 285 And with quick fall his massive hammers ftamp. The Harp, the Lily and the Lion join, And GEORGE and BRITAIN guard the sterling coin.

"Soon fhall thy arm, UNCONQUER'D STEAM! afar Drag the flow barge, or drive the rapid car; 290 Or on wide-waving wings expanded bear The flying-chariot through the fields of air.

With iron-lips. 1. 281. Mr. Boulton has lately conftructed at Soho near Birmingham, a most magnificent apparatus for Coining, which has cost him fome thousand pounds; the whole machinery is moved by an improved steam-engine, which rolls the copper for half-pence finer than copper has before been rolled for the purpose of making money; it works the coupoirs or fcrew-preffes for cutting out the circular pieces of copper; and coins both the faces and edges of the money at the fame time, with fuch superior excellence and cheapness of workmanship, as well as with marks of such powerful machinery as must totally prevent clandestine imitation, and in consequence fave many lives from the hand of the executioner; a circumstance worthy the attention of a great minister. If a civic crown was given in Rome for preferving the life of one citizen, Mr. Boulton should be covered with garlands of oak ! By this machinery four boys of ten or twelve years old are capable of striking thirty thousand guineas in an hour, and the machine itself keeps an unerring account of the pieces struck,

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-Fair crews triumphant, leaning from above, Shall wave their fluttering kerchiefs as they move; Or warrior-bands alarm the gaping crowd, And armies fhrink beneath the fhadowy cloud.

"So mighty HERCULES o'er many a clime Waved his vaft mace in Virtue's caufe fublime,

So mighty Hercules. 1. 297. The ftory of Hercules feems of great antiquity, as appears from the fimplicity of his drefs and armour, a lion's fkin and a club; and from the nature of many of his exploits, the deftruction of wild beafts and robbers. This part of the hiftory of Hercules feems to have related to times before the invention of the bow and arrow, or of fpinning flax. Other flories of Hercules are perhaps of later date, and appear to be allegorical, as his conquering the river-god Achilous, and bringing Cerberus up to day light; the former might refer to his turning the course of a river, and draining a morafs, and the latter to his exposing a part of the superstition of the times. The ftrangling the lion and tearing his jaws afunder, are defcribed from a ftatue in the Muleum Florentinum, and from an antique gem; and the grafping Anteus to death in his arms as he lifts him from the earth, is defcribed from another antient cameo. The famous pillars of Hercules have been varioufly explained. Pliny afferts that the natives of Spain and of Africa believed that the mountains of Abyla and Calpè on each fide of the ftraits of Gibraltar were the pillars of Hercules; and that they were reared by the hands of that god, and the fea admitted between them. Plin. Hift. Nat. p. 46. Edit. Manut. Venet. 1609.

If the paffage between the two continents was opened by an earthquake in antient times, as this allegorical fory would feem to countenance, there must have been an immenfe current of water at first run into the Mediterranean from the Atlantic; fince there is at prefent a ftrong ftream fets always from thence into the Mediterranean. Whatever may be the caufe, which now conftantly operates, fo as to make the furface of the Mediterranean lower than that of the Atlantic, it must have kept it very much lower before a paffage for the water through the ftreights was opened. It is probable before fuch an event took place, the coafts and iflands of the Mediterranean extended

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Unmeafured ftrength with early art combined, Awed, ferved, protected, and amazed mankind.— 300 Firft two dread Snakes at JUNO'S vengeful nod Climb'd round the cradle of the fleeping God ; Waked by the fhrilling hifs, and ruftling found, And fhrieks of fair attendants trembling round, Their gafping throats with clenching hands he holds ; And Death untwifts their convoluted folds. 306 Next in red torrents from her fevenfold heads Fell HYDRA'S blood on Lerna'S lake he fheds ; Grafps ACHELOUS with refiftlefs force, And drags the roaring River to his courfe ; 310 Binds with loud bellowing and with hideous yell The monfter Bull, and threefold Dog of Hell.

"Then, where Nemea's howling forefts wave, He drives the Lion to his dufky cave;

much further into that fea, and were then for a great extent of country, deftroyed by the floods occafioned by the new rife of water, and have fince remained beneath the fea. Might not this give rife to the flood of Deucalion? See note Caffia, V. II. of this work.

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Seized by the throat the growling fiend difarms, 315 And tears his gaping jaws with finewy arms; Lifts proud ANTEUS from his mother-plains, And with ftrong grafp the ftruggling Giant ftrains; Back falls his fainting head, and clammy hair, Writhe his weak limbs, and flits his life in air;— 310 By fteps reverted o'er the blood-dropp'd fen He tracks huge CACUS to his murderous den; Where breathing flames through brazen lips he fled, And fhakes the rock-roof'd cavern o'er his head.

"Laft with wide arms the folid earth He tears, 325 Piles rock on rock, on mountain mountain rears; Heaves up huge ABYLA on Afric's fand, Crowns with high CALPE Europe's faliant ftrand, Crefts with oppofing towers the fplendid fcene, And pours from urns immenfe the fea between.— 330 —Loud o'er her whirling flood Charybdis roars, Affrighted Scylla bellows round his fhores,

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Vefuvio groans through all his echoing caves, And Etna thunders o'er the infurgent waves.

VII. 1. NYMPHS ! YOUR fine hands ethereal floods amafs From the warm cufhion, and the whirling glafs; 336 Beard the bright cylinder with golden wire, And circumfufe the gravitating fire. Cold from each point cerulean luftres gleam, Or fhoot in air the fcintillating ftream. 340 So, borne on brazen talons, watch'd of old The fleeplefs dragon o'er his fruits of gold;

Ethereal floods amafs. 1. 335. The theory of the accumulation of the electric fluid by means of the glafs-globe and cufhion is difficult to comprehend. Dr. Franklin's idea of the pores of the glafs being opened by the friction, and thence rendered capable of attracting more electric fluid, which it again parts with, as the pores contract again, feems analogous in fome measure to the heat produced by the vibration, or condensation of bodies, as when a nail is hammered or filed till it becomes hot, as mentioned in additional Notes, No. VII. Some philosophers have endeavoured to account for this phenomenon by supposing the existence of two electric fluids which may be called the vitreous and refinous ones, instead of the plus and minus of the fame ether. But its accumulation on the rubbed glass bears great analogy to its accumulation on the furface of the Leyden bottle, and can not perhaps be explained from any known mechanical or chemical principle. See note on Gymnotus. 1. 202, of this Canto.

Cold from each point, 1. 339. See additional note, No. XIII.

PART L

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Bright beam'd his fcales, his eye-balls blazed with ire, And his wide noftrils breath'd inchanted fire.

"You bid gold-leaves, in cryftal lantherns held, Approach attracted, and recede repel'd; 346 While paper-nymphs inftinct with motion rife, And dancing fauns the admiring Sage furprize. OR, if on wax fome fearlefs Beauty ftand, And touch the fparkling rod with graceful hand; 350 Through her fine limbs the mimic lightnings dart, And flames innocuous eddy round her heart; O'er her fair brow the kindling luftres glare, Blue rays diverging from the briftling hair; While fome fond Youth the kifs ethereal fips. 355 And foft fires iffue from their meeting lips.

You bid gold leaves. 1. 345. Alluding to the very fenfible electrometer improved by Mr. Bennett, it confifts of two flips of gold-leaf fulpended from a tin cap in a glafs cylinder, which has a partial coating without, communicating with the wooden pedeftal. If a flick of fealing wax be rubbed for a moment on a dry cloth, and then held in the air at the diflance of two or three feet from the cap of this inftrument, the gold leaves feperate, fuch is its aftonifhing fenfibility to electric influence! (See Bennet on electricity, Johnfon, Lond.) The nerves of fenfe of animal bodies do not feem to be affected by lefs quantities of light or heat!

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So round the virgin Saint in filver streams The holy Halo shoots it's arrowy beams.

"You crowd in coated jars the denfer fire, Pierce the thin glafs, and fufe the blazing wire; 360 Or dart the red flafh through the circling band Of youths and timorous damfels, hand in hand. —Starts the quick Ether through the fibre-trains Of dancing arteries, and of tingling veins, Goads each fine nerve, with new fenfation thrill'd, 365 Bends the reluctant limbs with power unwill'd;

The boly Halo. 1. 358. I believe it is not known with certainty at what time the painters first introduced the luminous circle round the head to import a Saint or holy perfon. It is now become a part of the fymbolic language of painting, and it is much to be wished that this kind of hieroglyphic character was more frequent in that art; as it is much wanted to render historic pictures both more intelligible, and more fublime; and why should not painting as well as poetry express itself in metaphor, or in indistinct allegory? A truly great modern painter lately endeavoured to enlarge the sphere of pictorial language, by putting a demon behind the pillow of a wicked man on his death bed. Which unfortunately for the scientific part of painting, the cold criticism of the present day has depreciated; and thus barred perhaps the only road to the further improvement in this science.

With new fenfation thrill'd. 1. 365. There is probably a fystem of nerves in animal bodies for the purpose of perceiving heat; fince the degree of this fluid is so necessary to health that we become presently injured either by its access or defect; and because almost every part of our bodies is supplied with branches from different pairs of nerves, which

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Palfy's cold hands the fierce concuffion own, And Life clings trembling on her tottering throne.— So from dark clouds the playful lightning fprings, Rives the firm oak, or prints the Fairy-rings. 370

2. NYMPHS ! on that day YE fhed from lucid eyes. Celeftial tears, and breathed ethereal fighs !

would not feem neceffary for their motion alone. It is therefore probable, that our fenfation of electricity is only of its violence in paffing through our fyftem by its fuddenly diftending the mufcles, like any other mechanical violence; and that it is general pain alone that we feel, and not any fenfation analogous to the fpecific quality of the object. Nature may feem to have been niggardly to mankind in beftowing upon them fo few fenfes; fince a fenfe to have perceived electricity, and another to have perceived magnetifm might have been of great fervice to them, many ages before thefe fluids were difcovered by accidental experiment, but it is poffible an increafed number of fenfes might have incommoded us by adding to the fize of our bodies.

Palfy's cold hands. 1. 435. Paralytic limbs are in general only incapable of being ftimulated into action by the power of the will; fince the pulfe continues to beat and the fluids to be abforbed in them; and it commonly happens, when paralytic people yawn and ftretch themfelves, (which is not a voluntary motion,) that the affected limb moves at the fame time. The temporary motion of a paralytic limb is likewife caufed by paffing the electric fhock through it; which would feem to indicate fome analogy between the electric fluid, and the nervous fluid, which is feperated from the blood by the brain, and and thence diffufed along the nerves for the purpofes of motion and fenfation. It probably deftroys life by its fudden expansion of the nerves or fibres of the brain; in the fame manner as it fufes metals and fplinters wood or ftone, and removes the atmosphere, when it paffes from one object to another in a denfe ftate.

Prints the Fairy rings. 1. 370. See additional note No. XIII.

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When RICHMAN rear'd, by fearlefs hafte betray'd, The wiry rod in Nieva's fatal fhade ;— Clouds o'er the Sage, with fringed fkirts fucceed, 375 Flafh follows flafh, the warning corks recede ; Near and more near He ey'd with fond amaze The filver ftreams, and watch'd the faphire blaze ; Then burfts the fteel, the dart electric fped, And the bold Sage lay number'd with the dead !— 380 NYMPHS! on that day YE fhed from lucid eyes Celeftial tears, and breathed ethereal fighs !

3. "You led your FRANKLIN to your glazed retreats, Your air-built caftles, and your filken feats;

When Richman reared. I. 373. Dr. Richman Professor of natural philosophy at Petersburgh about the year 1763, elevated an infulated metallic rod to collect the aerial electricity, as Dr. Franklin had previously done at Philadelphia; and as he was observing the repulsion of the balls of his electrometer approached too near the conductor, and receiving the lightening in his head with a loud explosion, was struck dead amids this family.

You led your Franklin. 1. 383. Dr. Franklin was the first that discovered that lightening confisted of electric matter, he elevated a tall rod with a wire wrapped round it, and fixing the bottom of a rod into a glass bottle, and preferving it from falling by means of filk-ftrings, he found it electrified whenever a cloud passed over it, receiving sparks by his finger from it, and charging coated phials. This great discovery taught us to defend houses and ships and temples from lightning, and also to understand, that people are

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Bade his bold arm invade the lowering fky, 385
And feize the tiptoe lightnings, ere they fly;
O'er the young Sage your myftic mantle fpread,
And wreath'd the crown electric round his head.—
Thus when on wanton wing intrepid Love
Snatch'd the raifed lightning from the arm of Jove; 390
Quick o'er his knee the triple bolt He bent,
The clufter'd darts and forky arrows rent,
Snapp'd with illumin'd hands each flaming fhaft,
His tingling fingers fhook, and ftamp'd, and laugh'd;

always perfectly fafe in a room during a thunder florm if they keep themsfelves at three or four feet distance from the walls; for the matter of lightning in passing from the clouds to the earth, or from the earth to the clouds, runs through the walls of a house, the trunk of a tree, or other elevated object; except there be fome moister body, as an animal in contact with them, or nearly fo; and in that case the lightning leaves the wall or tree, and passes through the animal; but as it can pass through metals with ftill greater facility, it will leave animal bodies to pass through metallic ones.

If a perfon in the open air be furprized by a thunderform, he will know his danger by obferving on a fecond watch the time which paffes between the flash and the crack, and reckoning a mile for every four feconds and a half, and a little more. For found travels at the rate of 1142 feet in a fecond of time, and the velocity of light through fuch fmall diffances is not to be estimated. In these circumstances a perfon will be fafer by lying down on the ground, than erect, and still fafer if within a few feet of his horse; which being then a more elevated animal will receive the shock in preference as the cloud passes over. See additional notes, No. XIII.

Intrepid Love. 1. 389. This allegory is uncommonly beautiful, reprefenting Divine Juftice as difarmed by Divine Love, and relenting of his purpofe. It is expressed on an agate in the Great Duke's collection at Florence. Spence.

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Bright o'er the floor the featter'd fragments blaz'd, 395 And Gods retreating trembled as they gaz'd; The immortal Sire, indulgent to his child, Bow'd his ambrofial locks, and Heaven relenting fmiled.

VIII. "When Air's pure effence joins the vital flood, And with phofphoric Acid dyes the blood, 400 YOUR VIRGIN TRAINS the transfert HEAT dispart, And lead the fost combustion round the heart ;

Transfent beat difpart. 1. 401. Dr. Crawford in his ingenious work on animal heat has endeavoured to prove, that during the combination of the pure part of the atmosphere with the phlogiftic part of the blood, that much of the matter of the heat is given out from the air; and that this is the great and perpetual fource of the heat of animals; to which we may add that the phofphoric acid is probably produced by this combination; by which acid the colour of the blood is changed in the lungs from a deep crimfon to a bright fcarlet. There feems to be however another fource of animal heat, though of a fimilar nature; and that is from the chemical combinations produced in all the glands; fince by whatever caufe any glandular fecretion is increafed, as by friction or topical imflammation, the heat of that part becomes increased at the same time; thus after the hands have been for a time immerfed in fnow, on coming into a warm room, they become red and hot, without any increased pulmonary action. BESIDES THIS there would feem to be another material received from the air by refpiration; which is fo neceffary to life, that the embryon must learn to breath almost within a minute after its birth, or it dies. The perpetual neceffity of breathing fhews, that the material thus acquired is perpetually confuming or efcaping, and on that account requires perpetual renovation. Perhaps the fpirit of animation itfelf is thus acquired from the atmosphere, which if it be fuppofed to be finer or more fubtle than the electric matter, could not long be retained in our bodies, and must therefore require perpetual renovation.

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Life's holy lamp with fires fucceffive feed, From the crown'd forehead to the proftrate weed, From Earth's proud realms to all that fwim or fweep The yielding ether or tumultuous deep. 406 You fwell the bulb beneath the heaving lawn, Brood the live feed, unfold the burfting fpawn; Nurfe with foft lap, and warm with fragrant breath The embryon panting in the arms of Death ; 410 Youth's vivid eye with living light adorn, And fire the rifing blufh of Beauty's golden morn.

"Thus when the Egg of Night, on Chaos hurl'd, Burft, and difclofed the cradle of the world;

Thus when the egg of Night. 1. 413. There were two Cupids belonging to the antientmythology, one much elder than the other. The elder cupid, or Eros, or divine Love, was the first that came out of the great egg of night, wich floated in Chaos, and was broken by the horns of the celestial bull, that is, was hatched by the warmth of the fpring. He was winged and armed, and by his arrows and torch pierced and vivified all things, producing life and joy. Bacon, Vol. V. p. 197. Quarto edit. Lond. 1778. "At this "time, (fays Aristophanes,) fable-winged night produced an egg, from whence fprung "up like a bloss the lovely, the desirable, with his gloss globen wings." Avibus. Bryant's Mythology, Vol. II. p. 350. fecond edition. This interesting moment of this fublime allegory Mrs. Cofway has chosen for her very beautiful painting,

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Firft from the gaping fhell refulgent fprung415IMMORTAL LOVE, his bow celeftial ftrung ;—O'er the wide wafte his gaudy wings unfold,O'er the wide wafte his gaudy wings unfold,Beam his foft fmiles, and wave his curls of gold ;—With filver darts He pierced the kindling frame,420

IX. THE GODDESS paufed, admired with confcious pride
The effulgent legions marshal'd by her fide,
Forms sphered in fire with trembling light array'd,
Ens without weight, and substance without state;
And, while tumultuous joy her boson warms, 425
Waves her white hand, and calls her hosts to arms,

"Unite, ILLUSTRIOUS NYMPHS! your radiant powers, Call from their long repose the VERNAL HOURS.

She has reprefented Eros or divine Love with large wings having the ftrength of the eagle's wings, and the fplendor of the peacocks, with his hair floating in the form of flame, and with a halo of light vapour round his head; which illuminates the painting; while he is in the act of fpringing forwards, and with his hands feparating the elements.

PART L

Wake with foft touch, with rofy hands unbind The ftruggling pinions of the WESTERN WIND; Chafe his wan cheeks, his ruffled plumes repair, And wring the rain-drops from his tangled hair. Blaze round each frofted rill, or ftagnant wave, And charm the NAIAD from her filent cave; Where, fhrined in ice, like NIOBE fhe mourns, And clafps with hoary arms her empty urns.

Of the Western Wind. 1. 430. The principal frosts of this country are accompanied or produced by a N.E. wind, and the thaws by a S.W. wind; the reafon of which is that the N.E. winds confift of regions of air brought from the north, which appear to acquire an eafterly direction as they advance; and the S.W. winds confift of regions of air brought from the fouth, which appear to acquire a wefterly direction as they advance. The furface of the earth nearer the pole moves flower than it does in our latitude; whence the regions of air brought from thence, move flower, when they arrive hither, than the earth's furface with which they now become in contact; that is they acquire an apparent eafterly direction, as the earth moves from weft to eaft fafter than this new part of its atmosphere. The S.W. winds on the contrary confist of regions of air brought from the fouth, where the furface of the earth moves faster than in our latitude; and have therefore a wefterly direction when they arrive hither by their moving fafter than the furface of the earth, with which they are in contact; and in general the nearer to the weft and the greater the velocity of thefe winds the warmer they fhould be in respect to the feafon of the year, fince they have been brought more expeditioufly from the fouth, than those winds which have less westerly direction, and have thence been less cooled in their paffage.

Sometimes I have obferved the thaw to commence immediately on the change of the wind, even within an hour, if I am not miftaken, or fooner. At other times the S.W. wind has continued a day, or even two, before the thaw has commenced; during which time fome of the froity air, which had gone fouthwards, is driven back over us; and in confequence has taken a wefterly direction, as well as a fouthern one. At other times I have obferved a froft with a N.E. wind every morning, and a thaw with a S.W. wind every noon for feveral days together. See additional note, XXXIII.

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Call your bright myriads, trooping from afar, With beamy helms, and glittering fhafts of war; In phalanx firm the FIEND OF FROST affail, Break his white towers, and pierce his cryftal mail; 440 To Zembla's moon-bright coafts the Tyrant bear, And chain him howling to the Northern Bear.

"So when enormous GRAMPUS, iffuing forth From the pale regions of the icy North;

The Fiend of Froft. 1. 439. The principal injury done to vegetation by froft is from the expansion of the water contained in the veffels of plants. Water converted into ice occupies a greater space than it did before, as appears by the bursting of bottles filled with water at the time of their freezing. Hence frost deftroys those plants of our island first, which are most succulent; and the most succulent parts first of other plants; as their leaves and last year's shoots; the vessels of which are distended and burst by the expansion of their freezing fluids, while the drier or more refinous plants, as pines, yews, laurels, and other ever-greens, are less liable to injury from cold. The trees in vallies are on this account more injured by the vernal frosts than those on eminencies, because their early fucculent shouts come out fooner. Hence fruit trees covered by a fix-inch coping of a wall are less injured by the vernal frosts because their being shielded from showers and the defcending night-dews has prevented them from being moift at the time of their being frozen: which circumstance has given occasion to a vulgar error amongst gardeners, who suppose frost to defcend.

As the common heat of the earth in this climate is 48 degrees, those tender trees which will bear bending down, are easily fecured from the frost by spreading them upon the ground, and covering them with straw or fern. This particularly fuits fig-trees, as they easily bear bending to the ground, and are furnished with an acrid juice, which fecures them from the depredations of infects; but are nevertheless liable to be eaten by mice. See additional notes, No. XII.

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Waves his broad tail, and opes his ribbed mouth, 445
And feeks on winnowing fin the breezy South;
From towns deferted rufh the breathlefs hofts,
Swarm round the hills, and darken all the coafts;
Boats follow boats along the fhouting tides,
And fpears and javelins pierce his blubbery fides; 450
Now the bold Sailor, raifed on pointed toe,
Whirls the wing'd harpoon on the flimy foe;
Quick finks the monfter in his oozy bed,
The blood-ftain'd furges circling o'er his head,
Steers to the frozen pole his wonted track, 455
And bears the iron tempeft on his back.

X. "On wings of flame, ETHEREAL VIRGINS! fweep
O'er Earth's fair bofom, and complacent deep;
Where dwell my vegetative realms benumb'd,
In buds imprifon'd, or in bulbs intomb'd, 460

In buds imprifon'd. 1. 460. The buds and bulbs of plants conftitute what is termed by Linneus the Hybernaculum, or winter cradle of the embryon vegetable. The buds arife from the bark on the branches of trees, and the bulbs from the caudex of bulbous-

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Pervade, PELLUCID FORMS ! their cold retreat, Ray from bright urns your viewlefs floods of *heat*;

rooted plants, or the part from which the fibres of the root are produced, they are defended from too much moifture, and from frofts, and from the depredations of infects by various contrivances, as by fcales, hairs, refinous varnifhes, and by acrid rinds.

The buds of trees are of two kinds, either flower-buds or leaf buds; the former of thefe produce their feeds and die; the latter produce other leaf buds or flower buds and die. So that all the buds of trees may be confidered as annual plants, having their embryon produced during the preceeding fummer. The fame feems to happen with refpect to bulbs; thus a tulip produces annually one flower-bearing bulb, fometimes two, and feveral leaf-bearing bulbs; and then the old root perifhes. Next year the flower-bearing bulb produces feeds and other bulbs and perifhes; while the leaf-bearing bulb, producing other bulbs only, perifhes likewife; thefe circumftances eftablifh a ftrict analogy between bulbs and buds. See additional notes, No. XIV.

Viewless floods of heat. 1. 462. The fluid matter of heat, or Calorique, in which all bodies are immerfed, is as neceffary to vegetable as to animal exiftence. It is not yet determinable whether heat and light be different materials, or modifications of the fame materials, as they have fome properties in common. They appear to be both of them equally neceffary to vegetable health, fince without light green vegetables become first yellow, that is, they lose the blue colour, which contributed to produce the green; and afterwards they alfo lose the yellow and become white; as is feen in cellery blanched or etiolated for the table by excluding the light from it.

The upper furface of leaves, which I fuppofe to be their organ of refpiration, feems to require light as well as air; fince plants which grow in windows on the infide of houfes are equally follicitous to turn the upper fide of their leaves to the light. Vegetables at the fame time exfude or perfpire a great quantity from their leaves, as animals do from their lungs; this perfpirable matter as it rifes from their fine veffels, (perhaps much finer than the pores of animal fkins,) is divided into inconcievable tenuity; and when acted upon 'by the Sun's light appears to be decompofed; the hydrogene becomes a part of the vegetable, compofing oils or refins; and the Oxygene combined with light or calorique afcends, producing the pure part of the atmosphere or vital air. Hence during the light of the day vegetables give up more pure air than their refpiration injures; but not fo in the night, even though equally exposed to warmth. This fingle fact would feem to fhew, that light is effentially different from heat; and it is perhaps by its combination with bodies, that their combined or latent heat is fet at liberty, and becomes fensible. See additional note, XXXIV.

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From earth's deep waftes *electric* torrents pour, Or fhed from heaven the fcintillating fhower; Pierce the dull root, relax its fibre-trains, Thaw the thick blood, which lingers in its veins;

Electric torrents pour. 1. 463. The influence of electricity in forwarding the germination of plants and their growth feems to be pretty well eftablished; though Mr. Ingenhouz did not fucceed in his experiments, and thence doubts the fuccess of those of others. And though M. Rouland from his new experiments believes, that neither positive nor negative electricity increases vegetation; both which philosophers had previously been supporters of the contrary doctrine; for many other naturalists have fince repeated their experiments relative to this object, and their new refults have confirmed their former ones. Mr. D'Ormoy and the two Roziers have found the fame fuccess in numerous experiments which they have made in the last two years; and Mr. Carmoy has shewn in a convincing manner that electricity accelerates germination.

Mr. D'Ormoy not only found various feeds to vegetate fooner, and to grow taller which were put upon his infulated table and fupplied with electricity, but alfo that filkworms began to fpin much fooner which were kept electrified than those of the fame hatch which were kept in the fame place and manner, except that they were not electrified. These experiments of M. D'Ormoy are detailed at length in the Journal de Physique of Rozier, Tom. XXXV. p. 270.

M. Bartholon, who had before written a tract on this fubject, and proposed ingenious methods for applying electricity to agriculture and gardening, has also repeated a numerous fet of experiments; and shews both that natural electricity, as well as the artificial, increases the growth of plants, and the germination of feeds; and opposes Mr. Ingenhouz by very numerous and conclusive facts. Ib. Tom. XXXV. p. 401.

Since by the late difcoveries or opinions of the Chemifts there is reafon to believe that water is decomposed in the veffels of vegetables; and that the Hydrogene or inflammable air, of which it in part confists, contributes to the nourifhment of the plant, and to the production of its oils, rofins, gums, fugar, &c. and lastly as electricity decomposes water into these two airs termed Oxygene and Hydrogene, there is a powerful analogy to induce us to believe that it accelerates or contributes to the growth of vegetation, and like heat may possibly enter into combination with many bodies, or form the basis of fome yet unanalifed acid.

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Melt with warm breath the fragrant gums, that bind The expanding foliage in its fcaly rind; And as in air the laughing leaflets play, And turn their fhining bofoms to the ray, 470 NYMPHS ! with fweet fmile each opening flower invite, And on its damafk eyelids pour the *light*.

"So fhall my pines, Canadian wilds that fhade, Where no bold ftep has pierc'd the tangled glade, High-towering palms, that part the Southern flood 475 With fhadowy ifles and continents of wood, Oaks, whofe broad antlers creft Britannia's plain, Or bear her thunders o'er the conquer'd main, Shout, as you pafs, inhale the genial fkies, And bafk and brighten in your beamy eyes; 480 Bow their white heads, admire the changing clime, Shake from their candied trunks the tinkling rime; With burfting buds their wrinkled barks adorn, And wed the timorous floret to her thorn;

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Deep strike their roots, their lengthening tops revive, And all my world of foliage wave, alive. 458

"Thus with Hermetic art the ADEPT combines The royal acid with cobaltic mines; Marks with quick pen, in lines unfeen portrayed, The blufhing mead, green dell, and dufky glade; 490 Shades with pellucid clouds the tintlefs field, And all the future Group exifts conceal'd; Till waked by fire the dawning tablet glows, Green fprings the herb, the purple floret blows, Hills vales and woods in bright fucceffion rife, 495 And all the living landfcape charms his eyes.

IX. "With creft of gold fhould fultry SIRIUS glare, And with his kindling treffes fcorch the air;

Thus with Hermetic art. 1. 487. The fympathetic inks made by Zaffre diffolved in the marine and nitrous acids have this curious property, that being brought to the fire one of them becomes green, and the other red; but what is more wonderful, they again lofe these colours, (unless the heat has been too great,) on their being again withdrawn from the fire. Fire-screens have been thus painted, which in the cold have shewn only the trunk and branches of a dead tree, and fandy hills, which on their approach to the fire have put forth green leaves and red flowers, and grass upon the mountains. The process of making these inks is very easy, take Zaffre, as fold by the druggists, and digest

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With points of flame the fhafts of Summer arm, And burn the beauties he defigns to warm ;--500 -So erft when JovE his oath extorted mourn'd, And clad in glory to the Fair return'd; While Loves at forky bolts their torches light, And refting lightnings gild the car of Night; His blazing form the dazzled Maid admir'd, 505 Met with fond lips, and in his arms expir'd ;--NYMPHS! on light pinion lead your banner'd hofts High o'er the cliffs of ORKNEY's gulphy coafts; Leave on your left the red volcanic light, Which HECCLA lifts amid the dufky night; 510 Mark on the right the DOFRINE's fnow-capt brow, Where whirling MAELSTROME roars and foams below; Watch with unmoving eye, where CEPHEUS bends His triple crown, his fcepter'd hand extends;

it in aqua regia, and the calx of Cobalt will be diffolved; which folution muft be diluted with a little common water to prevent it from making too ftrong an imprefion on the paper; the colour when the paper is heated becomes of a fine green-blue. If Zaffre or Regulus of Cobalt be diffolved in the fame manner in fpirit of nitre, or aqua fortis, a reddifh colour is produced on exposing the paper to heat. Chemical Dictionary by Mr. Keir, Art. Ink Sympathetic.

PARTL

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Where fluds CASSIOPE with flars unknown 515
Her golden chair, and gems her fapphire zone;
Where with vaft convolution DRACO holds
The ecliptic axis in his fcaly folds,
O'er half the fkies his neck enormous rears,
And with immenfe meanders parts the BEARS; 520
Onward, the kindred BEARS with footflep rude
Dance round the Pole, purfuing and purfued.

" There in her azure coif and ftarry ftole, Grey Twilight fits, and rules the flumbering Pole; Bends the pale moon-beams round the fparkling coaft, And ftrews with livid hands eternal froft. 526 There, Nymphs! alight, array your dazzling powers, With fudden march alarm the torpid Hours;

With flars unknown. 1. 515. Alluding to the flar which appeared in the chair of Caffiopea in the year 1572, which at first furpassed Jupiter in magnitude and brightness, diminished by degrees and disappeared in 18 months; it alarmed all the astronomers of the age, and was esteemed a comet by fome.—Could this have been the Georgium fidus?

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On ice-built ifles expand a thoufand fails,

Hinge the ftrong helms, and catch the frozen gales;

On ice-built ifles. 1. 529. There are many reafons to believe from the accounts of travellers and navigators, that the iflands of ice in the higher northern latitudes as well as the Glaciers on the Alps continue perpetually to increafe in bulk. At certain times in the ice-mountains of Switzerland there happen cracks which have flewn the great thicknefs of the ice, as fome of these cracks have measured three or four hundred ells deep. The great islands of ice in the northern feas near Hudson's bay have been observed to have been immersed above one hundred fathoms beneath the furface of the fea, and to have rifen a fifth or fixth part above the furface, and to have measured between three and four miles in circumference. Phil. Trans. No. 465. Sect. 2.

Dr. Lifter endeavoured to fhew that the ice of fea-water contains fome falt and perhaps lefs air than common ice, and that it is therefore much more difficult of folution; whence he accounts for the perpetual and great increase of these floating islands of ice. Philof. Trans. No. 169.

As by a famous experiment of Mr. Boyles it appears that ice evaporates very faft in fevere frofty weather when the wind blows upon it; and as ice in a thawing flate is known to contain fix times more cold than water at the fame degree of fenfible coldnefs, it is eafy to underftand that winds blowing over iflands and continents of ice perhaps much below nothing on Farenheit's fcale, and coming from thence into our latitude muft bring great degrees of cold along with them. If we add to this the quantity of cold produced by the evaporation of the water as well as by the folution of the ice, we cannot doubt but that the northern ice is the principle fource of the coldnefs of our winters, and that it is brought hither by the regions of air blowing from the north, and which take an apparent eafterly direction by their coming to a part of the furface of the earth which moves fafter than the latitude they come from. Hence the increafe of the ice in the polar regions by increafing the cold of our climate adds at the fame time to the bulk of the Glaciers of Italy and Switzerland.

If the nations who inhabit this hemifphere of the globe, inftead of deftroying their fea-men and exhaufting their wealth in unneceffary wars, could be induced to unite their labours to navigate thefe immenfe maffes of ice into the more fouthern oceans, two great advantages would refult to mankind, the tropic countries would be much cooled by their folution, and our winters in this latitude would be rendered much milder for perhaps a century or two, till the maffes of ice became again enormous.

Mr. Bradley i ribes the cold winds and wet weather which fometimes happen in May and June to the folution of ice-iflands accidentally floating from the north. Treatife on Hufbandry and Gardening, Vol. II. p. 437. And adds, that Mr. Barham about The winged rocks to feverifh climates guide, Where fainting Zephyrs pant upon the tide; 530 Pafs, where to CEUTA CALPE's thunder roars, And anfwering echoes fhake the kindred fhores; Pafs, where with palmy plumes CANARY fmiles, And in her filver girdle binds her ifles; Onward, where NIGER's dufky Naiad laves 535 A thoufand kingdoms with prolific waves, Or leads o'er golden fands her threefold train In fteamy channels to the fervid main, While fwarthy nations croud the fultry coaft, Drink the frefh breeze, and hail the floating Froft, 540

the year 1718, in his voyage from Jamaica to England in the beginning of June, met with ice-iflands coming from the north, which were furrounded with fo great a fog that the fhip was in danger of ftriking upon them, and that one of them measured fixty miles in length.

We have lately experienced an inftance of ice-iflands brought from the Southern polar regions, on which the Guardian ftruck at the beginning of her paffage from the Cape of Good Hope towards Botany Bay, on December 22, 1789. These iflands were involved in mist, were about one hundred and fifty fathoms long, and about fifty fathoms above the furface of the water. A part from the top of one of them broke off and fell into the sea, causing an extraordinary commotion in the water and a thick smoke all round it.

Threefold train. 1.537. The river Niger after traverfing an immenfe tract of populous country is fuppofed to divide itfelf into three other great rivers. The Rio Grande, the Gambia, and the Senegal. Gold-duft is obtained from the fands of thefe rivers.

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NYMPHS! veil'd in mift, the melting treafures fteer, And cool with arctic fnows the tropic year. So from the burning Line by Monfoons driven Clouds fail in fquadrons o'er the darken'd heaven ; Wide waftes of fand the gelid gales pervade, 545 And ocean cools beneath the moving fhade.

XII. Should SOLSTICE, stalking through the fickening bowers,

Suck the warm dew-drops, lap the falling fhowers; Kneel with parch'd lip, and bending from it's brink From dripping palm the fcanty river drink; 550 NYMPHS! o'er the foil ten thoufand points erect, And high in air the electric flame collect.

Wide wastes of fand. 1. 545. When the fun is in the Southern tropic 36 deg. distant from the zenith, the thermometer is feldom lower than 72 deg. at Gondar in Abyffinia, but it falls to 60 or 53 deg. when the fun is immediately vertical; fo much does the approach of rain counteract the heat of the fun. Bruce's Travels, Vol. 3. p. 670.

Ten thousand points erect. 1. 551. The folution of water in air or in calorique, feems to acquire electric matter at the fame time, as appears from an experiment of Mr. Bennet. He put fome live coals into an infulated funnel of metal, and throwing on them a little water observed that the ascending steam was electrifed plus, and the water which de-

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Soon shall dark mifts with felf-attraction shroud The blazing day, and fail in wilds of cloud; Each filvery Flower the streams aerial quaff, Bow her fweet head, and infant Harvest laugh.

" Thus when ELIJA mark'd from Carmel's brow In bright expanse the briny flood below; Roll'd his red eyes amid the fcorching air, Smote his firm breaft, and breathed his ardent prayer; High in the midft a maffy altar flood, 561 And flaughter'd offerings prefs'd the piles of wood ; While ISRAEL's chiefs the facred hill furround, And famish'd armies crowd the dufty ground ;

fcended through the funnel was electrifed minus. Hence it appears that though clouds by their change of form may fometimes become electrifed minus yet they have in general an accumulation of electricity. This accumulation of electric matter also evidently contributes to fupport the atmospheric vapour when it is condensed into the form of clouds, becaufe it is feen to defcend rapidly after the flathes of lightning have diminished its quantity; whence there is reafon to conclude that very numerous metallic rods with fine points erected high in the air might induce it at any time to part with fome of its water.

If we may truft the theory of Mr. Lavoifier concerning the composition and decompolition of water, there would feem another fource of thunder-fhowers; and that is, that the two gaffes termed oxygene gas or vital air, and hydrogene gas or inflammable air, may exift in the fummer atmosphere in a flate of mixture but not of combination, and that the electric fpark or flash of lightning may combine them and produce water instantaneously.

555

While proud Idolatry was leagued with dearth, 565 And wither'd famine fwept the defert earth .---"OH, MIGHTY LORD ! thy woe-worn fervant hear, "Who calls thy name in agony of prayer; " Thy fanes difhonour'd, and thy prophets flain, " Lo! I alone furvive of all thy train !--570 " Oh fend from heaven thy facred fire, - and pour " O'er the parch'd land the falutary fhower,-" So shall thy Priest thy erring flock recal,-" And fpeak in thunder, " THOU ART LORD OF ALL."-He cried, and kneeling on the mountain-fands, 575 Stretch'd high in air his fupplicating hands. -Defcending flames the dufky fhrine illume; Fire the wet wood, the facred bull confume; Wing'd from the fea the gathering mifts arife, And floating waters darken all the fkies; 580 The King with shifted reins his chariot bends, And wide o'er earth the airy flood defcends; With mingling cries difperfing hofts applaud, And fhouting nations own THE LIVING GOD."

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The GODDESS ceafed,-the exulting tribes obey, Start from the foil, and win their airy way; 586 The vaulted skies with streams of transient rays Shine, as they pafs, and earth and ocean blaze. So from fierce wars when lawlefs Monarch's ceafe, Or Liberty returns with laurel'd Peace; 590 Bright fly the fparks, the colour'd luftres burn, Flash follows flash, and flame-wing'd circles turn ; Blue ferpents fweep along the dufky air, Imp'd by long trains of fcintillating hair; Red rockets rife, loud cracks are heard on high, 595 And showers of stars rush headlong from the sky, Burft, as in filver lines they hifs along, And the quick flash unfolds the gazing throng.

Argument of the Second Canto.

Matter circulates. Manures and Veretables like Chyle to Ani-

central fubterraneous fires. Production of Tin. Copper.

ADDRESS to the Gnomes. I. The Earth thrown from a volcano of the Sun; it's atmosphere and ocean; it's journey through the zodiac; viciffitude of day-light, and of feafons, 11. II. Primeval islands. Paradife, or the golden Age. Venus rifing from the fea, 33. III. The first great earthquakes; continents raifed from the fea; the Moon thrown from a volcano, has no atmosphere, and is frozen; the earth's diurnal motion retarded; it's axis more inclined; whirls with the moon round a new centre. 67. IV. Formation of lime-ftone by aqueous folution; calcaneous fpar; white marble; antient statue of Hercules refting from his labours. Antinous. Apollo of Belvidere. Venus de Medici. Lady Elizabeth Fofter, and Lady Melbourn by Mrs. Damer. 93. V. I. Of moraffes. Whence the production of Salt by elutriation. Salt-mines at Cracow, 115. 2. Production of nitre. Mars and Venus caught by Vulcan, 143. 3. Production of iron. Mr. Michel's improvement of artificial magnets. Ufes of Steel in agriculture, navigation, war, 183. IV. Production of acids, whence Flint. Sea-fand. Selenite. Afbeftus. Fluor. Onyx, Agate, Mocho, Opal, Sapphire, Ruby, Diamond. Jupiter and Europa, 215. VI. 1. New fubterraneous fires from fermentation. Production of Clays; manufacture of Porcelain in China; in Italy; in England. Mr. Wedgwood's works at Etruria in Staffordshire. Cameo of a Slave in Chains; of Hope. Figures on the Portland or Barberini vafe explained, 271. 2. Coal; Pyrite; Naphtha; Jet; Amber. Dr. Franklin's difcovery of difarming the Tempest of it's lightning. Liberty of America; of Ireland; of France, 349. VII. Antient

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the zodiac ... virisitude of day-light, and of fedore, rr. M. Primeral

nitre. Mars and Venus caught by Vulcan, 143. 3. Froduction of

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ECONOMY OF VEGETATION.

And ruftling harvefts how HHT golden heads, and What

Wide o'er the fields the billowy tumult foreads,

From the deep craters of his realins of fire,

And gave the affonified void another world.

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CANTO II.

When from it's vaporous air, condensed by cold, mi

When high in ether, with explorion dire, all and I made

AND NOW THE GODDESS with attention fweet Turns to the GNOMES, that circle round her feet; Orb within orb approach the marshal'd trains, And pigmy legions darken all the plains; Thrice fhout with filver tones the applauding bands, Bow, ere She fpeaks, and clap their fairy hands.

phone it diumal revolution. As 21 verour cooled the water would be preci-

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So the tall grafs, when noon-tide zephyr blows, Bends it's green blades in undulating rows; Wide o'er the fields the billowy tumult fpreads, And ruftling harvefts bow their golden heads.

I. "GNOMES! YOUR bright forms, prefiding at her birth, Clung in fond fquadrons round the new-born EARTH; When high in ether, with explosion dire, From the deep craters of his realms of fire, The whirling Sun this ponderous planet hurl'd, 15 And gave the aftonish'd void another world. When from it's vaporous air, condensed by cold, Descending torrents into oceans roll'd;

From the deep craters. I. 14. The exiftence of folar volcanos is countenanced by their analogy to terreftrial, and lunar volcanos; and by the fpots on the fun's difk, which have been fhewn by Dr. Wilfon to be excavations through its luminous furface, and may be fuppofed to be the cavities from whence the planets and comets were ejected by explosions. See additional notes, No. XV. on folar volcanos.

When from its vaporous air. 1. 17. If the nucleus of the earth was thrown out from the fun by an explosion along with as large a quantity of furrounding hot vapour as its attraction would occasion to accompany it, the ponderous femi-fluid nucleus would take a spherical form from the attraction of its own parts, which would become an oblate spheroid from its diurnal revolution. As the vapour cooled the water would be preci[61]

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And fierce attraction with relentless force Bent the reluctant wanderer to it's course.

"Where yet the Bull with diamond-eye adorns The Spring's fair forehead, and with golden horns; Where yet the Lion climbs the ethereal plain, And fhakes the Summer from his radiant mane; Where Libra lifts her airy arm, and weighs, Poifed in her filver ballance, nights and days; With paler luftres where Aquarius burns, And fhowers the ftill fnow from his hoary urns; YOUR ardent troops purfued the flying fphere, Circling the ftarry girdle of the year; While fweet vicifitudes of day and clime Mark'd the new annals of enafcent Time.

pitated, and an ocean would furround the fpherical nucleus with a fuperincumbent atmofphere. The nucleus of folar lava would likewife become harder as it became cooler. To understand how the strata of the earth were afterwards formed from the fediments of this circumfluent ocean the reader is referred to an ingenious Treatife on the Theory of the Earth by Mr. Whitehurst, who was many years a watch-maker and engineer at Derby, but whose ingenuity, integrity, and humanity, were rarely equalled in any station of life.

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II. "You trod with printlefs ftep Earth's tender globe,
While Ocean wrap'd it in his azure robe;
Beneath his waves her hardening ftrata fpread, 35
Raifed her PRIMEVAL ISLANDS from his bed,

While ocean wrap'd. 1. 34. See additional notes, No. XVI. on the production of calcareous earth.

The Spring's fair forehead, and with golden horns;

Her hardening firata fpread. 1. 35. The granite, or moor-ftone, or porphory, confitute the oldeft part of the globe, fince the limeftone, fhells, coralloids, ond other feaproductions reft upon them; and upon thefe fea-productions are found clay, iron, coal, falt, and filiceous fand or grit-ftone. Thus there feem to be three divisions of the globe diftinctly marked; the firft I fuppofe to have been the original nucleus of the earth, or lava projected from the fun; 2. over this lie the recrements of animal and vegetable matter produced in the ocean; and, 3. over thefe the recrements of animal and vegetable matter produced upon the land. Befides thefe there are bodies which owe their origin to a combination of thofe already mentioned, as filiceous fand, fluor, alabafter; which feem to have derived their acids originally from the vegetable kingdom, and their earthy bafes from fea-productions. See additional notes, No. XVI. on calcareous earth.

Raifed her primeval iflands. 1. 36. The nucleus of the earth, ftill covered with water, received perpetual increase by the immense quantities of shells and coralloids either annually produced and relinquished, or left after the death of the animals. These would gradually by their different degrees of cohesion be some of them more and others less removable by the influence of solar tides, and gentle tropical breezes, which then must have probably extended from one pole to the other; for it is supposed the moon was not yet produced, and that no storms or unequal winds had yet existence.

Hence then the primeval islands had their gradual origin, were raifed but a few feet above the level of the fea, and were not exposed to the great or fudden variations of heat and cold, as is fo well explained in Mr. Whithurst's Theory of the Earth, chap. xvi. Whence the paradife of the facred writers, and the golden age of the profane ones, feems to have had a real existence. As there can be no rainbow, when the heavens are covered with clouds, because the fun-beams are then precluded from falling upon the rain-drops opposite to the eye of the spectator, the rainbow is a mark of gentle or partial showers. Mr. Whitehurst has endeavoured to show that the primitive islands were only moistened
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Charm'd the blue fifterhood with plays

Stretch'd her wide lawns, and funk her winding dells, And deck'd her fhores with corals, pearls, and fhells.

"O'er thofe bleft ifles no ice-crown'd mountains tower'd, No lightnings darted, and no tempefts lower'd; 40 Soft fell the vefper-drops, condenfed below, Or bent in air the rain-refracted bow; Sweet breathed the zephyrs, juft perceiv'd and loft; And brinelefs billows only kifs'd the coaft; Round the bright zodiac danced the vernal hours, 45 And Peace, the Cherub, dwelt in mortal bowers !

by nocturnal dews and not by fhowers, as occurs at this day to the Delta of Egypt; and is thence of opinion, that the rainbow had no existence till after the production of mountains and continents. As the falt of the sea has been gradually accumulating, being washed down into it from the recrements of animal and vegetable bodies, the sea must originally have been as fresh as river water; and as it is not yet faturated with falt, must become annually more faline. See note on 1. 117 of this Canto.

So young Dione. 1. 47. There is an antient gem reprefenting Venus rifing out of the ocean fupported by two Tritons. From the formality of the defign it would appear to be of great antiquity before the introduction of fine tafte into the world. It is probable that this beautiful allegory was originally an hieroglyphic picture (before the invention of letters) defcriptive of the formation of the earth from the ocean, which feems to have been an opinion of many of the most antient philosophers.

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" So young DIONE, nurfed beneath the waves, And rock'd by Nereids in their coral caves, Charm'd the blue fifterhood with playful wiles, Lifp'd her fweet tones, and tried her tender fmiles. 50 Then, on her beryl throne by Triton's borne, Bright rofe the Goddefs like the Star of morn; When with foft fires the milky dawn He leads, And wakes to life and love the laughing meads ;--With rofy fingers, as uncurl'd they hung 55 Round her fair brow, her golden locks fhe wrung; O'er the fmooth furge on filver fandals ftood, And look'd enchantment on the dazzled flood .--The bright drops, rolling from her lifted arms, In flow meanders wander o'er her charms, 60 Seek round her fnowy neck their lucid track, Pearl her white fhoulders, gem her ivory back, Round her fine waift and fwelling bofom fwim, And ftar with glittering brine each cryftal limb .--

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-The immortal form enamour'd Nature hail'd, And Beauty blazed to heaven and earth, unvail'd.

III. "You! who then, kindling after many an age,
Saw with new fires the first VOLCANO rage,
O'er smouldering heaps of livid sulphur swell
At Earth's firm centre, and distend her shell, 70

The first volcano. 1. 68. As the earth before the existence of earthquakes was nearly level, and the greatest part of it covered with fea; when the first great fires began deep in the internal parts of it, those parts would become much expanded; this expansion would be gradually extended, as the heat increased, through the whole terraqueous globe of 7000 miles diameter; the crust would thence in many places open into fiffures, which by admitting the fea to flow in upon the fire, would produce not only a quantity of fteam beyond calculation by its expansion, but would also by its decomposition produce inflammable air and vital air in quantities beyond conception, fufficient to effect those violent explosions, the vestiges of which all over the world excite our admiration and our ftudy; the difficulty of understanding how subterraneous fires could exist without the prefence of air has disappeared fince Dr. Priestley's discoveries of such great quantities of pure air which conffitute all the acids, and confequently exist in all faline bodies, as feafalt, nitre, lime-stone, and in all calciform ores, as manganese, calamy, ochre, and other mineral substances. See an ingenious treatise by Mr. Michel on earthquakes in the Philof. Tranf.

In these first tremendous ignitions of the globe, as the continents were heaved up, the vallies, which now hold the sea, were formed by the earth fubsiding into the cavities made by the rifing mountains; as the steam, which raised them condensed; which would thence not have any caverns of great extent remain beneath them, as some philosophers have imagined. The earthquakes of modern days are of very small extent indeed compared to those of antient times, and are ingeniously compared by M. De Luc to the operations of a mole-hill, where from a small cavity are raised from time to time small quantities of lava or pumice store. Monthly Review, June, 1790.

PART I.

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Saw at each opening cleft the furnace glow, And feas rufh headlong on the gulphs below.— GNOMES! how you fhriek'd! when through the troubled air Roar'd the fierce din of elemental war; When rofe the continents, and funk the main, 75 And Earth's huge fphere exploding burft in twain.— GNOMES! how you gazed! when from her wounded fide Where now the South-Sea heaves its wafte of tide, Rofe on fwift wheels the MOON's refulgent car, Circling the folar orb, a fifter-ftar, 80 Dimpled with vales, with fhining hills embofs'd, And roll'd round Earth her airlefs realms of froft.

The moon's refulgent car. 1. 77. See additional notes, No. XV. on folar volcanos,

Her airlefs realms of froft. 1.82. If the moon had no atmosphere at the time of its elevation from the earth; or if its atmosphere was afterwards stolen from it by the earth's attraction; the water on the moon would rife quickly into vapour; and the cold produced by a certain quantity of this evaporation would congeal the remainder of it. Hence it is not probable that the moon is at present inhabited, but as it feems to have fuffered and to continue to fuffer much by volcanos, a fufficient quantity of air may in process of time be generated to produce an atmosphere; which may prevent its heat from fo easily escaping, and its water from fo easily evaporating, and thence become fit for the production of vegetables and animals.

That the moon possefiles little or no atmosphere is deduced from the undiminished Justre of the stars, at the instant when they emerge from behind her disk. That the

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"GNOMES! how you trembled! with the dreadful force When Earth recoiling ftagger'd from her courfe; When, as her Line in flower circles fpun, 85 And her fhock'd axis nodded from the fun, 85 With dreadful march the accumulated main Swept her vaft wrecks of mountain, vale, and plain; And, while new tides their fhouting floods unite, 90

ocean of the moon is frozen, is confirmed from there being no appearance of lunar tides; which, if they exifted, would cover the part of her difk nearest the earth. See note on Canto III. 1. 61.

When earth recoiling. 1.84. On fuppolition that the moon was thrown from the earth by the explosion of water or the generation of other vapours of greater power, the remaining part of the globe would recede from its orbit in one direction as the moon receded in another, and that in proportion to the respective momentum of each, and would afterwards revolve round their common centre of gravity.

If the moon role from any part of the earth except exactly at the line or poles, the fhock would tend to turn the axis of the earth out of its previous direction. And as a mass of matter rising from deep parts of the globe would have previously acquired lefs diurnal velocity than the earth's furface from whence it role, it would receive during the time of its rising additional velocity from the earth's furface, and would confequently fo much retard the motion of the earth round its axis.

When the earth thus receded the flock would overturn all its buildings and forefts, and the water would rufh with inconceivable violence over its furface towards the new fatellite, frem two caufes, both by its not at firft acquiring the velocity with which the earth receded, and by the attraction of the new moon, as it leaves the earth; on thefe accounts at firft there would be but one tide till the moon receded to a greater diffance, and the earth moving round a common centre of gravity between them, the water on the fide furtheft from the moon would acquire a centrifugal force in refpect to this common centre between itfelf and the moon.

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Chain'd to one centre whirl'd the kindred fpheres, And mark'd with lunar cycles folar years.

IV. "GNOMES! vou then bade diffolving SHELLS diftil From the loofe fummits of each fhatter'd hill, To each fine pore and dark interflice flow, 95 And fill with liquid chalk the mafs below. Whence fparry forms in dufky caverns gleam With borrow'd light, and twice refract the beam ; While in white beds congealing rocks beneath Court the nice chiffel, and defire to breathe.— 100

Diffolving fhells diffil. 1.93. The lime-ftone rocks have had their origin from fhells formed beneath the fea, the fofter ftrata gradually diffolving and filling up the interffices of the harder ones, afterwards when thefe accumulations of fhells were elevated above the waters the upper ftrata became diffolved by the actions of the air and dews, and filled up the interffices beneath, producing folid rocks of different kinds from the coarfe lime-ftones to the fineft marbles. When those lime-ftones have been in fuch a fituation that they could form perfect cryftals they are called fpars, fome of which poffers a double refraction, as observed by Sir Isaac Newton. When these crystals are jumbled together or mixed with fome colouring impurities it is termed marble, if its texture be equable and firm; if its texture be coarfe and porous yet hard, it is called lime-ftone; if its texture be very loofe and porous it is termed chalk. In fome rocks the fhells remain almost unchanged and only covered, or bedded with lime-ftone, which feems to have been diffolved and funk down amongft them. In others the fofter fhells and bones are diffolved, and only fharks teeth or harder echini have preferved their form inveloped in the chalk or lime-ftone; in fome marbles the folution has been compleat and no veftiges of fhell appear, as in the white kind called flatuary by the workmen. See addit. notes, No. XVI.

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"Hence wearied HERCULES in marble rears His languid limbs, and refts a thoufand years; Still, as he leans, fhall young ANTINOUS pleafe With carelefs grace, and unaffected eafe; Onward with loftier ftep APOLLO fpring, 105 And launch the unerring arrow from the ftring; In Beauty's bafhful form, the veil unfurl'd, Ideal VENUS win the gazing world. Hence on ROUBILIAC'S tomb fhall Fame fublime Wave her triumphant wings, and conquer Time; 110 Long with foft touch fhall DAMER'S chiffel charm, With grace delight us, and with beauty warm;

Hence wearied Hercules. 1. 101. Alluding to the celebrated Hercules of Glyco refting after his labours; and to the eafy attitude of Antinous; the lofty ftep of the Apollo of Belvidere; and the retreating modefly of the Venus de Medici. Many of the defigns by Roubiliac in Weftminfter Abbey are uncommonly poetical; the allegory of Time and Fame contending for the trophy of General Wade, which is here alluded to, is beautifully told; the wings of Fame are ftill expanded, and her hair ftill floating in the air; which not only fhews that fhe has that moment arrived, but alfo that her force is not yet expended; at the fame time, that the old figure of Time with his difordered wings is rather leaning backwards and yielding to her impulfe, and must apparently in another inftant be driven from his attack upon the trophy. FOSTER'S fine form shall hearts unborn engage, And MELBOURN'S smile enchant another age.

V. GNOMES! you then taught transuding dews to pass Through time-fall'n woods, and root-inwove morals 116 Age after age; and with filtration fine Dispart, from earths and fulphurs, the faline.

1. "HENCE with diffusive SALT old Ocean steeps His emerald shallows, and his sapphire deeps. 120

Foster's fine form. l. 113. Alluding to the beautiful statues of Lady Elizabeth Foster and of Lady Melbourn executed by the ingenious Mrs. Damer.

Root-inwove morafs. 1. 116. The great mass of matter which refts upon the lime-ftone ftrata of the earth, or upon the granite where the lime-ftone ftratum has been removed by earthquakes or covered by lava, has had its origin from the recrements of vegetables and of air-breathing animals, as the lime-ftone had its origin from fea animals. The whole habitable world was originally covered with woods, till mankind formed themfelves into focieties, and fubdued them by fire and by fteel. Hence woods in uncultivated countries have grown and fallen through many ages, whence moraffes of immenfe extent; and from these as the more foluble parts were washed away first, were produced fea-falt, nitre, iron, and variety of acids, which combining with calcareous matter were productive of many fosfil bodies, as flint, fea-fand, felenite, with the precious ftones, and perhaps the diamond. See additional notes, No. XVII.

Hence with diffusive falt. 1. 119. Salts of various kinds are produced from the recrements of animal and vegetable bodies, fuch as phosphoric, ammoniacal, marine falt, and

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Oft in wide lakes, around their warmer brim In hollow pyramids the cryftals fwim; Or, fufed by earth-born fires, in cubic blocks Shoot their white forms, and harden into rocks. 124

others; these are washed from the earth by rains, and carried down our rivers into the fea; they feem all here to decompose each other except the marine falt, which has therefore from the beginning of the habitable world been perpetually accumulating.

There is a town in the immenfe falt-mines of Cracow in Poland, with a marketplace, a river, a church, and a famous flatue, (here fuppofed to be of Lot's wife) by the moift or dry appearance of which the fubterranean inhabitants are faid to know when the weather is fair above ground. The galleries in these mines are so numerous and so intricate, that workmen have frequently loft their way, their lights having been burnt out, and have perifhed before they could be found. Effais, &c. par M. Macquart. And though the arches of these different stories of galleries are boldly executed, yet they are not dangerous; as they are held together or fupported by large maffes of timber of a foot fquare; and thefe vaft timbers remain perfectly found for many centuries, while all other pillars whether of brick, cement, or falt foon diffolve or moulder away. Ibid. Could the timbers over water-mill wheels or cellars, be thus preferved by occafionally foaking them with brine ? These immense masses of rock-falt seem to have been produced by the evaporation of fea-water in the early periods of the world by fubterranean fires. Dr. Hutton's Theory of the Earth. See alfo Theorie des Sources Salees, par Mr. Struve. Histoire de Sciences de Laufanne. Tom. II. This idea of Dr. Hutton's is confirmed by a fact mentioned in M. Macquart's Effais fur Minerologie, who found a great quantity of foffil fhells, principally bi-valves and madre-pores, in the falt-mines of Wialiczka near Cracow. During the evaporation of the lakes of falt-water, as in artificial faltworks, the falt begins to cryftallize near the edges where the water is fhalloweft, forming hollow inverted pyramids; which, when they become of a certain fize, fubfide by their gravity; if urged by a ftronger fire the falt fufes or forms large cubes; whence the falt fhaped in hollow pyramids, called flake-falt, is better tafted and preferves flefh better, than the bafket or powder falt; becaufe it is made by lefs heat and thence contains more of the marine acid. The fea-water about our ifland contains from about one twentyeighth to one thirtieth part of fea-falt, and about one eightieth of magnefian falt. See Brownrigg on Salt, See note on Ocymum, Vol. II. of this work,

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"Thus, cavern'd round in CRACOW's mighty mines, With cryftal walls a gorgeous city fhines; Scoop'd in the briny rock long streets extend Their hoary courfe, and glittering domes afcend; Down the bright steeps, emerging into day, Impetuous fountains burft their headlong way, 130 O'er milk-white vales in ivory channels fpread, And wondering feek their fubterraneous bed. Form'd in pellucid falt with chiffel nice, The pale lamp glimmering through the fculptured ice, With wild reverted eyes fair LOTTA stands, 135 And fpreads to Heaven, in vain, her glaffy hands; Cold dews condense upon her pearly breaft, And the big tear rolls lucid down her veft. Far gleaming o'er the town transparent fanes Rear their white towers, and wave their golden vanes; Long lines of luftres pour their trembling rays, 141 And the bright vault returns the mingled blaze.

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2. "HENCE orient NITRE owes it's fparkling birth,
And with prifmatic cryftals gems the earth,
O'er tottering domes in filmy foliage crawls, 145
Or frofts with branching plumes the mouldering walls.

Hence orient Nitre. 1. 143. Nitre is found in Bengal naturally cryftallized, and is fwept by brooms from earths and ftones, and thence called fweepings of nitre. It has lately been found in large quantities in a natural bafon of calcareous earth at Molfetta in Italy, both in thin ftrata between the calcareous beds, and in efflorefcences of various beautiful leafy and hairy forms. An account of this nitre-bed is given by Mr. Zimmerman and abridged in Rozier's Journal de Phyfique Fevrier. 1790. This acid appears to be produced in all fituations where animal and vegetable matters are compleatly decomposed, and which are exposed to the action of the air as on the walls of ftables, and flaughter-houses; the cryftals are prifms furrowed by longitudinal groves.

Dr. Prieftley difcovered that nitrous air or gas which he obtained by diffolving metals in nitrous acid, would combine rapidly with vital air, and produce with it a true nitrous acid; forming red clouds during the combination; the two airs occupy only the fpace before occupied by one of them, and at the fame time heat is given out from the new combination. This dimunition of the bulk of a mixture of nitrous gas and vital air, Dr. Prieftley ingenioufly ufed as a teft of the purity of the latter; a difcovery of the greateft importance in the analyfis of airs.

Mr. Cavendifh has fince demonstrated that two parts of vital air or oxygene, and one part of phlogistic air or azote, being long exposed to electric shocks, unite, and produce nitrous acid. Philos. Trans. Vols. LXXV. and LXXVIII.

Azote is one of the most abundant elements in nature, and combined with calorique or heat, it forms azotic gas or phlogistic air, and composes two thirds of the atmosphere; and is one of the principal component parts of animal bodies, and when united to vital air or oxygene produces the nitrous acid. Mr. Lavoisier found that $2I\frac{1}{2}$ parts by weight of azote, and $43\frac{1}{2}$ parts of oxygene produced 64 parts of nitrous gas, and by the further addition of 36 parts of oxygene nitrous acid was produced. Traité de Chimie. When two airs become united fo as to produce an unelastic liquid much calorique or heat is of necessity expelled from the new combination, though perhaps nitrous acid and oxygenated marine acid admit more heat into their combinations than other acids.

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As woos Azotic Gas the virgin Air, And veils in crimfon clouds the yielding Fair, Indignant Fire the treacherous courtship flies, Waves his light wing, and mingles with the skies. 150

" So Beauty's GODDESS, warm with new defire, Left, on her filver wheels, the GoD of Fire; Her faithlefs charms to fiercer MARS refign'd, Met with fond lips, with wanton arms intwin'd. -Indignant VULCAN eyed the parting Fair, 155 And watch'd with jealous ftep the guilty pair; O'er his broad neck a wiry net he flung, Quick as he ftrode, the tinkling methes rung; Fine as the fpider's flimfy thread He wove The immortal toil to lime illicit love; 160 Steel were the knots, and fteel the twifted thong, Ring link'd in ring, indiffolubly ftrong; On viewlefs hooks along the fretted roof He hung, unfeen, the inextricable woof.-

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-Quick ftart the fprings, the webs pellucid fpread, 165 And lock the embracing Lovers on their bed; Fierce with loud taunts vindictive VULCAN fprings, Tries all the bolts, and tightens all the ftrings, Shakes with inceffant fhouts the bright abodes, Claps his rude hands, and calls the feftive Gods .--170 --With fpreading palms the alarmed Goddefs tries To veil her beauties from celeftial eyes, Writhes her fair limbs, the flender ringlets strains, And bids her Loves untie the obdurate chains; Soft fwells her panting bofom, as fhe turns, 175 And her flush'd cheek with brighter blushes burns. Majeftic grief the Queen of Heaven avows, And chafte Minerva hides her helmed brows; Attendant Nymphs with bashful eyes askance Steal of intangled MARS a transient glance; 180 Surrounding Gods the circling nectar quaff, Gaze on the Fair, and envy as they laugh.

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III. "HENCE dufky IRON fleeps in dark abodes,
And ferny foliage neftles in the nodes;
Till with wide lungs the panting bellows blow, 185
And waked by fire the glittering torrents flow;

Hence dufky Iron. 1. 183. The production of iron from the decomposition of vegetable bodies is perpetually prefented to our view; the waters oozing from all moraffes are chalybeate, and deposit their ochre on being exposed to the air, the iron acquiring a calciform state from its union with oxygene or vital air. Where thin moraffes lie on beds of gravel the latter are generally stained by the filtration of some of the chalybeate water through them. This formation of iron from vegetable recrements is further evinced by the fern leaves and other parts of vegetables, so frequently found in the centre of the knobs or nodules of some iron-ores.

In fome of these nodules there is a nucleus of whiter iron-earth furrounded by many concentric firata of darker and lighter iron-earth alternately. In one, which now lies before me, the nucleus is a prifm of a triangular form with blunted angles, and about half an inch high, and an inch and half broad; on every fide of this are concentric ftrata of fimilar iron-earth alternately browner and lefs brown; each ftratum is about a tenth of an inch in thickness and there are ten of them in number. To what known caufe can this exactly regular diffribution of fo many earthy ftrata of different colours. furrounding the nucleus be afcribed ? I dont know that any mineralogists have attempted an explanation of this wonderful phenomenon. I fufpect it is owing to the polarity of the central nucleus. If iron-filings be regularly laid on paper by means of a fmall fieve, and a magnet be placed underneath, the filings will difpofe themfelves in concentric curves with vacant intervals between them. Now if thefe iron-filings are conceived to be fufpended in a fluid, whole fpecific gravity is fimilar to their own, and a magnetic bar was introduced as an axis into this fluid, it is eafy to forefee that the iron filings would difoofe themfelves into concentric fpheres, with intervals of the circumnatant fluid between them, exactly as is feen in these nodules of iron-earth. As all the lavas confist of one fourth of iron, (Kirvan's Mineral) and almost all other known bodies, whether of animal or vegetable origin, poffefs more or lefs of this property, may not the diffribution of a great portion of the globe of the earth into ftrata of greater or lefs regularity be owing to the polarity of the whole?

Quick whirls the wheel, the ponderous hammer falls,
Loud anvils ring amid the trembling walls,
Strokes follow ftrokes, the fparkling ingot fhines,
Flows the red flag, the lengthening bar refines; 19°
Cold waves, immerfed, the glowing mass congeal,
And turn to adamant the hiffing Steel.

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" Laft MICHELL's hands with touch of potent charm The polifh'd rods with powers magnetic arm;

And turn to adamant. 1. 192. The circumftances which render iron more valuable to mankind than any other metal are, 1. its property of being rendered hard to fo great a degree and thus conflituting fuch excellent tools. It was the difcovery of this property of iron, Mr. Locke thinks, that gave fuch pre-eminence to the European world over the American one. 2. Its power of being welded; that is, when two pieces are made very hot and applied together by hammering, they unite compleatly, unlefs any fcale of iron intervenes; and to prevent this it is ufual for fmiths to dip the very hot bar in fand, a little of which fufes into fluid glafs with the fcale and is fqueezed out from between the uniting parts by the force of hammering. 3. Its power of acquiring magnetifm.

It is however to be wifhed that gold or filver were difcovered in as great quantity as iron, fince thefe metals being indeftructible by expofure to air, water, fire or any common acids would fupply wholefome veffels for cookery, fo much to be defired, and fo difficult to obtain, and would form the moft light and durable coverings for houfes, as well as indeftructible fire-grates, ovens, and boiling veffels. See additional notes, No. XVIII. on Steel.

Last Michell's bands. 1. 193. The difcovery of the magnet feems to have been in very early times; it is mentioned by Plato, Lucretius, Pliny, and Galen, and is faid to have taken its name of magnes from Magnefia, a fea-port of antient Lybia.

As every piece of iron which was made magnetical by the touch of a magnet became itfelf a magnet, many attempts were made to improve these artificial magnets, but without much fuccess till Servingdon Savary, Efq. made them of *hardened* steel bars, which

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With points directed to the polar ftars

In one long line extend the temper'd bars;

were fo powerful that one of them weighing three pounds averdupois would lift another of the fame weight. Philof. Tranf.

After this Dr. Knight made very fuccefsful experiments on this fubject, which, though he kept his method fecret, feems to have excited others to turn their attention to magnetifm. At this time the Rev. Mr. Michell invented an equally efficacious and more expeditious way of making ftrong artificial magnets, which he publifhed in the end of the year 1750, in which he explained his method of what he called " the double touch," and which, fince Mr. Knight's method has been known, appears to be fomewhat different from it.

This method of rendering bars of hardened fteel magnetical confifts in holding vertically two or more magnetic bars nearly parallel to each other with their opposite poles very near each other, (but nevertheless feparated to a fmall distance,) these are to be flided over a line of bars laid horizontally a few times backward and forward. See Michell on Magnetism, also a detailed account in Chamber's Dictionary.

What Mr. Michell propoled by this method was to include a very fmall portion of the horizontal bars, intended to be made magnetical, between the joint forces of two or more bars already magnetical, and by fliding them from end to end every part of the line of bars became fucceflively included, and thus bars poffeffed of a very fmall degree of magnetifm to begin with, would in a few times fliding backwards and forwards make the other ones much more magnetical than themfelves, which are then to be taken up and ufed to touch the former, which are in fucceflion to be laid down horizontally in a line.

There is flill a great field remains for future difcoveries in magnetifm both in refpect to experiment and theory; the latter confifts of vague conjectures the more probable of which are perhaps those of Elpinus, as they affimulate it to electricity.

One conjecture I shall add, viz. that the polarity of magnetism may be owing to the earth's rotatory motion. If heat, electricity, and magnetism are supposed to be fluids of different gravities, heat being the heaviest of them, electricity the next heavy, and magnetism the lightest, it is evident that by the quick revolution of the earth the heat will be accumulated most over the line, electricity next beneath this, and that the magnetism will be detruded to the poles and axis of the earth, like the atmospheres of common air and of inflammable gas, as explained in the note on Canto I. l. 123.

Electricity and heat will both of them difplace magnetifin, and this fhews that they may gravitate on each other; and hence when too great a quantity of the electric fluid becomes accumulated at the poles by defeending fnows, or other unknown caufes, it may have a tendency to rife towards the tropics by its centrifugal force, and produce the northern lights. See additional notes, No. I. 2

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Then thrice and thrice with fleady eye he guides, And o'er the adhefive train the magnet flides; The obedient Steel with living inftinct moves, And veers for ever to the pole it loves. 200

" Hail, adamantine STEEL! magnetic Lord! King of the prow, the plowfhare, and the fword ! True to the pole, by thee the pilot guides His fleady helm amid the ftruggling tides, Braves with broad fail the immeafurable fea, 205 Cleaves the dark air, and afks no ftar but Thee .--By thee the plowfhare rends the matted plain, Inhumes in level rows the living grain; Intrusive forests quit the cultured ground, And Ceres laughs with golden fillets crown'd .--210 O'er reftlefs realms when fcowling Difcord flings Her fnakes, and loud the din of battle rings; Expiring Strength, and vanquish'd Courage feel Thy arm refiftlefs, adamantine STEEL !

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IV. "HENCE in fine ftreams diffusive ACIDS flow,
Or wing'd with fire o'er Earth's fair bosom blow; 216
Transmute to glittering Flints her chalky lands,
Or fink on Ocean's bed in countless Sands.
Hence filvery Selenite her chrystal moulds,
And fost Albestus smooths his filky folds; 220
His cubic forms phosphoric Fluor prints,
Or rays in spheres his amethystine tints.
Soft cobweb clouds transparent Onyx spreads,
And playful Agates weave their colour'd threads;

Diffusive Acids flow. 1. 215. The production of marine acid from decomposing vegetable and animal matters with vital air, and of nitrous acid from azote and vital air, the former of which is united to its basis by means of the exhalations from vegetable and animal matters, constitute an analogy which induces us to believe that many other acids have either their bases or are united to vital air by means of some part of decomposing vegetable and animal matters.

The great quantities of flint fand whether formed in mountains or in the fea would appear to derive its acid from the new world, as it is found above the ftrata of lime-ftone and granite which conflitute the old world, and as the earthy bafis of flint is probably calcareous, a great part of it feems to be produced by a conjunction of the new and old world; the recrements of air-breathing animals and vegetables probably afford the acid, and the fhells of marine animals the earthy bafis, while another part may have derived its calcareous part alfo from the decomposition of vegetable and animal bodies.

The fame mode of reafoning feems applicable to the filiceous fromes under various names, as amethyft, onyx, agate, mochoe, opal, &c. which do not feem to have undergone any process from volcanic fires, and as these fromes only differ from flint by a greater or lefs admixture of argillaceous and calcareous earths. The different proportions of which in each kind of frome may be feen in Mr. Kirwan's valuable Elements of Mineralogy. See additional notes, No. XIX.

Gay pictured Mochoes glow with landscape-dyes, 225 And changeful Opals roll their lucid eyes; Blue lambent light around the Sapphire plays, Bright Rubies blush, and living Diamonds blaze.

"Thus, for attractive earth, inconftant Jove Mafk'd in new shapes forfook his realms above.— 230

Living diamonds blaze. 1. 228. Sir Ifaac Newton having obferved the great power of refracting light, which the diamond poffeffes above all other crystallized or vitreous matter, conjectured that it was an inflammable body in fome manner congealed. Infomuch that all the light is reflected which falls on any of its interior furfaces at a greater angle of incidence than 24¹/₄ degrees; whereas an artificial gem of glafs does not reflect any light from its hinder furface, unlefs that furface is inclined in an angle of 41 degrees. Hence the diamond reflects half as much more light as a factitious gem in fimilar circumftances; to which must be added its great transparency, and the excellent polish it is capable of. The diamond had neverthelefs been placed at the head of cryftals or precious ftones by the mineralogifts, till Bergman ranged it of late in the combuftible clafs of bodies, because by the focus of Villette's burning mirror it was evaporated by a heat not much greater than will melt filver, and gave out light. Mr. Hoepfner however thinks the difperfion of the diamond by this great heat fhould be called a phofphorefcent evaporation of it, rather than a combustion; and from its other analogies of crystallization, hardnefs, transparency, and place of its nativity, wifhes again to replace it amongst the precious ftones. Obferv. fur la Phyfique, par Rozier, Tom. XXXV. p. 448. See new edition of the Translation of Cronsted, by De Costa.

Inconftant Jove. 1. 229. The purer air or ether in the antient mythology was reprefented by Jupiter, and the inferior air by Juno; and the conjunction of these deities was faid to produce the vernal showers, and procreate all things, as is further spoken of in Canto III. 1. 204. It is now discovered that pure air, or oxygene, uniting with variety of bases forms the various kinds of acids; as the vitriolic acid from pure air and fulphur;

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First her fweet eyes his Eagle-form beguiles, And HEBE feeds him with ambrofial fmiles; Next the chang'd God a Cygnet's down affumes, And playful LEDA fmooths his gloffy plumes; Then glides a filver Serpent, treacherous gueft! 235 And fair OLYMPIA folds him in her breaft; Now lows a milk-white Bull on Afric's ftrand, And crops with dancing head the daify'd land.-With rofy wreathes EUROPA's hand adorns His fringed forehead, and his pearly horns; 240 Light on his back the fportive Damfel bounds, And pleafed he moves along the flowery grounds; Bears with flow ftep his beauteous prize aloof, Dips in the lucid flood his ivory hoof; Then wets his velvet knees, and wading laves 245 His filky fides amid the dimpling waves.

the nitrous acid from pure air and phlogiftic air, or azote; and carbonic acid, (or fixed air,) from pure air and charcoal. Some of these affinities were perhaps portrayed by the Magi of Egypt, who were probably learned in chemistry, in their hieroglyphic pictures before the invention of letters, by the loves of Jupiter with terrestrial ladies. And thus physically as well as metaphysically might be faid " Jovis omnia plena."

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While her fond train with beckoning hands deplore, Strain their blue eyes, and fhriek along the fhore; Beneath her robe fhe draws her fnowy feet, And, half-reclining on her ermine feat, 250 Round his raifed neck her radiant arms fhe throws, And refts her fair cheek on his curled brows; Her yellow treffes wave on wanton gales, And high in air her azure mantle fails. -Onward He moves, applauding Cupids guide, 255 And fkim on fhooting wing the fhining tide; Emerging Triton's leave their coral caves, Sound their loud conchs, and fmooth the circling waves, Surround the timorous Beauty, as fhe fwims, And gaze enamour'd on her filver limbs. 260 -Now Europe's fhadowy fhores with loud acclaim Hail the fair fugitive, and fhout her name; Soft echoes warble, whifpering forefts nod, And confcious Nature owns the prefent God. -Changed from the Bull, the rapturous God affumes Immortal youth, with glow celeftial blooms, 261

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With lenient words her virgin fears difarms, And clafps the yielding Beauty in his arms; Whence Kings and Heroes own illustrious birth, Guards of mankind, and demigods on earth. 270

VI. "GNOMES! as you país'd beneath the labouring foil, The guards and guides of Nature's chemic toil, You faw, deep-fepulchred in dufky realms, Which Earth's rock-ribbed ponderous vault o'erwhelms, With felf-born fires the mafs fermenting glow, 275 And flame-wing'd fulphurs quit the earths below.

I. "HENCE ductile CLAYS in wide expansion spread, Soft as the Cygnet's down, their snow-white bed;

With felf-born fires. 1. 275. After the accumulation of plains and mountains on the calcareous rocks or granite which had been previoufly raifed by volcanic fires, a fecond fet of volcanic fires were produced by the fermentation of this new mafs, by which after the falts or acids and iron had been wafhed away in part by elutriation, diffipated the fulphurous parts which were infoluble in water; whence argillaceous and filiceous earths were left in fome places; in others, bitumen became fublimed to the upper part of the fratum, producing coals of various degrees of purity.

Hence ductile clays. 1. 277. See additional notes, No. XX.

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With yielding flakes fucceflive forms reveal,And change obedient to the whirling wheel.280—Firft CHINA's fons, with early art elate,280Form'd the gay tea-pot, and the pictured plate;280Saw with illumin'd brow and dazzled eyes280In the red ftove vitrefcent colours rife;285Speck'd her tall beakers with enamel'd ftars,285Her monfter-joffes, and gigantic jars;285Smear'd her huge dragons with metallic hues,285With golden purples, and cobaltic blues;290

"ETRURIA! next beneath thy magic hands Glides the quick wheel, the plaiftic clay expands,

Saw with illumin'd brow. l. 283. No colour is diffinguishable in the red-hot kiln but the red itself, till the workman introduces a small piece of dry wood, which by producing a white flame renders all the other colours visible in a moment.

With golden purples. 1. 288. See additional notes, No. XXI.

Etruria! next. l. 291. Etruria may perhaps vie with China itfelf in the antiquity of its arts. The times of its greatest fplendour were prior to the foundations of Rome, and

Nerved with fine touch, thy fingers (as it turns) Mark the nice bounds of vafes, ewers, and urns; Round each fair form in lines immortal trace Uncopied Beauty, and ideal Grace.

"GNOMES! as you now diffect with hammers fine The granite-rock, the nodul'd flint calcine; Grind with ftrong arm, the circling chertz betwixt, Your pure Ka-o-lins and Pe-tun-tfes mixt; 300 O'er each red faggars burning cave prefide, The keen-eyed Fire-Nymphs blazing by your fide;

the reign of one of its beft princes, Janus, was the oldeft epoch the Romans knew. The earlieft hiftorians fpeak of the Etrufcans as being then of high antiquity, moft probably a colony from Phœnicia, to which a Pelafgian colony acceded, and was united foon after Deucalion's flood. The peculiar character of their earthern vafes confifts in the admirable beauty, fimplicity, and diverfity of forms, which continue the beft models of tafte to the artifts of the prefent times; and in a fpecies of non-vitreous encauftic painting, which was reckoned, even in the time of Pliny, among the loft arts of antiquity, but which has lately been recovered by the ingenuity and induftry of Mr. Wedgwood. It is fuppofed that the principal manufactories were about Nola, at the foot of Vefuvius; for it is in that neighbourhood that the greateft quantities of antique vafes have been found; and it is faid that the general tafte of the inhabitants is apparently influenced by them; infomuch that ftrangers coming to Naples, are commonly ftruck with the diverfity and elegance even of the moft ordinary vafes for common ufes. See D'Hancarville's preliminary difcourfes to the magnificent collection of Etrufcan vafes, publifhed by Sir William Hamilton.





Copied from Capt. Phillips Foyage to Bolany Bay, by permission of the Propriater.



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And pleafed on WEDGWOOD ray your partial fmile, A new Etruria decks Britannia's ifle.— Charm'd by your touch, the flint liquefcent pours 305 Through finer fieves, and falls in whiter fhowers; Charm'd by your touch, the kneaded clay refines, The bifcuit hardens, the enamel fhines; Each nicer mould a fofter feature drinks, The bold Cameo fpeaks, the foft Intaglio thinks. 310

" To call the pearly drops from Pity's eye, Or ftay Defpair's difanimating figh, Whether, O Friend of art ! the gem you mould Rich with new tafte, with antient virtue bold; Form the poor fetter'd SLAVE on bended knee 315 From Britain's fons imploring to be free;

Form the poor fetter'd Slave. 1. 315. Alluding to two cameos of Mr. Wedgwood's manufacture; one of a Slave in chains, of which he diftributed many hundreds, to excite the humane to attend to and to affift in the abolition of the deteftable traffic in human creatures; and the other a cameo of Hope attended by Peace, and Art, and Labour; which was made of clay from Botany Bay; to which place he fent many of them to fhew the inhabitants what their materials would do, and to encourage their induftry. A print of this latter medallion is prefixed to Mr. Stockdale's edition of Philip's Expedition to Botany Bay.

Or with fair HOPE the brightening fcenes improve, And cheer the dreary waftes at Sydney-cove ; Or bid Mortality rejoice and mourn O'er the fine forms on PORTLAND's myftic urn.— 320

"Here by fall'n columns and disjoin'd arcades, On mouldering ftones, beneath deciduous fhades, Sits HUMANKIND in hieroglyphic ftate, Serious, and pondering on their changeful ftate; While with inverted torch, and fwimming eyes, 325 Sinks the fair fhade of MORTAL LIFE, and dies. There the pale GHOST through Death's wide portal bends His timid feet, the dufky fteep defcends; With fmiles affuafive LOVE DIVINE invites, Guides on broad wing, with torch uplifted lights; 330 IMMORTAL LIFE, her hand extending, courts The lingering form, his tottering ftep fupports;

Portland's mystic urn. 1. 320. See additional notes, No. XXII.

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Leads on to Pluto's realms the dreary way, And gives him trembling to Elyfian day. Beneath, in facred robes the PRIESTESS drefs'd, 335 The coif clofe-hooded, and the fluttering veft, With pointing finger guides the initiate youth, Unweaves the many-colour'd veil of Truth, Drives the profane from Myftery's bolted door, And Silence guards the Eleufinian lore.— 340

"Whether, O Friend of Art! your gems derive Fine forms from Greece, and fabled Gods revive; Or bid from modern life the Portrait breathe, And bind round Honour's brow the laurel wreath; Buoyant fhall fail, with Fame's hiftoric page, 345 Each fair medallion o'er the wrecks of age;

Fine forms from Greece. 1. 342. In real flones, or in pafte or foft coloured glafs, many pieces of exquisite workmanship were produced by the antients. Basso-relievos of various fizes were made in coarse brown earth of one colour; but of the improved kind of two or more colours, and of a true porcelain texture, none were made by the antients, nor attempted I believe by the moderns, before those of Mr. Wedgwood's manufactory.

N

Nor Time shall mar; nor steel, nor fire, nor rust Touch the hard polish of the immortal bust.

2. "HENCE fable COAL his maffy couch extends,
And ftars of gold the fparkling Pyrite blends; 350
Hence dull-eyed Naphtha pours his pitchy ftreams,
And Jet uncolour'd drinks the folar beams,
Bright Amber fhines on his electric throne,
And adds ethereal luftres to his own.
—Led by the phofphor-light, with daring tread 355
Immortal FRANKLIN fought the fiery bed;

Hence fable Coal. 1. 349. See additional notes, No. XXIII. on coal.

Bright Amber fhines. 1. 353. Coal has probably all been fublimed more or lefs from the clay, with which it was at first formed in decomposing moraffes; the petroleum feems to have been feparated and condensed again in superior strata, and a still finer kind of oil, as naphtha, has probably had the fame origin. Some of these liquid oils have again loss their more volatile parts, and become cannel-coal, as fighaltum, jet, and amber, according to the purity of the original fossil oil. Dr. Priestley has shewn, that effential oils long exposed to the atmosphere absorb both the vital and phlogistic part of it; whence it is probable their becoming folid may in great measure depend, as well as by the exhalation of their more volatile parts. On distillation with volatile alcaly all these fossil oils are shewn to contain the acid of amber, which evinces the identity of their origin. If a piece of amber be rubbed it attracts straws and hairs, whence the discovery of electricity, and whence its name, from electron the Greek word for amber.

Immortal Franklin. 1. 356. See note on Canto I. 1. 383.

Where, nurfed in night, incumbent Tempeft fhroudsThe feeds of Thunder in circumfluent clouds,Befieged with iron points his airy cell,And pierced the monfter flumbering in the fhell. 360

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"So, born on founding pinions to the WEST, When Tyrant-Power had built his eagle neft; While from his eyry fhriek'd the famifh'd brood, Clenched their fharp claws, and champ'd their beaks for blood, Immortal FRANKLIN watch'd the callow crew, 365 And ftabb'd the ftruggling Vampires, ere they flew. —The patriot-flame with quick contagion ran, Hill lighted hill, and man electrifed man; Her heroes flain awhile COLUMBIA mourn'd, And crown'd with laurels LIBERTY return'd. 370

"The Warrior, LIBERTY, with bending fails Helm'd his bold courfe to fair HIBERNIA's vales;— Firm as he fteps, along the fhouting lands, Lo! Truth and Virtue range their radiant bands;

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Sad Superfition wails her empire torn, 375 Art plies his oar, and Commerce pours her horn.

"Long had the Giant-form on GALLIA's plains Inglorious flept, unconfcious of his chains; Round his large limbs were wound a thoufand ftrings By the weak hands of Confeffors and Kings; 380 O'er his clofed eyes a triple veil was bound, And fteely rivets lock'd him to the ground; While ftern Baftile with iron cage inthralls His folded limbs, and hems in marble walls. —Touch'd by the patriot-flame, he rent amazed 385 The flimfy bonds, and round and round him gazed;

While ftern Baftile. 1. 383. "We defeended with great difficulty into the dungeons, which were made too low for our flanding upright; and were fo dark, that we were obliged at noon-day to vifit them by the light of a candle. We faw the hooks of thofe chains, by which the prifoners were faftened by their necks to the walls of their cells; many of which being below the level of the water were in a conftant flate of humidity; from which iffued a noxious vapour, which more than once extinguifhed the candles. Since the deftruction of the building many fubterraneous cells have been difcovered under a piece of ground, which feemed only a bank of folid earth before the horrid fecrets of this prifon-houfe were difclofed. Some skeletons were found in these recesses with irons ftill fastened to their decayed bones." Letters from France, by H. M. Williams. p. 24.

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Starts up from earth, above the admiring throng Lifts his Coloffal form, and towers along; High o'er his foes his hundred arms He rears, Plowfhares his fwords, and pruning hooks his fpears; 390 Calls to the Good and Brave with voice, that rolls Like Heaven's own thunder round the echoing poles; Gives to the winds his banner broad unfurl'd, And gathers in its fhade the living world!

VII. "GNOMES! YOU then taught volcanic airs to force Through bubbling Lavas their refiftlefs courfe, 396 O'er the broad walls of rifted Granite climb, And pierce the rent roof of incumbent Lime,

And pierce the rent roof. 1. 398. The granite rocks and the limeftone rocks have been cracked to very great depths at the time they were raifed up by fubterranean fires; in these cracks are found most of the metallic ores, except iron and perhaps manganese, the former of which is generally found in horizontal strata, and the latter generally near the furface of the earth.

Philofophers poffeffing fo convenient a teft for the difcovery of iron by the magnet, have long fince found it in all vegetable and animal matters; and of late Mr. Scheele has difcovered the existence of manganese in vegetable assessments. Scheele, 56 mem. Stock. 1774. Kirwan. Min. 353. Which accounts for the production of it near the furface of earth, and thence for its calciform appearance, or union with vital air. Bergman has likewise shewn, that the limestones which become bluish or dark coloured when calcined,

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Round fparry caves metallic luftres fling, And bear phlogifton on their tepid wing.

poffefs a mixture of manganefe, and are thence preferable as a cement to other kinds of lime. 2. Bergman, 229. Which impregnation with manganefe has probably been received from the decomposition of fuperincumbent vegetable matters.

These cracks or perpendicular caverns in the granite or limestone pass to unknown depths; and it is up thefe channels that I have endeavoured to fhew that the fleam rifes which becomes afterwards condenfed and produces the warm fprings of this ifland, and other parts of the world. (See note on Fucus, Vol. II.) And up these cracks I suppose certain vapours arife, which either alone, or by meeting with fomething defcending into them from above, have produced most of the metals; and feveral of the materials in which they are bedded. Thus the ponderous earth, Barytes, of Derbyfbire, is found in thefe cracks, and is ftratified frequently with lead-ore, and frequently furrounds it. This ponderous earth has been found by Dr. Hoepfner in a granite in Switzerland, and may have thus been fublimed from immenfe depths by great heat, and have obtained its carbonic or vitriolic acid from above. Annales de Chimie. There is alfo reafon to conclude that fomething from above is neceffary to the formation of many of the metals : at Hawkstone in Shropshire, the feat of Sir Richard Hill, there is an elevated rock of filiceous fand which is coloured green with copper in many places high in the air; and I have in my poffeffion a fpecimen of lead formed in the cavity of an iron nodule, and another of lead amid fpar from a crack of a coal-ftratum; all which countenance the modern production of those metals from defcending materials. To which should be added, that the higheft mountains of granite, which have therefore probably never been covered with marine productions on account of their early elevation, nor with vegetable or animal matters on account of their great coldnefs, contain no metallic ores, whilft the lower ones contain copper and tin in their cracks or veins, both in Saxony, Silefia, and Cornwall. Kirwan's Mineral. p. 374.

The tranfmutation of one metal into another, though hitherto undifcovered by the alchymifts, does not appear impoffible; fuch tranfmutations have been fuppofed to exift in nature, thus lapis calaminaris may have been produced from the deftruction of lead-ore, as it is generally found on the top of the veins of lead, where it has been calcined or united with air, and becaufe maffes of lead-ore are often found intirely inclofed in it. So filver is found mixed in almost all lead-ores, and fometimes in feperate filaments within the cavities of lead-ore, as I am informed by Mr. Michell, and is thence probably a partial transmutation of the lead to filver, the rapid progrefs of modern chemistry having fhewn the analogy between metallic calces and acids, may lead to the power of transmuting their bafes: a difcovery much to be wifhed.

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"HENCE glows, refulgent Tin ! thy chryftal grains,
And tawny Copper fhoots her azure veins;
Zinc lines his fretted vault with fable ore,
And dull Galena teffellates the floor;
On vermil beds in Idria's mighty caves 405
The living Silver rolls its ponderous waves;
With gay refractions bright Platina fhines,
And ftuds with fquander'd ftars his dufky mines;
Long threads of netted gold, and filvery darts,
Inlay the Lazuli, and pierce the Quartz;— 410
—Whence roof'd with filver beam'd PERU, of old,
And haplefs MEXICO was paved with gold.

"Heavens! on my fight what fanguine colours blaze! Spain's deathlefs fhame! the crimes of modern days! When Avarice, fhrouded in Religion's robe, 415 Sail'd to the Weft, and flaughter'd half the globe; While Superfition, ftalking by his fide, Mock'd the loud groans, and lap'd the bloody tide;

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For facred truths announced her frenzied dreams, And turn'd to night the fun's meridian beams.— 420 Hear, oh, BRITANNIA! potent Queen of ifles, On whom fair Art, and meek Religion fmiles, Now AFRIC's coafts thy craftier fons invade With murder, rapine, theft,—and call it Trade! —The SLAVE, in chains, on fupplicating knee, 425 Spreads his wide arms, and lifts his eyes to Thee; With hunger pale, with wounds and toil opprefs'd, "ARE WE NOT BRETHREN?" forrow choaks the reft;— —AIR! bear to heaven upon thy azure flood Their innocent cries!—EARTH! cover not their blood!

VIII. "When Heaven's dread juftice fmites in crimes o'ergrown 431
The blood-nurfed Tyrant on his purple throne,
GNOMES! YOUR bold forms unnumber'd arms outftretch,
And urge the vengeance o'er the guilty wretch.—
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Thus when CAMBYSES led his barbarous hofts 435 From Perfia's rocks to Egypt's trembling coafts, Defiled each hallowed fane, and facred wood, And, drunk with fury, fwell'd the Nile with blood; Waved his proud banner o'er the Theban states, And pour'd deftruction through her hundred gates; 440 In dread divisions march'd the marshal'd bands, And fwarming armies blacken'd all the lands, By Memphis these to ETHIOP's fultry plains, And those to HAMMON's fand-incircled fanes .---Slow as they pass'd, the indignant temples frown'd, 445 Low curfes muttering from the vaulted ground; Long ailes of Cyprefs waved their deepen'd glooms, And quivering spectres grinn'd amid the tombs; Prophetic whifpers breathed from SPHINX's tongue, And MEMNON's lyre with hollow murmurs rung; 450

Thus when Cambyfes. 1. 435. Cambyfes marched one army from Thebes, after having overturned the temples, ravaged the country, and deluged it with blood, to fubdue Ethiopia; this army almost perished by famine, infomuch, that they repeatedly flew every tenth man to fupply the remainder with food. He fent another army to plunder the temple of Jupiter Ammon, which perished overwhelm'd with fand.

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Burft from each pyramid expiring groans, And darker fhadows ftretch'd their lengthen'd cones.— Day after day their deathful rout They fteer, Luft in the van, and rapine in the rear.

"GNOMES! as they march'd, You hid the gather'd fruits, The bladed grafs, fweet grains, and mealy roots; 456 Scared the tired quails, that journey'd o'er their heads, Retain'd the locufts in their earthy beds; Bade on your fands no night-born dews diftil, Stay'd with vindictive hands the fcanty rill.-460 Loud o'er the camp the Fiend of Famine shrieks, Calls all her brood, and champs her hundred beaks; O'er ten square leagues her pennons broad expand, And twilight fwims upon the fhuddering fand; Perch'd on her creft the Griffin Difcord clings, 465 And Giant Murder rides between her wings; Blood from each clotted hair, and horny quill, And showers of tears in blended streams distil;

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High-poifed in air her fpiry neck fhe bends, Rolls her keen eye, her Dragon-claws extends, 470 Darts from above, and tears at each fell fwoop With iron fangs the decimated troop.

Now o'er their head the whizzing whirlwinds breathe,
And the live defert pants, and heaves beneath;
Tinged by the crimfon fun, vaft columns rife 475
Of eddying fands, and war amid the fkies,
In red arcades the billowy plain furround,
And ftalking turrets dance upon the ground.
—Long ranks in vain their fhining blades extend,
To Demon-Gods their knees unhallow'd bend, 480
Wheel in wide circle, form in hollow fquare,
And now they front, and now they fly the war,

And flalking turrets. 1. 478. " At one o'clock we alighted among fome acacia trees at Waadi el Halboub, having gone twenty-one miles. We were here at once furprifed and terrified by a fight furely one of the most magnificent in the world. In that valt expanse of defert, from W. to N. W. of us, we faw a number of prodigious pillars of fand at different distances, at times moving with great celerity, at others stalking on with a majestic flowness; at interv ls we thought they were coming in a very few minutes to overwhelm us; and stall quantities of fand did actually more than once reach us. Again they would retreat fo as to be almost out of fight, their tops reaching to the very clouds. There the tops often feparated from the bodies; and these, once disjoined, dispersed in the air, and

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Pierce the deaf tempeft with lamenting cries,

Prefs their parch'd lips, and clofe their blood-fhot eyes. —GNOMES! o'er the wafte vou led your myriad powers, Climb'd on the whirls, and aim'd the flinty fhowers!— 4⁸⁶ Onward refiftlefs rolls the infuriate furge,

Clouds follow clouds, and mountains mountains urge;

Wave over wave the driving defert fwims,

Burfts o'er their heads, inhumes their ftruggling limbs;

did not appear more. Sometimes they were broken in the middle, as if flruck with large cannon-fhot. About noon they began to advance with confiderable fwiftnefs upon us, the wind being very flrong at north. Eleven of them ranged along fide of us about the diftance of three miles. The greateft diameter of the largeft appeared to me at that diftance as if it would meafure ten feet. They retired from us with a wind at S. E. leaving an imprefion upon my mind to which I can give no name, though furely one ingredient in it was fear, with a confiderable deal of wonder and aftonifhment. It was in vain to think of flying; the fwifteft horfe, or fafteft failing fhip, could be of no ufe to carry us out of this danger; and the full perfuafion of this rivetted me as if to the fpot where I flood.

"The fame appearance of moving pillars of fand prefented themfelves to us this day in form and difpolition like those we had feen at Waadi Halboub, only they feemed to be more in number and less in fize. They came feveral times in a direction close upon us, that is, I believe, within less than two miles. They began immediately after fun rife like a thick wood and almost darkened the fun. His rays thining through them for near an hour, gave them an appearance of pillars of fire. Our people now became desperate, the Greeks thrieked out and faid it was the day of judgment; Ifmael pronounced it to be hell; and the Turcorories, that the world was on fire." Bruce's Travels, Vol. IV. p. 553,-555.

From this account it would appear, that the eddies of wind were owing to the long range of broken rocks, which bounded one fide of the fandy defert, and bent the currents of air, which ftruck againft their fides; and were thus like the eddies in a fiream of water, which falls againft oblique obftacles. This explanation is probably the true one, as thefe whirl-winds were not attended with rain or lightening like the tornadoes of the Weft-Indies.

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Man mounts on man, on camels camels rufh, 491 Hofts march o'er hofts, and nations nations crufh,— Wheeling in air the winged iflands fall, And one great earthy Ocean covers all !— Then ceafed the ftorm,—NIGHT bow'd his Ethiop brow To earth, and liften'd to the groans below,— 496 Grim HORROR fhook,—awhile the living hill Heaved with convulfive throes,—and all was ftill !

IX. "GNOMES! whole fine forms, impaffive as the air, Shrink with foft fympathy for human care; 500 Who glide unfeen, on printlefs flippers borne, Beneath the waving grafs, and nodding corn; Or lay your tiny limbs, when noon-tide warms, Where fhadowy cowflips ftretch their golden arms,— So mark'd on orreries in lucid figns, 5°5 Star'd with bright points the mimic zodiac fhines;

So mark'd on orreries. 1. 505. The first orrery was constructed by a Mr. Rowley, a mathematician born at Lichfield; and so named from his patron the Earl of Orrery. Johnson's Dictionary.

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Borne on fine wires amid the pictured fkies With ivory orbs the planets fet and rife; Round the dwarf earth the pearly moon is roll'd, And the fun twinkling whirls his rays of gold .--510 Call your bright myriads, march your mailed hofts, With fpears and helmets glittering round the coafts; Thick as the hairs, which rear the Lion's mane, Or fringe the Boar, that bays the hunter-train; Watch, where proud Surges break their treacherous mounds, And fweep refiftlefs o'er the cultured grounds; 516 Such as erewhile, impell'd o'er Belgia's plain, Roll'd her rich ruins to the infatiate main ; With piles and piers the ruffian waves engage, And bid indignant Ocean flay his rage. 520

"Where, girt with clouds, the rifted mountain yawns, And chills with length of shade the gelid lawns,

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Climb the rude fteeps, the granite-cliffs furround, Pierce with steel points, with wooden wedges wound; Break into clays the foft volcanic flaggs, 525 Or melt with acid airs the marble craggs; Crown the green fummits with adventurous flocks, And charm with novel flowers the wondering rocks. -So when proud Rome the Afric Warrior braved, And high on Alps his crimfon banner waved; 530 While rocks on rocks their beetling brows oppose With piny forefts, and unfathomed fnows;

The granite-cliffs. 1. 523. On long exposure to air the granites or porphories of this country exhibit a ferrugenous cruft, the iron being calcined by the air first becomes vifible, and is then washed away from the external surface, which becomes white or grey, and thus in time feems to decompofe. The marbles feem to decompofe by loofing their carbonic acid, as the outfide, which has been long exposed to the air, does not feem to effervesce so hastily with acids as the parts more recently broken. The immense quantity of carbonic acid, which exifts in the many provinces of lime-ftone, if it was extricated and decomposed would afford charcoal enough for fuel for ages, or for the production of new vegetable or animal bodies. The volcanic flaggs on Mount Vefuvius are faid by M. Ferber to be changed into clay by means of the fulphur-acid, and even pots made of clay and burnt or vitrified are faid by him to be again reducible to ductile. clay by the volcanic steams. Ferber's Travels through Italy, p. 166.

Wooden wedges wound. 1. 524. It is usual in feperating large mill-stones from the filiceous fand-rocks in fome parts of Derbyshire to bore horizontal holes under them in a circle, and fill these with pegs made of dry wood, which gradually swell by the moisture of the earth, and in a day or two lift up the mill-ftone without breaking it,

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Onward he march'd, to Latium's velvet ground With fires and acids burft the obdurate bound, Wide o'er her weeping vales deftruction hurl'd, And fhook the rifing empire of the world.

X. "Go, gentle GNOMES! refume your vernal toil, Seek my chill tribes, which fleep beneath the foil; On grey-mofs banks, green meads, or furrow'd lands Spread the dark mould, white lime, and crumbling fands; Each burfting bud with healthier juices feed, 546 Emerging fcion, or awaken'd feed. So, in defcending ftreams, the filver Chyle Streaks with white clouds the golden floods of bile;

With fires and acids. 1. 539. Hannibal was faid to erode his way over the Alps by fire and vinegar. The latter is fuppofed to allude to the vinegar and water which was the beverage of his army. In refpect to the former it is not improbable, but where wood was to be had in great abundance, that fires made round lime-ftone precipices would calcine them to a confiderable depth, the night-dews or mountain-mifts would penetrate these calcined parts and pulverize them by the force of the steam which the generated heat would produce, the winds would disperse this lime-powder, and thus by repeated fires a precipice of lime-ftone might be destroyed and a passage opened. It should be added, that according to Ferber's observations, these Alps confist of limeftone. Letters from Italy.

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Through each nice valve the mingling currents glide, 555 Join their fine rills, and fwell the fanguine tide; Each countlefs cell, and viewlefs fibre feek, Nerve the ftrong arm, and tinge the blufhing cheek.

" Oh, watch, where bofom'd in the teeming earth, Green fwells the germ, impatient for its birth; 560 Guard from rapacious worms its tender shoots, And drive the mining beetle from its roots; With ceafelefs efforts rend the obdurate clay, And give my vegetable babes to day ! -Thus when an Angel-form, in light array'd, 565 Like HowARD pierced the prifon's noifome fhade; Where chain'd to earth, with eyes to heaven upturn'd, The kneeling Saint in holy anguish mourn'd ;-Ray'd from his lucid veft, and halo'd brow O'er the dark roof celeftial luftres glow, 570 " PETER, arife !" with cheering voice He calls, And founds feraphic echo round the walls;

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Locks, bolts, and chains his potent touch obey, And pleafed he leads the dazzled Sage to day.

XI. "You! whofe fine fingers fill the organic cells, With virgin earth, of woods and bones and fhells; 576 Mould with retractile glue their fpongy beds, And ftretch and ftrengthen all their fibre-threads.— Late when the mafs obeys its changeful doom, And finks to earth, its cradle and its tomb, 5⁸⁰ GNOMES! with nice eye the flow folution watch, With foftering hand the parting atoms catch,

Mould with retractile glue. 1. 577. The confituent parts of animal fibres are believed to be earth and gluten. Thefe do not feperate except by long putrefaction or by fire. The earth then effervefces with acids, and can only be converted into glafs by the greateft force of fire. The gluten has continued united with the earth of the bones above 2000 years in Egyptian mummies; but by long exposure to air or moifture it diffolves and leaves only the earth. Hence bones long buried, when exposed to the air, abforb moifture and crumble into powder. Phil. Tranf. No. 475. The retractibility or elasticity of the animal fibre depends on the gluten; and of these fibres are composed the membranes muscles and bones. Haller. Physiol. Tom. I. p. 2.

For the chemical decomposition of animal and vegetable bodies fee the ingenious work of Lavoifier, Traité de Chimie, Tom. I. p. 132, who refolves all their component parts into oxygene, hydrogene, carbone, and azote, the three former of which belong principally to vegetable and the last to animal matter.

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Join in new forms, combine with life and fenfe, And guide and guard the transmigrating Ens.

"So when on Lebanon's fequester'd hight 585 The fair Adonis left the realms of light,

The transmigrating Ens. 1. 584. The perpetual circulation of matter in the growth and diffolution of vegetable and animal bodies feems to have given Pythagoras his idea of the metempfycofis or transmigration of spirit; which was afterwards dreffed out or ridiculed in variety of amufing fables. Other philosophers have supposed, that there are two different materials or effences, which fill the univerfe. One of thefe, which has the power of commencing or producing motion, is called fpirit; the other, which has the power of receiving and of communicating motion, but not of beginning it, is called matter. The former of thefe is fuppofed to be diffufed through all fpace, filling up the interffices of the funs and planets, and conftituting the gravitations of the fidereal bodies, the attractions of chemistry, with the spirit of vegetation, and of animation. The latter occupies comparatively but finall fpace, conflituting the folid parts of the funs and planets, and their atmospheres. Hence these philosophers have supposed, that both matter and fpirit are equally immortal and unperifhable; and that on the diffolution of vegetable or animal organization, the matter returns to the general mass of matter; and the fpirit to the general mais of fpirit, to enter again into new combinations, according to the original idea of Pythagoras.

The fmall apparent quantity of matter that exifts in the univerfe compared to that of fpirit, and the fhort time in which the recrements of animal or vegetable bodies become again vivified in the forms of vegetable mucor or microfcopic infects, feems to have given rife to another curious fable of antiquity. That Jupiter threw down a large handful of fouls upon the earth, and left them to fcramble for the few bodies which were to be had.

Adonis. 1. 586. The very antient flory of the beautiful Adonis paffing one half of the year with Venus, and the other with Proferpine alternately, has had variety of interpretations. Some have fuppofed that it allegorized the fummer and winter folfice; but this feems too obvious a fact to have needed an hieroglyphic emblem. Others have believed it to reprefent the corn, which was fuppofed to fleep in the earth during the

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Bow'd his bright locks, and, fated from his birth To change eternal, mingled with the earth ;— With darker horror fhook the confcious wood, Groan'd the fad gales, and rivers blufh'd with blood ; On cyprefs-boughs the Loves their quivers hung, 591 Their arrows fcatter'd, and their bows unftrung ; And BEAUTY'S GODDESS, bending o'er his bier, Breathed the foft figh, and pour'd the tender tear.— Admiring PROSERPINE through dufky glades 595 Led the fair phantom to Elyfian fhades, Clad with new form, with finer fenfe combined, And lit with purer flame the ethereal mind.

winter months, and to rife out of it in fummer. This does not accord with the climate of Egypt, where the harvest foon follows the feed-time.

It feems more probably to have been a ftory explaining fome hieroglyphic figures reprefenting the decomposition and refuscitation of animal matter; a fublime and interefting fubject, and which feems to have given origin to the doctrine of the transmigration, which had probably its birth alfo from the hieroglyphic treasures of Egypt. It is remarkable that the cyprefs groves in the antient greek writers, as in Theocritus, were dedicated to Venus; and afterwards became funereal emblems. Which was probably occasioned by the Cyprefs being an accompaniment of Venus in the annual processions, in which the was fupposed to lament over the funeral of Adonis; a ceremony which obtained over all the eastern world from great antiquity, and is fupposed to be referred to by Ezekiel, who accuses the idolatrous woman of weeping for Thammus.

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Erewhile, emerging from infernal night,
The bright Affurgent rifes into light,
Leaves the drear chambers of the infatiate tomb,
And fhines and charms with renovated bloom.—
While wondering Loves the burfting grave furround,
And edge with meeting wings the yawning ground,
Stretch their fair necks, and leaning o'er the brink
Korg with broad eyes ecftatic BEAUTY ftands,
Heaves her white bofom, fpreads her waxen hands ;
Then with loud fhriek the panting Youth alarms,
" My Life! my Love!" and fprings into his arms." 610

The GODDESS ceafed,—the delegated throng O'er the wide plains delighted rufh along; In dufky fquadrons, and in fhining groups, Hofts follow hofts, and troops fucceed to troops; Scarce bears the bending grafs the moving freight, **615** And nodding florets bow beneath their weight.

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So when light clouds on airy pinions fail, Flit the foft fhadows o'er the waving vale; Shade follows fhade, as laughing Zephyrs drive, And all the chequer'd landfcape feems alive.

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Zepbyrs drive. 1. 619. These lines were originally written thus,

Shade follows shade by laughing Zephyrs drove, And all the chequer'd landscape feems to move.

but were altered on account of the fuppofed falle grammar in using the word drove for driven, according to the opinion of Dr. Lowth: at the fame time it may be obferved, I. that this is in many cafes only an ellipfis of the letter n at the end of the word; as froze, for frozen; wove, for woven; fpoke, for fpoken; and that then the participle accidentally becomes fimilar to the paft tenfe: 2. that the language feems gradually tending to omit the letter n in other kind of words for the fake of euphony; as housen is become houses; eyne, eyes; thine, thy, &c. and in common conversation, the words forgot, fpoke, froze, rode, are frequently used for forgotten, fpoken, frozen, ridden. 3. It does not appear that any confusion would follow the indifcriminate use of the fame word for the past tenfe and the participle passive, fince the auxillary verb *bave*, or the preceding noun or pronoun always clearly diftinguishes them: and lastly, rhime-poetry must lose the use of many elegant words without this license. Argument of the Third Canto.

ADDRESS to the Nymphs. I. Steam rifes from the ocean, floats in clouds, defcends in rain and dew, or is condenfed on hills, produces fprings, and rivers, and returns to the fea. So the blood circulates through the body and returns to the heart. 11. II. 1. Tides, 57. 2. Echinus, nautilus, pinna, cancer. Grotto of a mermaid. 65. 3. Oil stills the waves. Coral rocks. Ship-worm, or Teredo. Maelftrome, a whirlpool on the coaft of Norway. 85. III. Rivers from beneath the fnows on the Alps. The Tiber. 103. IV. Overflowing of the Nile from African Monfoons, 129. V. 1. Giefar, a boiling fountain in Iceland, destroyed by inundation, and confequent earthquake, 145. 2. Warm medicinal fprings. Buxton. Duke and Dutchefs of Devonshire. 157. VI. Combination of vital air and inflammable gas produces water. Which is another fource of fprings and rivers. Allegorical loves of Jupiter and Juno productive of vernal showers. 201. VII. Aquatic Taste. Distant murmur of the fea by night. Sea-horfe. Nereid finging. 261. VIII. The Nymphs of the river Derwent lament the death of Mrs. French, 297. IX. Inland navigation. Monument for Mr. Brindley, 321. X. Pumps explained. Child fucking. Mothers exhorted to nurfe their children. Cherub fleeping. 345. XI. Engines for extinguishing fire. Story of two lovers perishing in the flames. 377. XII. Charities of Mifs Jones, 427. XIII. Marshes drained. Hercules conquers Achilous. The horn of Plenty. 463. XIV. Showers. Dews. Floating lands with water. Lacteal fystem in animals. Caravan drinking. 509. Departure of the Nymphs like water spiders; like northern nations skaiting on the ice. 549.

infrasted to much their children. Cherub Respire, as r

Multificance a whirling on the coaft of

THE

ECONOMY OF VEGETATION.

CANTO III.

AGAIN the GODDESS fpeaks !—glad Echo fwells The tuneful tones along her fhadowy dells, Her wrinkling founts with foft vibration fhakes, Curls her deep wells, and rimples all her lakes, Thrills each wide ftream, Britannia's ifle that laves, 5 Her headlong cataracts, and circumfluent waves.

Q

PART I.

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-Thick as the dews, which deck the morning flowers, Or rain-drops twinkling in the fun-bright flowers, Fair Nymphs, emerging in pellucid bands, Rife, as fhe turns, and whiten all the lands.

I. "YOUR buoyant troops on dimpling ocean tread, Wafting the moift air from his oozy bed, AQUATIC NYMPHS !—YOU lead with viewlefs march The winged vapours up the aerial arch, On each broad cloud a thoufand fails expand, 15 And fteer the fhadowy treafure o'er the land,

The winged vapours. 1. 14. See additional note No. XXV. on evaporation.

On each broad cloud. 1. 15. The clouds confift of condenfed vapour, the particles of which are too fmall feparately to overcome the tenacity of the air, and which therefore do not defcend. They are in fuch fmall fpheres as to repel each other, that is, they are applied to each other by fuch very fmall furfaces, that the attraction of the particles of each drop to its own centre is greater than its attraction to the furface of the drop in its vicinity; every one has obferved with what difficulty fmall fpherules of quickfilver can be made to unite, owing to the fame caufe; and it is common to fee on riding through fhallow water on a clear day, numbers of very fmall fpheres of water as they are thrown from the horfes feet run along the furface for many yards before they again unite with it. In many cafes thefe fpherules of water, which compofe clouds, are kept from uniting by a furplus of electric fluid; and fall in violent flowers as foon as that is withdrawn from them, as in thunder florms. See note on Canto I. 1. 554.

If in this flate a cloud becomes frozen, it is torn to pieces in its defcent by the friction of the air, and falls in white flakes of fnow. Or these flakes are rounded by being rubbed

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Through vernal skies the gathering drops diffuse, Plunge in fost rains, or fink in filver dews.---

together by the winds, and by having their angles thawed off by the warmer air beneath as they defcend; and part of the water produced by thefe angles thus diffolved is abforbed into the body of the hailftone, as may be feen by holding a lump of fnow over a candle, and there becomes frozen into ice by the quantity of cold which the hailftone poffeffes beneath the freezing point, or which is produced by its quick evaporation in falling; and thus hailftones are often found of greater or lefs denfity according as they confift of a greater portion of fnow or ice. If hailftones confifted of the large drops of fhowers frozen in their defcent, they would confift of pure transparent ice.

As hail is only produced in fummer, and is always attended with florms, fome philofophers have believed that the fudden departure of electricity from a cloud may effect fomething yet unknown in this phenomenon; but it may happen in fummer independent of electricity, becaufe the aqueous vapour is then raifed higher in the atmosphere, whence it has further to fall, and there is warmer air below for it to fall through.

Or fink in filver dews. 1. 18. During the coldness of the night the moisture before diffolved in the air is gradually precipitated, and as it fubfides adheres to the bodies it falls upon. Where the attraction of the body to the particles of water is greater than the attractions of those particles to each other, it becomes spread upon their furface, or flides down them in actual contact; as on the broad parts of the blades of moift grafs: where the attraction of the furface to the water is lefs than the attraction of the particles of water to each other, the dew ftands in drops; as on the points and edges of grafs or gorfe, where the furface prefented to the drop being fmall it attracts it fo little as but just to fupport it without much changing its globular form : where there is no attraction between the vegetable furface and the dew drops, as on cabbage leaves, the drop does not come into contact with the leaf, but hangs over it repelled, and retains it natural form, compoled of the attraction and preffure of its own parts, and thence looks like quickfilver, reflecting light from both its furfaces. Nor is this owing to any oilinefs of the leaf, but fimply to the polifh of its furface, as a light needle may be laid on water in the fame manner without touching it; for as the attractive powers of polifhed furfaces are greater when in actual contact, fo the repulsive power is greater before contact.

Q2

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YOUR lucid bands condenfe with fingers chill The blue mift hovering round the gelid hill; 20 In clay-form'd beds the trickling ftreams collect, Strain through white fands, through pebbly veins direct; Or point in rifted rocks their dubious way, And in each bubbling fountain rife to day.

The blue mift. 1. 20. Mifts are clouds refting on the ground, they generally come on at the beginning of night, and either fill the moift vallies, or hang on the fummits of hills, according to the degree of moifture previoufly diffolved, and the eduction of heat from them. The air over rivers during the warmth of the day fufpends much moifture, and as the changeful furface of rivers occafions them to cool fooner than the land at the approach of evening, mifts are most frequently feen to begin over rivers, and to fpread themfelves over moift grounds, and fill the vallies, while the mifts on the tops of mountains are more properly clouds, condenfed by the coldnefs of their fituation.

On afcending up the fide of a hill from a mifty valley, I have obferved a beautiful coloured halo round the moon when a certain thicknefs of mift was over me, which ceafed to be vifible as foon as I emerged out of it; and well remember admiring with other fpectators the fhadow of the three fpires of the cathedral church at Lichfield, the moon rifing behind it, apparently broken off, and lying diftinctly over our heads as if horizontally on the furface of the mift, which arofe about as high as the roof of the church. There are fome curious remarks on fhadows or reflections feen on the furface of mifts from high mountains in Ulloa's Voyages. The dry mift of fummer 1783, was probably occafioned by volcanic eruption, as mentioned in note on Chunda, Vol. II. and therefore more like the atmosphere of finoke which hangs on ftill days over great cities.

There is a dry mift, or rather a diminished transparence of the air, which according to Mr. Sausfure accompanies fair weather, while great transparence of air indicates rain. Thus when large rivers two miles broad, such as at Liverpool, appear narrow, it is faid to prognosticate rain; and when wide, fair weather. This want of transparence of the air in dry weather, may be owing to new combinations or decompositions of the vapours disolved in it, but wants further investigation. Essais fur L'Hygromet, p. 357.

Round the gelid bill. 1. 20. See additional notes, No. XXVI. on the origin of fprings.

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"NYMPHS! vou then guide, attendant from their fource, The affociate rills along their finuous courfe; 26 Float in bright fquadrons by the willowy brink, Or circling flow in limpid eddies fink ; Call from her cryftal cave the Naiad-Nymph, Who hides her fine form in the paffing lymph, 30 And, as below fhe braids her hyaline hair, Eyes her foft fmiles reflected in the air ; Or fport in groups with River-Boys, that lave Their filken limbs amid the dafhing wave ; Pluck the pale primrofe bending from its edge, 35 Or tittering dance amid the whifpering fedge.—

"Onward you pafs, the pine-capt hills divide, Or feed the golden harvefts on their fide; The wide-ribb'd arch with hurrying torrents fill, Shove the flow barge, or whirl the foaming mill. 40 OR lead with beckoning hand the fparkling train Of refluent water to its parent main,

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And pleafed revifit in their fea-mofs vales Blue Nereid-forms array'd in fhining scales, Shapes, whofe broad oar the torpid wave impels, 45 And Tritons bellowing through their twifted fhells.

" So from the heart the fanguine stream distils, O'er Beauty's radiant shrine in vermil rills, Feeds each fine nerve, each flender hair pervades, The fkins bright fnow with living purple fhades, Each dimpling cheek with warmer blufhes dyes, Laughs on the lips, and lightens in the eyes. -Erewhile abforb'd, the vagrant globules fwim From each fair feature, and proportion'd limb, Join'd in one trunk with deeper tint return To the warm concave of the vital urn.

II. I. " AQUATIC MAIDS ! YOU fway the mighty realms Of scale and shell, which Ocean overwhelms; As Night's pale Queen her rifing orb reveals, And climbs the zenith with refulgent wheels, 60

50

55

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Car'd on the foam your glimmering legion rides, Your little tridents heave the dafhing tides, Urge on the founding fhores their cryftal courfe, Reftrain their fury, or direct their force.

Car'd on the foam. 1. 61. The phenomena of the tides have been well inveftigated and fatisfactorily explained by Sir Ifaac Newton and Dr. Halley from the reciprocal gravitations of the earth, moon, and fun. As the earth and moon move round a centre of motion near the earth's furface, at the fame time that they are proceeding in their annual orbit round the fun, it follows that the water on the fide of the earth neareft this centre of motion between the earth and moon will be more attracted by the moon, and the waters on the opposite fide of the earth will be lefs attracted by the moon, than the central parts of the earth. Add to this that the centrifugal force of the water on the fide of the earth furtheft from the centre of the motion, round which the earth and moon move, (which, as was faid before, is near the furface of the earth) is greater than that on the opposite fide of the earth, From both thefe caufes it is eafy to comprehend that the water will rife on two fides of the earth, viz. on that neareft to the moon, and its opposite fide, and that it will be flattened in confequence at the quadratures, and thus produce two tides in every lunar day, which confifts of about twenty-four hours and forty-eight minutes.

These tides will be also affected by the folar attraction when it coincides with the lunar one, or opposes it, as at new and full moon, and will also be much influenced by the opposing shores in every part of the earth.

Now as the moon in moving round the centre of gravity between itfelf and the earth defcribes a much larger orbit than the earth defcribes round the fame centre, it follows that the centrifugal motion on the fide of the moon oppofite to the earth muft be much greater than the centrifugal motion of the fide of the earth oppofite to the moon round the fame centre, And fecondly, as the attraction of the earth exerted on the moon's furface next to the earth is much greater than the attraction of the moon exerted on the earth's furface, the tides on the lunar fea, (if fuch there be,) fhould be much greater than those of our ocean. Add to this that as the fame face of the moon always is turned to the earth, the lunar tides muft be permanent, and if the folid parts of the moon be fpherical, muft always cover the phasis next to us. But as there are evidently hills and vales and volcanos on this fide of the moon, the confequence is that the moon has no ocean, or that it is frozen.

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2. " NYMPHS ! vou adorn, in gloffy volumes roll'd,
The gaudy conch with azure, green, and gold.
66
You round Echinus ray his arrowy mail,
Give the keel'd Nautilus his oar and fail ;

The gaudy conch. 1. 66. The fpiral form of many fhells feem to have afforded a more frugal manner of covering the long tail of the fifh with calcareous armour; fince a fingle thin partition between the adjoining circles of the fifh was fufficient to defend both furfaces, and thus much cretaceous matter is faved; and it is probable that from this fpiral form they are better enabled to feel the vibrations of the element in which they exift. See note on Canto IV. 1. 162. This cretaceous matter is formed by a mucous fecretion from the fkin of the fifh, as is feen in crab-fifh, and others which annually caft their fhells, and is at firft a foft mucous covering, (like that of a hen's egg, when it is laid a day or two too foon,) and which gradually hardens. This may alfo be feen in common fhell fnails, if a part of their fhell be broken it becomes repaired in a fimilar manner with mucus, which by degrees hardens into fhell.

It it probable the calculi or ftones found in other animals may have a fimilar origin, as they are formed on mucous membranes, as those of the kidney and bladder, chalkftones in the gout, and gall-ftones; and are probably owing to the inflammation of the membrane where they are produced, and vary according to the degree of inflammation of the membrane which forms them, and the kind of mucous which it naturally produces. Thus the fhelly matter of different fhell-fifh differs, from the courser kinds which formthe fhells of crabs, to the finer kinds which produces the mother-pearl.

The beautiful colours of fome fhells originate from the thinnefs of the laminæ of which they confift, rather than to any colouring matter, as is feen in mother-pearl, which reflects different colours according to the obliquity of the light which falls on it. The beautiful prifmatic colours feen on the Labrodore ftone are owing to a fimilar caufe, viz. the thinnefs of the laminæ of which it confifts, and has probably been formed from mother-pearl fhells.

It is curious that fome of the most common fosfil steels are not now known in their recent flate, as the cornua ammonis; and on the contrary, many shells which are very plentiful in their recent steels, as limpets, fea-ears, volutes, cowries, are very rarely found fossil. Da Costa's Conchology, p. 163. Were all the ammoniæ destroyed when the continents were raised? Or do fome genera of animals perish by the increasing power of their enemies? Or do they still reside at inaccessible depths in the fea? Or do fome animals change their forms gradually and become new genera?

Echinus. Nautilus, 1. 67, 68. See additional notes, No. XXVII.

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Firm to his rock with filver cords fufpend The anchor'd Pinna, and his Cancer-friend; 70 With worm-like beard his toothlefs lips array, And teach the unwieldy Sturgeon to betray .---Ambush'd in weeds, or fepulcher'd in fands, In dread repose He waits the fcaly bands, Waves in red fpires the living lures, and draws 75 The unwary plunderers to his circling jaws, Eyes with grim joy the twinkling fhoals befet, And clafps the quick inextricable net. You chafe the warrior Shark, and cumberous Whale, And guard the Mermaid in her briny vale; 80 Feed the live petals of her infect-flowers, Her shell-wrack gardens, and her sea-fan bowers;

Pinna. Cancer. 1. 70. See additional notes, No. XXVII.

With worm-like beard. 1. 71. See additional notes, No. XXVIII.

Feed the live petals. 1. 82. There is a fea-infect defcribed by Mr. Huges whofe claws or tentacles being difpofed in regular circles and tinged with variety of bright lively colours reprefent the petals of fome most elegantly fringed and radiated flowers as the carnation, marigold, and anemone. Philof. Tranf. Abridg. Vol. IX. p. 110. The Abbe Dicquemarre has further elucidated the history of the actinia; and observed their manner PART I. R With ores and gems adorn her coral cell, And drop a pearl in every gaping fhell.

3. "YOUR myriad trains o'er ftagnant ocean's tow,
Harnefs'd with goffamer, the loitering prow;
86
Or with fine films, fufpended o'er the deep,
Of oil effufive lull the waves to fleep.
You ftay the flying bark, conceal'd beneath,
Where living rocks of worm-built coral breathe;
90

of taking their prey by inclofing it in these beautiful rays like a net. Phil. Trans. Vol LXIII. and LXV. and LXVII.

And drop a pearl. 1. 84. Many are the opinions both of antient and modern writers concerning the production of pearls. Mr. Reaumur thinks they are formed like the hard concretions in many land animals as ftones of the bladder, gall-ftones, and bezoar, and hence concludes them to be a difeafe of the fifh, but there feems to be a ftricter analogy between thefe and the calcareous productions found in crab-fifh called crab's eyes, which are formed near the ftomach of the animal, and conflitute a refervoir of calcareous matter against the renovation of the fhell, at which time they are re-disfolved and deposited for that purpofe. As the internal part of the fhell of the pearl oyster or muscle consists of mother-pearl which is a fimilar material to the pearl and as the animal has annually occasion to enlarge his shell there is reason to suppect the loose pearls are fimilar refervoirs of the pearly matter for that purpofe.

Or with fine films. 1. 87. See additional notes, No. XXIX.

Where living rocks. 1. 90. The immense and dangerous rocks built by the swarms of coral infects which rife almost perpendicularly in the southern ocean like walls are

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Meet fell TEREDO, as he mines the keel With beaked head, and break his lips of fteel; Turn the broad helm, the fluttering canvas urge From MAELSTROME's fierce innavigable furge. —'Mid the lorn ifles of Norway's ftormy main, 95 As fweeps o'er many a league his eddying train, Vaft watery walls in rapid circles fpin, And deep-ingulph'd the Demon dwells within; Springs o'er the fear-froze crew with Harpy-claws, Down his deep den the whirling veffel draws; 100 Churns with his bloody mouth the dread repaft, The booming waters murmuring o'er the maft.

defcribed in Cook's voyages, a point of one of thefe rocks broke off and fluck in the hole which it had made in the bottom of one of his fhips, which would otherwife have perifhed by the admiffion of water. The numerous lime-ftone rocks which confift of a congeries of the cells of thefe animals and which conftitute a great part of the folid earth fhew their prodigious multiplication in all ages of the world. Specimens of thefe rocks are to be feen in the Lime-works at Linfel near Newport in Shropfhire, in Coal-brook Dale, and in many parts of the Peak of Derbyfhire. The infect has been well defcribed by M. Peyffonnel, Ellis, and others. Phil. Tranf. Vol. XLVII. L. LII. and LVII.

Meet fell Teredo. 1. 91. See additional notes, No. XXX.

Turn the broad helm. I. 93. See additional notes, No. XXXI. R 2

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III. "Where with chill frown enormous ALPS alarms A thousand realms, horizon'd in his arms; While cloudlefs funs meridian glories fhed 105 From fkies of filver round his hoary head, Tall rocks of ice refract the coloured rays, And Frost fits throned amid the lambent blaze; NYMPHS ! YOUR thin forms pervade his glittering piles, His roofs of chryftal, and his glaffy ailes; IIO Where in cold caves imprifoned Naiads fleep, Or chain'd on moffy couches wake and weep; Where round dark crags indignant waters bend Through rifted ice, in ivory veins defcend, Seek through unfathom'd fnows their devious track, II5 Heave the vaft fpars, the ribbed granites crack,

Where round dark craggs. 1. 113. See additional notes, No. XXXII.

Heave the vaft fpars. 1. 116. Water in defeending down elevated fituations if the outlet for it below is not fufficient for its emiffion acts with a force equal to the height of the column, as is feen in an experimental machine called the philofophical bellows, in which a few pints of water are made to raife many hundred pounds. To this caufe is to be afcribed many large promontories of ice being occafionally thrown down from the glaciers; rocks have likewife been thrown from the fides of mountains by the fame

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Rush into day, in foamy torrents shine,

And fwell the imperial Danube or the Rhine.— —Or feed the murmuring TIBER, as he laves His realms inglorious with diminifh'd waves, ·120 Hears his lorn Forum found with Eunuch-ftrains, Sees dancing flaves infult his martial plains;

caufe, and large portions of earth have been removed many hundred yards from their fituations at the foot of mountains. On infpecting the locomotion of about thirty acres of earth with a fmall houfe near Bilder's Bridge in Shropfhire, about twenty years ago, from the foot of a mountain towards the river, I well remember it bore all the marks of having been thus lifted up, pufhed away, and as it were crumpled into ridges, by a column of water contained in the mountain.

From water being thus confined in high columns between the ftrata of mountainous countries it has often happened that when wells or perforations have been made into the earth, that fprings have arifen much above the furface of the new well. When the new bridge was building at Dublin Mr. G. Semple found a fpring in the bed of the river where he meant to lay the foundation of a pierre, which, by fixing iron pipes into it, he raifed many feet. Treatife on Building in Water, by G. Semple. From having obferved a valley north-weft of St. Alkmond's well near Derby, at the head of which that fpring of water once probably exifted, and by its current formed the valley, (but which in after times found its way out in its prefent fituation,) I fufpect that St. Alkmond's well might by building round it be raifed high enough to fupply many ftreets in Derby with fpring-water which are now only fupplied with river-water. See an account of an artificial fpring of water, Phil. Tranf. Vol. LXXV. p. I.

In making a well at Sheernefs the water rofe 300 feet above its fource in the well. Phil. Tranf. Vol. LXXIV. And at Hartford in Connecticut there is a well which was dug feventy feet deep before water was found, then in boring an augur-hole through a rock the water rofe fo faft as to make it difficult to keep it dry by pumps till they could blow the hole larger by gunpowder, which was no fooner accomplifhed than it filled and run over, and has been a brook for near a century. Travels through America. Lond. 1789. Lane.

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Parts with chill ftream the dim religious bower, Time-mouldered baftion, and difmantled tower; By alter'd fanes and namelefs villas glides, And claffic domes, that tremble on his fides; Sighs o'er each broken urn, and yawning tomb, And mourns the fall of LIBERTY and ROME.

IV. "Sailing in air, when dark MONSOON infhrouds His tropic mountains in a night of clouds; 130 Or drawn by whirlwinds from the Line returns, And fhowers o'er Afric all his thoufand urns;

Dark monfoon in/brouds. 1. 129. When from any peculiar fituations of land in refpect to fea the tropic becomes more heated, when the fun is vertical over it, than the line, the periodical winds called monfoons are produced, and thefe are attended by rainy feafons; for as the air at the tropic is now more heated than at the line it afcends by decreafe of its fpecific gravity, and floods of air rufh in both from the South Weft and North Eaft, and thefe being one warmer than the other the rain is precipitated by their mixture as obferved by Dr. Hutton. See additional notes, No. XXV. All late travellers have afcribed the rife of the Nile to the monfoons which deluge Nubia and Abyffinia with rain. The whirling of the afcending air was even feen by Mr. Bruce in Abyffinia; he fays, "every morning a fmall cloud began to whirl round, and prefently after the whole "heavens became covered with clouds," by this vortex of afcending air the N. E. winds and the S. W. winds, which flow in to fupply the place of the afcending column, became mixed more rapidly and depofited their rain in greater abundance.

Mr. Volney observes that the time of the rifing of the Nile commences about the 19th of June, and that Abyflinia and the adjacent parts of Africa are deluged with rain

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Fertilization of Egypt.

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High o'er his head the beams of SIRIUS glow, And, Dog of Nile, ANUBIS barks below. NYMPHS! YOU from cliff to cliff attendant guide 135 In headlong cataracts the impetuous tide; Or lead o'er waftes of Abyffinian fands The bright expanse to EGYPT's shower-less lands. —Her long canals the facred waters fill, And edge with filver every peopled hill; 140

in May, June, and July, and produce a mafs of water which is three months in draining off. The Abbe Le Pluche obferves that as Sirius, or the dog-ftar, rofe at the time of the commencement of the flood its rifing was watched by the aftronomers, and notice given of the approach of inundation by hanging the figure of Anubis, which was that of a man with a dog's head, upon all their temples. Hiftoire de Ciel.

Egypt's forwer-lefs lands. 1. 138. There feem to be two fituations which may be conceived to be exempted from rain falling upon them, one where the conftant trade-winds meet beneath the line, for here two regions of warm air are mixed together, and thence do not feem to have any caufe to precipitate their vapour; and the other is, where the winds are brought from colder climates and become warmer by their contact with the earth of a warmer one. Thus Lower Egypt is a flat country warmed by the fun more than the higher lands of one fide of it, and than the Mediterranean on the other; and hence the winds which blow over it acquire greater warmth, which ever way they come, than they poffeffed before, and in confequence have a tendency to acquire and not to part with their vapour like the north-eaft winds of this country. There is faid to be a narrow fpot upon the coaft of Peru where rain feldom occurs, at the fame time according to Ulloa on the mountainous regions of the Andes beyond there is almost perpetual rain. For the wind blows uniformly upon this hot part of the coaft of Peru, but no caufe of devaporation occurs till it begins to afcend the mountainous Andes, and then its own expansion produces cold fufficient to condense its vapour.

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Gigantic SPHINX in circling waves admire, And MEMNON bending o'er his broken lyre; O'er furrow'd glebes and green favannas fweep, And towns and temples laugh amid the deep.

V. I. "High in the frozen North where HECCLA glows, And melts in torrents his coeval fnows; 146 O'er ifles and oceans fheds a fanguine light, Or fhoots red ftars amid the ebon night; When, at his bafe intomb'd, with bellowing found Fell GIESAR roar'd, and ftruggling fhook the ground; 150

Fell Giefar roar'd. 1. 150. The boiling column of water at Giefar in Iceland was nineteen feet in diameter, and fometimes rofe to the height of ninety-two feet. On cooling it depofited a filiceous matter or chalcedony forming a bafon round its bafe. The heat of this water before it rofe out of the earth could not be afcertained, as water loofes all its heat above 212 (as foon as it is at liberty to expand) by the exhalation of a part, but the flinty bafon which is depofited from it fhews that water with great degrees of heat will diffolve filiceous matter. Van Troil's Letters on Iceland. Since the above account in the year 1780 this part of Iceland has been deftroyed by an earthquake or covered with lava, which was probably effected by the force of aqueous fteam, a greater quantity of water falling on the fubterraneous fires than could efcape by the antient outlets and generating an increafed quantity of vapour. For the difperfion of contagious vapours from volcanos fee an account of the Harmattan in the notes on Chunda, Vol. II.

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Pour'd from red noftrils, with her fealding breath, A boiling deluge o'er the blafted heath; And, wide in air, in mifty volumes hurl'd Contagious atoms o'er the alarmed world; NYMPHS! YOUR bold myriads broke the infernal fpell, 155 And crufh'd the Sorcerefs in her flinty cell.

2. "Where with foft fires in unextinguish'd urns,
Cauldron'd in rock, innocuous Lava burns;
On the bright lake your gelid hands diftil
In pearly showers the parsimonious rill; 160
And, as aloft the curling vapours rife
Through the cleft roof, ambitious for the skies,
In vaulted hills condense the tepid steams,
And pour to HEALTH the medicated streams.
—So in green vales amid her mountains bleak 165
BUXTONIA streams, the Goddess-Nymyh of Peak;

Buxtonia fmiles. 1. 166. Some arguments are mentioned in the note on Fucus Vol. II. to fhew that the warm fprings of this country do not arife from the decomposition of pyrites near the furface of the earth, but that they are produced by fleam rifing up the PART I. S

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Deep in warm waves, and pebbly baths fhe dwells, And calls HYGEIA to her fainted wells.

" Hither in fportive bands bright DEVON leads Graces and Loves from Chatfworth's flowery meads.— 170 Charm'd round the NYMPH, they climb the rifted rocks; And fteep in mountain-mift their golden locks; On venturous ftep her fparry caves explore, And light with radiant eyes her realms of ore; —Oft by her bubbling founts, and fhadowy domes, 175 In gay undrefs the fairy legion roams, Their dripping palms in playful malice fill, Or tafte with ruby lip the fparkling rill; Croud round her baths, and, bending o'er the fide, Unclafp'd their fandals, and their zones untied, 180 Dip with gay fear the fhuddering foot undrefs'd, And quick retract it to the fringed veft;

fiffures of the mountains from great depths, owing to water falling on fubterraneous fires, and that this fleam is condenfed between the firata of the incumbent mountains and collected into fprings. For further proofs on this fubject the reader is referred to a Letter from Dr. Darwin in Mr. Pilkington's View of Derbyfhire, Vol. I. p. 256.
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Or cleave with brandifh'd arms the lucid ftream, And fob, their blue eyes twinkling in the fteam. —High o'er the chequer'd vault with transfient glow ¹⁸⁵ Bright luftres dart, as dafh the waves below ; And Echo's fweet refponfive voice prolongs The dulcet tumult of their filver tongues.— O'er their flufh'd cheeks uncurling treffes flow, And dew-drops glitter on their necks of fnow ; ¹⁹⁰ Round each fair Nymph her dropping mantle clings, And Loves emerging fhake their flowery wings.

And [ob, their blue eyes. 1. 184. The bath at Buxton being of 82 degrees of heat is called a warm bath, and is fo compared with common fpring-water which poffeffes but 48 degrees of heat, but is neverthelefs a cold bath compared to the heat of the body which is 98. On going into this bath there is therefore always a chill perceived at the first immersion, but after having been in it a minute the chill ceases and a sensation of warmth fucceeds though the body continues to be immerfed in the water. The caufe of this curious phenomenon is to be looked for in the laws of animal fenfation and not from any properties of heat. When a perfon goes from clear day-light into an obfcure room for a while it appears gloomy, which gloom however in a little time ceafes, and the deficiency of light becomes no longer perceived. This is not folely owing to the enlargement of the iris of the eye, fince that is performed in an inftant, but to this law of fenfation, that when a lefs ftimulus is applied (within certain bounds) the fenfibility increafes. Thus at going into a bath as much colder than the body as that of Buxton, the diminution of heat on the fkin is at first perceived, but in about a minute the fenfibility to heat increases and the nerves of the skin are equally excited by the lessend stimulus. The fenfation of warmth at emerging from a cold-bath, and the pain called the hot-ach, after the hands have been immerfed in fnow, depend on the fame principle, viz. the increafed fenfibility of the fkin after having been previoufly exposed to a ftimulus lefs than ufual.

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"Here oft her LORD furveys the rude domain, Fair arts of Greece triumphant in his train; Lo! as he fteps, the column'd pile afcends, 195 The blue roof clofes, or the crefcent bends; New woods afpiring clothe their hills with green, Smooth flope the lawns, the grey rock peeps between; Relenting Nature gives her hand to Tafte, And Health and Beauty crown the laughing wafte. 200

VI. "NYMPHS ! YOUR bright fquadrons watch with chemic eyes

The cold-elaftic vapours, as they rife; With playful force arreft them as they pafs, And to *pure* AIR betroth the *flaming* GAS.

Here oft her Lord. 1. 193. Alluding to the magnificent and beautiful crefcent, and fuperb stables lately erected at Buxton for the accomodation of the company by the Duke of Devonshire; and to the plantations with which he has decorated the furround-ing mountains.

And to pure air. I. 204. Until very lately water was effeemed a fimple element, nor are all the most celebrated chemists of Europe yet converts to the new opinion of its decomposition. Mr. Lavoisier and others of the French school have most ingeniously endeavoured to shew that water confists of pure air, called by them oxygene, and of

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Round their translucent forms at once they fling 205 Their rapturous arms, with filver bosons cling; In fleecy clouds their fluttering wings extend, Or from the skies in lucid showers descend; Whence rills and rivers owe their secret birth, And Ocean's hundred arms infold the earth. 210

"So, robed by Beauty's Queen, with fofter charms SATURNIA woo'd the Thunderer to her arms; O'er her fair limbs a veil of light fhe fpread, And bound a ftarry diadem on her head';

inflammable air, called hydrogene, with as much of the matter of heat, or calorique, as is neceffary to preferve them in the form of gas. Gas is diftinguished from fleam by its preferving its elafticity under the preffure of the atmosphere, and in the greatest degrees of cold yet known. The hiftory of the progrefs of this great difcovery is detailed in the Memoires of the Royal Academy for 1781, and the experimental proofs of it are delivered in Lavoifier's Elements of Chemistry. The refults of which are that water confifts of eighty-five parts by weight of oxygene, and fifteen parts by weight of hydrogene, with a fufficient quantity of Calorique. Not only numerous chemical phenomena, but many atmospherical and vegetable facts receive clear and beautiful elucidation from this important analyfis. In the atmosphere inflammable air is probably perpetually uniting with vital air and producing moifture which defcends in dews and fhowers, while the growth of vegetables by the affiftance of light is perpetually again decomposing the water they imbibe from the earth, and while they retain the inflammable air for the formation of oils, wax, honey, refin, &c. they give up the vital air to replenish the atmosphere. 2

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Long braids of pearl her golden treffes grac'd, 215 And the charm'd CESTUS sparkled round her waist. -Raifed o'er the woof, by Beauty's hand inwrought, Breathes the foft Sigh, and glows the enamour'd Thought; Vows on light wings fucceed, and quiver'd Wiles, Affuafive Accents, and feductive Smiles. 220 -Slow rolls the Cyprian car in purple pride, And, fteer'd by Love, afcends admiring Ide; Climbs the green flopes, the nodding woods pervades, Burns round the rocks, or gleams amid the fhades .--Glad ZEPHYR leads the train, and waves above 225 The barbed darts, and blazing torch of Love; Reverts his fmiling face, and paufing flings Soft fhowers of rofes from aurelian wings. Delighted Fawns, in wreathes of flowers array'd, With tiptoe Wood-Boys beat the chequer'd glade; 230

And fleer'd by love. 1. 222. The younger love, or Cupid, the fon of Venus, owes his existence and his attributes to much later times than the Eros, or divine love, mentioned in Canto I. fince the former is no where mentioned by Homer, though fo many apt opportunities of introducing him occur in the works of that immortal bard. Bacon.

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Alarmed Naiads, rifing into air, Lift o'er their filver urns their leafy hair; Each to her oak the bashful Dryads shrink, And azure eyes are feen through every chink. -LOVE culls a flaming shaft of broadeft wing, 235 And refts the fork upon the quivering ftring; Points his arch eye aloft, with fingers ftrong Draws to his curled ear the filken thong; Loud twangs the fteel, the golden arrow flies, Trails a long line of luftre through the fkies; 240 "'Tis done !" he fhouts, " the mighty Monarch feels !" And with loud laughter shakes the filver wheels; Bends o'er the car, and whirling, as it moves, His loofen'd bowftring, drives the rifing doves. -Pierced on his throne the ftarting Thunderer turns, 245 Melts with foft fighs, with kindling rapture burns; Clafps her fair hand, and eyes in fond amaze The bright Intruder with enamour'd gaze. " And leaves my Goddefs, like a blooming bride, " The fanes of Argos for the rocks of Ide?

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"Her gorgeous palaces, and amaranth bowers,
"For cliff-top'd mountains, and aerial towers?"
He faid; and, leading from her ivory feat
The blufhing Beauty to his lone retreat,
Curtain'd with night the couch imperial fhrouds, 255
And refts the crimfon cufhions upon clouds.—
Earth feels the grateful influence from above,
Sighs the foft Air, and Ocean murmurs love;
Etherial Warmth expands his brooding wing,
And in ftill fhowers defcends the genial Spring. 260

VII. "NYMPHS OF AQUATIC TASTE! whofe placid fmile Breathes fweet enchantment o'er BRITANNIA's ifle; Whofe fportive touch in fhowers refplendent flings Her lucid cataracts, and her bubbling fprings; Through peopled vales the liquid filver guides, 265 And fwells in bright expanse her freighted tides.

And in fill flowers. 1. 260. The allegorical interpretation of the very antient mythology which fuppofes Jupiter to reprefent the fuperior part of the atmosphere or ether, and Juno the inferior air, and that the conjunction of these two produces vernal showers, as alluded to in Virgil's Georgics, is so analogous to the prefent

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You with nice ear, in tiptoe trains, pervade Dim walks of morn or evening's filent fhade; Join the lone Nightingale, her woods among, And roll your rills fymphonious to her fong; 270 Through fount-full dells, and wave-worn valleys move, And tune their echoing waterfalls to love; Or catch, attentive to the diftant roar, The paufing murmurs of the dafhing fhore; Or, as aloud fhe pours her liquid ftrain, 275 Purfue the NEREID on the twilight main. —Her playful Sea-horfe woos her foft commands, Turns his quick ears, his webbed claws expands,

important difcovery of the production of water from pure air, or oxygene, and inflammable air, or hydrogene, (which from its greater levity probably refides over the former,) that one fhould be tempted to believe that the very antient chemifts of Egypt had difcovered the composition of water, and thus represented it in their hieroglyphic figures before the invention of letters.

In the paffage of Virgil Jupiter is called ether, and defcends in prolific flowers on the bofom of Juno, whence the fpring fucceeds and all nature rejoices.

Tum pater omnipotens fœcundis imbribus Æther Conjugis in gremium lætæ defcendit, et omnes Magnus alit, magno commixtus corpore, fætus.

Virg. Georg. Lib. II. 1. 325.

Her playful feaborfe. 1. 277. Described form an antique gem.

PART I.

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His watery way with waving volutes wins, 280 Or liftening librates on unmoving fins. The Nymph emerging mounts her fcaly feat, Hangs o'er his gloffy fides her filver feet, With fnow-white hands her arching veil detains, Gives to his flimy lips the flacken'd reins, Lifts to the ftar of Eve her eye ferene, 285 And chaunts the birth of Beauty's radiant Queen .--O'er her fair brow her pearly comb unfurls Her beryl locks, and parts the waving curls, Each tangled braid with gliftening teeth unbinds And with the floating treafure mufks the winds.-290 Thrill'd by the dulcet accents, as fhe fings, The rippling wave in widening circles rings; Night's fhadowy forms along the margin gleam With pointed ears, or dance upon the ftream; The Moon transported flays her bright career, 300 And maddening Stars fhoot headlong from the fphere.

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VIII. "NYMPHS! whofe fair eyes with vivid luftres glow For human weal, and melt at human woe; Late as you floated on your filver fhells, Sorrowing and flow by DERWENT'S willowy dells; 300 Where by tall groves his foamy flood he fteers Through ponderous arches o'er impetuous wears, By DERBY'S fhadowy towers reflective fweeps, And gothic grandeur chills his dufky deeps; You pearl'd with Pity's drops his velvet fides, 305 Sigh'd in his gales, and murmur'd in his tides, Waved o'er his fringed brink a deeper gloom, And bow'd his alders o'er MILCENA's tomb.

"Oft with fweet voice She led her infant-train, Printing with graceful step his spangled plain, 310 Explored his twinkling swarms, that swim or sty, And mark'd his florets with botanic eye.—

O'er Milcena's tomb. l. 308. In memory of Mrs. French, a lady who to many other elegant accomplifhments added a proficiency in botany and natural hiftory. T 2

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"Sweet bud of Spring! how frail thy transfient bloom,
"Fine film," fhe cried, " of Nature's faireft loom !
"Soon Beauty fades upon its damafk throne !"— 315
—Unconfcious of the worm, that mined her own !—
—Pale are those lips, where fost careffes hung,
Wan the warm cheek, and mute the tender tongue,
Cold refts that feeling heart on Derwent's fhore,
And those love-lighted eye-balls roll no more ! 320

IX. "Your virgin trains on BRINDLEY's cradle fmiled, And nurfed with fairy-love the unletter'd child, Spread round his pillow all your fecret fpells, Pierced all your fprings, and open'd all your wells.— As now on grafs, with gloffy folds reveal'd, Glides the bright ferpent, now in flowers conceal'd;

On Brindley's cradle fmiled. 1. 321. The life of Mr. Brindley, whofe great abilities in the conftruction of canal navigation were called forth by the patronage of the Duke of Bridgwater, may be read in Dr. Kippis's Biographia Britannica, the excellence of his genius is visible in every part of this island. He died at Turnhurst in Staffordshire in 1772, and ought to have a monument in the cathedral church at Lichfield.

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Far fhine the fcales, that gild his finuous back, And lucid undulations mark his track; So with ftrong arm immortal BRINDLEY leads His long canals, and parts the velvet meads; 330 Winding in lucid lines, the watery mass Mines the firm rock, or loads the deep morafs, With rifing locks a thoufand hills alarms, Flings o'er a thousand streams its filver arms, Feeds the long vale, the nodding woodland laves, 335 And Plenty, Arts, and Commerce freight the waves. -NYMPHS ! who erewhile round BRINDLEY's early bier On fnow-white bofoms fhower'd the inceffant tear. Adorn his tomb !---oh, raife the marble buft, Proclaim his honours, and protect his duft! 340 With urns inverted, round the facred fhrine Their ozier wreaths let weeping Naiads twine; While on the top MECHANIC GENIUS stands, Counts the fleet waves, and balances the lands.

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X. "NYMPHS! you first taught to pierce the fecret caves Of humid earth, and lift her ponderous waves; 346 Bade with quick stroke the sliding piston bear The viewless columns of incumbent air ;— Prefs'd by the incumbent air the floods below, Through opening valves in foaming torrents flow, 350 Foot after foot with lessen'd impulse move, And rising feek the vacancy above.— So when the Mother, bending o'er his charms, Class her fair nurfeling in delighted arms;

Lift her ponderous waves. 1. 346. The invention of the pump is of very antient date, being afcribed to one Ctefebes an Athenian, whence it was called by the Latins machina Ctefebiana; but it was long before it was known that the afcent of the pifton lifted the fuperincumbent column of the atmosphere, and that then the preffure of the furrounding air on the furface of the well below forced the water up into the vacuum, and that on that account in the common lifting pump the water would rife only about thirty-five feet, as the weight of fuch a column of water was in general an equipoife to the furrounding atmosphere. The foamy appearance of water, when the preffure of the air over it is diminished, is owing to the expansion and escape of the air previously diffolved by it, or existing in its pores. When a child first fucks it only preffes or champs the teat, as observed by the great Harvey, but afterwards it learns to make an incipient vacuum in its mouth, and acts by removing the preffure of the atmosphere from the nipple, like a pump.

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Throws the thin kerchief from her neck of fnow, And half unveils the pearly orbs below; 356 With fparkling eye the blamelefs Plunderer owns Her foft embraces, and endearing tones, Seeks the falubrious fount with opening lips, Spreads his inquiring hands, and fmiles, and fips. 360

"CONNUBIAL FAIR! whom no fond transport warms To lull your infant in maternal arms; Who, blefs'd in vain with tumid bofoms, hear His tender wailings with unfeeling ear; The foothing kifs and milky rill deny 365 To the fweet pouting lip, and gliftening eye !--Ah! what avails the cradle's damafk roof, The eider bolfter, and embroider'd woof !--Oft hears the gilded couch unpity'd plains, And many a tear the taffel'd cushion stains ! 370

Ab! what avails. 1. 367. From an elegant little poem of Mr. Jerningham's intitled Il Latte, exhorting ladies to nurfe their own children.

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No voice fo fweet attunes his cares to reft, So foft no pillow, as his Mother's breaft !— —Thus charm'd to fweet repofe, when twilight hours Shed their foft influence on celeftial bowers, The Cherub, Innocence, with fmile divine 375 Shut his white wings, and fleeps on Beauty's fhrine.

XI. "From dome to dome when flames infuriate climb, Sweep the long ftreet, inveft the tower fublime; Gild the tall vanes amid the aftonifh'd night, And reddening heaven returns the fanguine light; 380 While with vaft ftrides and briftling hair aloof Pale Danger glides along the falling roof; And Giant Terror howling in amaze Moves his dark limbs acrofs the lurid blaze. NYMPHS ! YOU firft taught the gelid wave to rife, 385 Hurl'd in refplendent arches to the fkies;

Hurl'd in refplendent arches. 1. 386. The addition of an air-cell to machines for raifing water to extinguish fire was first introduced by Mr. Newsham of London, and

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In iron cells condenfed the airy fpring, And imp'd the torrent with unfailing wing; —On the fierce flames the fhower impetuous falls, And fudden darknefs fhrouds the fhatter'd walls; 390 Steam, fmoak, and duft in blended volumes roll, And Night and Silence repoffefs the Pole.—

"Where were ye, NYMPHS! in those difasterous hours,
Which wrap'd in flames Augusta's finking towers?
Why did ye linger in your wells and groves, 395
When fad Woodmason mourn'd her infant loves?

is now applied to fimilar engines for wafhing wall-trees in gardens, and to all kinds of forcing pumps, and might be applied with advantage to lifting pumps where the water is brought from a great diftance horizontally. Another kind of machine was invented by one Greyl, in which a veffel of water was every way difperfed by the explosion of gun-powder lodging in the centre of it, and lighted by an adapted match; from this idea Mr. Godfrey proposed a water-bomb of similar construction. Dr. Hales to prevent the spreading of fire proposed to cover the floors and stairs of the adjoining houses with earth; Mr. Hartley proposed to prevent houses from taking fire by covering the cieling with thin iron-plates, and Lord Mahon by a bed of coarse mortar or plaisfer between the cieling and floor above it. May not this age of chemical science discover fome method of injecting or foaking timber with lime-water and afterwards with vitriolic acid, and thus fill its pores with alabaster? or of penetrating it with filiceous matter, by processes fimilar to those of Bergman and Achard? See Cronstadt's Mineral. 2d. edit. Vol. I. p. 222.

Woodmason, Molestworth. 1. 396. The histories of these unfortunate families may be seen in the Annual Register, or in the Gentleman's Magazine.

PART I.

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When thy fair Daughters with unheeded fcreams, Ill-fated MOLESWORTH ! call'd the loitering ftreams ?---The trembling Nymph on bloodlefs fingers hung Eyes from the tottering wall the diftant throng, 400 With ceafelefs fhrieks her fleeping friends alarms, Drops with finged hair into her lover's arms .---The illumin'd Mother feeks with footfteps fleet, Where hangs the fafe balcony o'er the ftreet, Wrap'd in her fheet her youngeft hope fufpends, 405 And panting lowers it to her tiptoe friends; Again fhe hurries on affection's wings, And now a third, and now a fourth, fhe brings; Safe all her babes, fhe fmooths her horrent brow, And burfts through bickering flames, unfcorch'd, below. So, by her Son arraign'd, with feet unfhod 4II O'er burning bars indignant Emma trod.

"E'en on the day when Youth with Beauty wed, The flames furprized them in their nuptial bed ;---

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Seen at the opening fafh with bofom bare, 415 With wringing hands, and dark difhevel'd hair, The blufhing Beauty with diforder'd charms Round her fond lover winds her ivory arms; Beat, as they clafp, their throbbing hearts with fear, And many a kifs is mix'd with many a tear; 420 Ah me! in vain the labouring engines pour Round their pale limbs the ineffectual flower !— —Then crafh'd the floor, while finking crouds retire, And Love and Virtue funk amid the fire !— With piercing fcreams afflicted ftrangers mourn, 425 And their white afhes mingle in their urn.

XII. "PELLUCID FORMS! whofe cryftal bofoms fhow The fhine of welfare, or the fhade of woe; Who with foft lips falute returning Spring, And hail the Zephyr quivering on his wing; 430 Or watch, untired, the wintery clouds, and fhare With ftreaming eyes my vegetable care;

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Go, fhove the dim mift from the mountain's brow, Chafe the white fog, which floods the vale below; Melt the thick fnows, that linger on the lands, And catch the hailftones in your little hands; Guard the coy bloffom from the pelting flower, And dafh the rimy fpangles from the bower; From each chill leaf the filvery drops repel, And clofe the timorous floret's golden bell.

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Shove the dim mift. 1. 433. See note on 1. 20 of this Canto.

Catch the bail-flones. 1. 436. See note on 1. 15 of this Canto.

From each chill leaf. 1. 439. The upper fide of the leaf is the organ of vegetable refpiration, as explained in the additional notes, No XXXVII, hence the leaf is liable to injury from much moifture on this furface, and is deftroyed by being fineared with oil, in these respects refembling the lungs of animals or the spiracula of infects. To prevent these injuries fome leaves repel the dew-drops from their upper furfaces as those of cabbages; other vegetables close the upper furfaces of their leaves together in the night or in wet weather, as the sensitive plant; others only hang their leaves downwards fo as to shoot the wet from them, as kidney-beans, and many trees. See note on 1. 18 of this Canto.

Golden bell. 1. 440. There are mufcles placed about the footfalks of the leaves or leaflets of many plants, for the purpole of clofing their upper furfaces together, or of bending them down fo as to fhoot off the fhowers or dew-drops, as mentioned in the preceeding note. The claws of the petals or of the divisions of the calyx of many flowers are furnished in a fimilar manner with mufcles, which are exerted to open or clofe the corol and calyx of the flower as in tragopogon, anemone. This action of opening and clofing the leaves or flowers does not appear to be produced fimply by *irritation* on the mufcles themfelves, but by the connection of those mufcles with a

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"So fhould young SYMPATHY, in female form, Climb the tall rock, fpectatrefs of the ftorm; Life's finking wrecks with fecret fighs deplore, And bleed for others' woes, Herfelf on fhore; To friendlefs Virtue, gafping on the ftrand, 445 Bare her warm heart, her virgin arms expand, Charm with kind looks, with tender accents cheer, And pour the fweet confolatory tear; Grief's curelefs wounds with lenient balms affwage, Or prop with firmer ftaff the fteps of Age; 450

fensitive fensorium or brain existing in each individual bud or flower. Ift. Because many flowers close from the defect of ftimulus, not by the excess of it, as by darkness, which is the absence of the ftimulus of light; or by cold, which is the absence of the ftimulus of heat. Now the defect of heat, or the absence of food, or of drink, affects our *fensations*, which had been previously accustomed to a greater quantity of them; but a muscle cannot be faid to be ftimulated into action by a defect of ftimulus. 2. Because the muscles around the footstalks of the subdivisions of the leaves of the fensitive plant are exerted when any injury is offered to the other extremity of the leaf, and fome of the ftamens of the flowers of the class Syngenesia contract themselves when others are irritated. See note on Chondrilla, Vol. II. of this work.

From this circumftance the contraction of the muscles of vegetables feems to depend on a difagreeable *fenfation* in fome diffant part, and not on the *irritation* of the muscles themfelves. Thus when a particle of dust flimulates the ball of the eye, the eye-lids are inftantly closed, and when too much light pains the retina, the muscles of the iris contract its aperture, and this not by any connection or confent of the nerves of those parts, but as an effort to prevent or to remove a difagreeable fensation, which evinces that vegetables are endued with fensation, or that each bud has a common fensorium, and is furnished with a brain or a central place where its nerves were connected.

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The lifted arm of mute Defpair arreft, And fnatch the dagger pointed to his breaft; Or lull to flumber Envy's haggard mien, And rob her quiver'd fhafts with hand unfeen. —Sound, NYMPHS OF HELICON! the trump of Fame, And teach Hibernian echoes JONES'S name; 456 Bind round her polifh'd brow the civic bay, And drag the fair Philanthropift to day.— So from feeluded fprings, and fecret caves, Her Liffy pours his bright meandering waves, 460 Cools the parch'd vale, the fultry mead divides, And towns and temples ftar his fhadowy fides.

XIII. "CALL YOUR light legions, tread the fwampy heath, Pierce with fharp fpades the tremulous peat beneath; With colters bright the rufhy fward bifect, 465 And in new veins the gufhing rills direct;—

Jones's name. 1. 456. A young lady who devotes a great part of an ample fortune to well chosen acts of fecret charity.

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So flowers fhall rife in purple light array'd, And bloffom'd orchards ftretch their filver fhade; Admiring glebes their amber ears unfold, And Labour fleep amid the waving gold. 470

"Thus when young HERCULES with firm difdain Braved the foft fimiles of Pleafure's harlot train; To valiant toils his forceful limbs affign'd, And gave to Virtue all his mighty mind, Fierce ACHELOUS rufh'd from mountain-caves, 475 O'er fad Etolia pour'd his wafteful waves, O'er lowing vales and bleating paftures roll'd, Swept her red vineyards, and her glebes of gold, Mined all her towns, uptore her rooted woods, And Famine danced upon the fhining floods. 480

Fierce Achelous. 1. 475. The river Achelous deluged Etolia, by one of its branches or arms, which in the antient languages are called horns, and produced famine throughout a great tract of country, this was reprefented in hieroglyphic emblems by the winding courfe of a ferpent and the roaring of a bull with large horns. Hercules, or the emblem of ftrength, ftrangled the ferpent, and tore off one horn from the bull; that is, he ftopped and turned the courfe of one arm of the river, and reftored plenty to the country. Whence the antient emblem of the horn of plenty. Dict. par M. Danet.

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The youthful Hero feized his curled creft, And dafh'd with lifted club the watery Peft; With waving arm the billowy tumult quell'd, And to his courfe the bellowing Fiend repell'd.

"Then to a Snake the finny Demon turn'd 485 His lengthen'd form, with fcales of filver burn'd; Lafh'd with refiftlefs fweep his dragon-train, And fhot meandering o'er the affrighted plain. The Hero-God, with giant fingers clafp'd Firm round his neck, the hiffing monfter grafp'd; 49° With ftarting eyes, wide throat, and gaping teeth, Curl his redundant folds, and writhe in death.

"And now a Bull, amid the flying throng The grifly Demon foam'd, and roar'd along; With filver hoofs the flowery meadows fpurn'd, Roll'd his red eye, his threatening antlers turn'd.

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Dragg'd down to earth, the Warrior's victor-hands Prefs'd his deep dewlap on the imprinted fands; Then with quick bound his bended knee he fix'd High on his neck, the branching horns betwixt, 500 Strain'd his ftrong arms, his finewy fhoulders bent, And from his curled brow the twifted terror rent. —Pleafed Fawns and Nymphs with dancing ftep applaud, And hang their chaplets round the refting God; Link their foft hands, and rear with paufing toil 505 The golden trophy on the furrow'd foil; Fill with ripe fruits, with wreathed flowers adorn, And give to PLENTY her prolific horn.

XIV. "On Spring's fair lap, CERULEAN SISTERS! pour From airy urns the fun-illumined fhower, 510 Feed with the dulcet drops my tender broods, Mellifluous flowers, and aromatic buds; Hang from each bending grafs and horrent thorn The tremulous pearl, that glitters to the morn;

Dragg'd down to earth. 1. 497. Defcribed from an antique gem. PART I. X

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Or where cold dews their fecret channels lave, 515 And Earth's dark chambers hide the ftagnant wave, O, pierce, YE NYMPHS! her marble veins, and lead Her gufhing fountains to the thirfty mead; Wide o'er the fhining vales, and trickling hills Spread the bright treafure in a thoufand rills. 520 So fhall my peopled realms of Leaf and Flower Exult, inebriate with the genial fhower;

Spread the bright treafure. 1. 520. The practice of flooding lands long in use in China has been but lately introduced into this country. Befides the supplying water to the herbage in dryer feasons, it seems to defend it from frost in the early part of the year, and thus doubly advances the vegetation. The waters which rise from springs passing through marl or limestone are replete with calcareous earth, and when thrown over morasses they deposit this earth and incruss or consolidate the morass. This kind of earth is deposited in great quantity from the springs at Matlock bath, and supplies the soft porous limestone of which the houses and walls are there constructed; and has formed the whole bank for near a mile on that fide of the Derwent on which they stand.

The water of many fprings contains much azotic gas, or phlogiftic air, befides carbonic gas, or fixed air, as that of Buxton and Bath; this being fet at liberty may more readily contribute to the production of nitre by means of the putrefcent matters which it is exposed to by being fpread upon the furface of the land; in the fame manner as frequently turning over heaps of manure facilitates the nitrous process by imprisoning atmospheric air in the interflices of the putrefcent materials. Water arising by landfloods brings along with it much of the most foluble parts of the manure from the higher lands to the lower ones. River-water in its clear state and those springs which are called fost are less beneficial for the purpose of watering lands, as they contain less earthy or faline matter; and water from diffolving fnow from its flow folution brings but little earth along with it, as may be feen by the comparative clearness of the water of fnow-floods.

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Dip their long treffes from the moffy brink, With tufted roots the glaffy currents drink; Shade your cool manfions from meridian beams, 525 And view their waving honours in your ftreams.

"Thus where the veins their confluent branches bend, And milky eddies with the purple blend; The Chyle's white trunk, diverging from its fource, Seeks through the vital mafs its fhining courfe; 53° O'er each red cell, and tiffued membrane fpreads In living net-work all its branching threads; Maze within maze its tortuous path purfues, Winds into glands, inextricable clues; Steals through the ftomach's velvet fides, and fips 535 The filver furges with a thoufand lips; Fills each fine pore, pervades each flender hair, And drinks falubrious dew-drops from the air.

"Thus when to kneel in Mecca's awful gloom, Or prefs with pious kifs Medina's tomb, 540

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League after league, through many a lingering day, Steer the fwart Caravans their fultry way; O'er fandy waftes on gafping camels toil, Or print with pilgrim-fteps the burning foil; If from lone rocks a fparkling rill defcend, 545 O'er the green brink the kneeling nations bend, Bathe the parch'd lip, and cool the feverifh tongue, And the clear lake reflects the mingled throng."

THE GODDESS PAUSED,—the liftening bands awhile Still feem to hear, and dwell upon her finile; 55° Then with foft murmur fweep in lucid trains Down the green flopes, and o'er the pebbly plains, To each bright ftream on filver fandals glide, Reflective fountain, and tumultuous tide.

So fhoot the Spider-broods at breezy dawn 555 Their glittering net-work o'er the autumnal lawn; From blade to blade connect with cordage fine The unbending grafs, and live along the line;

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Or bathe unwet their oily forms, and dwell With feet repulsive on the dimpling well.

So when the North congeals his watery mafs, Piles high his fnows, and floors his feas with glafs; While many a Month, unknown to warmer rays, Marks its flow chronicle by lunar days; Stout youths and ruddy damfels, fportive train, 565 Leave the white foil, and rufh upon the main; From ifle to ifle the moon-bright fquadrons ftray, And win in eafy curves their graceful way; On ftep alternate borne, with balance nice Hang o'er the gliding fteel, and hifs along the ice. 570



Argument of the Fourth Canto.

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ADDRESS to the Sylphs. I. Trade-winds. Monfoons. N. E. and S. W. winds. Land and fea breezes. Irregular winds. q. II. Production of vital air from oxygene and light. The marriage of Cupid and Pfyche. 25. III. 1. Syroc. Simoom. Tornado. 63. 2. Fog. Contagion. Story of Thyrfis and Aegle. Love and Death. 79. IV. 1. Barometer. Air-pump. 127. 2. Air-balloon of Mongulfier. Death of Rozier. Icarus. 143. V. Difcoveries of Dr. Prieftley. Evolutions and combinations of pure air. Rape of Proferpine. 165. VI. Sea-balloons, or houfes constructed to move under the fea. Death of Mr. Day. Of Mr. Spalding. Of Captain Pierce and his Daughters. 195. VII. Sylphs of mufic. Cecelia finging. Cupid with a lyre riding upon a lion. 233. VIII. Destruction of Senacherib's army by a peftilential wind. Shadow of Death. 263. IX. 1. Wifh to polfefs the fecret of changing the courfe of the winds. 305. 2. Monfter devouring air fubdued by Mr. Kirwan. 321. X. 1. Seeds fuspended in their pods. Stars discovered by Mr. Herschel. Deftruction and refuscitation of all things. 351. 2. Seeds within feeds, and bulbs within bulbs. Picture on the retina of the eye. Concentric strata of the earth. The great feed. 381. 3. The root, pith, lobes, plume, calyx, coral, fap, blood, leaves refpire and abforb light. The crocodile in its egg. 400. XI. Opening

of the flower. The petals, ftyle, anthers, prolific duft. Tranfmutation of the filkworm. 441. XII. 1. Leaf-buds changed into flower-buds by wounding the bark, or ftrangulating a part of the branch. 461. 2. Ingrafting. Aaron's rod pullulates. 477. XIII. 1. Infects on trees. Humming-bird alarmed by the fpiderlike apearance of Cyprepedia. 491. 2. Difeafes of vegetables. Scratch on unnealed glafs. 511. XIV. 1. Tender flowers. Amaryllis, fritillary, erythrina, mimofa, cerea. 523. 2. Vines. Oranges. Diana's trees. Kew garden. The royal family. 541. XV. Offering to Hygeia. 587. Departure of the Goddefs. 615.

to pollicle the fearst of changing the courts of the winds, 305.

THE

ECONOMY OF VEGETATION.

CANTO IV.

As when at noon in Hybla's fragrant bowers CACALIA opens all her honey'd flowers;

Cacalia opens. 1. 2. The importance of the nectarium or honey-gland in the vegetable economy is feen from the very complicated apparatus, which nature has formed in fome flowers for the prefervation of their honey from infects, as in the aconites or monkfhoods; in other plants inftead of a great apparatus for its protection a greater fecretion of it is produced that thence a part may be fpared to the depredation of infects. The cacalia fuaveolens produces fo much honey that on fome days it may be fmelt at a great diffance from the plant. I remember once counting on one of thefe plants befides bees of various kinds without number, above two hundred painted butterflies, which gave it the beautiful appearance of being covered with additional flowers.

PART I.

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5

Contending fwarms on bending branches cling, And nations hover on aurelian wing; So round the GODDESS, ere fhe fpeaks, on high Impatient SYLPHS in gawdy circlets fly; Quivering in air their painted plumes expand, And coloured fhadows dance upon the land.

I. "SYLPHS! YOUR light troops the tropic Winds confine, And guide their ftreaming arrows to the Line; 10 While in warm floods ecliptic breezes rife, And fink with wings benumb'd in colder fkies. You bid Monfoons on Indian feas refide, And veer, as moves the fun, their airy tide; While fouthern gales o'er weftern oceans roll, 15 And Eurus fteals his ice-winds from the Pole. Your playful trains, on fultry iflands born, Turn on fantaftic toe at eve and morn; With foft fufurrant voice alternate fweep Earth's green pavilions and encircling deep. 20

The tropic winds. 1. 9. See additional notes, No. XXXIII.

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OR in itinerant cohorts, borne fublime On tides of ether, float from clime to clime; O'er waving Autumn bend your airy ring, Or waft the fragrant bofom of the Spring.

II. "When Morn, efcorted by the dancing Hours, O'er the bright plains her dewy luftre fhowers; 26 Till from her fable chariot Eve ferene Drops the dark curtain o'er the brilliant fcene; You form with chemic hands the airy furge, Mix with broad vans, with fhadowy tridents urge. 30 Sylphs! from each fun-bright leaf, that twinkling fhakes O'er Earth's green lap, or fhoots amid her lakes, Your playful bands with fimpering lips invite, And wed the enamour'd OXYGENE to LIGHT.—

The enamour'd oxygene. 1. 34. The common air of the atmosphere appears by the analysis of Dr. Prieftley and other philosophers to confift of about three parts of an elastic fluid unfit for respiration or combustion, called azote by the French school, and about one fourth of pure vital air fit for the support of animal life and of combustion, called oxygene. The principal source of the azote is probably from the decomposition of all vegetable and animal matters by putrefaction and combustion; the principal Y_2

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Round their white necks with fingers interwove, 35 Cling the fond Pair with unabating love; Hand link'd in hand on buoyant ftep they rife, And foar and gliften in unclouded fkies. Whence in bright floods the VITAL AIR expands, And with concentric fpheres involves the lands; 40 Pervades the fwarming feas, and heaving earths, Where teeming Nature broods her myriad births; Fills the fine lungs of all that *breathe* or *bud*, Warms the new heart, and dyes the gufhing blood;

fource of vital air or oxygene is perhaps from the decomposition of water in the organs of vegetables by means of the fun's light. The difficulty of injecting vegetable veffels feems to fhew that their perfpirative pores are much lefs than those of animals, and that the water which conftitutes their perfpiration is fo divided at the time of its exclusion that by means of the fun's light it becomes decomposed, the inflammable air or hydrogene, which is one of its conftituent parts, being retained to form the oil, refin, wax, honey, &c. of the vegetable economy; and the other part, which united with light or heat becomes vital air or oxygene gas, rifes into the atmosphere and replenishes it with the food of life.

Dr. Prieftley has evinced by very ingenious experiments that the blood gives out phlogifton, and receives vital air, or oxygene-gas by the lungs. And Dr. Crawford has fhewn that the blood acquires heat from this vital air in refpiration. There is however ftill a fomething more fubtil than heat, which muft be obtained in refpiration from the vital air, a fomething which life can not exift a few minutes without, which feems neceffary to the vegetable as well as to the animal world, and which as no organized veffels can confine it, requires perpetually to be renewed. See note on Canto I. 1. 407.

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With Life's first spark inspires the organic frame, 45 And, as it wastes, renews the subtile flame.

"So pure, fo foft, with fweet attraction fhone Fair PSYCHE, kneeling at the ethereal throne; Won with coy fmiles the admiring court of Jove, And warm'd the bofom of unconquer'd Love. 50 Beneath a moving fhade of fruits and flowers Onward they march to HYMEN's facred bowers; With lifted torch he lights the feftive train, Sublime, and leads them in his golden chain; Joins the fond pair, indulgent to their vows, 55 And hides with myftic veil their blufhing brows. Round their fair forms their mingling arms they fling, Meet with warm lip, and clafp with ruftling wing.—

Fair Pfyche. 1. 48. Defcribed from an antient gem on a fine onyx in possefilion of the Duke of Marlborough, of which there is a beautiful print in Bryant's Mythol. Vol II. p. 392. And from another antient gem of Cupid and Pfyche embracing, of which there is a print in Spence's Polymetis. p. 82.

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Hence plaftic Nature, as Oblivion whelms
Her fading forms, repeoples all her realms;
Soft Joys difport on purple plumes unfurl'd,
And Love and Beauty rule the willing world.

III. I. "SYLPHS! YOUR bold myriads on the withering heath

Stay the fell Syroc's fuffocative breath; Arreft Siмоом in his realms of fand, The poifoned javelin balanced in his hand;—

Repeoples all her realms. 1. 60.

Quæ mare navigerum et terras frugiferentes Concelebras; per te quoniam genus omne animantum Concipitur, vifitque exortum lumina folis.

Lucret.

65

Arreft Simoom. 1. 65. "At eleven o'clock while we were with great pleafure contemplating the rugged tops of Chiggre, where we expected to folace ourfelves with plenty of good water, Idris cried out with a loud voice, "fall upon your faces, for here is the fimoom !" I faw from the S. E. a haze come in colour like the purple part of a rainbow, but not fo comprefied or thick; it did not occupy twenty yards in breadth, and was about twelve feet high from the ground. It was a kind of a blufh upon the air, and it moved very rapidly, for I fcarce could turn to fall upon the ground with my head to the northward, when I felt the heat of its current plainly upon my face. We all lay flat upon the ground, as if dead, till Idris told us it was blown over. The meteor, or purple haze, which I faw was indeed paffed;
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Fierce on blue ftreams he rides the tainted air, Points his keen eye, and waves his whiftling hair; While, as he turns, the undulating foil Rolls in red waves, and billowy deferts boil. 71

but the light air that still blew was of heat to threaten fuffocation. For my part I found distinctly in my breast, that I had imbibed a part of it; nor was I free of an asthmatic fensation till I had been some months in Italy." Bruce's Travels. Vol. IV. p. 557.

It is difficult to account for the narrow track of this peftilential wind, which is faid not to exceed twenty yards, and for its fmall elevation of twelve feet. A whirlwind will pass forwards, and throw down an avenue of trees by its quick revolution as it passes, but nothing like a whirling is described as happening in these narrow streams of air, and whirlwinds ascend to greater heights. There seems but one known manner in which this channel of air could be effected, and that is by electricity.

The volcanic origin of these winds is mentioned in the note on Chunda in Vol. II. of this work; it must here be added, that Professor Vairo at Naples found, that during the eruption of Vefuvius perpendicular iron bars were electric; and others have obferved fuffocating damps to attend thefe eruptions. Ferber's Travels in Italy, p. 133. And laftly, that a current of air attends the paffage of electric matter, as is feen in prefenting an electrized point to the flame of a candle. In Mr. Bruce's account of this fimoom, it was in its course over a quite dry defert of fand, (and which was in confequence unable to conduct an electric fiream into the earth beneath it,) to fome moift rocks at but a few miles diffance; and thence would appear to be a ftream of electricity from a volcano attended with noxious air; and as the bodies of Mr. Bruce and his attendants were infulated on the fand, they would not be fensible of their increased electricity, as it paffed over them; to which it may be added, that a fulphurous or fuffocating fenfation is faid to accompany flafhes of lightning, and even ftrong fparks of artificial electricity. In the above account of the fimoom, a great rednefs in the air is faid to be a certain fign of its approach, which may be occafioned by the eruption of flame from a diftant volcano in these extensive and impenetrable deferts of fand. See Note on l. 292 of this Canto.

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You feize TORNADO by his locks of mift, Burft his denfe clouds, his wheeling fpires untwift; Wide o'er the Weft when borne on headlong gales, Dark as meridian night, the Monfter fails, Howls high in air, and fhakes his curled brow, Lafhing with ferpent-train the waves below, Whirls his black arm, the forked lightning flings, And fhowers a deluge from his demon-wings.

2. "SYLPHS! with light fhafts you pierce the drowfy Fog,

75

That lingering flumbers on the fedge-wove bog, 80 With webbed feet o'er midnight meadows creeps, Or flings his hairy limbs on ftagnant deeps.

Tornado's. 1. 71. See additional notes, No. XXXIII.

On flagnant deeps. 1. 82. All contagious miafmata originate either from animal bodies, as those of the small pox, or from putrid morass; these latter produce agues in the colder climates, and malignant fevers in the warmer ones. The volcanic vapours which cause epidemic coughs, are to be ranked amongst poisons, rather than amongst the miafmata, which produce contagious difeases.

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YOU meet CONTAGION iffuing from afar, And dafh the baleful conqueror from his car; When, Gueft of DEATH! from charnel vaults he fteals, And bathes in human gore his armed wheels. 86

"Thus when the PLAGUE, upborne on Belgian air, Look'd through the mift and fhook his clotted hair, O'er fhrinking nations fteer'd malignant clouds, And rain'd deftruction on the gafping crouds. 90 The beauteous ÆGLE felt the venom'd dart, Slow roll'd her eye, and feebly throbb'd her heart ; Each fervid figh feem'd fhorter than the laft, And ftarting Friendfhip fhunn'd her, as fhe pafs'd. —With weak unfteady ftep the fainting Maid 95 Seeks the cold garden's folitary fhade,

The beauteous Ægle. 1.91. When the plague raged in Holland in 1636, a young girl was feized with it, had three carbuncles, and was removed to a garden, where her lover, who was betrothed to her, attended her as a nurfe, and flept with her as his wife. He remained uninfected, and the recovered, and was married to him. The flory is related by Vinc. Fabricius in the Mifc. Cur. Ann. II. Obf. 188.

PART I.

Eved, as he fwam.

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Sinks on the pillowy mofs her drooping head, And prints with lifeless limbs her leafy bed. -On wings of Love her plighted Swain purfues, Shades her from winds, and shelters her from dews, 100 Extends on tapering poles the canvas roof, Spreads o'er the ftraw-wove matt the flaxen woof, Sweet buds and bloffoms on her bolfter ftrows, And binds his kerchief round her aching brows; Sooths with foft kifs, with tender accents charms, 105 And clafps the bright Infection in his arms.-With pale and languid fmiles the grateful Fair Applauds his virtues, and rewards his care; Mourns with wet cheek her fair companions fled On timorous step, or number'd with the dead; 110 Calls to her bofom all its fcatter'd rays, And pours on THYRSIS the collected blaze; Braves the chill night, careffing and carefs'd, And folds her Hero-lover to her breaft .---Lefs bold, LEANDER at the dufky hour II5 Eyed, as he fwam, the far love-lighted tower;

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Breafted with ftruggling arms the toffing wave, And funk benighted in the watery grave. Lefs bold, TOBIAS claim'd the nuptial bed, Where feven fond Lovers by a Fiend had bled; 120 And drove, inftructed by his Angel-Guide, The enamour'd Demon from the fatal bride.— —SYLPHS! while your winnowing pinions fan'd the air, And fhed gay vifions o'er the fleeping pair; LOVE round their couch effufed his rofy breath, 125 And with his keener arrows conquer'd DEATH.

IV. 1. "You charm'd, indulgent Sylphs! their learned toil,

And crown'd with fame your TORRICELL, and BOYLE;

Torricell and Boyle. 1. 128. The preffure of the atmosphere was discovered by Torricelli, a disciple of Galileo, who had previously found that the air had weight. Dr. Hook and M. Du Hamel ascribe the invention of the air-pump to Mr. Boyle, who however confesses he had fome hints concerning its construction from De Guerick. The vacancy at the summit of the barometer is termed the Torricellian vacuum, and the exhausted receiver of an air pump the Boylean vacuum, in honour of these two philosophers.

The mift and defcending dew which appear at first exhausting the receiver of an air-pump, are explained in the Phil. Trans. Vol. LXXVIII. from the cold produced by

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Taught with fweet fmiles, refponfive to their prayer, The fpring and preffure of the viewlefs air. 130 —How up exhaufted tubes bright currents flow Of liquid filver from the lake below, Weigh the long column of the incumbent fkies, And with the changeful moment fall and rife. —How, as in brazen pumps the piftons move, 135 The membrane-valve fuftains the weight above ;

the expansion of air. For a thermometer placed in the receiver finks fome degrees, and in a very little time, as foon as a fufficient quantity of heat can be acquired from the furrounding bodies, the dew becomes again taken up. See additional notes, No. VII. Mr. Sauffure obferved on placing his hygrometer in a receiver of an air-pump, that though on beginning to exhauft it the air became mifty, and parted with its moifture, yet the hair of his hygrometer contracted, and the inftrument pointed to greater drynefs. This unexpected occurrence is explained by M. Monge (Annales de Chymie, Tom. V.) to depend on the want of the ufual preffure of the atmosphere to force the aqueous particles into the pores of the hair; and M. Sauffure fuppofes, that his veficular vapour requires more time to be rediffolved, than is neceffary to dry the hair of his thermometer. Effais fur l'Hygrom. p. 226. but I fuspect there is a lefs hypothetical way of understanding it; when a colder body is brought into warm and moift air, (as a bottle of fpring-water for inftance,) a fleam is quickly collected on its furface; the contrary occurs when a warmer body is brought into cold and damp air, it continues free from dew fo long as it continues warm; for it warms the atmosphere around it, and renders it capable of receiving inftead of parting with moifture. The moment the air becomes rarefied in the receiver of the air-pump it becomes colder, as appears by the thermometer, and depofits its vapour; but the hair of Mr. Sauffure's hygrometer is now warmer than the air in which it is immerfed, and in confequence becomes dryer than before, by warming the air which immediately furrounds it, a part of its moifture evaporating along with its. heat.

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Stroke follows ftroke, the gelid vapour falls, And mifty dew-drops dim the cryftal walls; Rare and more rare expands the fluid thin, And Silence dwells with Vacancy within.— 140 So in the mighty Void with grim delight Primeval Silence reign'd with ancient Night.

2. "SYLPHS ! your foft voices, whifpering from the fkies, Bade from low earth the bold MONGULFIER rife; Outftretch'd his buoyant ball with airy fpring, 145 And bore the Sage on levity of wing;— Where were ye, SYLPHS ! when on the ethereal main Young ROSIERE launch'd, and call'd your aid in vain ? Fair mounts the light balloon, by Zephyr driven, Parts the thin clouds, and fails along the heaven; 150

Young Rofiere launch'd. 1. 148. M. Pilatre du Rofiere with a M. Romain rofe in a balloon from Boulogne in June 1785, and after having been about a mile high for about half an hour the balloon took fire, and the two adventurers were dashed to pieces on their fall to the ground. Mr. Rofiere was a philosopher of great talents and activity, joined with such urbanity and elegance of manners, as conciliated the affections of his acquaintance and rendered his misfortune universally lamented. Annual Register for 1784 and 1785, p. 329. 2

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Higher and yet higher the expanding bubble flies, Lights with quick flash, and bursts amid the skies.— Headlong He rushes through the affrighted air With limbs distorted, and dishevel'd hair, Whirls round and round, the flying croud alarms, 155 And DEATH receives him in his fable arms!— So erst with melting wax and loofen'd strings Sunk hapless ICARUS on unfaithful wings; His fcatter'd plumage danced upon the wave, And forrowing Mermaids deck'd his watery grave; 160 O'er his pale corfe their pearly fea-flowers sched, And struck in their coral towers the pausing bell, And wide in ocean toll'd his echoing knell.

And wide in ocean. 1. 164. Denfer bodies propagate vibration or found better than rarer ones; if two ftones be ftruck together under the water, they may be heard a mile or two by any one whole head is immerfed at that diftance, according to an experiment of Dr. Franklin. If the ear be applied to one end of a long beam of timber, the ftroke of a pin at the other end becomes fenfible; if a poker be fulpended in the middle of a garter, each end of which is preffed againft the ear, the leaft percuffions on the poker give great founds. And I am informed by laying the ear on the ground the tread of a horfe may be difcerned at a great diffance in the night. The organs of hearing belonging to fifh are for this reafon much lefs complicated than of quadrupeds, as the

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V. " SYLPHS! YOU, retiring to fequefter'd bowers, Where oft your PRIESTLEY woos your airy powers, 166

fluid they are immerfed in fo much better conveys its vibrations. And it is probable that fome fhell-fifh which have twifted fhells like the cochlea and femicircular canals of the ears of men and quadrupeds may have no appropriated organ for perceiving the vibrations of the element they live in, but may by their fpiral form be in a manner all ear.

Where oft your Priefley. 1. 166. The fame of Dr. Priefley is known in every part of the earth where fcience has penetrated. His various difcoveries refpecting the analyfis of the atmosphere, and the production of variety of new airs or gaffes, can only be clearly underftood by reading his Experiments on Airs, (3 vols. octavo, Johnson, London.) the following are amongst his many difcoveries. I. The difcovery of nitrous and dephlogisticated airs. 2. The exhibition of the acids and alkalies in the form of air. 3. Afcertaining the purity of refpirable air by nitrous air. 4. The reftoration of vitiated air by vegetation. 5. The influence of light to enable vegetables to yield pure air. 6. The conversion by means of light of animal and vegetable fubstances, that would otherwife become putrid and offensive, into nourisfiment of vegetables. 7. The use of refpiration by the blood parting with phlogiston, and imbibing dephlogisticated air.

The experiments here alluded to are, I. Concerning the production of nitrous gas from diffolving iron and many other metals in nitrous acid, which though first discovered by Dr. Hales (Static. Eff. Vol. I. p. 224) was fully investigated, and applied to the important purpose of distinguishing the purity of atmospheric air by Dr. Priestley. When about two measures of common air and one of nitrous gas are mixed together a red effervescence takes place, and the two airs occupy about one fourth less space than was previously occupied by the common air alone.

2. Concerning the green fubftance which grows at the bottom of refervoirs of water, which Dr. Prieftley difcovered to yield much pure air when the fun fhone on it. His method of collecting this air is by placing over the green fubftance, which he believes to be a vegetable of the genus conferva, an inverted bell-glafs previoufly filled with water, which fubfides as the air arifes; it has fince been found that all vegetables give up pure air from their leaves, when the fun fhines upon them, but not in the night, which may be owing to the fleep of the plant.

3. The third refers to the great quantity of pure air contained in the calces of metals. The calces were long known to weigh much more than the metallic bodies before calcination, infomuch that 100 pounds of lead will produce 112 pounds of

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On noifelefs ftep or quivering pinion glide, As fits the Sage with Science by his fide; To his charm'd eye in gay undrefs appear, Or pour your fecrets on his raptured ear. How nitrous Gas from iron ingots driven Drinks with red lips the pureft breath of heaven; How, while Conferva from its tender hair Gives in bright bubbles empyrean air; The cryftal floods phlogiftic ores calcine, And the pure ETHER marries with the MINE.

"So in Sicilia's ever-blooming shade When playful PROSERPINE from CERES stray'd,

minium; the ore of manganese, which is always found near the surface of the earth, is replete with pure air, which is now used for the purpose of bleaching. Other metals when exposed to the atmosphere attract the pure air from it, and become calces by its combination, as zinc, lead, iron; and increase in weight in proportion to the air, which they imbibe.

When playful Proferpine. 1. 178. The fable of Proferpine's being feized by Pluto as the was gathering flowers, is explained by Lord Bacon to fignify the combination or marriage of etherial fpirit with earthly materials. Bacon's Works, Vol. V. p. 470. edit. 4to. Lond. 1778. This allufion is ftill more curioufly exact, from the late difcovery of pure air being given up from vegetables, and that then in its unmixed

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Led with unwary ftep her virgin trains O'er Etna's steeps, and Enna's golden plains; 180 Pluck'd with fair hand the filver-bloffom'd bower, And purpled mead, --- herfelf a fairer flower; Sudden, unfeen amid the twilight glade, Rufh'd gloomy Dis, and feized the trembling maid.-Her ftarting damfels fprung from moffy feats, 185 Dropp'd from their gauzy laps the gather'd fweets, Clung round the ftruggling Nymph, with piercing cries, Purfued the chariot, and invoked the fkies ;---Pleafed as he grafps her in his iron arms, Frights with foft fighs, with tender words alarms, 190 The wheels defcending roll'd in fmoky rings, Infernal Cupids flapp'd their demon wings; Earth with deep yawn received the Fair, amaz'd, And far in Night celeftial Beauty blaz'd.

ftate it more readily combines with metallic or inflammable bodies. From these fables which were probably taken from antient hieroglyphics there is frequently reason to believe that the Egyptians possessed much chemical knowledge, which for want of alphabetical writing perished with their philosophers.

PART I.

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VI. "Led by the Sage, Lo! Britain's fons fhall guide Huge SEA-BALLOONS beneath the toffing tide; 196 The diving caftles, roof'd with fpheric glafs, Ribb'd with ftrong oak, and barr'd with bolts of brafs, Buoy'd with pure air fhall endlefs tracks purfue, And PRIESTLEY'S hand the vital flood renew. 200 Then fhall BRITANNIA rule the wealthy realms, Which Ocean's wide infatiate wave o'erwhelms; Confine in netted bowers his fcaly flocks, Part his blue plains, and people all his rocks.

Led by the Sage. 1. 195. Dr. Prieftley's difcovery of the production of pure air from fuch variety of fubftances will probably foon be applied to the improvement of the diving bell, as the fubftances which contain vital air in immenfe quantities are of little value as manganefe and minium. See additional notes, No. XXXIII. In every hundred weight of minium there is combined about twelve pounds of pure air, now as fixty pounds of water are about a cubic foot, and as air is eight hundred times lighter than water, five hundred weight of minium will produce eight hundred cubic feet of air or about fix thoufand gallons. Now, as this is at leaft thrice as pure as atmospheric air, a gallon of it may be fuppofed to ferve for three minutes refpiration for one man. At prefent the air can not be fet at liberty from minium by viriolic acid without the application of fome heat, this is however very likely foon to be difcovered, and will then enable adventurers to journey beneath the ocean in large inverted fhips or diving balloons.

Mr. Boyle relates, that Cornelius Drebelle contrived not only a veffel to be rowed under water, but also a liquor to be caried in that veffel, which would supply the want of fresh air. The veffel was made by order of James I. and carried twelve rowers besides passengers. It was tried in the river Thames, and one of the perfons who was in that submarine voyage told the particulars of the experiments to a perfon who related them to Mr. Boyle. Annual Register for 1774, p. 248. Deep, in warm waves beneath the Line that roll, 205 Beneath the fhadowy ice-ifles of the Pole, Onward, through bright meandering vales, afar, Obedient Sharks shall trail her sceptred car, With harnefs'd necks the pearly flood difturb, Stretch the filk rein, and champ the filver curb; 210 Pleafed round her triumph wondering Tritons play, And Seamaids hail her on the watery way. -Oft fhall fhe weep beneath the cryftal waves O'er fhipwreck'd lovers weltering in their graves; Mingling in death the Brave and Good behold 215 With flaves to glory, and with flaves to gold; Shrin'd in the deep shall DAY and SPALDING mourn, Each in his treacherous bell, fepulchral urn !--

Day and Spalding mourn. 1. 217. Mr. Day perifhed in a diving bell, or diving boat, of his own conftruction at Plymouth in June 1774, in which he was to have continued for a wager twelve hours one hundred feet deep in water, and probably perifhed from his not poffeffing all the hydroftatic knowledge that was neceffary. See note on Ulva, Vol. II. of this work. See Annual Register for 1774. p. 245.

Mr. Spalding was profefionally ingenious in the art of confructing and managing the diving bell, and had practifed the bufinefs many years with fuccefs. He went down accompanied by one of his young men twice to view the wreck of the Imperial Eaft-Indiaman at the Kifh bank in Ireland. On defcending the third time in June, 1783, A a 2

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Oft o'er thy lovely daughters, haplefs PIERCE ! Her fighs fhall breathe, her forrows dew their hearfe.— With brow upturn'd to Heaven, "WE WILL NOT PART !" He cried, and clafp'd them to his aching heart.— —Dafh'd in dread conflict on the rocky grounds, Crafh the fhock'd mafts, the ftaggering wreck rebounds ; Through gaping feams the rufhing deluge fwims, 225 Chills their pale bofoms, bathes their fhuddering limbs, Climbs their white fhoulders, buoys their ftreaming hair, And the laft fea-fhriek bellows in the air.— Each with loud fobs her tender fire carefs'd, And gafping ftrain'd him clofer to her breaft !— 230

they remained about an hour under water, and had two barrels of air fent down to them, but on the fignals from below not being again repeated, after a certain time, they were drawn up by their affiftants and both found dead in the bell. Annual Register for 1783, p. 206. These two unhappy events may for a time check the ardor of adventurers in traversing the bottom of the ocean, but it is probable in another half century it may be faser to travel under the ocean than over it, fince Dr. Priestley's discovery of procuring pure air in fuch great abundance from the calces of metals.

Haplefs Pierce! 1. 219. The Haflewell Eaft-Indiaman, outward bound, was wrecked off Seacomb in the ifle of Purbec on the 6th of January, 1786; when Capt. Pierce, the commander, with two young ladies, his daughters, and the greateft part of the crew and paffengers perifhed in the fea. Some of the officers and about feventy feamen efcaped with great difficulty on the rocks, but Capt. Pierce finding it was impoffible to fave the lives of the young ladies refufed to quit the fhip, and perifhed with them.

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-Stretch'd on one bier they fleep beneath the brine, And their white bones with ivory arms intwine !

"VII. SYLPHS OF NICE EAR ! with beating wings you guide

The fine vibrations of the aerial tide; Join in fweet cadences the meafured words, 235 Or ftretch and modulate the trembling cords. You ftrung to melody the Grecian lyre, Breathed the rapt fong, and fan'd the thought of fire, Or brought in combinations, deep and clear, Immortal harmony to HANDEL's ear .---240 You with foft breath attune the vernal gale, When breezy evening broods the liftening vale; Or wake the loud tumultuous founds, that dwell In Echo's many-toned diurnal fhell. You melt in dulcet chords, when Zephyr rings 245 The Eolian Harp, and mingle all its ftrings;

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Or trill in air the foft fymphonious chime, When rapt CECILIA lifts her eye fublime, Swell, as fhe breathes, her bofoms rifing fnow, O'er her white teeth in tuneful accents flow, 250 Through her fair lips on whifpering pinions move, And form the tender fighs, that kindle love !

"So playful LOVE on Ida's flowery fides With ribbon-rein the indignant Lion guides; Pleafed on his brinded back the lyre he rings, 255 And fhakes delirious rapture from the ftrings; Slow as the paufing Monarch ftalks along, Sheaths his retractile claws, and drinks the fong; Soft Nymphs on timid ftep the triumph view, And liftening Fawns with beating hoofs purfue; 260

Indignant lion guides. 1. 254. Defcribed from an antient gem, expressive of the combined power of love and music, in the Museum Florent.

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With pointed ears the alarmed foreft ftarts, And Love and Music fosten favage hearts.

VIII. "SYLPHS ! YOUR bold hofts, when Heaven with juffice dread

Calls the red tempeft round the guilty head, Fierce at his nod affume vindictive forms, 265 And launch from airy cars the vollied ftorms .---From Ashur's vales when proud SENACHERIB trod, Pour'd his fwoln heart, defied the living Gon, Urged with inceffant fhouts his glittering powers; And JUDAH fhook through all her maffy towers; 270 Round her fad altars prefs'd the proftrate crowd, Hofts beat their breafts, and fuppliant chieftains bow'd; Loud fhrieks of matrons thrill'd the troubled air, And trembling virgins rent their fcatter'd hair; High in the midft the kneeling King adored, 275 Spread the blafpheming fcroll before the Lord, Raifed his pale hands, and breathed his paufing fighs, And fixed on Heaven his dim imploring eyes,-

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" Oh ! MIGHTY GOD ! amidft thy Seraph-throng "Who fit'ft fublime, the Judge of Right and Wrong;" " Thine the wide earth, bright fun, and ftarry zone, 281 " That twinkling journey round thy golden throne; " Thine is the cryftal fource of life and light, " And thine the realms of Death's eternal night. " Oh, bend thine ear, thy gracious eye incline, 285 " Lo! Afhur's King blafphemes thy holy fhrine, " Infults our offerings, and derides our vows,-" Oh ! strike the diadem from his impious brows, " Tear from his murderous hand the bloody rod, " And teach the trembling nations, " THOU ART GOD !"--SYLPHS ! in what dread array with pennons broad 290 Onward ye floated o'er the ethereal road, Call'd each dank fteam the reeking marsh exhales, Contagious vapours, and volcanic gales,

Volcanic gales. 1. 294. The peftilential winds of the eaft are defcribed by various authors under various denominations; as harmattan, famiel, famium, fyrocca, kamfin, feravanfum. M. de Beauchamp defcribes a remarkable fouth wind in the deferts about Bagdad, called feravanfum, or poifon-wind; it burns the face, impedes refpiration, ftrips the trees of their leaves, and is faid to pafs on in a ftreight line, and often kills people in

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Gave the foft South with poifonous breath to blow, 295 And rolled the dreadful whirlwind on the foe !— Hark ! o'er the camp the venom'd tempeft fings, Man falls on Man, on buckler buckler rings ; Groan anfwers groan, to anguifh anguifh yields, And DEATH's loud accents fhake the tented fields ! 300 —High rears the Fiend his grinning jaws, and wide Spans the pale nations with coloffal ftride, Waves his broad falchion with uplifted hand, And his vaft fhadow darkens all the land.

fix hours. P. Cotte fur la Meteorol. Analytical Review for February, 1790. M. Volney fays, the hot wind or ramfin feems to blow at the feafon when the fands of the deferts are the hotteft; the air is then filled with an extreamly fubtle duft. Vol. I. p. 61. Thefe winds blow in all directions from the deferts; in Egypt the most violent proceed from the S. S. W. at Mecca from the E. at Surat from the N. at Baffora from the N. W. at Bagdad from the W. and in Syria from the S. E.

On the fouth of Syria, he adds, where the Jordan flows is a country of volcanos; and it is obferved that the earthquakes in Syria happen after their rainy feafon, which is alfo conformable to a fimilar obfervation made by Dr. Shaw in Barbary. Travels in Egypt, Vol. I. p. 303.

These winds feem all to be of volcanic origin, as before mentioned, with this difference, that the Simoom is attended with a stream of electric matter; they seem to be in confequence of earthquakes caused by the monsoon floods, which fall on volcanic fires in Syria, at the same time that they inundate the Nile.

PART I.

Вb

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IX. 1. "Ethereal cohorts ! Effences of Air ! 305 Make the green children of the Spring your care ! Oh, SYLPHS ! difclofe in this inquiring age One GOLDEN SECRET to fome favour'd fage ; Grant the charm'd talifman, the chain, that binds, Or guides the changeful pinions of the winds ! 310 —No more fhall hoary Boreas, iffuing forth With Eurus, lead the tempefts of the North ; Rime the pale Dawn, or veil'd in flaky fhowers Chill the fweet bofoms of the fmiling Hours. By whifpering Aufter waked fhall Zephyr rife, 315 Meet with foft kifs, and mingle in the fkies,

One golden fecret. 1. 308. The fuddennefs of the change of the wind from N. E. to S. W. feems to fhew that it depends on fome minute chemical caufe; which if it was difcovered might probably, like other chemical caufes, be governed by human agency; fuch as blowing up rocks by gunpowder, or extracting the lightening from the clouds. If this could be accomplifhed, it would be the moft happy difcovery that ever has happened to thefe northern latitudes, fince in this country the N. E. winds bring froft, and the S. W. ones are attended with warmth and moifture; if the inferior currents of air could be kept perpetually from the S. W. fupplied by new productions of air at the line, or by fuperior currents flowing in a contrary direction, the vegetation of this country would be doubled; as in the moift vallies of Africa, which know no froft; the number of its inhabitants would be increafed, and their lives prolonged; as great abundance of the aged and infirm of mankind, as well as many birds and animals, are deftroyed by fevere continued frofts in this climate.

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Fan the gay floret, bend the yellow ear, And rock the uncurtain'd cradle of the year; Autumn and Spring in lively union blend, And from the fkies the Golden Age defcend.

2. " Caftled on ice, beneath the circling Bear,
A vaft CAMELION fpits and fwallows air;
O'er twelve degrees his ribs gigantic bend,
And many a league his leathern jaws extend;
Half-fifh, beneath, his fcaly volutes fpread, 325
And vegetable plumage crefts his head;
Huge fields of air his wrinkled fkin receives,
From panting gills, wide lungs, and waving leaves;
Then with dread throes fubfides his bloated form,
His fhriek the thunder, and his figh the ftorm. 33°
Oft high in heaven the hiffing Demon wins
His towering courfe, upborne on winnowing fins;

A vaft Camelion. 1. 322. See additional notes, No. XXXIII. on the deftruction and reproduction of the atmosphere.

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Steers with expanded eye and gaping mouth, His mafs enormous to the affrighted South; Spreads o'er the shuddering Line his shadowy limbs, 335 And Froft and Famine follow as he fwims .---SYLPHS ! round his cloud-built couch your bands array, And mould the Monster to your gentle fway; Charm with foft tones, with tender touches check, Bend to your golden yoke his willing neck, 340 With filver curb his yielding teeth reftrain, And give to KIRWAN's hand the filken rein. -Pleafed shall the Sage, the dragon-wings between, Bend o'er difcordant climes his eye ferene, With Lapland breezes cool Arabian vales, 345 And call to Hindoftan antarctic gales, Adorn with wreathed ears Kampschatca's brows, And fcatter rofes on Zealandic fnows,

To Kirwan's band. 1. 342. Mr. Kirwan has published a valuable treatise on the temperature of climates, as a step towards investigating the theory of the winds; and has since written some ingenious papers on this subject in the Transactions of the Royal Irish Society.

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Earth's wondering Zones the genial feafons fhare, And nations hail him "MONARCH OF THE AIR." 350

X. I. "SYLPHS! as you hover on ethereal wing, Brood the green children of parturient Spring !— Where in their burfting cells my Embryons reft, I charge you guard the vegetable neft; Count with nice eye the myriad SEEDS, that fwell 355 Each vaulted womb of hufk, or pod, or fhell; Feed with fweet juices, clothe with downy hair, Or hang, infhrined, their little orbs in air.

The myriad feeds. 1. 355. Nature would feem to have been wonderfully prodigal in the feeds of vegetables, and the fpawn of fifh; almost any one plant, if all its feeds fhould grow to maturity, would in a few years alone people the terrestrial globe. Mr. Ray afferts that 1012 feeds of tobacco weighed only one grain, and that from one tobacco plant the feeds thus calculated amounted to 360,000! The feeds of the ferns are by him supposed to exceed a million on a leaf. As the works of nature are governed by general laws this exuberant reproduction prevents the accidental extinction of the species, at the fame time that they ferve for food for the higher orders of animation.

Every feed possefies a refervoir of nutriment defigned for the growth of the future plant, this confist of flarch, mucilage, or oil, within the coat of the feed, or of fugar and fubacid pulp in the fruits, which belongs to it.

For the prefervation of the immature feed nature has ufed many ingenious methods; fome are wrapped in down, as the feeds of the rofe, bean, and cotton-plant; others are fufpended in a large air-veffel, as those of the bladder-fena, ftaphylæa, and pea.

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" So, late decry'd by HERSCHEL's piercing fight, 360 Hang the bright fquadrons of the twinkling Night; Ten thousand marshall'd stars, a filver zone, Effuse their blended lustres round her throne; Suns call to funs, in lucid clouds confpire, And light exterior fkies with golden fire; Refiftlefs rolls the illimitable fphere, 365 And one great circle forms the unmeafured year. -Roll on, YE STARS ! exult in youthful prime, Mark with bright curves the printlefs fteps of Time; Near and more near your beamy cars approach, And leffening orbs on leffening orbs encroach ;--370 Flowers of the fky ! ye too to age must yield, Frail as your filken fifters of the field!

And light exterior. 1. 364. I fufpect this line is from Dwight's Conquest of Canaan, a poem written by a very young man, and which contains much fine versification.

Near and more near. 1. 269. From the vacant fpaces in fome parts of the heavens, and the correspondent clusters of stars in their vicinity, Mr. Herschel concludes that the nebulæ or constellations of fixed stars are approaching each other, and must finally coalesce in one mass. Phil. Trans Vol. LXXV.

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Star after ftar from Heaven's high arch fhall rufh, Suns fink on funs, and fyftems fyftems crufh, Headlong, extinct, to one dark centre fall, 375 And Death and Night and Chaos mingle all ! —Till o'er the wreck, emerging from the ftorm, Immortal NATURE lifts her changeful form, Mounts from her funeral pyre on wings of flame, And foars and fhines, another and the fame. 3⁸⁰

2. " Lo! on each SEED within its flender rind Life's golden threads in endlefs circles wind; Maze within maze the lucid webs are roll'd, And, as they burft, the living flame unfold.

Till o'er the wreck. 1. 377. The flory of the phenix rifing from its own afters with a twinkling flar upon its head, feems to have been an antient hieroglyphic emblem of the deftruction and refuscitation of all things.

There is a figure of the great Platonic year with a phenix on his hand on the reverse of a medal of Adrian. Spence's Polym. p. 189.

Maze within maze. 1. 383. The elegant appearance on diffection of the young tulip in the bulb was first observed by Mariotte and is mentioned in the note on tulipa in Vol. II. and was afterwards noticed by Du Hamel. Acad. Scien. Lewenhook affures us that in the bud of a currant tree he could not only discover the ligneous part but even the berries themselves, appearing like small grapes. Chamb. Dict. art. Bud. Mr. Baker fays he dissected a feed of trembling grass in which a perfect plant appeared with its root,

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The pulpy acorn, ere it fwells, contains The Oak's vaft branches in its milky veins; Each ravel'd bud, fine film, and fibre-line Traced with nice pencil on the fmall defign. The young Narciffus, in it's bulb comprefs'd, Cradles a fecond neftling on its breaft; In whofe fine arms a younger embryon lies, Folds its thin leaves, and fhuts its floret-eyes; Grain within grain fucceffive harvefts dwell, And boundlefs forefts flumber in a fhell. —So yon grey precipice, and ivy'd towers, Long winding meads, and intermingled bowers,

fending forth two branches, from each of which feveral leaves or blades of grafs proceeded. Microfc. Vol. I. p. 252. Mr. Bonnet faw four generations of fucceffive plants in the bulb of a hyacinth. Bonnet Corps Organ. Vol. I. p. 103. Haller's Phyfiol. Vol. I. p. 91. In the terminal bud of a horfe-chefnut the new flower may be feen by the naked eye covered with a mucilaginous down, and the fame in the bulb of a narciffus, as I this morning obferved in feveral of them fent me by Mifs for that purpofe. Sept. 16.

Mr. Ferber fpeaks of the pleafure he received in obferving in the buds of Hepatica and pedicularis hirfuta yet lying hid in the earth, and in the gems of the fhrub daphne mezereon, and at the bafe of ofmunda lunaria a perfect plant of the future year, difcernable in all its parts a year before it comes forth, and in the feeds of nymphea nelumbo the leaves of the plant were feen fo diffinctly that the author found out by them what plant the feeds belonged to. The fame of the feeds of the tulip tree or liriodendum tulipiferum. Amæn. Aced. Vol. VI.

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Green files of poplars, o'er the lake that bow, And glimmering wheel, which rolls and foams below, In one bright point with nice diffinction lie Plan'd on the moving tablet of the eye. 400 —So, fold on fold, Earth's wavy plains extend, And, fphere in fphere, its hidden ftrata bend ;— Incumbent Spring her beamy plumes expands O'er reftlefs oceans, and impatient lands, With genial luftres warms the mighty ball, 405 And the GREAT SEED evolves, difclofing ALL ; LIFE buds or breathes from Indus to the Poles, And the vaft furface kindles, as it rolls !

And the great feed. 1. 406. Alluding to the π_{govov} wov, or first great egg of the antient philosophy, it had a serpent wrapped round it emblematical of divine wisdom, an image of it was afterwards preserved and worshipped in the temple of Dioscuri, and supposed to represent the egg of Leda. See a print of it in Bryant's Mythology. It was faid to have been broken by the horns of the celestial bull, that is, it was hatched by the warmth of the spring. See note on Canto I. 1. 413.

And the vast furface. 1. 408. L'Organization, le sentiment, le movement spontané, la vie, n'existent qu'a la surface de la terre, et dans le lieux exposes à la lumière. Traité de Chymie par M. Lavoisier, Tom. I. p. 202.

PART I.

Cc

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3. "Come, YE SOFT SYLPHS ! who fport on Latian land, Come, fweet-lip'd Zephyr, and Favonius bland ! 410 Teach the fine SEED, inftinct with life, to fhoot On Earth's cold bofom its defcending root; With Pith elaftic ftretch its rifing ftem, Part the twin Lobes, expand the throbbing Gem; Clafp in your airy arms the afpiring Plume, 415 Fan with your balmy breath its kindling bloom, Each widening fcale and burfting film unfold, Swell the green cup, and tint the flower with gold;

Teach the fine feed. 1. 411. The feeds in their natural flate fall on the furface of the earth, and having abforbed fome moifture the root fhoots itfelf downwards into the earth and the plume rifes in air. Thus each endeavouring to feek its proper pabulum directed by a vegetable irritability fimilar to that of the lacteal fystem and to the lungs in animals.

The pith feems to pufh up or elongate the bud by its elafticity, like the pith in the callow quills of birds. This medulla Linneus believes to confift of a bundle of fibres, which diverging breaks through the bark yet gelatinons producing the buds.

The lobes are refervoirs of prepared nutriment for the young feed, which is abforbed by its placental veffels, and converted into fugar, till it has penetrated with its roots far enough into the earth to extract fufficient moifture, and has acquired leaves to convert it into nourifhment. In fome plants thefe lobes rife from the earth and fupply the place of leaves, as in kidney-beans, cucumbers, and hence feem to ferve both as a placenta to the fœtus, and lungs to the young plant. During the process of germination the ftarch of the feed is converted into fugar, as is feen in the process of malting barley for the purpose of brewing. And is on this account very fimilar to the digestion of food in the stores of animals, which converts all their aliment into a chyle, which consists of mucilage, oil, and fugar; the placentation of buds will be spoken of hereafter.

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While in bright veins the filvery Sap afcends,
And refluent blood in milky eddies bends;
420
While, fpread in air, the leaves refpiring play,
Or drink the golden quinteffence of day.
—So from his fhell on Delta's fhower-lefs ifle
Burfts into life the Monfter of the Nile;
Firft in transflucent lymph with cobweb-threads
425
The Brain's fine floating tiffue fwells, and fpreads;
Nerve after nerve the gliftening fpine defcends,
The red Heart dances, the Aorta bends;
Through each new gland the purple current glides,
New veins meandering drink the refluent tides;
430

The filvery fap. 1. 419. See additional notes, No. XXXVI.

Or drink the golden. 1. 422. Linneus having observed the great influence of light on vegetation, imagined that the leaves of plants inhaled electric matter from the light with their upper furface. (System of Vegetables translated, p. 8.)

The effect of light on plants occafions the actions of the vegetable muscles of their leaf-ftalks, which turn the upper fide of the leaf to the light, and which open their calyxes and chorols, according to the experiments of Abbe Teffier, who exposed variety of plants in a cavern to different quantities of light. Hift. de L'Academie Royal. Ann. 1783. The fleep or vigilance of plants feems owing to the prefence or absence of this ftimulus. See note on Nimofa, Vol. II.

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3. "Come, YE SOFT SYLPHS ! who fport on Latian land, Come, fweet-lip'd Zephyr, and Favonius bland ! 410 Teach the fine SEED, inftinct with life, to fhoot On Earth's cold bofom its defcending root; With Pith elaftic ftretch its rifing ftem, Part the twin Lobes, expand the throbbing Gem; Clafp in your airy arms the afpiring Plume, 415 Fan with your balmy breath its kindling bloom, Each widening fcale and burfting film unfold, Swell the green cup, and tint the flower with gold;

Teach the fine feed. 1. 411. The feeds in their natural flate fall on the furface of the earth, and having abforbed fome moifture the root floots itfelf downwards into the earth and the plume rifes in air. Thus each endeavouring to feek its proper pabulum directed by a vegetable irritability fimilar to that of the lacteal fyftem and to the lungs in animals.

The pith feems to pufh up or elongate the bud by its elafticity, like the pith in the callow quills of birds. This medulla Linneus believes to confift of a bundle of fibres, which diverging breaks through the bark yet gelatinons producing the buds.

The lobes are refervoirs of prepared nutriment for the young feed, which is abforbed by its placental veffels, and converted into fugar, till it has penetrated with its roots far enough into the earth to extract fufficient moifture, and has acquired leaves to convert it into nourifhment. In fome plants thefe lobes rife from the earth and fupply the place of leaves, as in kidney-beans, cucumbers, and hence feem to ferve both as a placenta to the fœtus, and lungs to the young plant. During the process of germination the ftarch of the feed is converted into fugar, as is feen in the process of malting barley for the purpose of brewing. And is on this account very fimilar to the digestion of food in the stores of animals, which converts all their aliment into a chyle, which confiss of mucilage, oil, and fugar; the placentation of buds will be spoken of hereafter.

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While in bright veins the filvery Sap afcends,
And refluent blood in milky eddies bends;
420
While, fpread in air, the leaves refpiring play,
Or drink the golden quinteffence of day.
—So from his fhell on Delta's fhower-lefs ifle
Burfts into life the Monfter of the Nile;
Firft in transflucent lymph with cobweb-threads
425
The Brain's fine floating tiffue fwells, and fpreads;
Nerve after nerve the gliftening fpine defcends,
The red Heart dances, the Aorta bends;
Through each new gland the purple current glides,
New veins meandering drink the refluent tides;
430

The filvery fap. 1. 419. See additional notes, No. XXXVI.

Or drink the golden. 1. 422. Linneus having observed the great influence of light on vegetation, imagined that the leaves of plants inhaled electric matter from the light with their upper furface. (System of Vegetables translated, p. 8.)

The effect of light on plants occasions the actions of the vegetable muscles of their leaf-ftalks, which turn the upper fide of the leaf to the light, and which open their calyxes and chorols, according to the experiments of Abbe Teffier, who exposed variety of plants in a cavern to different quantities of light. Hift. de L'Academie Royal. Ann. 1783. The fleep or vigilance of plants feems owing to the prefence or absence of this ftimulus. See note on Nimofa, Vol. II.

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Wound them, ye Sylphs! with little knives, or bind A wiry ringlet round the fwelling rind; Bifect with chiffel fine the root below, 465 Or bend to earth the inhofpitable bough.

Wound them, ye Sylphs! 1. 463. Mr. Whitmill advised to bind fome of the most vigorous shoots with strong wire, and even some of the large roots; and Mr. Warner cuts, what he calls a wild worm about the body of the tree, or fcores the bark quite to the wood like a fcrew with a sharp knife. Bradley on Gardening, Vol. II. p. 155. Mr. Fitzgerald produced flowers and fruit on wall trees by cutting off a part of the bark. Phil. Trans. Ann. 1761. M. Buffon produced the same effect by a straight bandage put round a branch, Act. Paris, Ann. 1738, and concludes that an ingrafted branch bears better from its vessels being compressed by the callous.

A compleat cylinder of the bark about an inch in height was cut off from the branch of a pear tree againft a wall in Mr. Howard's garden at Lichfield about five years ago, the circumcifed part is now not above half the diameter of the branch above and below it, yet this branch has been full of fruit every year fince, when the other branches of the tree bore only fparingly. I lately obferved that the leaves of this wounded branch were fmaller and paler, and the fruit lefs in fize, and ripened fooner than on the other parts of the tree. Another branch has the bark taken off not quite all round with much the fame effect.

The theory of this curious vegetable fact has been efteemed difficult, but receives great light from the foregoing account of the individuallity of buds. A flower-bud dies, when it has perfected its feed, like an annual plant, and hence requires no place on the bark for new roots to pass downwards; but on the contrary leaf-buds, as they advance into shoots, form new buds in the axilla of every leaf, which new buds require new roots to pass down the bark, and thus thicken as well as elongate the branch, now if a wire or ftring be tied round the bark, many of these new roots cannot defcend, and thence more of the buds will be converted into flower-buds.

And bend to earth. 1. 466. Mr. Hitt in his treatife on fruit trees observes that if a vigorous branch of a wall tree be bent to the horizon, or beneath it, it loofes its vigour and becomes a bearing branch. The theory of this I fuppose to depend on the difficulty with which the leaf-shoots can protrude the roots necessary for their new progeny of buds upwards along the bended branch to the earth contrary to their natural

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So fhall each germ with new prolific power Delay the leaf-bud, and expand the flower; Clofed in the *Style* the tender pith fhall end, The lengthening Wood in circling *Stamens* bend; The fmoother Rind its foft embroidery fpread In vaulted *Petals* o'er their fertile bed; While the rough Bark, in circling mazes roll'd, Forms the green *Cup* with many a wrinkled fold; And each fmall bud-fcale fpreads its foliage hard, 475 Firm round the callow germ, a *Floral Guard*.

2. "Where cruder juices fwell the leafy vein,
Stint the young germ, the tender bloffom ftain;
On each lop'd fhoot a fofter fcion bind,
Pith prefs'd to pith, and rind applied to rind, 480
So fhall the trunk with loftier creft afcend,
And wide in air its happier arms extend;

habits or powers, whence more flower-floots are produced which do not require new roots to pass along the bark of the bended branch, but which let their offspring, the feeds, fall upon the earth and feek roots for themselves.

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Nurse the new buds, admire the leaves unknown, And blushing bend with fruitage not its own.

" Thus when in holy triumph Aaron trod, 485
And offer'd on the fhrine his myftic rod;
Firft a new bark its filken tiffue weaves,
New buds emerging widen into leaves;
Fair fruits protrude, enafcent flowers expand,
And blufh and tremble round the living wand. 490

XIII. 1. " SYLPHS! on each Oak-bud wound the wormy galls,

With pigmy fpears, or crush the venom'd balls;

Nurfe the new buds. 1. 483. Mr. Fairchild budded a paffion-tree, whofe leaves were fpotted with yellow, into one which bears long fruit. The buds did not take, neverthelefs in a fortnight yellow fpots began to fhew themfelves about three feet above the inoculation, and in a fhort time afterwards yellow fpots appeared on a fhoot which came out of the ground from another part of the plant. Bradley, Vol. II. p. 129. Thefe facts are the more curious fince from experiments of ingrafting red currants on black (Ib. Vol. II.) the fruit does not acquire any change of flavour, and by many other experiments neither colour nor any other change is produced in the fruit ingrafted on other flocks.

There is an apple defcribed in Bradley's work which is faid to have one fide of it a fweet fruit which boils foft, and the other fide a four fruit which boils hard, which Mr.

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Fright the green Locust from his foamy bed, Unweave the Caterpillar's gluey thread; Chafe the fierce Earwig, fcare the bloated Toad, 495 Arreft the fnail upon his flimy road; Arm with fharp thorns the Sweet-brier's tender wood, And dash the Cynips from her damask bud; Steep in ambrofial dews the Woodbine's bells, And drive the Night-moth from her honey'd cells. 500 So where the Humming-bird in Chili's bowers On murmuring pinions robs ths pendent flowers; Seeks, where fine pores their dulcet balm diftill, And fucks the treafure with probofcis-bill; Fair CYPREPEDIA with fuccefsful guile 505 Knits her fmooth brow, extinguishes her fmile;

Bradley fo long ago as the year 1721 ingenioufly afcribes to the farina of one of thefe apples impregnating the other, which would feem the more probable if we confider that each division of an apple is a feparate womb, and may therefore have a feparate impregnation like puppies of different kinds in one litter. The fame is faid to have occurred in oranges and lemons, and grapes of different colours.

Fair Cyprepedia. 1. 505. The cyprepedium from South America is fuppofed to be of larger fize and brighter colours than that from North America from which this print is taken; it has a large globular nectary about the fize of a pidgeon's egg of a PART I. D d

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A Spiders bloated paunch and jointed arms Hide her fine form, and mask her blushing charms; In ambush sly the mimic warrior lies,

And on quick wing the panting plunderer flies. 510

2 " Shield the young Harvest from devouring blight, The Smut's dark poison, and the Mildew white;

flefhy colour, and an incifion or depreffion on its upper part, much refembling the body of the large American fpider; this globular nectary is attached to divergent flender petals not unlike the legs of the fame animal. This fpider is called by Linneus Arenea avicularia, with a convex orbicular thorax, the center transverfely excavated, he adds that it catches fmall birds as well as infects, and has the venemous bite of a ferpent. System Nature, Tom. I. p. 1034. M. Lonvilliers de Poincy, (Histoire Nat. des Antilles, Cap. xiv. art. III.) calls it Phalange, and defcribes the body to be the fize of a pidgeon's egg, with a hollow on its back like a navel, and mentions its catching the humming-bird in its ftrong nets.

The fimilitude of this flower to this great fpider feems to be a vegetable contrivance to prevent the humming-bird from plundering its honey. About Matlock in Derbyfhire the fly-ophris is produced, the neclary of which fo much refembles the fmall wall-bee, perhaps the apis ichneumonea, that it may be eafily miftaken for it at a fmall diftance. It is probable that by this means it may often efcape being plundered. See note on lonicera in the next poem.

A bird of our own country called a willow-wren (Motacilla) runs up the ftem of the crown-imperial (Frittillaria coronalis) and fips the pendulous drops within its petals. This fpecies of Motacilla is called by Ray Regulus non criftatus. White's Hift. of Selborne.

Shield the young harvefl. l. 511. Linneus enumerates but four difeafes of plants; Eryfyche, the white mucor or mould, with feffile tawny heads, with which the leaves are fprinkled, as is frequent on the hop, humulus, maple, acer, &c. Rubigo, the ferrugineous powder fprinkled under the leaves frequent in lady's mantle, alchemilla, &c.




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Deep-rooted Mould, and Ergot's horn uncouth, And break the Canker's defolating tooth. Firft in one point the feftering wound confin'd 555 Mines unperceived beneath the fhrivel'd rin'd ; Then climbs the branches with increafing ftrength, Spreads as they fpread, and lengthens with their length ; —Thus the flight wound ingraved on glafs unneal'd Runs in white lines along the lucid field ; 520

Clavus, when the feeds grow out into larger horns black without, as in rye. This is called Ergot by the french writers.

Uffulago, when the fruit inftead of feed produces a black powder, as in barley, oats, &c. To which perhaps the honey-dew ought to have been added, and the canker, in the former of which the nourifhing fluid of the plant feems to be exfuded by a retrograde motion of the cutaneous lymphatics, as in the fweating ficknefs of the laft century. The latter is a phagedenic ulcer of the bark, very deftructive to young apple-trees, and which in cherry-trees is attended with a deposition of gum arabic, which often terminates in the death of the tree.

Ergot's born. 1. 513. There is a difeafe frequently affects the rye in France, and fometimes in England in moift feafons, which is called Ergot, or horn feed; the grain becomes confiderably elongated and is either fraight or crooked, containing black meal along with the white, and appears to be pierced by infects, which were probably the caufe of the difeafe. Mr. Duhamel afcribes it to this caufe, and compares it to galls on oak-leaves. By the ufe of this bad grain amongft the poor difeafes have been produced attended with great debility and mortification of the extremities both in France and England. Dift. Raifon. art. Siegle. Philofop. Tranfact.

On glass unneal²d. 1. 519. The glass makers occasionally make what they call proofs, which are cooled hashily, whereas the other glass vessels are removed from warmer ovens to cooler ones, and fuffered to cool by flow degrees, which is called annealing, or nealing

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Crack follows crack, to laws elaftic juft, And the frail fabric fhivers into duft.

XIV. I. " SYLPHS! if with morn deftructive Eurus fprings,

O, clafp the Harebel with your velvet wings; Screen with thick leaves the Jafmine as it blows, 525 And fhake the white rime from the fhuddering Rofe; Whilft Amaryllis turns with graceful eafe Her blufhing beauties, and eludes the breeze.— SYLPHS! if at noon the Fritillary droops, With drops nectarous hang her nodding cups; 530

them. If an unnealed glafs be foratched by even a grain of fand falling into it, it will feem to confider of it for fome time, or even a day, and will then crack into a thoufand pieces,

The fame happens to a fmooth furfaced lead-ore in Derbyfhire, the workmen having cleared a large face of it fcratch it with picks, and in a few hours many tons of it crack to pieces and fall, with a kind of explosion. Whitehurft's Theory of Earth.

Glafs dropped into cold water, called Prince Rupert's drops, explode when a fmall part of their tails are broken off, more fuddenly indeed, but probably from the fame caufe. Are the internal particles of thefe elaftic bodies kept fo far from each other by the external cruft that they are nearly in a flate of repulfion into which flate they are thrown by their vibrations from any violence applied? Or, like elaftic balls in certain proportions fufpended in contact with each other, can motion once began be increafed by their elafticity, till the whole explodes? And can this power be applied to any mechanical purpofes?





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Thin clouds of Goffamer in air difplay, And hide the vale's chafte Lily from the ray; Whilft Erythrina o'er her tender flower Bends all her leaves, and braves the fultry hour;— Shield, when cold Hefper fheds his dewy light, 535 Mimofa's foft fenfations from the night; Fold her thin foilage, clofe her timid flowers, And with ambrofial flumbers guard her bowers; O'er each warm wall while Cerea flings her arms, And waftes on night's dull eye a blaze of charms. 540

2. Round her tall Elm with dewy fingers twine The gadding tendrils of the adventurous Vine;

With ambrofial flumbers. 1. 538. Many vegetables during the night do not feem to refpire, but to fleep like the dormant animals and infects in winter. This appears from the mimofa and many other plants clofing the upper fides of their leaves together in their fleep, and thus precluding that fide of them from both light and air. And from many flowers clofing up the polifhed or interior fide of their petals, which we have also endeavoured to fhew to be a refpiratory organ.

The irritability of plants is abundantly evinced by the abforption and pulmonary circulation of their juices; their fenfibility is fhewn by the approaches of the males to the females, and of the females to the males in numerous inftances; and, as the effential circumftance of fleep confifts in the temporary abolition of voluntary power alone, the fleep of plants evinces that they poffefs voluntary power; which alfo indifputably appears in many of them by clofing their petals or their leaves during cold, or rain, or darknefs, or from mechanic violence.

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From arm to arm in gay feftoons fufpend Her fragrant flowers, her graceful foliage bend; Swell with fweet juice her vermil orbs, and teed 545 Shrined in transparent pulp her pearly feed; Hang round the Orange all her filver bells, And guard her fragrance with Hefperian fpells; Bud after bud her polifh'd leaves unfold, And load her branches with fucceffive gold. 550 So the learn'd Alchemift exulting fees Rife in his bright matrafs DIANA's trees; Drop after drop, with just delay he pours The red-fumed acid on Potofi's ores; With fudden flash the fierce bullitions rife, 555 And wide in air the gas phlogiftic flies; Slow fhoot, at length, in many a brilliant mafs Metallic roots acrofs the netted glafs; Branch after branch extend their filver ftems, Bud into gold, and bloffoms into gems.

So fits enthron'd in vegetable pride Imperial Kew by Thames's glittering fide; Obedient fails from realms unfurrow'd bring For her the unnam'd progeny of fpring; Attendant Nymphs her dulcet mandates hear, 565 And nurfe in fostering arms the tender year, Plant the young bulb, inhume the living feed, Prop the weak ftem, the erring tendril lead; Or fan in glafs-built fanes the ftranger flowers With milder gales, and fleep with warmer flowers. 570 Delighted Thames through tropic umbrage glides, And flowers antarctic, bending o'er his tides; Drinks the new tints, the fweets unknown inhales, And calls the fons of fcience to his vales. In one bright point admiring Nature eyes 575 The fruits and foliage of discordant skies, Twines the gay floret with the fragrant bough, And bends the wreath round GEORGE's royal brow. -Sometimes retiring, from the public weal One tranquil hour the ROYAL PARTNERS fteal;

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Through glades exotic pafs with ftep fublime, Or mark the growths of Britain's happier clime; With beauty bloffom'd, and with virtue blaz'd, Mark the fair Scions, that themfelves have rais'd; Sweet blooms the Rofe, the towering Oak expands, 585 The Grace and Guard of Britain's golden lands.

XV. SYLPHS! who, round earth on purple pinions borne, Attend the radiant chariot of the morn; Lead the gay hours along the ethereal hight, And on each dun meridian fhower the light; 59° SYLPHS! who from realms of equatorial day To climes, that fhudder in the polar ray, From zone to zone purfue on fhifting wing, The bright perennial journey of the fpring; 595 Bring my rich Balms from Mecca's hallow'd glades, Sweet flowers, that glitter in Arabia's fhades; Fruits, whofe fair forms in bright fucceffion glow Gilding the Banks of Arno, or of Po;

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Each leaf, whole fragrant fteam with ruby lip Gay China's nymphs from pictur'd vafes fip; 600 Each fpicy rind, which fultry India boafts, Scenting the night-air round her breezy coafts; Roots whofe bold ftems in bleak Siberia blow, And gem with many a tint the eternal fnow; Barks, whofe broad umbrage high in ether waves 605 O'er Ande's steeps, and hides his golden caves; -And, where yon oak extends his dufky fhoots Wide o'er the rill, that bubbles from his roots; Beneath whole arms, protected from the ftorm A turf-built altar rears it's rustic form; 610 SYLPHS ! with religious hands fresh garlands twine, And deck with lavish pomp Hygela's shrine.

" Call with loud voice the Sifterhood, that dwell On floating cloud, wide wave, or bubbling well; Stamp with charm'd foot, convoke the alarmed Gnomes From golden beds, and adamantine domes; 615

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Each from her fphere with beckoning arm invite, Curl'd with red flame, the Veftal Forms of light. Clofe all your fpotted wings, in lucid ranks Prefs with your bending knees the crowded banks, 620 Crofs your meek arms, incline your wreathed brows, And win the Goddefs with unwearied vows.

"Oh, wave, HYGEIA! o'er BRITANNIA's throne Thy ferpent-wand, and mark it for thy own; Lead round her breezy coafts thy guardian trains, 625 Her nodding forefts, and her waving plains; Shed o'er her peopled realms thy beamy finile, And with thy airy temple crown her ifle!"

The GODDESS ceafed,—and calling from afar The wandering Zephyrs, joins them to her car; 630 Mounts with light bound, and graceful, as fhe bends, Whirls the long lafh, the flexile rein extends; On whifpering wheels the filver axle flides, Climbs into air, and cleaves the cryftal tides;

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Burft from its pearly chains, her amber hair635Streams o'er her ivory fhoulders, buoy'd in air;Swells her white veil, with ruby clafp confinedRound her fair brow, and undulates behind;The leffening courfers rife in fpiral rings,Pierce the flow-failing clouds, and ftretch their fhadowy
wings.640

Shall hail with firecter finile returning day,

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Verses omitted by mistake, to be inserted after line 320. Canto III. page 140.

----HERE her fad Confort, stealing through the gloom Of murmuring cloysters, gazes on her tomb; Hangs in mute anguish o'er the scutcheon'd hearse, Or graves with trembling style the votive verse.

"Sexton ! oh, lay beneath this facred fhrine, When Time's cold hand fhall clofe my aching eyes, Oh, gently lay this wearied earth of mine, Where wrap'd in night my loved MILCENA lies.

5.

"So fhall with purer joy my fpirit move, When the laft trumpet thrills the caves of Death, Catch the first whispers of my waking love, And drink with holy kiss her kindling breath.

"The fpotlefs Fair, with blufh ethereal warm, Shall hail with fweeter fmile returning day, Rife from her marble bed a brighter form, And win on buoyant ftep her airy way.

"Shall bend approved, where beckoning hofts invite, On clouds of filver her adoring knee, Approach with Seraphim the throne of light, —And BEAUTY plead with angel-tongue for Me!"

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ADDITIONAL NOTES.

NOTE I.---METEORS.

Etherial Forms ! you chase the shooting stars, Or yoke the vollied lightnings to your cars.

CANTO I. 1. 115.

THERE feem to be three concentric ftrata of our incumbent atmosphere; in which, or between them, are produced four kinds of meteors; lightning, fhooting ftars, fire-balls, and northern lights. First, the lower region of air, or that which is dense enough to refift by the adhesion of its particles the descent of condensed vapour, or clouds, which may extend from one to three or four miles high. In this region the common lightning is produced from the accumulation or descent of electric matter in those floating fields of vapour either in respect to each other, or in respect to the earth beneath them, or the dissolved vapour above them, which is constantly varying both with the change of the form of the clouds, which thus evolve a greater or less furface; and also with their ever-changing degree of condensation. As the lightning is thus produced in dense air, it proceeds but a fhort course on account of the greater resistance which it encounters, is attended with a loud explosion, and appears with a red light.

2. The fecond region of the atmosphere I suppose to be that which has too little tenacity to support condensed vapour or clouds; but which yet contains invisible vapour, or water in aerial folution. This aerial folution of water differs from that diffolved in the matter of heat, as it is supported by its adhesion to the particles of air, and is not precipitated by cold. In this stratum it feems probable that the meteors called shooting stars are produced; and that they consist of electric sparks, or lightning, passing from one region to another of these invisible fields of aero-aqueous solution. The height of these shooting stars has not yet been ascertained by sufficient observation; Dr. Blagden thinks their situation is lower down in the atmosphere than that of fireballs, which he conjectures from their swift apparent motion, and ascribes their stalles to the more minute division of the electric matter of which they are supposed to consist, owing to

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METEORS.

the geater refiftance of the denfer medium through which they pafs, than that in which the fire-balls exift. Mr. Brydone obferved that the fhooting ftars appeared to him to be as high in the atmosphere, when he was near the fummit of mount Etna, as they do when obferved from the plain. Phil. Tran. Vol. LXIII.

As the ftratum of air, in which fhooting ftars are fuppofed to exift is much rarer than that in which lightning refides, and yet much denfer than rhat in which fireballs are produced, they will be attracted at a greater diftance than the former, and at a lefs than the latter. From this rarity of the air fo fmall a found will be produced by their explosion, as not to reach the lower parts of the atmosphere; their quantity of light from their greater diftance being fmall, is never feen through denfe air at all, and thence does not appear red, like lightning or fire balls. There are no apparent clouds to emit or to attract them, because the conflituent parts of these aero-aqueous regions may posses an abundance or deficiency of electric matter and yet be in perfect reciprocal folution. And lastly their apparent train of light is probably owing only to a continuance of their impression on the eye; as when a fire-flick is whirled in the dark it gives the appearance of a compleat circle of fire: for these white trains of shooting stars quickly vanish, and do not star for the tary thing on fire in their passage, as feems to happen in the transit of fire-balls.

3. The fecond region or ftratum of air terminates I fuppofe where the twilight ceafes to be refracted, that is, where the air is 3000 times rarer than at the furface of the earth; and where it feems probable that the common air ends, and is furrounded by an atmofphere of inflammable gas tenfold rarer than itfelf. In this region I believe fire-balls fometimes to pafs, and at other times the northern lights to exift. One of thefe fire-balls or draco volans, was obferved by Dr. Pringle and many others on Nov. 26, 1758, which was afterwards effimated to have been a mile and a half in circumference, to have been about one hundred miles high, and to have moved towards the north with a velocity of near thirty miles in a fecond of time. This meteor had a real tail many miles long, which threw off fparks in its courfe, and the whole exploded with a found like diftant thunder. Philof. Tranf. Vol. LI.

Dr. Blagden has related the hiftory of another large meteor, or fire-ball, which was feen the 18th of August, 1783, with many ingenious observations and conjectures. This was estimated to be between 60 and 70 miles high, and to travel 1000 miles at the rate of about twenty miles in a fecond. This fire-ball had likewise a real train of light left behind it in its passage, which varied in colour; and in fome part of its course gave off sparks or explosions where it had been brightess; and a dusky red streak remained visible perhaps a minute. Philos. Trans. Vol. LXXIV.

These fire-balls differ from lightning, and from shooting flars in many remarkable circumstances; as their very great bulk, being a mile and a half in diameter; their travelling 1000 miles nearly horizontally; their throwing off sparks in their passage; and changing colours from bright blue to dusky red; and leaving a train of fire behind them, continuing about a minute. They differ from the northern lights in not being diffused, but passing from one point of the heavens to another in a defined line; and this in a region above the crepuscular atmosphere, where the air is 3000 times rarer than at the

NOTE I.

furface of the earth. There has not yet been even a conjecture which can account for these appearances !--One I shall therefore hazard; which, if it does not inform, may amuse the reader.

In the note on l. 123, it was fhewn that there is probably a fupernatant ftratum of inflammable gas or hydrogene, over the common atmosphere; and whose density at the furface where they meet, must be at least ten times less than that upon which it fwims; like chemical ether floating upon water, and perhaps without any real contact. I. In this region, where the aerial atmosphere terminates and the inflammable one begins, the quantity of tenacity or resistance must be almoss inconceivable; in which a ball of electricity might pass 1000 miles with greater ease than through a thousandth part of an inch of glass. 2. Such a ball of electricity passing between inflammable and common air would fet fire to them in a line as it passed along; which would differ in colour according to the greater proportionate commixture of the two airs; and from the fame cause there might occur greater degrees of inflammation, or branches of fire, in fome parts of its course.

As these fire-balls travel in a defined line, it is pretty evident from the known laws of electricity, that they must be attracted; and as they are a mile or more in diameter, they must be emitted from a large furface of electric matter; because large nobs give larger fparks, lefs diffufed, and more brightly luminous, than lefs ones or points, and refift more forceably the emiffion of the electric matter. What is there in nature can attract them at fo great a diffance as 1000 miles, and fo forceably as to detach an electric fpark of a mile diameter ? Can volcanos at the time of their eruptions have this effect, as they are generally attended with lightning? Future obfervations must discover these fecret operations of nature! As a fiream of common air is carried along with the paffage of electric aura from one body to another; it is eafy to conceive, that the common air and the inflammable air between which the fire-ball is fuppofed to pafs, will be partially intermixed by being thus agitated, and fo far as it becomes intermixed it will take fire, and produce the linear flame and branching fparks above defcribed. In this circumftance of their being attracted, and thence paffing in a defined line, the fire-balls feem to differ from the corufcations of the aurora borealis, or northern lights, which probably take place in the fame region of the atmosphere; where the common air exists in extreme tenuity, and is covered by a ftill rarer fphere of inflammable gas, ten times lighter than itfelf.

As the electric ftreams, which conflitute these northern lights, feem to be repelled or radiated from an accumulation of that fluid in the north, and not attracted like the fireballs; this accounts for the diffusion of their light, as well as the filence of their passage; while their variety of colours, and the permanency of them, and even the breadth of them in different places, may depend on their fetting on fire the mixture of inflammable and common air through which they pass; as seems to happen in the transit of the fire-balls.

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METEORS.

It was obferved by Dr. Prieftley that the electric fhock taken through inflammable air was red, in common air it is blueifh; to thefe circumflances perhaps fome of the colours of the northern lights may bear analogy; though the denfity of the medium through which light is feen muft principally vary its colour, as is well explained by Mr. Morgan. Phil. Tranf. Vol. LXXV. Hence lightning is red when feen through a dark cloud, or near the horizon; becaufe the more refrangible rays cannot permeate fo denfe a medium. But the fhooting flars confift of white light, as they are generally feen on clear nights, and nearly vertical : in other fituations their light is probably too faint to come to us. But as in fome remarkable appearances of the northern lights, as in March, 1716, all the prifmatic colours were feen quickly to fucceed each other, thefe appear to have been owing to real combuftion; as the denfity of the interpofed medium could not be fuppofed to change fo frequently; and therefore thefe colours muft have been owing to different degrees of heat according to Mr. Morgan's theory of combuftion. In Smith's Optics, p. 69. the prifmatic colours, and optical deceptions of the northern lights are defcribed by Mr. Cotes.

The Torricellian vacuum, if perfectly free from air, is faid by Mr. Morgan and others to be a perfect non-conductor. This circumftance therefore would preclude the electric ftreams from rifing above the atmosphere. But as Mr. Morgan did not try to pass an electric flock through a vacuum, and as air, or fomething containing air, furrounding the transit of electricity may be necessary to the production of light, the conclusion may perhaps fill be dubious. If however the ftreams of the northern lights were fupposed to rife above our atmosphere, they would only be visible at each extremity of their course; where they emerge from, or are again immerged into the atmosphere; but not in their journey through the vacuum; for the absence of electric light in a vacuum is fufficiently proved by the common experiment of fhaking a barometer in the dark; the, electricity, produced by the friction of the mercury in the glass at its top, is luminous if the barometer has a little air in it; but there is no light if the vacuum be complete.

The aurora borealis, or northern dawn, is very ingenioufly accounted for by Dr. Franklin on principles of electricity. He premifes the following electric phenomena: I. that all new fallen fnow has much politive electricity flanding on its furface. 2. That about twelve degrees of latitude round the poles are covered with a cruft of eternal ice, which is impervious to the electric fluid. 3. That the denfe part of the atmosphere rifes but a few miles high; and that in the rarer parts of it the electric fluid will pass to almost any diffance.

Hence he fuppofes there must be a great accumulation of positive electric matter on the fresh fallen show in the polar regions; which, not being able to pass through the crust of ice into the earth, must rife into the rare air of the upper parts of our atmosphere, which will the least result is passing and passing towards the equator defcend again into the denser atmosphere, and thence into the earth in filent streams. And that many of the appearances attending these lights are optical deceptions, owing to the fituation of the eye that beholds them; which makes all ascending parallel lines appear to converge to a point.

METEORS.

NOTE I.

The idea, above explained in note on l. 123, of the existence of a sphere of inflammable gas over the aerial atmosphere would much favour this theory of Dr. Franklin; becaufe in that cafe the denfe aerial atmosphere would rife a much lefs height in the polar regions, diminishing almost to nothing at the pole itself; and thus give an eafier paffage to the afcent of the electric fluid. And from the great difference in the fpecific gravity of the two airs, and the velocity of the earth's rotation, there must be a place between the poles and the equator, where the fuperior atmosphere of inflammable gas would terminate; which would account for these ftreams of the aurora borealis not appearing near the equator; add to this that it is probable the electric fluid may be heavier than the magnetic one; and will thence by the rotation of the earth's furface afcend over the magnetic one by its centrifugal force; and may thus be induced to rife through the thin ftratum of aerial atmosphere over the poles. See note on Canto II. 1. 193. I shall have occasion again to mention this great accumulation of inflammable air over the poles; and to conjecture that thefe northern lights may be produced by the union of inflammable with common air, without the affiftance of the electric fpark to throw them into combustion.

The antiquity of the appearance of northern lights has been doubted; as none were recorded in our annals fince the remarkable one on Nov. 14, 1574, till another remarkable one on March 6, 1716, and the three following nights, which were feen at the fame time in Ireland, Ruffia, and Poland, extending near 30 degrees of longitude and from about the 50th degree of latitude over almost all the north of Europe. There is however reason to believe them of remote antiquity though inaccurately described; thus the following curious passage from the Book of Maccabees, (B. II. c. v.) is such a defeription of them, as might probably be given by an ignorant and alarmed people. "Through all the city, for the space of almost forty days, there were feen horfemen running in the air, in cloth of gold, and armed with lances, like a band of foldiers; and troops of horsemen in array encountering and running one against another, with shaking of thields and multitude of pikes, and drawing of fwords, and casting of darts, and glittering of golden ornaments and harnes?"

NOTE II.---PRIMARY COLOURS.

Cling round the aerial bow with prisms bright, And pleased untwist the sevenfold threads of light. CANTO I. 1. 117.

THE manner in which the rainbow is produced was in fome meafure underflood before Sir Ifaac Newton had difcovered his theory of colours. The first perfon who expressly shewed the rainbow to be formed by the reflection of the funbeams from drops of falling rain was Antonio de Dominis. This was afterwards more fully and distinctly explained by Des Cartes. But what caufed the diversity of its colours was not then understood; it was referved for the immortal Newton to discover that the rays of light confished of feven combined colours of different refrangibility, which could be feperated at pleasure by a wedge of glafs. Pemberton's View of Newton.

Sir Ifaac Newton difcovered that the prifmatic fpectrum was composed of feven colours in the following proportions, violet 80, indigo 40, blue 60, green 60, yellow 48, orange 27, red 45. If all these colours be painted on a circular card in the proportions above mentioned, and the card be rapidly whirled on its center, they produce in the eye the fensation of white. And any one of these colours may be imitated by painting a card with the two colours which are contiguous to it, in the fame proportions as in the spectrum, and whirling them in the fame manner.

My ingenious friend, Mr. Galton of Birmingham, afcertained in this manner by a fet of experiments the following propositions; the truth of which he had preconceived from the above data.

I. Any colour in the prifmatic fpectrum may be imitated by a mixture of the two colours contiguous to it.

2. If any three fucceffive colours in the prifmatic fpectrum are mixed, they compose only the fecond or middlemost colour.

3. If any four fucceflive colours in the prifmatic fpectrum be mixed, a tint fimilar to a mixture of the fecond and third colours will be produced, but not precifely the fame, becaufe they are not in the fame proportion.

4. If beginning with any colour in the circular fpectrum, you take of the fecond colour a quantity equal to the firft, fecond, and third; and add to that the fifth colour, equal in quantity to the fourth, fifth, and fixth; and with these combine the feventh colour in the proportion it exists in the spectrum, white will be produced. Because the first, fecond, and third, compose only the fecond; and the fourth, fifth, and fixth, compose only the fifth; therefore if the seaded, the same effect is produced, as if all the feven were employed.

5. Beginning with any colour in the circular fpectrum, if you take a tint composed of a certain proportion of the fecond and third, (equal in quantity to the first, fecond, third, and fourth,) and add to this the fixth colour equal in quantity to the fifth, fixth, and feventh, white will be produced.

NOTE II.

From thefe curious experiments of Mr. Galton many phenomena in the chemical changes of colours may probably become better underftood; efpecially if, as I fuppofe, the fame theory muft apply to transmitted colours, as to reflected ones. Thus it is well known, that if the glafs of mangonefe, which is a tint probably compofed of violet and indigo, be mixed in a certain proportion with the glafs of lead, which is yellow; that the mixture becomes transparent. Now from Mr. Galton's experiments it appears, that in reflected colours fuch a mixture would produce white, that is, the fame as if all the colours were reflected. And therefore in transmitted colours the fame circumftances muft produce transparency, that is, the fame as if all the colours were transmitted. For the particles, which conflitute the glafs of mangonefe will transmit red, violet, indigo, and blue; and those of the glafs of lead will transmit orange, yellow, and green; hence all the primary colours by a mixture of these glaffes become transmitted, that is, the glafs becomes transparent.

Mr. Galton has further obferved that five fucceffive prifmatic colours may be combined in fuch proportions as to produce but one colour, a circumftance which might be of confequence in the art of painting. For if you begin at any part of the circular fpectrum above defcribed, and take the firft, fecond, and third colours in the proportions in which they exift in the fpectrum; thefe will compofe only the fecond colour equal in quantity to the firft, fecond, and third; add to thefe the third, fourth, and fifth in the proportion they exift in the fpectrum, and thefe will produce the fourth colour equal in quantity to the third, fourth, and fifth. Confequently this is precifely the fame thing, as mixing the fecond and fourth colours only; which mixture would only produce the third colour. Therefore if you combine the firft, fecond, fourth, and fifth in the proportions in which they exift in the fpectrum, with double the quantity of the third colour, this third colour will be produced. It is probable that many of the unexpected changes in mixing colours on a painter's eafle, as well as in more fluid chemical mixtures, may depend on thefe principles rather than on a new arrangement or combination of their minute particles.

Mr. Galton further obferves, that white may univerfally be produced by the combination of one prifmatic colour, and a tint intermediate to two others. Which tint may be diftinguifhed by a name compounded of the two colours, to which it is intermediate. Thus white is produced by a mixture of red with blue-green. Of orange with indigoblue. Of Yellow with violet-indigo. Of green with red-violet. Of blue with Orange-red. Of indigo with yellow-orange. Of violet with green-yellow. Which he further remarks exactly coincides with the theory and facts mentioned by Dr. Robert Darwin of Shrewfbury in his account of ocular fpectra; who has fhewn that when one of these contrasted colours has been long viewed, a spectrum or appearance of the other becomes visible in the fatigued eye. Philof. Tranf. Vol. LXXVI. for the year 1786.

These experiments of Mr. Galton might much affift the copper-plate printers of callicoes and papers in colours; as three colours or more might be produced by two copper-plates. Thus fuppose fome yellow figures were put on by the first plate, and upon fome parts of these yellow figures and on other parts of the ground blue was laid on by another copper-plate. The three colours of yellow, blue, and green might be produced; as green leaves with yellow and blue flowers.

NOTE III. ____COLOURED CLOUDS.

Eve's filken couch with gorgeous tints adorn, Or fire the arrowy throne of rifing morn.

CANTO I. 1. 119.

THE rays from the rifing and fetting fun are refracted by our fpherical atmosphere, hence the most refrangible rays, as the violet, indigo, and blue are reflected in greater quantities from the morning and evening fkies; and the leaft refrangible ones, as red and orange, are laft feen about the fetting fun. Hence Mr. Beguelin obferved that the fhadow of his finger on his pocket-book was much bluer in the morning and evening, when the fhadow was about eight times as long as the body from which it was projected. Mr. Melville obferves, that the blue rays being more refrangible are bent down in the evenings by our atmosphere, while the red and orange being lefs refrangible continue to pafs on and tinge the morning and evening clouds with their colours. See Prieftley's Hiftory of Light and Colours, p. 440. But as the particles of air, like those of water, are themfelves blue, a blue fhadow may be feen at all times of the day, though much more beautifully in the mornings and evenings, or by means of a candle in the middle of the day. For if a fhadow on a piece of white paper is produced by placing your finger between the paper and a candle in the day light, the fhadow will appear very blue; the yellow light of the candle upon the other parts of the paper apparently deepens the blue by its contraft; these colours being opposite to each other, as explained in note II.

Colours are produced from clouds or mifts by refraction, as well as by reflection. In riding in the night over an unequal country I obferved a very beautiful coloured halo round the moon, whenever I was covered with a few feet of mift, as I afcended from the vallies; which ceafed to appear when I rofe above the mift. This I fuppofe was owing to the thinnefs of the ftratum of mift, in which I was immerfed; had it been thicker, the colours refracted by the fmall drops, of which a fog confifts, would not have paffed through it down to my eye.

There is a bright fpot feen on the cornea of the eye, when we face a window, which is much attended to by portrait painters; this is the light reflected from the fpherical furface of the polifhed cornea, and brought to a focus; if the obferver is placed in this focus, he fees the image of the window; if he is placed before or behind the focus, he only fees a luminous fpot, which is more luminous and of lefs extent, the nearer he approaches to the focus. The luminous appearance of the eyes of animals in the dufky corners of a room, or in holes in the earth, may arife in fome inftances from the fame principle; viz. the reflection of the light from the fpherical cornea; which will be coloured red or blue in fome degree by the morning, evening, or meridian light; or by the objects from which that light is previoufly reflected. In the cavern at Colebrook Dale, where the mineral tar exfudes, the eyes of the horfe, which was drawing a cart from within

COMETS.

NOTE IV.

towards the mouth of it, appeared like two balls of phofphorus, when he was above 100 yards off, and for a long time before any other part of the animal was vifible. In this cafe I fufpect the luminous appearance to have been owing to the light, which had entered the eye, being reflected from the back furface of the vitreous humour, and thence emerging again in parallel rays from the animals eye, as it does from the back furface of the drops of the rainbow, and from the water-drops which lie, perhaps without contact, on cabbage-leaves, and have the brilliancy of quickfilver. This accounts for this luminous appearance being beft feen in those animals which have large apertures in their iris, as in cats and horfes, and is the only part visible in obscure places, because this is a better reflecting furface than any other part of the animal. If any of these emergent rays from the animals eye can be fupposed to have been reflected from the choroid coat through the femi-transparent retina, this would account for the coloured glare of the eyes of dogs or cats and rabits in dark corners.

NOTE IV.—COMETS.

Alarm with comet-blaze the fapphire plain, The wan ftars glimmering through its filver train.

CANTO I. 1. 134.

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THERE have been many theories invented to account for the tails of comets. Sir Ifaac Newton thinks that they confift of rare vapours raifed from the nucleus of the comet, and fo rarefied by the fun's heat as to have their general gravitation diminifhed, and that they in confequence afcend oppofite to the fun, and from thence reflect the rays of light. Dr. Halley compares the light of the tails of comets to the ftreams of the aurora berealis, and other electric effluvia. Philof. Tranf. No. 347.

Dr. Hamilton observes that the light of small stars are seen undiminished through both the light of the tails of comets, and of the aurora borealis, and has further illustrated their electric analogy, and adds that the tails of comets confist of a lucid felf-shining substance which has not the power of refracting or reflecting the rays of light. Essays.

The tail of the comet of 1744 at one time appeared to extend above 16 degrees from its body, and muft have thence been above twenty three millions of miles long. And the comet of 1680, according to the calculations of Dr. Halley on November the 11th, was not above one femi-diameter of the earth, or lefs than 4000 miles to the northward of the way of the earth; at which time had the earth been in that part of its orbit, what might have been the confequence ! no one would probably have furvived to have registered the tremendous effects. The comet of 1531, 1607, and 1682 having returned in the year 1759, according to Dr. Halley's prediction in the Philof. Tranf. for 1705, there feems no reafon to doubt that all the other comets will return after their proper periods. Aftronomers have in general acquiefced in the conjecture of Dr. Halley, that the comets of 1532, and 1661 are one and the fame comet, from the fimilarity of the elements of their orbits, and were therefore induced to expect its return to its perihelium 1789. As this comet is liable to be diffurbed in its afcent from the fun by the planets Jupiter and Saturn, Dr. Mafkelyne expected its return to its perihelium in the beginning of the year 1789, or the latter end of the year 1788, and certainly fometime before the 27th of April, 1789, which prediction has not been fulfilled. Phil. Tranf. Vol. LXXVI.

NOTE V.—SUN'S RAYS.

Or give the fun's phlogistic orb to roll.

CANTO I. 1. 1.36.

THE difpute among philofophers about phlogifton is not concerning the exiftence of an inflammable principle, but rather whether there be one or more inflammable principles. The difciples of Stahl, which till lately included the whole chemical world, believed in the identity of phlogifton in all bodies which would flame or calcine. The difciples of Lavoifier pay homage to a plurality of phlogiftons under the various names of charcoal, fulphur, metals, &c. Whatever will unite with *pure* air, and thence compofe an acid, is efteemed in this ingenious theory to be a different kind of phlogiftic or inflammable body. At the fame time there remains a doubt whether thefe inflammable bodies, as metals, fulphur, charcoal, &c. may not be compounded of the fame phlogifton along with fome other material yet undifcovered, and thus an unity of phlogifton exift, as in the theory of Stahl, though very differently applied in the explication of chemical phenomena.

Some modern philofophers are of opinion that the fun is the great fountain from which the earth and other planets derive all the phlogifton which they poffefs; and that this is formed by the combination of the folar rays with all opake bodies, but particularly with the leaves of vegetables, which they fuppofe to be organs adapted to abforb them. And that as animals receive their nourifhment from vegetables they alfo obtain in a fecondary manner their phlogifton from the fun. And laftly as great maffes of the mineral kingdom, which have been found in the thin cruft of the earth which human labour has penetrated, have evidently been formed from the recrements of animal and vegetable bodies, thefe alfo are fuppofed thus to have derived their phlogifton from the fun.

Another opinion concerning the fun's rays is, that they are not luminous till they arrive at our atmosphere; and that there uniting with some part of the air they produce NOTE VI.

combustion, and light is emitted, and that an etherial acid, yet undifcovered, is formed from this combustion.

The more probable opinion is perhaps, that the fun is a phlogiftic mafs of matter, whofe furface is in a flate of combuftion, which like other burning bodies emits light with immenfe velocity in all directions; that thefe rays of light act upon all opake bodies, and combining with them either difplace or produce their elementary heat, and become chemically combined with the phlogiftic part of them; for light is given out when phlogiftic bodies unite with the oxygenous principle of the air, as in combuftion, or in the reduction of metallic calxes; thus in prefenting to the flame of a candle a letterwafer, (if it be coloured with red-lead,) at the time the red-lead becomes a metallic drop, a flafh of light is perceived. Dr. Alexander Wilfon very ingenioufly endeavours to prove that the fun is only in a flate of combuftion on its furface, and that the dark fpots feen on the difk are excavations or caverns through the luminous cruft, fome of which are 4000 miles in diameter. Phil. Tranf. 1774. Of this I fhall have occafion to fpeak again.

NOTE VI.—CENTRAL FIRES.

Round her still centre tread the burning soil, And watch the billowy Lawas, as they boil.

CANTO I. 1. 139.

M. DE MAIRAN in a paper published in the Histoire de l'Academic de Sciences, 1765, has endeavoured to shew that the earth receives but a small part of the heat which it possesses from the fun's rays, but is principally heated by fires within itself. He thinks the fun is the cause of the vicifitudes of our feasons of summer and winter by a very small quantity of heat in addition to that already residing in the earth, which by emanations from the centre to the circumference renders the furface habitable, and without which, though the fun was constantly to illuminate two thirds of the globe at once, with a heat equal to that at the equator, it would foon become a mass of folid ice. His reasonings and calculations on this subject are too long and too intricate to be inferted here, but are equally curious and ingenious and carry much conviction along with them.

The opinion that the center of the earth confifts of a large mafs of burning lava, has been efpouled by Boyle, Boerhave, and many other philosophers. Some of whom confidering its supposed effects on vegetation and the formation of minerals have called it a fecond fun. There are many arguments in support of this opinion. I. Because the power of the sum does not extend much beyond ten feet deep into the earth, all below being in winter and summer always of the same degree of heat, viz. 48, which being

NOTE VI.

much warmer than the mildeft froft, is fuppofed to be fuftained by fome internal diftant fire. Add to this however that from experiments made fome years ago by Dr. Franklin the fpring-water at Philadelphia appeared to be of 52° of heat, which feems further to confirm this opinion, fince the climates in North America are fuppofed to be colder than those of Europe under fimilar degrees of latitude. 2. Mr. De Luc in going 1359 feet perpendicular into the mines of Hartz on July the 5th, 1778, on a very fine day found the air at the bottom a little warmer than at the top of the fhaft. Phil. Tranf. Vol. LXIX. p. 488. In the mines in Hungary, which are 500 cubits deep, the heat becomes very troublesome when the miners get below 480 feet depth. Morinus de Locis subter. p. 131. But as fome other deep mines as mentioned by Mr. Kirwan are faid to poffefs but the common heat of the earth; and as the cruft of the globe thus penetrated by human labour is fo thin compared with the whole, no certain deduction can be made from thefe facts on either fide of the queftion. 3. The warm-fprings in many parts of the earth at great diftance from any Volcanos feem to originate from the condenfation of vapours arifing from water which is boiled by fubterraneous fires, and cooled again in their paffage through a certain length of the colder foil; for the theory of chemical folution will not explain the equality of their heat at all feafons and through fo many centuries. See note on Fucus in Vol. II. See a letter on this fubject in Mr. Pilkinton's View of Derbyfhire from Dr. Darwin. 4. From the fituations of volcanos which are always found upon the fummit of the higheft mountains. For as these mountains have been lifted up and lofe feveral of their uppermoft ftrata as they rife, the loweft ftrata of the earth yet known appear at the tops of the higheft hills; and the beds of the Volcanos upon thefe hills must in confequence belong to the lowest strata of the earth, confisting perhaps of granite or bafaltes, which were produced before the existance of animal or vegetable bodies, and might conftitute the original nucleus of the earth, which I have fuppofed to have been projected from the fun, hence the volcanos themfelves appear to be fpiracula or chimneys belonging to great central fires. It is probably owing to the efcape of the elaftic vapours from these spiracula that the modern earthquakes are of such small extent compared with those of remote antiquity, of which the veftiges remain all over the globe. 5. The great fize and height of the continents, and the great fize and depth of the South-fea, Atlantic, and other oceans, evince that the first earthquakes, which produced thefe immenfe changes in the globe, must have been occasioned by central fires. 6. The very diftant and expeditious communication of the flocks of fome great earthquakes. The earthquake at Lifbon in 1755 was perceived in Scotland, in the Peak of Derbyshire, and in many other distant parts of Europe. The percussions of it travelled with about the velocity of found, viz. about thirteen miles in a minute. The earthquake in 1693 extended 2600 leagues. (Goldfmith's Hiftory.) These phenomena are easily explained if the central parts of the earth confift of a fluid lava, as a percuffion on one part of fuch a fluid mafs would be felt on other parts of its confining vault, like a ftroke on a fluid contained in a bladder, which however gentle on one fide is perceptible to the hand placed on the other; and the velocity with which fuch a concufiion would travel would be that of found, or thirteen miles in a minute. For further information on this part of the fubject the reader is referred to Mr. Michell's excellent Treatife on Earthquakes in the

NOTE VII. ELEMENTARY HEAT.

Philof. Tranf. Vol. LI. 7. That there is a cavity at the center of the earth is made probable by the late experiments on the attraction of mountains by Mr. Mafkerlyne, who fuppofed from other confiderations that the denfity of the earth near the furface fhould be five times lefs than its mean denfity. Phil. Tranf. Vol. LXV. p. 498. But found from the attraction of the mountain Schehallien, that it is probable, the mean denfity of the earth is but double that of the hill. Ibid. p. 532. Hence if the first supposition be well founded there would appear to be a cavity at the centre of confiderable magnitude, from whence the immenfe beds and mountains of lava, toadftone, bafaltes, granite, &c. have been protruded. 8. The variation of the compass can only be accounted for by fuppoling the central parts of the earth to confift of a fluid mals, and that part of this fluid is iron, which requiring a greater degree of heat to bring it into fusion than glafs or other metals, remains a folid, and the vis inertiæ of this fluid mafs with the iron in it, occafions it to perform fewer revolutions than the cruft of folid earth over it, and thus it is gradually left behind, and the place where the floating iron refides is pointed to by the direct or retrograde motions of the magnetic needle. This feems to have been nearly the opinion of Dr. Halley and Mr. Euler.

NOTE VII.—ELEMENTARY HEAT.

Or sphere on sphere in widening waves expand, And glad with genial warmth the incumbent land. CANTO I. 1. 143.

A CERTAIN quantity of heat feems to be combined with all bodies befides the fenfible quantity which gravitates like the electric fluid amongst them. This combined heat or latent heat of Dr. Black, when fet at liberty by fermentation, inflammation, crystallization, freezing, or other chemical attractions producing new combinations, passes as a fluid element into the furrounding bodies. And by thawing, diffusion of neutral falts in water, melting, and other chemical *folutions*, a portion of heat is attracted from the bodies in vicinity and enters into or becomes combined with the new folutions.

Hence a *combination* of metals with acids, of effential oils and acids, of alcohol and water, of acids and water, give out heat; whilft a *folution* of fnow in water or in acids, and of neutral falts in water, attract heat from the furrounding bodies. So the acid of nitre mixed with oil of cloves unites with it and produces a most violent flame; the fame acid of nitre poured on fnow inftantly diffolves it and produces the greatest degree of cold yet known, by which at Petersburgh quickfilver was first frozen in 1760.

Water may be cooled below 32° without being frozen, if it be placed on a folid floor and fecured from agitation, but when thus cooled below the freezing point the leaft. agitation turns part of it fuddenly into ice, and when this fudden freezing takes place a thermometer placed in it inftantly rifes as fome heat is given out in the act of congelation, and the ice is thus left with the fame *fenfible* degree of cold as the water had poffeffed before it was agitated, but is neverthelefs now combined with lefs *latent* heat.

A cubic inch of water thus cooled down to 32° mixed with an equal quantity of boiling water at 212° will cool it to the middle number between these two, or to 122. But a cubit inch of ice whose sensible cold also is but 32, mixed with an equal quantity of boiling water, will cool it fix times as much as the cubic inch of cold water abovementioned, as the ice not only gains its share of the fensible or gravitating heat of the boiling water but attracts to itself also and combines with the quantity of latent heat which it had lost at the time of its congelation.

So boiling water will acquire but 212° of heat under the common preffure of the atmosphere, but the steam raifed from it by its expansion or by its solution in the atmosolution fphere combines with and carries away a prodigious quantity of heat which it again parts with on its condensation; as is seen in common distillation where the large quantity of water in the worm-tub is so so so heated. Hence the evaporation of ether on a thermometer soon finks the mercury below freezing, and hence a warmth of the air in winter frequently succeeds a solution.

When the matter of heat or calorique is fet at liberty from its combinations, as by inflammation, it paffes into the furrounding bodies, which poffefs different capacities of acquiring their fhare of the loofe or fenfible heat; thus a pint meafure of cold water at 48° mixed with a pint of boiling water at 212° will cool it to the degree between thefe two numbers, or to 154°, but it requires two pint meafures of quickfilver at 48° of heat to cool one pint of water as above. Thefe and other curious experiments are adduced by Dr. Black to evince the existance of combined or latent heat in bodies, as has been explained by some of his pupils, and well illustrated by Dr. Crawford. The world has long been in expectation of an account of his discoveries on this subject by the celebrated author himself.

As this doctrine of elementary heat in its fluid and combined flate is not yet univerfally received, I fhall here add two arguments in fopport of it drawn from different fources, viz. from the heat given out or abforbed by the mechanical condenfation or expansion of the air, and perhaps of other bodies, and from the analogy of the various phenomena of heat with those of electricity.

I. If a thermometer be placed in the receiver of an air-pump, and the air haftily exhaufted, the thermometer will fink fome degrees, and the glafs become fteamy; the fame occurs in haftily admitting a part of the air again. This I fuppofe to be produced by the expansion of part of the air, both during the exhaustion and re-admission of it; and that the air fo expanded becomes capable of attracting from the bodies in its vicinity a part of their heat, hence the vapours contained in it and the glafs receiver are for a time colder and the strate is precipitated. That the air thus parts with its moiss receiver from the cold occasioned by its rarefaction and not simply by the rarefaction itself is evident, because in a minute or two the fame rarefied air will again take up the dew deposited on the receiver; and because water will evaporate fooner in rare than in dense air.

NOTE VII. ELEMENTARY HEAT.

There is a curious phenomenon fimilar to this observed in the fountain of Hiero confiructed on a large scale at the Chemnicensian mines in Hungary. In this machine the air in a large vessel is compressed by a column of water 260 feet high, a stop-cock is then opened, and as the air issues out with great vehemence, and thus becomes immediately greatly expanded, so much cold is produced that the moissure from this stream of air is precipitated in the form of show, and ice is formed adhering to the nosel of the cock. This remarkable circumstance is described at large with a plate of the machine in Philos. Trans. Vol. LII. for 1761.

The following experiment is related by Dr. Darwin in the Philof. Tranf. Vol. LXXVIII. Having charged an air-gun as forcibly as he well could the air-cell and fyringe became exceedingly hot, much more fo than could be afcribed to the friction in working it; it was then left about half an hour to cool down to the temperature of the air, and a thermometer having been previoufly fixed againft a wall, the air was difcharged in a continual ftream on its bulb, and it funk many degrees. From thefe three experiments of the fteam in the exhaufted receiver being deposited and re-abforbed, when a part of the air is exhaufted or re-admitted, and the fnow produced by the fountain of Hiero, and the extraordinary heat given out in charging, and the cold produced in difcharging an air-gun, there is reafon to conclude that when air is mechanically comprefied the elementary fluid heat is prefied out of it, and that when it is mechanically expanded the fame fluid heat is re-abforbed from the common mafs.

It is probable all other bodies as well as air attract heat from their neighbours when they are mechanically expanded, and give it out when they are mechanically condenfed. Thus when a vibration of the particles of hard bodies is excited by friction or by percuffion, these particles mutually recede from and approach each other reciprocally; at the times of their receffion from each other, the body becomes enlarged in bulk, and is then in a condition to attract heat from those in its vicinity with great and fudden power; at the times of their approach to each other this heat is again given out, but the bodies in contact having in the mean while received the heat they had thus loft, from other bodies behind them, do not fo fuddenly or fo forcibly re-abforb the heat again from the body in vibration; hence it remains on its furface like the electric fluid on a rubbed glafs globe, and for the fame reafon, becaufe there is no good conductor to take it up again. Hence at every vibration more and more heat is acquired and ftands loofe upon the furface; as in filing metals or rubbing glafs tubes; and thus a fmith with a few ftrokes on a nail on his anvil can make it hot enough to light a brimftone-match; and hence in ftriking flint and fteel together heat enough is produced to vitrify the parts thus ftrucken off, the quantity of which heat is again probably increased by the new chemical combination.

II. The analogy between the phenomena of the electric fluid and of heat furnishes another argument in support of the existence of heat as a gravitating fluid. I. They are both accumulated by friction on the excited body. 2. They are propagated easily or with difficalty along the same classes of bodies; with ease by metals, with less ease by water; and with difficulty by refins, bees-wax, filk, air, and glass. Thus glass canes or canes of fealing-wax may be melted by a blow-pipe or a candle within a quarter of an

NOTE VII.

inch of the fingers which hold them, without any inconvenient heat, while a pin or other metallic fubftance applyed to the flame of a candle fo readily conducts the heat as immediately to burn the fingers. Hence clothes of filk keep the body warmer than clothes of linen of equal thicknefs, by confining the heat upon the body. And hence plains are fo much warmer than the fummits of mountains by the greater denfity of the air confining the acquired heat upon them. 3. They both give out light in their paffage through air, perhaps not in their paffage through a vacuum. 4. They both of them fufe or vitrify metals. 5. Bodies after being electrized if they are mechanically extended will receive a greater quantity of electricity, as in Dr. Franklin's experiment of the chain in the tankard; the fame feems true in refpect to heat as explained above. 6. Both heat and electricity contribute to fufpend fteam in the atmosphere by producing or increafing the repulsion of its particles. 7. They both gravitate, when they have been accumulated, till they find their equilibrium.

If we add to the above the many chemical experiments which receive an eafy and elegant explanation from the fuppofed matter of heat, as employed in the works of Bergman and Lavoifier, I think we may reafonably allow of its exiftence as an element, occafionally combined with other bodies, and occafionally exifting as a fluid, like the electric fluid gravitating amongft them. and that hence it may be propagated from the central fires of the earth to the whole mafs, and contribute to preferve the mean heat of the earth, which in this country is about 48 degrees but variable from the greater or lefs effect of the fun's heat in different climates, fo well explained in Mr. Kirwan's Treatife on the Temperature of different Latitudes. 1787, Elmíly. London.

NOTE VIII.---MEMNON'S LYRE.

So to the facred Sun in Memnon's fane Spontaneous concords quired the matin firain. CANTO I. 1. 181.

THE gigantic flatue of Memnon in his temple at Thebes had a lyre in his hands, which many credible writers affure us, founded when the rifing fun fhone upon it. Some philofophers have fuppofed that the fun's light poffeffes a mechanical impulfe, and that the founds abovementioned might be thence produced. Mr. Michell conftructed a very tender horizontal balance, as related by Dr. Prieftley in his hiftory of light and colours, for this purpofe, but fome experiments with this balance which I faw made by the late Dr. Powel, who threw the focus of a large reflector on one extremity of it, were not conclusive eitherway, as the copper leaf of the balance approached in one experiment and receded in another.

There are however methods by which either a rotative or alternating motion may be produced by very moderate degrees of heat. If a ftraight glafs tube, fuch as are ufed for barometers, be fufpended horizontally before a fire, like a roafting fpit, it will revolve by intervals; for as glafs is a bad conductor of heat the fide next the fire becomes heated fooner than the oppofite fide, and the tube becomes bent into a bow with the external part of the curve towards the fire, this curve then falls down and produces a fourth part of a revolution of the glafs tube, which thus revolves with intermediate paufes.

Another alternating motion I have feen produced by fufpending a glafs tube about eight inches long with bulbs at each end on a centre like a fcale beam. This curious machine is filled about one third part with pureft fpirit of wine, the other two thirds being a vacuum, and is called a pulfe-glafs, if it be placed in a box before the fire, fo that either bulb, as it rifes, may become fhaded from the fire, and expofed to it when it defcends, an alternate libration of it is produced. For fpirit of wine in vacuo emits fteam by a very fmall degree of heat, and this fteam forces the fpirit beneath it up into the upper bulb, which therefore defcends. It is probable fuch a machine on a larger fcale might be of ufe to open the doors or windows of hot-houfes or mellon-frames, when the air within them fhould become too much heated, or might be employed in more important mechanical purpofes.

On travelling through a hot fummer's day in a chaife with a box covered with leather on the fore-axle-tree, I obferved, as the fun fhone upon the black leather, the box began to open its lid, which at noon rofe above a foot, and could not without great force be preffed down; and which gradually clofed again as the fun declined in the evening. This I fuppofe might with ftill greater facility be applied to the purpofe of opening melonframes or the fafhes of hot-houfes.

The flatue of Memnon was overthrown and fawed in two by Cambyles to difcover its internal flructure, and is faid fill to exift. See Savary's Letters on Egypt. The truncated flatue is faid for many centuries to have faluted the rifing fun with chearful tones, and the fetting fun with melancholy ones.

NOTE IX.-LUMINOUS INSECTS.

Star of the earth, and diamond of the night. CANTO I. 1. 192.

THERE are eighteen species of Lampyris or glow-worm, according to Linneus, fome of which are found in almost every part of the world. In many of the species the females have no wings, and are fuppofed to be difcovered by the winged males by their fhining in the night. They become much more lucid when they put themfelves in motion, which would feem to indicate that their light is owing to their refpiration; in which procefs it is probable phofphoric acid is produced by the combination of vital air with fome part of the blood, and that light is given out through their transparent bodies by this flow internal combustion.

There is a fire-fly of the beetle-kind defcribed in the Dict. Raifonné under the name of Acudia, which is faid to be two inches long, and inhabits the Weft-Indies and South America; the natives use them instead of candles, putting from one to three of them under a glafs. Madam Merian fays, that at Surinam the light of this fly is fo great, that fhe faw fufficiently well by one of them to paint and finish one of the figures of them in her work on infects. The largeft and oldeft of them are faid to become four inches long, and to fhine like a fhooting ftar as they fly, and are thence called Lanternbearers. The use of this light to the infect itself feems to be that it may not fly against objects in the night; by which contrivance thefe infects are enabled to procure their fustenance either by night or day, as their wants may require, or their numerous enemies permit them; whereas fome of our beetles have eyes adapted only to the night, and if they happen to come abroad too foon in the evening are fo dazzled that they fly againft every thing in their way. See note on Phofphorus, No. X.

In fome feas, as particularly about the coaft of Malabar, as a fhip floats along, it feems during the night to be furrounded with fire, and to leave a long tract of light behind it. Whenever the fea is gently agitated it feems converted into little flars, every drop as it breaks emits light, like bodies electrified in the dark. Mr. Bomare fays, that when he was at the port of Cettes in Languedoc, and bathing with a companion in the fea after a very hot day, they both appeared covered with fire after every immersion, and that laying his wet hand on the arm of his companion, who had not then dipped himfelf, the exact mark of his hand and fingers was feen in characters of fire. As numerous microfcopic infects are found in this fhining water, its light has been generally afcribed to them, though it feems probable that fifh-flime in hot countries may become in fuch a ftate of incipient putrefaction as to give light, especially when by agitation it is more expofed to the air; otherwife it is not eafy to explain why agitation fhould be neceffary to produce this marine light. See note on Phofphorus No. X.
NOTE X.—PHOSPHORUS.

(19)

Or mark in shining letters Kunckel's name In the pale phosphor's self-consuming flame.

CANTO I. 1. 237.

KUNCKEL, a native of Hamburgh, was the first who difcovered to the world the process for producing phosphorus; though Brandt and Boyle were likewise faid to have previously had the art of making it. It was obtained from fal microcosmicum by evaporation in the form of an acid, but has fince been found in other animal fubstances, as in the assess of bones, and even in some vegetables, as in wheat flour. Keir's chemical Dict. This phosphoric acid is like all other acids united with vital air, and requires to be treated with charcoal or phlogiston to deprive it of this air, it then becomes a kind of animal fulphur, but of so inflammable a nature, that on the access of air it takes fire fpontaneously, and as it burns becomes again united with vital air, and re-assures its form of phosphoric acid.

As animal refpiration feems to be a kind of flow combuftion, in which it is probable that pbofphoric acid is produced by the union of phofphorus with the vital air, fo it is alfo probable that phofphoric acid is produced in the excretory or refpiratory veffels of luminous infects, as the glow-worm and fire-fly, and fome marine infects. From the fame principle I fuppofe the light from putrid fifh, as from the heads of hadocks, and from putrid veal, and from rotten wood in a certain ftate of their putrefaction, is produced, and phofphorus thus flowly combined with air is changed into phofphoric acid. The light from the Bolognian ftone, and from calcined fhells, and from white paper, and linen after having been expofed for a time to the fun's light, feem to produce either the phofphoric or fome other kind of acid from the fulphurous or phlogiftic matter which they contain. See note on Beccari's fhells. 1. 180.

There is another process feems fimilar to this flow combustion, and that is *bleaching*. By the warmth and light of the fun the water sprinkled upon linen or cotton cloth seems to be decomposed, (if we credit the theory of M. Lavoisier,) and a part of the vital air thus set at liberty and uncombined and not being in its elastic form, more easily diffolves the colouring or phlogistic matter of the cloth, and produces a new acid, which is itself colourles, or is washed out of the cloth by water. The new process of bleaching confirms a part of this theory, for by uniting much vital air to marine acid by diffilling it from manganese, on dipping the cloth to be bleached in water repleat with this superaerated marine acid, the colouring matter disappears immediately, sooner indeed in cotton than in linen. See note XXXIV.

There is another process which I fuspect bears analogy to these above-mentioned, and that is the rancidity of animal fat, as of bacon; if bacon be hung up in a warm kitchen, with much falt adhering on the outfide of it, the fat part of it foon becomes

C 2

STEAM-ENGINE.

NOTE XI.

yellow and rancid; if it be wafhed with much cold water after it has imbibed the falt, and juft before it is hung up, I am well informed, that it will not become rancid, or in very flight degrees. In the former cafe I imagine the falt on the furface of the bacon attracts water during the cold of the night, which is evaporated during the day, and that in this evaporation a part of the water becomes decomposed, as in bleaching, and its vital air uniting with greater facility in its unelastic state with the animal fat, produces an acid, perhaps of the phosphoric kind, which being of a fixed nature lies upon the bacon, giving it the yellow colour and rancid tafte. It is remarkable that the fuperaerated marine acid does not bleach living animal fubftances, at least it did not whiten a part of my hand which I for fome minutes exposed to it.

NOTE XI.---STEAM-ENGINE.

Quick moves the balanced beam, of giant-birth, Wields his large limbs, and nodding shakes the earth. CANTO I. 1. 267.

THE expansive force of steam was known in fome degree to the antients, Hero of Alexandria describes an application of it to produce a rotative motion by the re-action of steam issues from a sphere mounted upon an axis, through two small tubes bent into tangents, and issues from the opposite sides of the equatorial diameter of the sphere, the sphere was supplied with steam by a pipe communicating with a pan of boiling water, and entering the sphere at one of its poles.

A french writer about the year 1630 defcribes a method of raifing water to the upper part of a houfe by filling a chamber with fteam, and fuffering it to condenfe of itfelf, but it feems to have been mere theory, as his method was fcarcely practicable as he defcribes it. In 1655 the Marquis of Worcefter mentions a method of raifing water by fire in his Century of Inventions, but he feems only to have availed himfelf of the expansive force and not to have known the advantages arifing from condensing the fteam by an injection of cold water. This latter and most important improvement feems to have been made by Capt. Savery fometime prior to 1698, for in that year his patent for the use of that invention was confirmed by act of parliament. This gentleman appears to have been the first who reduced the machine to practice and exhibited it in an useful form. This method consisted only in expelling the air from a vessel by steam and condensing the fteam by an injection of cold water, which making a vacuum, the preffure of the atmostrate forced the water to assess the atmost the fream-vessel through a pipe of 24 to 26 feet

NOTE XI.

high, and by the admiffion of denfe fteam from the boiler, forcing the water in the fteamveffel to afcend to the height defired. This conftruction was defective becaufe it required very ftrong veffels to refift the force of the fteam, and becaufe an enormous quantity of fteam was condenfed by coming in contact with the cold water in the fteam-veffel.

About or foon after that time M. Papin attempted a fteam-engine on fimilar principles but rather more defective in its conftruction.

The next improvement was made very foon afterwards by Meffrs. Newcomen and Cawley of Dartmouth, it confifted in employing for the fteam-veffel a hollow cylinder, fhut at bottom and open at top, furnished with a piston fliding easily up and down in it, and made tight by oakum or hemp, and covered with water. This piston is fuspended by chains from one end of a beam, moveable upon an axis in the middle of its length, to the other end of this beam are fuspended the pump-rods.

The danger of burfting the veffels was avoided in this machine, as however high the water was to be raifed it was not neceffary to increase the density of the fleam but only to enlarge the diameter of the cylinder.

Another advantage was, that the cylinder not being made fo cold as in Savary's method, much lefs fteam was loft in filling it after each condenfation.

The machine however full remained imperfect, for the cold water thrown into the cylinder acquired heat from the fteam it condenfed, and being in a veffel exhaufted of air it produced fteam itfelf, which in part refifted the action of the atmosphere on the pifton; were this remedied by throwing in more cold water the deftruction of fteam in the next filling of the cylinder would be proportionally increased. It has therefore in practice been found adviseable not to load these engines with columns of water weighing more than feven pounds for each square inch of the area of the pifton. The bulk of water when converted into fteam remained unknown until Mr. J. Watt, then of Glasgow, in 1764, determined it to be about 1800 times more rare than water. It foon occurred to Mr. Watt that a perfect engine would be that in which no steam should be condensed in filling the cylinder, and in which the steam should be fo perfectly cooled as to produce nearly a perfect vacuum.

Mr. Watt having afcertained the degree of heat in which water boiled in vacuo, and under progreffive degrees of preffure, and infructed by Dr. Black's difcovery of latent heat, having calculated the quantity of cold water neceffary to condenfe certain quantities of fteam fo far as to produce the exhauftion required, he made a communication from the cylinder to a cold veffel previoufly exhaufted of air and water, into which the fteam rufhed by its elafticity, and became immediately condenfed. He then adapted a cover to the cylinder and admitted fteam above the pifton to prefs it down inftead of air, and inftead of applying water he ufed oil or greafe to fill the pores of the oakum and to lubricate the cylinder.

He next applied a pump to extract the injection water, the condenfed fteam, and the air, from the condenfing veffel, every ftroke of the engine. To prevent the cooling of the cylinder by the contact of the external air, he furrounded it with a cafe containing fleam, which he again protected by a covering of matters which conduct heat flowly.

This conftruction prefented an eafy means of regulating the power of the engine, for the fteam being the acting power, as the pipe which admits it from the boiler is more or lefs opened, a greater or fmaller quantity can enter during the time of a ftroke, and confequently the engine can act with exactly the neceffary degree of energy.

Mr. Watt gained a patent for his engine in 1768, but the further perfecution of his defigns were delayed by other avocations till 1775, when in conjunction with Mr. Boulton of Soho near Birmingham, numerous experiments were made on a large fcale by their united ingenuity, and great improvements added to the machinery, and an act of parliament obtained for the prolongation of their patent for twenty-five years, they have fince. that time drained many of the deep mines in Cornwall, which but for the happy union of fuch genius must immediately have ceafed to work. One of these engines works a pump of eighteen inches diameter, and upwards of 100 fathom or 600 feet high, at the rate of ten to twelve ftrokes of feven feet long each, in a minute, and that with one fifth part of the coals which a common engine would have taken to do the fame work. The power of this engine may be eafier comprehended by faying that it raifed a weight equal to 81000 pounds 80 feet high in a minute, which is equal to the combined action of 200 good horfes. In Newcomen's engine this would have required a cylinder of the enormous diameter of 120 inches or ten feet, but as in this engine of Mr. Watt and Mr. Boulton the fleam acts, and a vacuum is made, alternately above and below the pifton, the power exerted is double to what the fame cylinder would otherways produce, and is further augmented by an inequality in the length of the two ends of the lever.

These gentlemen have also by other contrivances applied their engines to the turning of mills for almost every purpose, of which that great pile of machinery the Albion Mill is a well known instance. Forges, flitting mills, and other great works are erected where nature has furnished no running water, and future times may boast that this grand and useful engine was invented and perfected in our own country.

Since the above article went to the prefs the Albion Mill is no more; it is fuppofed to have been fet on fire by interefted or malicious incendaries, and is burnt to the ground. Whence London has loft the credit and the advantage of poffeffing the most powerful machine in the world !

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NOTE XII.-FROST.

In phalanx firm the fiend of Frost affail.

CANTO I. 1. 446.

THE caufe of the expansion of water during its conversion into ice is not yet well afcertained, it was fuppofed to have been owing to the air being fet at liberty in the act of congelation which was before diffolved in the water, and the many air bubbles in ice were thought to countenance this opinion. But the great force with which ice expands during its congelation, fo as to burst iron bombs and coehorns, according to the experiments of Major Williams at Quebec, invalidates this idea of the caufe of it, and may fometime be brought into use as a means of breaking rocks in mining, or projecting cannon-balls, or for other mechanical purposes, if the means of producing congelation should ever be discovered to be as eafy as the means of producing combustion.

Mr. de Mairan attributes the increafe of bulk of frozen water to the different arrangement of the particles of it in cryftallization, as they are conftantly joined at an angle of 60 degrees; and muft by this difposition he thinks occupy a greater volume than if they were parallel. He found the augmentation of the water during freezing to amount to one-fourteenth, one-eighteenth, one-nineteenth, and when the water was previously purged of air to only one-twenty-fecond part. He adds that a piece of ice, which was at first only one-fourteenth part specifically lighter than water, on being exposed fome days to the frost became one-twelfth lighter than water. Hence he thinks ice by being exposed to greater cold still increases in volume, and to this attributes the bursting of ice in ponds and on the glaciers. See Lewis's Commerce of Arts, p. 257. and the note on Muschus in the other volume of this work.

This expansion of ice well accounts for the greater mischief done by vernal frosts attended with moisture, (as by hoar-frosts,) than by the dry frosts called black frosts. Mr. Lawrence in a letter to Mr. Bradley complains that the dale-miss attended with a frost on may-day had destroyed all his tender fruits; though there was a sharper frost the night before without a miss, that did him no injury; and adds, that a garden not a store's throw from his own on a higher stuation, being above the dale-miss, had received no damage. Bradley, Vol. II. p. 232.

Mr. Hunter by very curious experiments difcovered that the living principle in fifth, in vegetables, and even in eggs and feeds, poffeffes a power of refifting congelation. Phil. Tranf. There can be no doubt but that the exertions of animals to avoid the pain of cold may produce in them a greater quantity of heat, at leaft for a time, but that vegetables, eggs, or feeds, fhould poffefs fuch a quality is truly wonderful. Others have imagined that animals poffefs a power of preventing themfelves from becoming much warmer than 98 degrees of heat, when immerfed in an atmosphere above that degree of heat. It is true that the increafed exhalation from their bodies will in fome measure cool them, as much heat is carried off by the evaporation of fluids, but this is a chemical not an animal procefs. The experiments made by those who continued many minutes in the air of a room heated fo much above any natural atmospheric heat, do not feem conclusive, as they remained in it a lefs time than would have been neceffary to have heated a mass of beef of the fame magnitude, and the circulation of the blood in living animals, by perpetually bringing new supplies of fluid to the skin, would prevent the external surface from becoming hot much sooner than the whole mass. And thirdly, there appears no power of animal bodies to produce cold in difeases, as in scarlet fever, in which the increased action of the vessels of the skin produces heat and contributes to exhauss the animal power already too much weakened.

It has been thought by many that frofts meliorate the ground, and that they are in general falubrious to mankind. In refpect to the former it is now well known that ice or fnow contain no nitrous particles, and though froft by enlarging the bulk of moift clay leaves it fofter for a time after the thaw, yet as foon as the water exhales, the clay becomes as hard as before, being prefied together by the incumbent atmosphere, and by its felf-attraction, called *fetting* by the potters. Add to this that on the coafts of Africa, where froft is unknown, the fertility of the foil is almost beyond our conceptions of it. In respect to the general falubrity of frosty feasons the bills of mortality are an evidence in the negative, as in long frosts many weakly and old people perish from debility occasioned by the cold, and many classes of birds and other wild animals are benumbed by the cold or deftroyed by the confequent fearcity of food, and many tender vegetables perish from the degree of cold.

I do not think it fhould be objected to this doctrine that there are moift days attended with a brifk cold wind when no vifible ice appears, and which are yet more difagreeable and deftructive than frofty weather. For on these days the cold moifture, which is deposited on the fkin is there evaporated and thus produces a degree of cold perhaps greater than the milder frofts. Whence even in fuch days both the difagreeable fensations and infalubrious effects belong to the cause abovementioned, viz. the intensity of the cold. Add to this that in these cold moift days as we pass along or as the wind blows upon us, a new sheet of cold water is as it were perpetually applied to us and hangs upon our bodies, now as water is 800 times denser than air and is a much better conductor of heat, we are starved with cold like those who go into a cold bath, both by the great number of particles in contact with the star and their greater facility of receiving our heat.

It may neverthelefs be true that fnows of long duration in our winters may be lefs injurious to vegetation than great rains and fhorter frofts, for two reafons. I. Becaufe great rains carry down many thoufand pounds worth of the beft part of the manure off the lands into the fea, whereas fnow diffolves more gradually and thence carries away lefs from the land; any one may diffinguifh a fnow-flood from a rain-flood by the transparency of the water. Hence hills or fields with confiderable inclination of furface fhould be ploughed horizontally that the furrows may ftay the water from fhowers till it deposits its mud. 2. Snow protects vegetables from the feverity of the froft, fince it is always in a flate of thaw where it is in contact with the earth; as the earth's heat is about 48° and the heat of thawing fnow is 32° the vegetables between them are kept in a degree of heat about 40, by which many of them are preferved. See note on Mufchus, Vol. II. of this work.

NOTE XIII.--ELECTRICITY.

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Cold from each point cerulean lustres gleam.

CANTO I. 1. 345.

ELECTRIC POINTS.

THERE was an idle difpute whether knobs or points were preferable on the top of conductors for the defence of houfes. The defign of these conductors is to permit the electric matter accumulated in the clouds to pass through them into the earth in a smaller continued stream as the cloud approaches, before it comes to what is termed striking distance; now as it is well known that accumulated electricity will pass to points at a much greater distance than it will to knobs there can be no doubt of their preference; and it would seem that the finer the point and the less liable to become rusty the better, as it would take off the lightening while it was still at a greater distance, and by that means preferve a greater extent of building; the very extremity of the point should be of pure filver or gold, and might be branched into a kind of brush, fince one small point can not be supposed to receive fo great a quantity as a thicker bar might conduct into the earth.

If an infulated metallic ball is armed with a point, like a needle, projecting from one part of it, the electric fluid will be feen in the dark to pass off from this point, to long as the ball is kept fupplied with electricity. The reason of this is not difficult to comprehend, every part of the electric atmosphere which furrounds the infulated ball is attracted to that ball by a large furface of it, whereas the electric atmosphere which is near the extremity of the needle is attracted to it by only a fingle point, in confequence the particles of electric matter near the furface of the ball approach towards it and push off by their greater gravitation the particles of electric matter over the point of the needle in a continued fiream.

Something like this happens in refpect to the diffusion of oil on water from a pointed cork, an experiment which was many years ago shewn me by Dr. Franklin; he cut a piece of cork about the fize of a letter-wafer and left on one edge of it a point about a fixth of an inch in length projecting as a tangent to the circumference. This was dipped in oil and thrown on a pond of water and continued to revolve as the oil left the point for a great many minutes. The oil defcends from the floating cork upon the water being diffused upon it without friction and perhaps without contact; but its going off at the point fo forcibly as to make the cork revolve in a contrary direction feems analogous to the departure of the electric fluid from points.

Can any thing fimilar to either of these happen in respect to the earth's atmosphere and give occasion to the breezes on the tops of mountains, which may be confidered as points on the earths circumference?

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NOTE XIII.

FAIRY-RINGS.

There is a phenomenon supposed to be electric which is yet unaccounted for, I mean the Fairy-rings, as they are called, fo often feen on the grafs. The numerous flashes of lightning which occur every fummer are, I believe, generally discharged on the earth, and but feldom (if ever) from one cloud to another. Moift trees are the moft frequent conductors of these flashes of lightning, and I am informed by purchasers of wood that innumerable trees are thus cracked and injured. At other times larger parts or prominences of clouds gradually finking as they move along, are difcharged on the moifture parts of graffy plains. Now this knob or corner of a cloud in being attracted by the earth will become nearly cylindrical, as loofe wool would do when drawn out into a thread, and will firike the earth with a fiream of electricity perhaps two or ten yards in diameter. Now as a ftream of electricity difplaces the air it paffes through, it is plain no part of the grafs can be burnt by it, but just the external ring of this cylinder where the grafs can have accefs to the air, fince without air nothing can be calcined. This earth after having been fo calcined becomes a richer foil, and either fungufes or a bluer grafs for many years mark the place. That lightning difplaces the air in its paffage is evinced by the loud crack that fucceeds it, which is owing to the fides of the aerial vacuum clapping together when the lightning is withdrawn. That nothing will calcine without air is now well underftood from the acids produced in the burning of phlogiftic fubftances, and may be agreeably feen by fufpending a paper on an iron prong and putting it into the centre of the blaze of an iron-furnace; it may be held there fome feconds and may be again withdrawn without its being burnt, if it be paffed quickly into the flame and out again through the external part of it which is in contact with the air. I know fome circles of many yards diameter of this kind near Foremark in Derbyshire which annually produce large white fungules and stronger grafs, and have done fo, I am informed, above thirty years. This increafed fertility of the ground by calcination or charring, and its continuing to operate fo many years is well worth the attention of the farmer, and fhews the use of paring and burning new turf in agriculture, which produces its effect not fo much by the afhes of the vegetable fibres as by charring the foil which adheres to them.

These fituations, whether from eminence or from moisture, which were proper once to attract and discharge a thunder-cloud, are more liable again to experience the fame. Hence many fairy-rings are often seen near each other either without intersecting each other, as I faw this summer in a garden in Nottinghamshire, or intersecting each other as described on Arthur's seat near Edinburgh in the Edinb. Trans. Vol. II. p. 3.

NOTE XIV .---- BUDS AND BULBS.

Where dwell my vegetative realms benumb'd In buds imprison'd, or in bulbs intomb'd.

CANTO I. 1. 465.

A TREE is properly fpeaking a family or fwarm of buds, each bud being an individual plant, for if one of thefe buds be torn or cut out and planted in the earth with a glafs cup inverted over it to prevent its exhalation from being at first greater than its power of abforption, it will produce a tree fimilar to its parent; each bud has a leaf, which is its lungs, appropriated to it, and the bark of the tree is a congeries of the roots of thefe individual buds, whence old hollow trees are often feen to have fome branches flourish with vigour after the internal wood is almost intirely decayed and vanished. According to this idea Linneus has observed that trees and shrubs are roots above ground, for if a tree be inverted leaves will grow from the root-part and roots from the trunk-part. Phil. Bot. p. 39. Hence it appears that vegetables have two methods of propagating themfelves, the oviparous as by feeds, and the viviparous as by their buds and bulbs, and that the individual plants, whether from feeds or buds or bulbs, are all annual productions like many kinds of infects as the filk-worm, the parent perifhing in the autumn after having produced an embryon, which lies in a torpid flate during the winter, and is matured in the fucceeding fummer. Hence Linneus names buds and bulbs the winter-cradles of the plant or hybernacula, and might have given the fame term to feeds. In warm climates few plants produce buds, as the vegetable life can be compleated in one fummer, and hence the hybernacle is not wanted; in cold climates alfo fome plants do not produce buds, as philadelphus, frangula, viburnum, ivy, heath, wood-nightshade, rue, geranium.

The bulbs of plants are another kind of winter-cradle, or hybernacle, adhering to the defeending trunk, and are found in the perennial herbaceous plants which are too tender to bear the cold of the winter. The production of these fubterraneous winter lodges, is not yet perhaps clearly underflood, they have been diffributed by Linneus according to their forms into fcaly, folid, coated, and jointed bulbs, which however does not elucidate their manner of production. As the buds of trees may be truly efteemed individual annual plants, their roots conftituting the bark of the tree, it follows that these roots (viz. of each individual bud) fpread themselves over the last years bark, making a new bark over the old one, and thence defcending cover with a new bark the old roots alfo in the fame manner. A fimilar circumftance I fuppofe to happen in fome herbaceous plants, that is, a new bark is annually produced over the old root, and thus for fome years at leaft the old root or caudex increafes in fize and puts up new ftems. As these roots increase in fize the central part I suppose changes like the internal wood of a tree and does not poffefs any vegetable life, and therefore gives out no fibres or rootlets, and hence appears bitten off, as in valerian, plantain, and devil's-bit. And this decay of the central part of the root I suppose has given occasion to the belief of the root-fibres drawing down the bulb fo much infifted on by Mr. Milne in his Botanical Dictionary, Art. Bulb.

From the obfervations and drawings of various kinds of bulbous roots at different times of their growth, fent me by a young lady of nice obfervation, it appears probable that all bulbous roots properly fo called perifh annually in this climate: Bradley, Miller, and the Author of Spectacle de la Nature, obferve that the tulip annually renews its bulb, for the ftalk of the old flower is found under the old dry coat but on the outfide of the new bulb. This large new bulb is the flowering bulb, but befides this there are other fmall new bulbs produced between the coats of this large one but from the fame caudex, (or circle from which the root-fibres fpring;) thefe fmall bulbs are leaf-bearing bulbs, and renew themfelves annually with increasing fize till they bear flowers.

Mifs —— favoured me with the following curious experiment: She took a fmall tulip-root out of the earth when the green leaves were fufficiently high to fhow the flower, and placed it in a glafs of water; the leaves and flower foon withered and the bulb became wrinkled and foft, but put out one fmall fide bulb and three bulbs beneath defcending an inch into the water by long proceffes from the caudex, the old bulb in fome weeks intirely decayed; on diffecting this monfter, the middle defcending bulb was found by its procefs to adhere to the caudex and to the old flower-ftem, and the fide ones were feparated from the flower-ftem by a few fhrivelled coats but adhered to the caudex. Whence fhe concludes that thefe laft were off-fets or leaf-bulbs which fhould have been feen between the coats of the new flower-bulb if it had been left to grow in the earth, and that the middle one would have been the new flower-bulb. In fome years (perhaps in wet feafons) the florifts are faid to lofe many of their tulip-roots by a fimilar procefs, the new leaf-bulbs being produced beneath the old ones by an elongation of the caudex without any new flower-bulbs.

By repeated diffections the obferves that the leaf-bulbs or off-fets of tulip, crocus, gladiolus, fritillary, are renewed in the fame manner as the flowering-bulbs, contrary to the opinion of many writers; this new leaf-bulb is formed on the infide of the coats from whence the leaves grow, and is more or lefs advanced in fize as the outer coats and leaves are more or lefs thrivelled. In examining tulip, iris, hyacinth, hare-bell, the new bulb was invariably found *letween* the flower-ftem and the bafe of the innermoft leaf of those roots which had flowered, and *inclosed by* the bafe of the innermoft leaf in those roots which had not flowered, in both cafes adhering to the caudex or flefhy circle from which the root-fibres fpring.

Hence it is probable that the bulbs of hyacinths are renewed annually, but that this is performed from the caudex within the old bulb, the outer coat of which does not fo fhrivel as in crocus and fritillary and hence this change is not fo apparent. But I believe as foon as the flower is advanced the new bulbs may be feen on diffection, nor does the annual increase of the fize of the root of cyclamen and of aletris capenfis militate against this annual renewal of them, fince the leaf-bulbs or off-fets, as described above, are increased in fize as they are annually renewed. See note on orchis, and on anthoxanthum, in Vol. II. of this work.

NOTE XV. SOLAR VOLCANOS.

From the deep craters of his realms of fire The whirling fun this ponderous planet hurld.

CANTO II. 1. 14.

DR. ALEXANDER WILSON, Professor of Astronomy at Glasgow, published a paper in the Philosophical Transactions for 1774, demonstrating that the spots in the fun's difk are real cavities, excavations through the luminous material, which covers the other parts of the fun's furface. One of these cavities he found to be about 4000 miles deep and many times as wide. Some objections were made to this doctrine by M. De la Laude in the Memoirs of the French Academy for the year 1776, which however have been ably answered by Professor Wilson in reply in the Philos. Trans. for 1783. Keil observes, in his Astronomical Lectures, p. 44, "We frequently see spots in the fun which are larger and broader not only than Europe or Africa, but which even equal, if they do not exceed, the furface of the whole terraqueous globe." Now that these cavities are made in the fun's body by a process of nature fimilar to our earthquakes does not feem improbable on feveral accounts. I. Becaufe from this difcovery of Dr. Wilfon it appears that the internal parts of the fun are not in a flate of inflammation or of ejecting light, like the external part or luminous ocean which covers it; and hence that a greater degree of heat or inflammation and confequent expansion or explosion may occafionally be produced in its internal or dark nucleus. 2. Becaufe the folar fpots or cavities are frequently increafed or diminished in fize. 3. New ones are often produced. 4. And old ones vanish. 5. Because there are brighter or more luminous parts of the fun's difk, called faculæ by Scheiner and Hevelius, which would feem to be volcanos in the fun, or, as Dr. Wilfon calls them, " eructations of matter more luminous than that which covers the fun's furface." 6. To which may be added that all the planets added together with their fatellites do not amount to more than one fix hundred and fiftieth part of the mais of the fun according to Sir Ifaac Newton.

Now if it could be fuppofed that the planets were originally thrown out of the fun by larger fun-quakes than those frequent ones which occasion these spots or excavations above-mentioned, what would happen? I. According to the observations and opinion of Mr. Herschel the fun itself and all its planets are moving forwards round some other centre with an unknown velocity, which may be of opake matter corresponding with the very antient and general idea of a chaos. Whence if a ponderous planet, as Saturn, could be supposed to be projected from the fun by an explosion, the motion of the fun itself might be at the fame time diffurbed in such a manner as to prevent the planet from falling again into it. 2. As the fun revolves round its own axis its form must be that of an oblate spheroid like the earth, and therefore a body projected from its furface perpendicularly upwards from that furface would not rise perpendicularly from the fun's centre, unless it happened to be projected exactly from either of its poles or

SOLAR VOLCANOS.

from its equator. Whence it may not be neceffary that a planet if thus projected from the fun by explosion should again fall into the fun. 3. They would part from the fun's furface with the velocity with which that furface was moving, and with the velocity acquired by the explosion, and would therefore move round the fun in the fame direction in which the fun rotates on its axis, and perform eliptic orbits. 4. All the planets would move the fame way round the fun, from this first motion acquired at leaving its furface, but their orbits would be inclined to each other according to the diftance of the part, where they were thrown out, from the fun's equator. Hence those which were ejected near the fun's equator would have orbits but little inclined to each other, as the primary planets; the plain of all whofe orbits are inclined but feven degrees and a half from each other. Others which were ejected near the fun's poles would have much more eccentric orbits, as they would partake fo much lefs of the fun's rotatory motion at the time they parted from his furface, and would therefore be carried further from the fun by the velocity they had gained by the explosion which ejected them, and become comets. 5. They would all obey the fame laws of motion in their revolutions round the fun; this has been determined by aftronomers, who have demonstrated that they move through equal areas in equal times. 6. As their annual periods would depend on the height they role by the explosion, these would differ in them all. 7. As their diurnal revolutions would depend on one fide of the exploded matter adhering more than the other at the time it was torn off by the explosion, these would also differ in the different planets, and not bear any proportion to their annual periods. Now as all these circumstances coincide with the known laws of the planetary fystem, they ferve to strengthen this conjecture.

This coincidence of fuch a variety of circumftances induced M. de Buffon to fuppofe that the planets were all ftruck off from the fun's furface by the impact of a large comet, fuch as approached fo near the fun's difk, and with fuch amazing velocity, in the year 1680, and is expected to return in 2255. But Mr. Buffon did not recollect that thefe comets themfelves are only planets with more eccentric orbits, and that therefore it muft be afked, what had previoufly ftruck off thefe comets from the fun's body? 2. That if all thefe planets were ftruck off from the fun at the fame time, they muft have been fo near as to have attracted each other and have formed one mafs: 3. That we fhall want new caufes for feparating the fecondary planets from the primary ones, and muft therefore look out for fome other agent, as it does not appear how the impulfe of a comet could have made one planet roll round another at the time they both of them were driven off from the fun.

If it fhould be afked, why new planets are not frequently ejected from the fun? it may be anfwered, that after many large earthquakes many vents are left for the elaftic vapours to escape, and hence, by the present appearance of the furface of our earth, earthquakes prodigiously larger than any recorded in history have existed; the fame circumstances may have affected the fun, on whose furface there are appearances of volcanos, as described above. Add to this, that some of the comets, and even the georgium fidus, may, for ought we know to the contrary, have been emitted from the fun in more

NOTE XV.

modern days, and have been diverted from their courfe, and thus prevented from returning into the fun, by their approach to fome of the older planets, which is fomewhat countenanced by the opinion feveral philofophers have maintained, that the quantity of matter of the fun has decreafed. Dr. Halley obferved, that by comparing the proportion which the periodical time of the moon bore to that of the fun in former times, with the proportion between them at prefent, that the moon is found to be fomewhat accelerated in refpect to the fun. Pemberton's View of Sir Ifaac Newton, p. 247. And fo large is the body of this mighty luminary, that all the planets thus thrown out of it would make fcarcely any perceptible diminution of it, as mentioned above. The cavity mentioned above, as meafured by Dr. Wilfon of 4000 miles in depth, not penetrating an hundredth part of the fun's femi-diameter; and yet, as its width was many times greater than its depth, was large enough to contain a greater body than our terreftrial world.

I do not mean to conceal, that from the laws of gravity unfolded by Sir Ifaac Newton, fuppofing the fun to be a fphere and to have no progreffive motion, and not liable itfelf to be difturbed by the fuppofed projection of the planets from it, that fuch planets muft return into the fun. The late Rev. William Ludlam, of Leicefter, whofe genius never met with reward equal to its merits, in a letter to me, dated January, 1787, after having fhewn, as mentioned above, that planets fo projected from the fun would return to it, adds, "That a body as large as the moon fo projected, would difturb the motion of the " earth in its orbit, is certain; but the calculation of fuch difturbing forces is difficult. "The body in fome circumftances might become a fatellite, and both move round their " common centre of gravity, and that centre be carried in an annual orbit round the " fun."

There are other circumftances which might have concurred at the time of fuch fuppofed explosions, which would render this idea not impossible. I. The planets might be thrown out of the fun at the time the fun itself was rising from chaos, and be attracted by other funs in their vicinity rising at the fame time out of chaos, which would prevent them from returning into the fun. 2. The new planet in its course or ascent from the fun, might explode and eject a fatellite, or perhaps more than one, and thus by its course being affected might not return into the fun. 3. If more planets were ejected at the fame time from the fun, they might attract and diffurb each others course at the time they left the body of the fun, or very foon afterwards, when they would be fo much nearer each other.

NOTE XVI.-CALCAREOUS EARTH.

While Ocean wrap'd it in his azure robe.

CANTO II. 1. 34.

FROM having obferved that many of the higheft mountains of the world confift of lime-ftone replete with fhells, and that these mountains bear the marks of having been lifted up by subterraneous fires from the interior parts of the globe; and as lime-ftone replete with solution of many of our deepest mines fome philofophers have concluded that the nucleus of the earth was for many ages covered with water which was peopled with its adapted animals; that the solution for the field of the field of the field of the earth was for many ages of these animals in a long feries of time produced folid strata in the ocean furrounding the original nucleus.

These strata confist of the accumulated exuviæ of shell-fish, the animals perished age after age but their fhells remained, and in progression of time produced the amazing quantities of lime-ftone which almost cover the earth. Other marine animals called coralloids raifed walls and even mountains by the congeries of their calcareous habitations, thefe perpendicular corralline rocks make fome parts of the Southern Ocean highly dangerous, as appears in the journals of Capt. Cook. From contemplating the immenfe ftrata of lime-ftone, both in refpect to their extent and thickness, formed from these fhells of animals, philosophers have been led to conclude that much of the water of the fea has been converted into calcareous earth by paffing through their organs of digeftion. The formation of calcareous earth feems more particularly to be an animal procefs as the formation of clay belongs to the vegetable economy; thus the fhells of crabs and other teftaceous fifh are annually reproduced from the mucous membrane beneath them; the fhells of eggs are first a mucous membrane, and the calculi of the kidneys and those found in all other parts of our fystem which fometimes contain calcareous earth, feem to originate from inflamed membranes; the bones themfelves confift of calcareous earth united with the phofphoric or animal acid, which may be feparated by diffolving the afhes of calcined bones in the nitrous acid; the various fecretions of animals, as their faliva and urine, abound likewife with calcareous earth, as appears by the incrustations about the teeth and the fediments of urine. It is probable that animal mucus is a previous procefs towards the formation of calcareous earth; and that all the calcareous earth in the world which is feen in lime-flones, marbles, fpars, alabafters, marls, (which make up the greatest part of the earth's cruft, as far as it has yet been penetrated,) have been formed originally by animal and vegetable bodies from the mais of water, and that by these means the folid part of the terraqueous globe has perpetually been in an increasing state and the water perpetually in a decreasing one.

After the mountains of fhells and other recrements of aquatic animals were elevated above the water the upper heaps of them were gradually diffolved by rains and dews and oozing through were either perfectly cryftallized in fmaller cavities and formed

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calcarcous fpar, or were imperfectly cryftallized on the roofs of larger cavities and produced ftalactites; or mixing with other undiffolved fhells beneath them formed marbles, which were more or lefs cryftallized and more or lefs pure; or laftly, after being diffolved, the water was exhaled from them in fuch a manner that the external parts became folid, and forming an arch prevented the internal parts from approaching each other fo near as to become folid, and thus chalk was produced. I have fpecimens of chalk formed at the root of feveral ftalactites, and in their central parts; and of other ftalactites which are hollow like quills from a fimilar caufe, viz. from the external part of the ftalactite hardening firft by its evaporation, and thus either attracting the internal diffolved particles to the cruft, or preventing them from approaching each other fo as to form a folid body. Of thefe I faw many hanging from the arched roof of a cellar under the high ftreet in Edinburgh.

If this diffolved limeftone met with vitriolic acid it was converted into alabafter, parting at the fame time with its fixable air. If it met with the fluor acid it became fluor; if with the filiceous acid, flint; and when mixed with clay and fand, or either of them, acquires the name of marl. And under one or other of these forms composes a great part of the folid globe of the earth.

Another mode in which limeftone appears is in the form of round granulated particles, but flightly cohering together; of this kind a bed extends over Lincoln heath, perhaps twenty miles long by ten wide. The form of this calcareous fand, its angles having been rubbed off, and the flatness of its bed, evinces that that part of the country was fo formed under water, the particles of fand having thus been rounded, like all other rounded pebbles. This round form of calcareous fand and of other larger pebbles is produced under water, partly by their being more or less foluble in water, and hence the angular parts become disfolved, first, by their exposing a larger furface to the action of the menstruum, and fecondly, from their attrition against each other by the streams or tides, for a great length of time, fucceffively as they were collected, and perhaps when some of them had not acquired their hardest ftate.

This calcareous fand has generally been called ketton-ftone and believed to refemble the fpawn of fifh, it has acquired a form fo much rounder than filiceous fand from its being of fo much fofter a texture and alfo much more foluble in water. There are other foft calcareous ftones called tupha which are deposited from water on moss, as at Matlock, from which moss it is probable the water may receive fomething which induces it the readier to part with its earth.

In fome lime-ftones the living animals feem to have been buried as well as their fhells during fome great convultion of nature, thefe fhells contain a black coaly fubftance within them, in others fome phlogifton or volatile alcali from the bodies of the dead animals remains mixed with the ftone, which is then called liver-ftone as it emits a fulphurous fmell on being ftruck, and there is a ftratum about fix inches thick extends a confiderable way over the iron ore at Wingerworth near Chefterfield in Derbyfhire which feems evidently to have been formed from the fhells of frefh-water mufcles There is however another fource of calcareous earth befides the aquatic one above defcribed and that is from the recrements of land animals and vegetables as found in marls, which confift of various mixtures of calcareous earth, fand, and clay, all of them perhaps principally from vegetable origin.

Dr. Hutton is of opinion that the rocks of marble have been foftened by fire into a fluid mafs, which he thinks under immenfe preffure might be done without the efcape of their carbonic acid or fixed air. Edinb. Tranfact. Vol. I. If this ingenious idea be allowed it might account for the purity of fome white marbles, as during their fluid ftate there might be time for their partial impurities, whether from the bodies of the animals which produced the fhells or from other extraneous matter, either to fublime to the uppermost part of the ftratum or to fubfide to the lowermost part of it. As a confirmation of this theory of Dr. Hutton's it may be added that fome calcareous ftones are found mixed with lime, and have thence loft a part of their fixed air or carbonic gas, as the bath-ftone, and on that account hardens on being exposed to the air, and mixed with fulphur produces calcareous liver of fulphur. Falconer on Bathwater. Vol. I. p. 156. and p. 257. Mr. Monnet found lime in powder in the mountains of Auvergne, and fulpected it of volcanic origin. Kirwan's Min. p. 22.

NOTE XVII. MORASSES.

Gnomes! you then taught transuding dews to pass Through time-fallen woods, and root-inwove morals. CANTO II. 1. 113.

WHERE woods have repeatedly grown and perifhed moraffes are in process of time produced, and by their long roots fill up the interflices till the whole becomes for many yards deep a mass of vegetation. This fact is curiously verified by an account given many years ago by the Earl of Cromartie, of which the following is a short abstract.

In the year 1651 the EARL OF CROMARTIE being then nineteen years of age faw a plain in the parifh of Lockburn covered over with a firm ftanding wood, which was fo old that not only the trees had no green leaves upon them but the bark was totally thrown off, which he was there informed by the old countrymen was the univerfal manner in which fir-woods terminated, and that in twenty or thirty years the trees would caft themfelves up by the roots. About fifteen years after he had occafion to travel the fame way and obferved that there was not a tree nor the appearance of a root of any of them; but in their place the whole plain where the wood ftood was

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covered with a flat green mofs or morafs, and on afking the country people what was become of the wood he was informed that no one had been at the trouble to carry it away, but that it had all been overturned by the wind, that the trees lay thick over each other, and that the mofs or bog had overgrown the whole timber, which they added was occafioned by the moifture which came down from the high hills above it and flagnated upon the plain, and that nobody could yet pafs over it, which however his Lordfhip was fo incautious as to attempt and flipt up to the arm-pits. Before the year 1699 that whole piece of ground was become a folid mofs wherein the peafants then dug turf or peat, which however was not yet of the beft fort. Philof, Tranf. No. 330. Abridg. Vol. V.

Moraffes in great length of time undergo variety of changes, first by elutriation, and afterwards by fermentation, and the confequent heat. I. By water perpetually oozing through them the most foluble parts are first washed away, as the effential falts, these together with the falts from animal recrements are carried down the rivers into the fea, where all of them feem to decompose each other except the marine falt. Hence the afhes of peat contain little or no vegetable alcali and are not used in the countries, where peat conftitutes the fuel of the lower people, for the purpose of washing linen. The fecond thing which is always feen oozing from moraffes is iron in folution, which produces chalybeate fprings, from whence depolitions of ochre and variety of iron ores. The third elutriation feems to confift of vegetable acid, which by means unknown appears to be converted into all other acids. I. Into marine and nitrous acids as mentioned above. 2. Into vitriolic acid which is found in fome morafles fo plentifully as to preferve the bodies of animals from putrefaction which have been buried in them, and this acid carried away by rain and dews and meeting with calcareous earth produces gypfum or alabafter, with clay it produces alum, and deprived of its vital air produces fulphur. 3. Fluor acid which being washed away and meeting with calcareous earth produces fluor or cubic fpar. 4. The filiceous acid which feems to have been diffeminated in great quantity either by folution in water or by folution in air, and appears to have produced the fand in the fea uniting with calcareous earth previoufly diffolved in that element, from which were afterwards formed fome of the grit-ftone rocks by means of a filiceous or calcareous cement. By its union with the calcareous earth of the morals other ftrata of filiceous fand have been produced; and by the mixture of this with clay and lime arofe the beds of marl.

In other circumstances, probably where lefs moisture has prevailed, moraffes feem to have undergone a fermentation, as other vegetable matter, new hay for instance is liable to do from the great quantity of fugar it contains. From the great heat thus produced in the lower parts of immense beds of morafs the phlogistic part, or oil, or asphaltum, becomes distilled, and rising into higher strata becomes again condensed forming coalbeds of greater or less purity according to their greater or less quantity of inflammable matter; at the same time the clay beds become purer or less fo, as the phlogistic part is more or less completely exhaled from them. Though coal and clay are frequently produced in this manner, yet I have no doubt, but that they are likewise often produced by elutriation; in fituations on declivities the clay is washed away down into the valleys, and the phlogistic part or coal left behind; this circumstance is seen in many valleys near the beds of rivers, which are covered recently by a whitish impure clay, called waterclay. See note XIX. XX. and XXIII.

LORD CROMARTIE has furnished another curious observation on moraffes in the paper above referred to. In a moss near the town of Eglin in Murray, though there is no river or water which communicates with the moss, yet for three or four feet of depth in the moss there are little shell-fish refembling offers with living fish in them in great quantities, though no such fish are found in the adjacent rivers, nor even in the water pits in the moss, but only in the folid substance of the moss. This curious fact not only accounts for the sometimes found on the surface of coals, and in the clay above them; but also for a thin stratum of such sometimes exists over iron-ore.

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Cold waves, immerged, the glowing mass congeal, And turn to adamant the hisfing Steel.

CANTO II. 1. 191.

AS iron is formed near the furface of the earth, it becomes expoled to ftreams of water and of air more than most other metallic bodies, and thence becomes combined with oxygene, or vital air, and appears very frequently in its calciform ftate, as in variety of ochres. Manganese, and zinc, and sometimes lead, are also found near the surface of the earth, and on that account become combined with vital air and are exhibited in their calciform state.

The avidity with which iron unites with oxygene, or vital air, in which process much heat is given out from the combining materials, is fhewn by a curious experiment of M. Ingenhouz. A fine iron wire twifted fpirally is fixed to a cork, on the point of the fpire is fixed a match made of agaric dipped in folution of nitre; the match is then ignited, and the wire with the cork put immediately into a bottle full of vital air, the match first burns vividly, and the iron foon takes fire and confumes with brilliant starks till it is reduced to finall brittle globules, gaining an addition of about one third of its weight by its union with vital air. Annales de Chymic. Traité de Chimie, per Lavoifier, c. iii, 2

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It is probably owing to a total deprivation of vital air which it holds with fo great avidity, that iron on being kept many hours or days in ignited charcoal becomes converted into fteel, and thence acquires the faculty of being welded when red hot long before it melts, and alfo the power of becoming hard when immerfed in cold water; both which I fuppofe depend on the fame caufe, that is, on its being a worfe conductor of heat than other metals; and hence the furface both acquires heat much fooner, and lofes it much fooner, than the internal parts of it, in this circumftance refembling glafs.

When fteel is made very hot, and fuddenly immerged in very cold water, and moved about in it, the furface of the fteel becomes cooled firft, and thus producing a kind of cafe or arch over the internal part, prevents that internal part from contracting quite fo much as it otherwife would do, whence it becomes brittler and harder, like the glafsdrops called Prince Rupert's drops, which are made by dropping melted glafs into cold water. This idea is countenanced by the circumftance that hardened fteel is fpecifically lighter than fteel which is more gradually cooled. (Nicholfon's Chemiftry, p. 313.) Why the brittlenefs and hardnefs of fteel or glafs fhould keep pace or be companions to each other may be difficult to conceive.

When a fteel fpring is forcibly bent till it break, it requires lefs power to bend it through the first inch than the fecond, and lefs through the fecond than the third; the fame I fuppofe to happen if a wire be diftended till it break by hanging weights to it; this fhews that the particles may be forced from each other to a fmall diffance by lefs power, than is neceffary to make them recede to a greater diftance; in this circumftance perhaps the attraction of cohefion differs from that of gravitation, which exerts its power inverfely as the fquares of the diftance. Hence it appears that if the innermost particles of a fteel bar, by cooling the external furface first, are kept from approaching each other fo nearly as they otherwife would do, that they become in the fituation of the particles on the convex fide of a bent fpring, and can not be forced further from each other except by a greater power than would have been neceffary to have made them recede thus far. And fecondly, that if they be forced a little further from each other they feparate; this may be exemplified by laying two magnetic needles parallel to each other, the contrary poles together, then drawing them longitudinally from each other, they will flide with fmall force till they begin to feparate, and will then require a ftronger force to really feparate them. Hence it appears, that hardnefs and brittlenefs depend on the fame circumftance, that the particles are removed to a greater diftance from each other and thus refift any power more forcibly which is applied to difplace them further, this conftitutes hardnefs. And fecondly, if they are difplaced by fuch applied force they immediately feparate, and this conftitutes brittlenefs.

Steel may be thus rendered too brittle for many purpoles, on which account artifts have means of foftening it again, by exposing it to certain degrees of heat, for the conftruction of different kinds of tools, which is called tempering it. Some artifts plunge large tools in very cold water as foon as they are compleatly ignited, and moving it about, take it out as foon as it ceafes to be luminous beneath the water; it is then rubbed quickly with a file or on fand to clean the furface, the heat which the metal ftill retains foon begins to produce a fucceffion of colours; if a hard temper be required, the piece is dipped again and ftirred about in cold water as foon as the yellow tinge appears, if it be cooled when the purple tinge appears it becomes fit for gravers' tools ufed in working upon metals; if cooled while blue it is proper for fprings. Nicholfon's Chemiftry, p. 313, --Keir's Chemical Dictionary.

MODERN PRODUCTION OF IRON.

The recent production of iron is evinced from the chalybeate waters which flow from moraffes which lie upon gravel-beds, and which must therefore have produced iron after those gravel-beds were raifed out of the fea. On the fouth fide of the road between Cheadle and Okeymoor in Staffordshire, yellow stains of iron are seen to penetrate the gravel from a thin morafs on its furface. There is a fiffure eight or ten feet wide, in a gravel-bed on the eaftern fide of the hollow road afcending the hill about a mile from Trentham in Staffordshire, leading toward Drayton in Shropshire, which fiffure is filled up with nodules of iron-ore. A bank of fods is now raifed againft this fiffure to prevent the loofe iron nodules from falling into the turnpike road, and thus this natural curiofity is at prefent concealed from travellers. A fimilar fiffure in a bed of marl, and filled up with iron nodules and with fome large pieces of flint, is feen on the eaftern fide of the hollow road afcending the hill from the turnpike houfe about a mile from Derby in the road towards Burton. And another fuch fiffure filled with iron nodes, appears about half a mile from Newton-Solney in Derbyshire, in the road to Burton, near the fummit of the hill. These collections of iron and of flint must have been produced posterior to the elevation of all those hills, and were thence evidently of vegetable or animal origin. To which fhould be added, that iron is found in general in beds either near the furface of the earth, or ftratified with clay coals or argillaceous grit, which are themfelves productions of the modern world, that is, from the recrements of vegetables and air-breathing animals.

Not only iron but manganele, calamy, and even copper and lead appear in fome inftances to have been of recent production. Iron and manganele are detected in all vegetable productions, and it is probable other metallic bodies might be found to exift in vegetable or animal matters, if we had tefts to detect them in very minute quantities. Manganele and calamy are found in beds like iron near the furface of the earth, and in a calciform ftate, which countenances their modern production. The recent production of calamy, one of the ores of zinc, appears from its frequently incrusting calcareous fpar in its defcent from the furface of the earth into the uppermost fiffures of the limestone mountains of Derbyshire. That the calamy has been carried by its folution or diffusion in water into these cavities, and not by its afcent from below in form of steam, is evinced from its not only forming a crust over the dogtooth state, but by its afterwards diffolving or deftroying the fparry crystal. I have specimens of calamy in the form of dogtooth fpar, two inches high, which are hollow, and stand half an inch above the diministed

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fparry cryftal on which they were formed, like a fheath a great deal too big for it; this feems to fhew, that this procefs was carried on in water, otherwife after the calamy had incrufted its fpar, and diffolved its furface, fo as to form a hollow cavern over it, it could not act further upon it except by the interpolition of fome medium. As these fpars and calamy are formed in the fiffures of mountains they must both have been formed after the elevation of those mountains.

In refpect to the recent production of copper, it was before obferved in note on Canto II. 1. 394, that the fummit of the grit-ftone mountain at Hawkftone in Shropfhire, is tinged with copper, which from the appearance of the blue ftains feems to have defcended to the parts of the rock beneath. I have a calciform ore of copper confifting of the hollow crufts of cubic cells, which has evidently been formed on cryftals of fluor, which it has eroded in the fame manner as the calamy erodes the calcareous cryftals, from whence may be deduced in the fame manner, the aqueous folution or diffusion, as well as the recent production of this calciform ore of copper.

Lead in fmall quantities is fometimes found in the fiffures of coal-beds, which fiffures are previoufly covered with fpar; and fometimes in nodules of iron-ore. Of the former I have a fpecimen from near Caulk in Derbyfhire, and of the latter from Colebrook Dale in Shropfhire. Though all these facts shew that fome metallic bodies are formed from vegetable or animal recrements, as iron, and perhaps manganese and calamy, all which are found near the surface of the earth; yet as the other metals are found only in fiffures of rocks, which penetrate to unknown depths, they may be wholly or in part produced by ascending steams from subterraneous fires, as mentioned in note on Canto II. 1. 394.

SEPTARIA OF IRON-STONE.

Over fome lime works at Walfall in Staffordshire, I observed fome years ago a stratum of iron earth about fix inches thick, full of very large cavities; these cavities were evidently produced when the material paffed from a femifluid flate into a folid one; as the frit of the potters, or a mixture of clay and water is liable to crack in drying; which is owing to the further contraction of the internal part, after the cruft is become hard. These hollows are liable to receive extraneous matter, as I believe gypfum, and fometimes fpar, and even lead; a curious fpecimen of the last was prefented to me by Mr. Darby of Colebrook Dale, which contains in its cavity fome ounces of lead-ore. But there are other feptaria of iron-ftone which feem to have had a very different origin, their cavities having been formed in cooling or congealing from an ignited flate, as is ingenioufly deduced by Dr. Hutton from their internal ftructure. Edinb. Tranfact. Vol. I. p. 246. The volcanic origin of these curious septaria appears to me to be further evinced from their form and the places where they are found. They confift of oblate fpheroids and are found in many parts of the earth totally detached from the beds in which they lie, as at East Lothian in Scotland. Two of these, which now lie before me, were found with many others immerfed in argillaceous fhale or fhiver, furrounded by broken limeftone mountains at Bradbourn near Afhbourn in Derbyshire, and were prefented to me by Mr. Buxton, a gentleman of that town. One of thefe is about fifteen inches in its equatorial diameter, and about fix inches in its polar one, and contains beautiful ftarlike feptaria incrufted and in part filled with calcareous fpar. The other is about eight inches in its equatorial diameter, and about four inches in its polar diameter, and is quite folid, but fhews on its internal furface marks of different colours, as if a beginning feparation had taken place. Now as thefe feptaria contain fifty per cent. of iron, according to Dr. Hutton, they would foften or melt into a femifluid globule by fubterraneous fire by lefs heat than the limeftone in their vicinity; and if they were ejected through a hole or fiffure would gain a circular motion along with their progreffive one by their greater friction or adhefion to one fide of the hole. This whirling motion would produce the oblate fpheroidical form which they poffefs, and which as far as I know can not in any other way be accounted for. They would then harden in the air as they rofe into the colder parts of the atmosphere; and as they defcended into fo fort a material as fhale or fhiver, their forms would not be injured in their fall; and their prefence in materials fo different from themfelves becomes accounted for.

About the tropics of the large feptarium above mentioned, are circular eminent lines, fuch as might have been left if it had been coarfely turned in a lathe. These lines feemto confift of a fluid matter, which feems to have exfuded in circular zones, as their edges appear blunted or retracted; and the feptarium feems to have fplit eafier in fuch fections. parallel to its equator. Now as the cruft would first begin to cool and harden after its ejection in a femifluid state, and the equatorial diameter would become gradually enlarged as it role in the air; the internal parts being fofter would flide beneath the polar cruft, which might crack and permit part of the femifluid to exfude, and it is probable the adhefion would thus become lefs in fections parallel to the equator. Which further confirms this idea of the production of these curious septaria. A new-cast cannon ball red-hot with its cruft only folid, if it were fhot into the air would propably burft in its paffage; as it would confift of a more fluid material than these feptaria; and thus by difcharging a flower of liquid iron would produce more dreadful combustion, if ufed in war, than could be effected by a ball, which had been cooled and was heated again : fince in the latter cafe the ball could not have its internal parts made hotter than the cruft of it, without firft loofing its form.

NOTE XIX.-FLINT.

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Transmute to glittering flints ber chalky lands, Or sink on Ocean's bed in countles sands.

CANTO II. 1. 217.

1. SILICEOUS ROCKS.

THE great maffes of filiceous fand which lie in rocks upon the beds of limeftone, or which are ftratified with clay, coal, and iron-ore, are evidently produced in the decompolition of vegetable or animal matters, as explained in the note on moraffes. Hence the imprefions of vegetable roots and even whole trees are often found in fand-ftone, as well as in coals and iron-ore. In these fand-rocks both the filiceous acid and the calcareous base feem to be produced from the materials of the morafs; for though the prefence of a filiceous acid and of a calcareous base have not yet been sparately exhibited from flints, yet from the analogy of flint to fluor, and gypfum, and marble, and from the conversion of the latter into flint, there can be little doubt of their existence.

Thefe filiceous fand-rocks are either held together by a filiceous cement, or have a greater or lefs portion of clay in them, which in fome acts as a cement to the filiceous cryftals, but in others is in fuch great abundance that in burning them they become an imperfect porcelain and are then ufed to repair the roads, as at Chefterfield in Derbyfhire; thefe are called argillaceous grit by Mr. Kirwan. In other places a calcareous matter cements the cryftals together; and in other places the filiceous cryftals lie in loofe ftrata under the marl in the form of white fand; as at Normington about a mile from Derby.

The loweft beds of filiceous fand-ftone produced from moraffes feem to obtain their acid from the morafs, and their calcareous bafe from the limeftone on which it refts. Thefe beds poffels a filiceous cement, and from their greater purity and hardnefs are ufed for courfe grinding-ftones and fcyth ftones, and are fituated on the edges of limeftone countries, having loft the other ftrata of coals, or clay, or iron, which were originally produced above them. Such are the fand-rocks incumbent on limeftone near Matlock in Derbyfhire. As thefe filiceous fand-rocks contain no marine productions fcattered amongft them, they appear to have been elevated, torn to pieces, and many fragments of them fcattered over the adjacent country by explosions, from fires within the morafs from which they have been formed; and which diffipated every thing inflammable above and beneath them, except fome ftains of iron, with which they are in fome places fpotted. If thefe fand-rocks had been accumulated beneath the fea, and elevated along with the beds of limeftone on which they reft, fome veftiges of marine fhells either in their filiceous or calcareous ftate muft have been difcerned amongft them.

2. SILICEOUS TREES.

In many of thefe fand-rocks are found the imprefions of vegetable roots, which feem to have been the moft unchangeable parts of the plant, as fhells and fhark's teeth are found in chalk-beds from their being the moft unchangeable parts of the animal. In other inftances the wood itfelf is penetrated, and whole trees converted into flint; fpecimens of which I have by me, from near Coventry, and from a gravel-pit in Shropfhire near Child's Archal in the road to Drayton. Other polifhed fpecimens of vegetable flints abound in the cabinets of the curious, which evidently fhew the concentric circles of woody fibres, and their interflices filled with whiter filiceous matter, with the branching off of the knots when cut horizontally, and the parallel lines of wood when cut longitudinally, with uncommon beauty and variety. Of thefe I poffefs fome beautiful fpecimens, which were prefented to me by the Earl of Uxbridge.

The colours of these filiceous vegetables are generally brown, from the iron, I suppose, or manganefe, which induced them to cryftallize or to fufe more eafily. Some of the cracks of the wood in drying are filled with white flint or calcedony, and others of them remain hollow, lined with innumerable fmall cryftals tinged with iron, which I fuppofe had a fhare in converting their calcareous matter into filiceous cryftals, becaufe the cryftals called Peak-diamonds are always found bedded in an ochreous earth; and those called Briftol-ftones are fituated on limeftone coloured with iron. Mr. F. French prefented me with a congeries of filiceous cryftals, which he gathered on the crater (as he fuppofes) of an extinguished volcano at Cromach Water in Cumberland. The crystals are about an inch high in the fhape of dogtooth or calcareous fpar, covered with a dark ferruginous matter. The bed on which they reft is about an inch in thickness, and is flained with iron on its underfurface. This curious foffil fhews the transmutation of calcareous earth into filiceous, as much as the filiceous fhells which abound in the cabinets of the curious. There may fometime be difcovered in this age of fcience, a method of thus impregnating wood with liquid flint, which would produce pillars for the fupport, and tiles for the covering of houses, which would be uninflammable and endure as long as the earth beneath them.

That fome filiceous productions have been in a fluid flate without much heat at the time of their formation appears from the vegetable flints above defcribed not having quite loft their organized appearance; from fhells, and coralloids, and entrochi being converted into flint without loofing their form; from the bafon of calcedony round Giefar in Iceland; and from the experiment of Mr. Bergman, who obtained thirteen regular formed cryftals by fuffering the powder of quartz to remain in a veffel with fluor acid for two years; these cryftals were about the fize of fmall peas, and were not fo hard as quartz. Opusc. de Terrâ Siliceâ, p. 33. Mr. Achard procured both calcareous and filiceous cryftals, one from calcareous earth, and the other from the earth of alum, both diffolved in water impregnated with fixed air; the water filtrating very flowly through a porous bottom of baked clay. See Journal de Phyfique, for January, 1778.

3. AGATES, ONYXES, SCOTS-PEBBLES.

In fmall cavities of thefe fand-rocks, I am informed, the beautiful filiceous nodules are found which are called Scot's-pebbles; and which on being cut in different directions take the names of agates, onyxes, fardonyxes, &c. according to the colours of the lines or firata which they exhibit. Some of the nodules are hollow and filled with cryftals, others have a nucleus of lefs compact filiceous matter which is generally white, furrounded with many concentric firata coloured with iron, and other alternate firata of white agate or calcedony, fometimes to the number of thirty.

I think these nodules bear evident marks of their having been in perfect fusion by either heat alone, or by water and heat, under great preffure, according to the ingenious theory of Dr. Hutton; but I do not imagine, that they were injected into cavities from materials from without, but that fome vegetables or parts of vegetables containing more iron or manganese than others, facilitated the compleat fusion, thus destroying the vestiges of vegetable organization, which were confpicuous in the filiceous trees above mentioned. Some of these nodules being hollow and lined with crystals, and others containing a nucleus of white filiceous matter of a loofer texture, shew they were composed of the materials then existing in the cavity; which confisting before of loofe fand, must take up less space when fused into a folid mass.

These filiceous nodules refemble the nodules of iron-flone mentioned in note on Canto II. 1. 179, in respect to their posseful a great number of concentric spheres coloured generally with iron, but they differ in this circumstance, that the concentric spheres generally obey the form of the external crust, and in their not posseful a chalybeate nucleus. The states formed on the roofs of caverns are often coloured in concentric strata, by their coats being spread over each other at different times; and some of them, as the cupreous ones, posses great beauty from this formation; but as these are necessarily more or less of a cylindrical or conic form, the nodules or globular flints above described cannot have been constructed in this manner. To what law of nature then is to be referred the production of such numerous concentric spheres? I sufficient to the law of congelation.

When falt and water are expoled to fevere frofty air, the falt is faid to be precipitated as the water freezes; that is, as the heat, in which it was diffolved, is withdrawn; where the experiment is tried in a bowl or bafon, this may be true, as the furface freezes firft, and the falt is found at the bottom. But in a fluid exposed in a thin phial, I found by experiment, that the extraneous matter previously diffolved by the heat in the mixture was not fimply fet at liberty to fubfide, but was detruded or pushed backward as the ice was produced. The experiment was this: about two ounces of a folution of blue vitriol were accidentally frozen in a thin phial, the glass was cracked and fallen to pieces, the ice was diffolved, and I found a pillar of blue vitriol ftanding erect on the bottom of the broken bottle. Nor is this power of congelation more extraordinary, than that by its powerful and fudden expansion it fhould burft iron fhells and coehorns, or throw

out the plugs with which the water was fecured in them above one hundred and thirty yards, according to the experiments at Quebec by Major Williams. Edinb. Tranfact. Vol. II. p. 23.

In fome filiceous nodules which now lie before me, the external cruft for about the tenth of an inch confifts of white agate, in others it is much thinner, and in fome much thicker; corresponding with this cruft there are from twenty to thirty superincumbent firata, of alternately darker and lighter colour; whence it appears, that the external cruft as it cooled or froze, propelled from it the iron or manganese which was diffolved in it; this receded till it had formed an arch or vault firong enough to refift its further protrusion; then the next inner sphere or firatum as it cooled or froze, propelled forwards its colouring matter in the fame manner, till another arch or sphere produced fufficient refiftance to this frigorific expulsion. Some of them have detruded their colouring matter quite to the centre, the rings continuing to become darker as they are nearer it; in others the chalybeate arch seems to have flopped half an inch from the centre, and become thicker by having attracted to itself the irony matter from the white nucleus, owing probably to its cooling less precipitately in the central parts than at the furface of the pebble.

A fimilar detrution of a marly matter in circular arches or vaults obtains in the falt mines in Chefhire; from whence Dr. Hutton very ingenioufly concludes, that the falt must have been liquified by heat; which would feem to be be much confirmed by the above theory. Edinb. Transact. Vol. I. p. 244.

I cannot conclude this account of Scots-pebbles without obferving that fome of them on being fawed longitudinally afunder, feem ftill to poffefs fome veftiges of the cylindrical organization of vegetables; others poffefs a nucleus of white agate much refembling fome bulbous roots with their concentric coats, or the knots in elm-roots or crab-trees; fome of thefe I fuppofe were formed in the manner above explained, during the congelation of maffes of melted flint and iron; others may have been formed from a vegetable nucleus, and retain fome veftiges of the organization of the plant.

4. SAND OF THE SEA.

The great abundance of filiceous fand at the bottom of the ocean may in part be wafhed down from the filiceous rocks above defcribed, but in general I fuppofe it derives its acid only from the vegetable and animal matter of morafles, which is carried down by floods or by the atmosphere, and becomes united in the fea with its calcareous bafe from fhells and coralloids, and thus affumes its cryftalline form at the bottom of the ocean, and is there intermixed with gravel or other matters wafhed from the mountains in its vicinity.

5. CHERT, OR PETROSILEX.

The rocks of marble are often alternately intermixed with ftrata of chert, or coarfe flint, and this in beds from one to three feet thick, as at Ilam and Matlock, or of lefs than the tenth of an inch in thicknefs, as a mile or two from Bakewell in the road to

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NOTE XIX.

Buxton. It is difficult to conceive in what manner ten or twenty ftrata of either limeftone or flint, of different fhades of white and black, could be laid quite regularly over each other from fediments or precipitations from the fea; it appears to me much eafier to comprehend, by fuppofing with Dr. Hutton, that both the folid rocks of marble and the flint had been fufed by great heat, (or by heat and water,) under immenfe preffure; by its cooling or congelating the colouring matter might be detruded, and form parallel or curvilinean ftrata, as above explained.

The colouring matter both of limeftone and flint was probably owing to the flefh of peculiar animals, as well as the filiceous acid, which converted fome of the limeftone into flint; or to fome ftrata of fhell-fifh having been overwhelmed when alive with new materials, while others dying in their natural fituations would lofe their flefhy parts, either by its putrid folution in the water or by its being eaten by other fea-infects. I have fome calcareous foffil thells which contain a black coaly matter in them, which was evidently the body of the animal, and others of the fame kind filled with fpar inftead of it. The Labradore ftone has I fuppofe its colours from the nacre or mother-pearl fhells, from which it was probably produced. And there is a ftratum of calcareous matter about fix or eight inches thick at Wingerworth in Derbyshire over the iron-beds, which is replete with fhells of frefh-water mufcles, and evidently obtains its dark colour from them, as mentioned in note XVI. Many nodules of flint refemble in colour as well as in form the fhell of the echinus or fea-urchin; others refemble fome coralloids both in form and colour; and M. Arduini found in the Monte de Pancrafio, red flints branching like corals, from whence they feem to have obtained both their form and their colour. Ferber's Travels in Italy, p. 42.

6. NODULES OF FLINT IN CHALK-BEDS.

As the nodules of flint found in chalk-beds poffefs no marks of having been rounded by attrition or folution, I conclude that they have gained their form as well as their dark colour from the flefh of the fhell-fifh from which they had their origin; but which have been fo compleatly fufed by heat, or heat and water, as to obliterate all veftiges of the fhell, in the fame manner as the nodules of agate and onyx were produced from parts of vegetables, but which had been fo completely fufed as to obliterate all marks of their organization, or as many iron-nodules have obtained their form and origin from peculiar vegetables.

Some nodules in chalk-beds confift of fhells of echini filled up with chalk, the animal having been diffolved away by putrefcence in water, or eaten by other fea-infects; other fhells of echini, in which I fuppofe the animal's body remained, are converted into flint but ftill retain the form of the fhell. Others, I fuppofe as above, being more completely fufed, have become flint coloured by the animal flefh, but without the exact form either of the flefh or fhell of the animal. Many of thefe are hollow within and lined with cryftals, like the Scot's-pebbles above defcribed; but as the colouring matter of animal

bodies differs but little from each other compared with those of vegetables, these flints vary less in their colours than those above mentioned. At the fame time as they cooled in concentric spheres like the Scot's-pebbles, they often possibles faint rings of colours, and always break in concholoid forms like them.

This idea of the production of nodules of flint in chalk-beds is countenanced from the iron which generally appears as thefe flints become decomposed by the air; which by uniting with the iron in their composition reduces it from a vitrefcent flate to that of calx, and thus renders it visible. And fecondly, by there being no appearance in chalkbeds of a ftring or pipe of filiceous matter connecting one nodule with another, which must have happened if the filiceous matter, or its acid, had been injected from without according to the idea of Dr. Hutton. And thirdly, because many of them have very large cavities at their centres, which should not have happened had they been formed by the injection of a material from without.

When fhells or chalk are thus converted from calcareous to filiceous matter by the flefh of the animal, the new flint being heavier than the fhell or chalk occupies lefs fpace than the materials it was produced from; this is the caufe of frequent cavities within them, where the whole mafs has not been completely fufed and preffed together. In Derbyfhire there are maffes of coralloid and other fhells which have become filiceous, and are thus left with large vacuities fometimes within and fometimes on the outfide of the remaining form of the fhell, like the French millftones, and I fuppofe might ferve the fame purpofe; the gravel of the Derwent is full of fpecimens of this kind.

Since writing the above I have received a very ingenious account of chalk-beds from Dr. MENISH of Chelmsford. He diftinguishes chalk-beds into three kinds; fuch as have been raifed from the fea with little diffurbance of their ftrata, as the cliffs of Dover and Margate, which he terms intire chalk. Another flate of chalk is where it has fuffered much derangement, as the banks of the Thames at Gravefend and Dartford. And a third flate where fragments of chalk have been rounded by water, which he terms alluvial chalk. In the first of these fituations of chalk he observes, that the flint lies in ftrata horizontally, generally in diffinct nodules, but that he has obferved two inftances of folid plates or ftrata of flint, from an inch to two inches in thicknefs, interpofed between the chalk-beds; one of thefe is in a chalk-bank by the road fide at Berkhamftead, the other in a bank on the road from Chatham leading to Canterbury. Dr. Menifh has further observed, that many of the echini are crushed in their form, and yet filled with flint, which has taken the form of the crushed shell, and that though many flint nodules are hollow, yet that in fome echini the filiceum feems to have enlarged, as it paffed from a fluid to a folid flate, as it fwells out in a protuberance at the mouth and anus of the shell, and that though these shells are so filled with flint yet that in many places the shell itfelf remains calcareous. These strata of nodules and plates of flint feem to countenance their origin from the flefh of a ftratum of animals which perifhed by fome natural violence, and were buried in their fhells.

7. ANGLES OF SILICEOUS SAND.

In many rocks of filiceous fand the particles retain their angular form, and in fome beds of loofe fand, of which there is one of confiderable purity a few yards beneath the marl at Normington about a mile fouth of Derby. Other filiceous fands have had their angles rounded off, like the pebbles in gravel-beds. Thefe feem to owe their globular form to two caufes; one to their attrition againft each other, when they may for centuries have lain at the bottom of the fea, or of rivers; where they may have been progreffively accumulated, and thus progreffively at the fame time rubbed upon each other by the dafhing of the water, and where they would be more eafily rolled over each other by their gravity being fo much lefs than in air. This is evidently now going on in the river Derwent, for though there are no limeftone rocks for ten or fifteen miles above Derby, yet a great part of the river-gravel at Derby confifts of limeftone nodules, whofe angles are quite worn off in their defcent down the ftream.

There is however another caufe which muft have contributed to round the angles both of calcareous and filiceous fragments; and that is, their folubility in water; calcareous earth is perpetually found fufpended in the waters which pafs over it; and the earth of flints was obferved by Bergman to be contained in water in the proportion of one grain to a gallon. Kirwan's Mineralogy, p. 107. In boiling water, however, it is foluble in much greater proportion, as appears from the filiceous earth fublimed in the diftillation of fluor acid in glafs veffels; and from the bafons of calcedony which furrounded the jets of hot water near mount Heccla in Iceland. Troil on Iceland. It is probable moft filiceous fands or pebbles have at fome ages of the world been long expofed to aqueous fteams raifed by fubterranean fires. And if fragments of ftone were long immerfed in a fluid menftrum, their angular parts would be firft diffolved, on account of their greater furface.

Many beds of filiceous gravel are cemented together by a filiceous cement, and are called breccia; as the plumb-pudding ftones of Hartfordshire, and the walls of a fubterraneous temple excavated by Mr. Curzon, at Hagley near Rugely in Staffordshire; these may have been exposed to great heat as they were immersed in water; which water under great preffure of fuperincumbent materials may have been rendered red-hot, as in Papin's digefter; and have thus possessed powers of folution with which we are unacquainted.

8. BASALTES AND GRANITES.

Another fourfe of filiceous ftones is from the granite, or bafaltes, or porphyries, which are of different hardneffes according to the materials of their composition, or to the fire they have undergone; fuch are the ftones of Arthur's-hill near Edinburgh, of the Giant's Caufway in Ireland, and of Charnwood Foreft in Leicefterfhire; the uppermoft ftratum of which laft feems to have been cracked either by its elevation, or by its haftily cooling after ignition by the contact of dews or fnows, and thus breaks into angular fragments, fuch as the ftreets of London are paved with; or have had their angles rounded by attrition or by partial folution; and have thus formed the common paving ftones or bowlers; as well as the gravel, which is often rolled into ftrata amid the filiceous fandbeds, which are either formed or collected in the fea.

In what manner fuch a mais of crystallized matter as the Giant's Caufway and fimilar columns of bafaltes, could have been raifed without other volcanic appearances, may be a matter not eafy to comprehend; but there is another power in nature befides that of expansile vapour which may have raifed fome materials which have previously been in igneous or aqueous folution; and that is the act of congelation. When the water in the experiments above related of Major Williams had by congelation thrown out the plugs from the bomb-fhells, a column of ice role from the hole of the bomb fix or eight inches high. Other bodies I fufpect increafe in bulk which cryftallize in cooling, as iron and type-metal. I remember pouring eight or ten pounds of melted brimítone into a pot to cool and was furprized to fee after a little time a part of the fluid beneath break a hole in the congealed cruft above it, and gradually rife into a promontory feveral inches high; the bafaltes has many marks of fusion and of crystallization and may thence, as well as many other kinds of rocks, as of fpar, marble, petrofilex, jafper, &c. have been raifed by the power of congelation, a power whole quantity has not yet been afcertained, and perhaps greater and more univerfal than that of vapours expanded by heat. These basaltic columns rife fometimes out of mountains of granite itself, as mentioned by Dr. Beddoes, (Phil. Tranfact. Vol. LXXX.) and as they feem to confift of fimilar materials more completely fufed, there is ftill greater reafon to believe them to have been elevated in the cooling or cryftallization of the mais. See note XXIV.

NOTE XX.-CLAY.

Whence dustile Clays in wide expansion spread, Soft as the Cygnet's down, their snow-white bed. CANTO II. 1. 276.

THE philosophers, who have attended to the formation of the earth, have acknowledged two great agents in producing the various changes which the terraqueous globe has undergone, and these are water and fire. Some of them have perhaps ascribed too much to one of these great agents of nature, and some to the other. They have generally agreed that the stratification of materials could only be produced from sediments or precipitations, which were previously mixed or dissolved in the sea; and that whatever effects were produced by fire were performed afterwards.

There is however great difficulty in accounting for the univerfal fratification of the folid globe of the earth in this manner, fince many of the materials, which appear in ftrata, could not have been fufpended in water; as the nodules of flint in chalk-beds, the extensive beds of fhells, and laftly the ftrata of coal, clay, fand, and iron-ore, which in most coal-countries lie from five to feven times alternately ftratified over each other, and none of them are foluble in water. Add to this if a folution of them or a mixture of them in water could be fuppofed, the caufe of that folution must ceafe before a precipitation could commence.

1. The great maffes of lava, under the various names of granite, porphyry, toadftone, moor-ftone, rag, and flate, which conftitute the old word, may have acquired the ftratification, which fome of them appear to poffefs, by their having been formed by fucceffive eruptions of a fluid mafs, which at different periods of antient time arofe from volcanic fhafts and covered each other, the furface of the interior mafs of lava would cool and become folid before the fuperincumbent ftratum was poured over it; to the fame caufe may be afcribed their different compositions and textures, which are fcarcely the fame in any two parts of the world.

2. The ftratifications of the great maffes of limeftone, which were produced from fea-fhells, feem to have been formed by the different times at which the innumerable fhells were produced and deposited. A colony of echini, or madrepores, or cornua ammonis, lived and perished in one period of time; in another a new colony of either fimilar or different shells lived and died over the former ones, producing a stratum of more recent shell over a stratum of others which had began to petrify or to become marble; and thus from unknown depths to what are now the summits of mountains the limestone is disposed in stratum of varying folidity and colour. These have afterwards undergone variety of changes by their folution and deposition from the water in which they were immersed, or from having been exposed to great heat under great prefiure, according to the ingenious theory of Dr. Hutton. Edinb. Transact. Vol. I. See Note XVI.

3. In most of the coal-countries of this island there are from five to feven beds of coal ftratified with an equal number of beds, though of much greater thickness, of clay and fandstone, and occasionally of iron-ores. In what manner to account for the ftratification of these materials feems to be a problem of greater difficulty. Philosophers have generally supposed that they have been arranged by the currents of the fea; but confidering their infolubility in water, and their almost fimilar specific gravity, an accumulation of them in such distinct beds from this cause is altogether inconceiveable, though fome coal-countries bear marks of having been at fome time immersed beneath the waves and raised again by subterranean fires.

The higher and lower parts of moraffes were neceffarily produced at different periods of time, fee Note XVII. and would thus originally be formed in ftrata of different ages. For when an old wood perifhed, and produced a morafs, many centuries would elapfe before another wood could grow and perifh again upon the fame ground, which would thus produce a new ftratum of morafs over the other, differing indeed principally in its age, and perhaps, as the timber might be different, in the proportions of its component parts.

Now if we fuppofe the lowermoft ftratum of a morafs become ignited, like fermenting hay, (after whatever could be carried away by folution in water was gone,) what would happen? Certainly the inflammable part, the oil, fulphur, or bitumen, would burn away, and be evaporated in air; and the fixed parts would be left, as clay, lime, and iron; while fome of the calcareous earth would join with the filiceous acid, and produce fand, or with the argillaceous earth, and produce marl. Thence after many centuries another bed would take fire, but with lefs degree of ignition, and with a greater body of morafs over it, what then would happen? The bitumen and fulphur would rife and might become condenfed under an impervious ftratum, which might not be ignited, and there form coal of different purities according to its degree of fluidity, which would permit fome of the clay to fubfide through it into the place from which it was fublimed.

Some centuries afterwards another fimilar process might take place, and either thicken the coal-bed, or produce a new clay-bed, or marl, or fand, or deposit iron upon it, according to the concomitant circumstances above mentioned.

I do not mean to contend that a few maffes of fome materials may not have been rolled together by currents, when the mountains were much more elevated than at prefent, and in confequence the rivers broader and more rapid, and the forms of rain and wind greater both in quantity and force. Some gravel-beds may have been thus wafhed from the mountains; and fome white clay wafhed from moraffes into valleys beneath them; and fome ochres of iron diffolved and again deposited by water; and fome calcareous depositions from water, (as the bank for inftance on which ftand the houses at Matlock-bath;) but these are of small extent or confequence compared to the primitive rocks of granite or porpyhry which form the nucleus of the earth, or to the immense ftrata of limestone which cruft over the greatest part of this granite or porphyry; or laftly to the very extensive beds of clay, marl, fandstone, coal, and iron,

NOTE XXI.

which were probably for many millions of years the only parts of our continents and iflands, which were then elevated above the level of the fea, and which on that account became covered with vegetation, and thence acquired their later or fuperincumbent ftrata, which conflitute, what fome have termed, the new world.

There is another fource of clay, and that of the fineft kind, from decomposed granite, this is of a fnowy white and mixed with fhining particles of mica, of this kind is an earth from the country of Cherokees. Other kinds are from lefs pure lavas; Mr. Ferber afferts that the fulphurous fteams from Mount Vefuvius convert the lava into clay.

"The lavas of the antient Solfatara volcano have been undoubtedly of a vitreous nature, and thefe appear at prefent argillaceous. Some fragments of this lava are but half or at one fide changed into clay, which either is vifcid or ductile, or hard and ftoney. Clays by fire are deprived of their coherent quality, which cannot be reftored to them by pulverization, nor by humectation. But the fulphureous Solfatara fteams reftore it, as may be eafily obferved on the broken pots wherein they gather the fal ammoniac; though very well baked and burnt at Naples they are mollified again by the acid fteams into a vifcid clay which keeps the former fire-burnt colour." Travels in Italy, p. 156.

NOTE XXI.—ENAMELS.

Smear'd ber buge dragons with metallic bues, With golden purples, and cobaltic blues; CANTO II. 1. 287.

THE fine bright purples or rofe colours which we fee on china cups are not producible with any other material except gold, manganese indeed gives a purple but of a very different kind.

In Europe the application of gold to thefe purpofes appears to be of modern invention. Caffius's difcovery of the precipitate of gold by tin, and the ufe of that precipitate for colouring glafs and enamels, are now generally known, but though the precipitate with tin be more fuccefsful in producing the ruby glafs, or the colourlefs glafs which becomes red by fubfequent ignition, the tin probably contributing to prevent the gold from feparating, (which it is very liable to do during the fufion; yet, for enamels, the precipitates made by alcaline falts anfwer equally well, and give a finer red, the colour produced by the tin precipitate being a bluifh purple, but with the others a rofe red. I am informed that fome of our beft artifts prefer aurum fulminans, mixing it, before it has become dry, with the white composition or enamel flux; when once it is divided by the other matter, it is ground with great fafety, and without the leaft danger of explosion, whether moift or dry. The colour is remarkably improved and brought forth by long grinding, which accordingly makes an effential circumfance in the process.

ENAMELS.

The precipitates of gold, and the colcothar or other red preparations of iron, are called *tender* colours. The heat must be no greater than is just fufficient to make the enamel run upon the piece, for if greater, the colours will be deftroyed or changed to a different kind. When the vitreous matter has just become fluid it feems as if the coloured metallic calx remained barely *intermixed* with it, like a coloured powder of exquisite tenuity fuspended in water: but by ftronger fire the calx is *diffelved*, and metallic colours are altered by *folution* in glafs as well as in acids or alcalies.

The Saxon mines have till very lately almost exclusively supplied the rest of Europe with cobalt, or rather with its preparations, zaffre and smalt, for the exportation of the ore itself is there a capital crime. Hungary, Spain, Sweden, and some other parts of the continent, are now faid to afford cobalts equal to the Saxon, and specimens have been discovered in our own island, both in Cornwall and in Scotland; but hitherto in no great quantity.

Calces of cobalt and of copper differ very materially from those above mentioned in their application for colouring enamels. In those the calx has previously acquired the intended colour, a colour which bears a red heat without injury, and all that remains is to fix it on the piece by a vitreous flux. But the blue colour of cobalt, and the green or bluish green of copper, are *produced* by vitrification, that is, by *folution* in the glass, and a ftrong fire is neceffary for their perfection. These calces therefore, when mixed with the enamel flux, are melted in crucibles, once or oftener, and the deep coloured opake glass, thence refulting, is ground into unpalpable powder, and used for enamel. One part of either of these calces is put to ten, fixteen, or twenty parts of the flux, according to the depth of colour required. The heat of the enamel kiln is only a full red, fuch as is marked on Mr. Wedgwood's thermometer 6 degrees. It is therefore neceffary that the flux be fo adjusted as to melt in that low heat. The usual materials are flint, or flint-glass, with a due proportion of red-led, or borax, or both, and fometimes a little tin calx to give opacity.

Ka-o-lin is the name given by the Chinefe to their porcelain clay, and pe-tun-tfe to the other ingredient in their China ware. Specimens of both thefe have been brought into England, and found to agree in quality with fome of our own materials. Kaolin is the and the petuntfe is a granite fimilar very fame with the clay called in Cornwall to the Cornish moorstone. There are differences, both in the Chinese petunties, and the English moorstones; all of them contain micaceous and quartzy particles, in greater or lefs quantity, along with feltfpat, which laft is the effential ingredient for the porcelain manufactory. The only injurious material commonly found in them is iron, which difcolours the ware in proportion to its quantity, and which our moorftones are perhaps more frequently tainted with than the Chinefe. Very fine porcelain has been made from English materials but the nature of the manufacture renders the process precarious and the profit hazardous; for the femivitrification, which conftitutes porcelain, is neceffarily accompanied with a degree of foftnefs, or femifufion, fo that the veffels are liable to have their forms altered in the kiln, or to run together with any accidental augmentations of the fire.




NOTE XXII.---PORTLAND VASE.

Or bid Mortality rejoice or mourn O'er the fine forms of Portland's mystic urn. CANTO II. 1. 321.

THE celebrated funereal vafe, long in poffeffion of the Barberini family, and lately purchafed by the Duke of Portland for a thoufand guineas, is about ten inches high and fix in diameter in the broadeft part. The figures are of moft exquifite workmanfhip in bas relief of white opake glafs, raifed on a ground of deep blue glafs, which appears black except when held againft the light. Mr. Wedgwood is of opinion from many circumftances that the figures have been made by cutting away the external cruft of white opake glafs, in the manner the fineft cameo's have been produced, and that it muft thence have been the labour of a great many years. Some antiquarians have placed the time of its production many centuries before the chriftian æra; as fculpture was faid to have been declining in refpect to its excellence in the time of Alexander the Great. See an account of the Barberini or Portland vafe by M. D'Hancarville, and by Mr. Wedgwood.

Many opinions and conjectures have been published concerning the figures on this celebrated vale. Having carefully examined one of Mr. Wedgwood's beautiful copies of this wonderful production of art, I shall add one more conjecture to the number.

Mr. Wedgwood has well observed that it does not feem probable that the Portland vafe was purposely made for the afhes of any particular perfon deceased, because many years must have been necessary for its production. Hence it may be concluded, that the subject of its embellishments is not private history but of a general nature. This subject appears to me to be well chosen, and the flory to be finely told; and that it represents what in antient times engaged the attention of philosophers, poets, and heroes, I mean a part of the Eleusinian mysteries.

These mysteries were invented in Ægypt, and afterwards transferred to Greece, and flourished more particularly at Athens, which was at the same time the set of the sine arts. They confisted of scenical exhibitions representing and inculcating the expectation of a future life after death, and on this account were encouraged by the government, infomuch that the Athenian laws punished a discovery of their secrets with death. Dr. Warburton has with great learning and ingenuity shewn that the descent of Æneas into hell, described in the Sixth Book of Virgil, is a poetical account of the representations of the future state in the Eleusinian mysteries. Divine Legation, Vol. I. p. 210.

And though fome writers have differed in opinion from Dr. Warburton on this fubject, becaufe Virgil has introduced fome of his own heroes into the Elyfian fields, as Deiphobus, Palinurus, and Dido, in the fame manner as Homer had done before him, yet it is agreed that the received notions about a future flate were exhibited in thefe myfteries, and as thefe poets defcribed thofe received notions, they may be faid, as far as thefe religious doctrines were concerned, to have defcribed the myfteries. Now as thefe were emblematic exhibitions they muft have been as well adapted to the purpofes of fculpture as of poetry, which indeed does not feem to have been uncommon, fince one compartment of figures in the fheild of Æneas reprefented the regions of Tartarus. Æn. Lib. X. The proceffion of torches, which according to M. De St. Croix was exhibited in thefe myfteries, is ftill to be feen in baffo relievo, difcovered by Spon and Wheler. Memoires fur le Myfteres par De St. Croix. 1784. And it is very probable that the beautiful gem reprefenting the marriage of Cupid and Pfyche, as defcribed by Apuleus, was originally defcriptive of another part of the exhibitions in thefe myfteries, though afterwards it became a common fubject of antient art. See Divine Legat. Vol. I. p. 323. What fubject could have been imagined fo fublime for the ornaments of a funereal urn as the mortality of all things and their refufcitation? Where could the defigner be fupplied with emblems for this purpofe, before the Chriftian æra, but from the Eleufinian myfteries?

1. The exhibitions of the mysteries were of two kinds, those which the people were permitted to fee, and those which were only shewn to the initiated. Concerning the latter, Aristides calls them "the most shocking and most ravishing representations." And Stobœus afferts that the initiation into the grand mysteries exactly refembles death. Divine Legat. Vol. I. p. 280, and p. 272. And Virgil in his entrance to the shades below, amongst other things of terrible form, mentions death. Æn. VI. This part of the exhibition feems to be represented in one of the compartments of the Portland vafe.

Three figures of exquifite workmanship are placed by the fide of a ruined column whose capital is fallen off, and lies at their feet with other disjointed stones, they fit on loose piles of stone beneath a tree, which has not the leaves of any evergreen of this climate, but may be supposed to be an elm, which Virgil places near the entrance of the infernal regions, and adds, that a dream was believed to dwell under every leaf of it. Æn. VI. l. 281. In the midst of this group reclines a female figure in a dying attitude, in which extreme languor is beautifully represented, in her hand is an inverted torch, an antient emblem of extinguished life, the elbow of the fame arm refting on a stone supports her as sthe finks, while the other hand is raifed and thrown over her drooping head, in some measure sufficient is a man, and on the left a woman, both supporting themselves on their arms, as people are liable to do when they are thinking intensely. They have their backs towards the dying figure, yet with their faces turned towards her, as is feriously contemplating her situation, but without forething out their hands to affish her.

This central figure then appears to me to be an hieroglyphic or Eleufinian emblem of MORTAL LIFF, that is, the lethum, or death, mentioned by Virgil amongst the terrible things exhibited at the beginning of the mysteries. The inverted torch shews the figure to be emblematic, if it had been defigned to represent a real person in the act of dying there had been no necessfity for the expiring torch, as the dying figure alone would have been fufficiently intelligible;—it would have been as absurd as to have put an inverted torch into the hand of a real person at the time of his expiring. Besides if this









3. London, Published Dec 2 #270. by & Johnson S' Put is Church Tart.

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figure had reprefented a real dying perfon would not the other figures, or one of them at leaft, have firetched out a hand to fupport her, to have eafed her fall among loofe flones, or to have finoothed her pillow? These circumflances evince that the figure is an emblem, and therefore could not be a representation of the private history of any particular family or event.

The man and woman on each fide of the dying figure must be confidered as emblems, both from their fimilarity of fituation and drefs to the middle figure, and their being grouped along with it. These I think are hieroglyphic or Eleusinian emblems of HUMANKIND, with their backs toward the dying figure of MORTAL LIFF, unwilling to affociate with her, yet turning back their ferious and attentive countenances, curious indeed to behold, yet forry to contemplate their latter end. These figures bring strongly to one's mind the Adam and Eve of facred writ, whom fome have fuppofed to have been allegorical or hieroglyphic perfons of Ægyptian origin, but of more antient date, amongft whom I think is Dr. Warburton. According to this opinion Adam and Eye were the names of two hieroglyphic figures reprefenting the early flate of mankind; Abel was the name of an hieroglyphic figure reprefenting the age of pafturage, and Cain the name of another hieroglyphic fymbol reprefenting the age of agriculture, at which time the uses of iron were discovered. And as the people who cultivated the earth and built houfes would increafe in numbers much fafter by their greater production of food, they would readily conquer or deftroy the people who were fuftained by pafturage, which was typified by Cain flaying Abel.

2. On the other compartment of this celebrated vafe is exhibited an emblem of immortality, the reprefentation of which was well known to conftitute a very principal part of the fhews at the Eleufinian mysteries, as Dr. Warburton has proved by variety of authority. The habitation of fpirits or ghofts after death was fuppofed by the antients to be placed beneath the earth, where Pluto reigned, and difpenfed rewards or punifhments. Hence the first figure in this group is of the MANES or GHOST, who having paffed through an open portal is defcending into a dufky region, pointing his toe with timid and unfteady ftep, feeling as it were his way in the gloom. This portal Æneas enters, which is defcribed by Virgil,-patet atri janua ditis, Æn. VI. 1. 126; as well as the eafy defcent,-facilis defcenfus Averni. Ib. The darknefs at the entrance to the fhades is humoroufly defcribed by Lucian. Div. Legat. Vol. I. p. 241. And the horror of the gates of hell was in the time of Homer become a proverb ; Achilles fays to Ulyfies, "I hate a liar worfe than the gates of hell;" the fame expression is used in Ifaiah, ch. xxxviii. v. 10. The MANES or GHOST apppears lingering and fearful, and wifhes to drag after him a part of his mortal garment, which however adheres to the fide of the portal through which he has paffed. The beauty of this allegory would have been expressed by Mr. Pope, by "We feel the ruling passion strong in death."

A little lower down in the group the manes or ghoft is received by a beautiful female, a fymbol of IMMORTAL LIFE. This is evinced by her fondling between her knees a large and playful ferpent, which from its annually renewing its external fkin has from great antiquity, even as early as the fable of Prometheus, been effecemed an emblem of renovated youth. The flory of the ferpent acquiring immortal life from the afs of Prometheus, who carried it on his back, is told in Bacon's Works, Vol. V. p. 462. Quarto edit. Lond. 1778. For a fimilar purpofe a ferpent was wrapped round the large hieroglyphic egg in the temple of Diofcuri, as an emblem of the renewal of life from a flate of death. Bryant's Mythology, Vol II. p. 359. fec. edit. On this account alfo the ferpent was an attendant on Æfculapius, which feems to have been the name of the hieroglyphic figure of medicine. This ferpent flews this figure to be an emblem, as the torch flewed the central figure of the other compartment to be an emblem, hence they agreeably correfpond, and explain each other, one reprefenting MORTAL LIFE, and the other IMMORTAL LIFE.

This emblematic figure of immortal life fits down with her feet towards the figure of Pluto, but, turning back her face towards the timid ghoft, fhe ftretches forth her hand, and taking hold of his elbow, fupports his tottering fteps, as well as encourages him to advance, both which circumftances are thus with wonderful ingenuity brought to the eye. At the fame time the fpirit loofely lays his hand upon her arm, as one walking in the dark would naturally do for the greater certainty of following his conductrefs, while the general part of the fymbol of IMMORTAL LIFE, being turned toward the figure of Pluto, fhews that fhe is leading the phantom to his realms.

In the Pamphili gardens at Rome, Perfeus in affifting Andromeda to defcend from the rock takes hold of her elbow to fleady or fupport her ftep, and the lays her hand loofely on his arm as in this figure. Admir. Roman. Antiq.

The figure of PLUTO can not be miltaken, as is agreed by moft of the writers who have mentioned this vafe; his grifley beard, and his having one foot buried in the earth, denotes the infernal monarch. He is placed at the loweft part of the group, and refting his chin on his hand, and his arm upon his knee, receives the ftranger-fpirit with inquifitive attention; it was before obferved that when people think attentively they naturally reft their bodies in fome eafy attitude, that more animal power may be employed on the thinking faculty. In this group of figures there is great art fhewn in giving an idea of a defcending plain, viz. from earth to Elyfium, and yet all the figures are in reality on an horizontal one. This wonderful deception is produced firft by the defcending ftep of the manes or ghoft; fecondly, by the arm of the fitting figure of immortal life being raifed up to receive him as he defcends; and laftly, by Pluto having one foot funk into the earth.

There is yet another figure which is concerned in conducting the manes or ghoft to the realms of Pluto, and this is LOVE. He precedes the defcending fpirit on expanded wings, lights him with his torch, and turning back his beautiful countenance beckons him to advance. The antient God of love was of much higher dignity than the modern Cupid. He was the first that came out of the great egg of night, (Hefiod. Theog. V. CXX. Bryant's Mythol. Vol. II. p. 348.) and is faid to poffers the keys of the fky, fea, and earth. As he therefore led the way into this life, he feems to conftitute a proper emblem for leading the way to a future life. See Bacon's works. Vol. I. p. 568. and Vol. III. p. 582. Quarto edit.

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The introduction of love into this part of the mysteries requires a little further explanation. The Pfyche of the Ægyptians was one of their most favourite emblems, and reprefented the foul, or a future life; it was originally no other than the aurelia, or butterfly, but in after times was reprefented by a lovely female child with the beautiful wings of that infect. The aurelia, after its first stage as an eruca or caterpillar, lies for a feafon in a manner dead, and is inclofed in a fort of coffin, in this flate of darknefs it remains all the winter, but at the return of fpring it burfts its bonds and comes out with new life, and in the most beautiful attire. The Ægyptians thought this a very proper picture of the foul of man, and of the immortality to which it afpired. But as this was all owing to divine Love, of which EROS was an emblem, we find this perfon frequently introduced as a concomitant of the foul in general or Pfyche. (Bryant's Mythol. Vol. II. p. 386.) EROS, or divine Love, is for the fame reafon a proper attendant on the manes or foul after death, and much contributes to tell the ftory, that is, to fhew that a foul or manes is defigned by the defcending figure. From this figure of Love M. D'Hancarville imagines that Orpheus and Eurydice are typified under the figure of the manes and immortal life as above defcribed. It may be fufficient to anfwer, first, that Orpheus is always represented with a lyre, of which there are prints of four different gems in Spence's Polymetis, and Virgil fo defcribes him, Æn. VI. cytharå fretus. And fecondly, that it is abfurd to fuppofe that Eurydice was fondling and playing with a ferpent that had flain her. Add to this that Love feems to have been an inhabitant of the infernal regions, as exhibited in the mysteries, for Claudian, who treats more openly of the Eleufinian mysteries, when they were held in lefs veneration, invokes the deities to difclose to him their fecrets, and amongst other things by what torch Love foftens Pluto.

Dii, quibus in numerum, &c.

Vos mihi facrarum penetralia pandite rerum,

Et vestri fecreta poli, quà lampade Ditem

Flexit amor.

In this compartment there are two trees, whole branches fpread over the figures, one of them has fmoother leaves like fome evergreens, and might thence be fuppoled to have fome allufion to immortality, but they may perhaps have been defigned only as ornaments, or to relieve the figures, or becaufe it was in groves, where these mysteries were originally celebrated. Thus Homer speaks of the woods of Proferpine, and mentions many trees in Tartarus, as prefenting their fruits to Tantalus; Virgil speaks of the pleafant groves of Elysium; and in Spence's Polymetis there are prints of two antient gems, one of Orpheus charming Cerberus with his lyre, and the other of Hercules binding him in a cord, each of them standing by a tree. Polymet, p. 284. As however these trees have all different foliage to clearly marked by the artis, they may have had specific meanings in the exhibitions of the mysteries, which have not reached posterity, of this kind feem to have been the tree of knowledge of good and evil, and the tree of life, in facred writ, both which must have been emblematic or allegorical. The masks

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hanging to the handles of the vafe, feem to indicate that there is a concealed meaning in the figures befides their general appearance. And the prieftefs at the bottom, which I come now to defcribe, feems to fhew this concealed meaning to be of the facred or Eleufinian kind.

3. The figure on the bottom of the vafe is on a larger fcale than the others, and lefs finely finished, and less elevated, and as this bottom part was afterwards cemented to the upper part, it might be executed by another artift for the fake of expedition, but there feems no reafon to fuppofe that it was not originally defigned for the upper part of it as fome have conjectured. As the mysteries of Ceres were celebrated by female priest, for Porphyrius fays the antients called the priefteffes of Ceres, Melifiai, or bees, which were emblems of chaftity. Div. Leg. Vol. I. p. 235. And as, in his Satire against the fex, Juvenal fays, that few women are worthy to be priesteffes of Ceres. Sat. VI. the figure at the bottom of the vafe would feem to reprefent a PRIESTESS OF HIEROPHANT, whofe office it was to introduce the initiated, and point out to them, and explain the exhibitions in the mysteries, and to exclude the uninitiated, calling out to them, "Far, far retire, ye profane !" and to guard the fecrets of the temple. Thus the introductory hymn fung by the hierophant, according to Eufebius, begins, " I will declare a fecret to the initiated, but let the doors be fhut against the profane." Div. Leg. Vol. I. p. 177. The prieftefs or hierophant appears in this figure with a clofe hood, and dreffed in linen, which fits close about her; except a light cloak, which flutters in the wind. Wool, as taken from flaughtered animals, was effeemed profane by the priefts of Ægypt, who were always dreffed in linen. Apuleus, p. 64. Div. Leg. Vol. I. p. 318. Thus Eli made for Samuel a linen ephod. Samuel i. 3.

Secrecy was the foundation on which all mysteries refled, when publicly known they ceased to be mysteries; hence a discovery of them was not only punished with death by the Athenian law; but in other countries a disgrace attended the breach of a folemm oath. The prieftes in the figure before us has her finger pointing to her lips as an emblem of filence. There is a figure of Harpocrates, who was of Ægyptian origin, the fame as Orus, with the lotus on his head, and with his finger pointing to his lips not preffed upon them, in Bryant's Mythol. Vol. II. p. 398, and another female figure standing on a lotus, as if just risen from the Nile, with her finger in the fame attitude, these feem to have been representations or emblems of male and female priefts of the fecret mysteries. As these fort of emblems were frequently changed by artists for their more elegant exhibition, it is possible the foliage over the head of this figure may bear fome analogy to the lotus above mentioned.

This figure of fecrecy feems to be here placed, with great ingenuity, as a caution to the initiated, who might understand the meaning of the emblems round the vafe, not to divulge it. And this circumstance feems to account for there being no written explanation extant, and no tradition concerning these beautiful figures handed down to us along with them.

Another explanation of this figure at the bottom of the vafe would feem to confirm the idea that the baffo relievos round its fides are reprefentations of a part of the





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myfteries, I mean that it is the head of ATIS. Lucian fays that Atis was a young man of Phrygia, of uncommon beauty, that he dedicated a temple in Syria to Rhea, or Cybele, and firft taught her myfteries to the Lydians, Phrygians, and Samothracians, which myfteries he brought from India. He was afterwards made an eunuch by Rhea, and lived like a woman, and affumed a feminine habit, and in that garb went over the world teaching her ceremonies and myfteries. Dict. par M. Danet, art. Atis. As this figure is covered with clothes, while thofe on the fides of the vafe are naked, and has a Phrygian cap on the head, and as the form and features are fo foft, that it is difficult to fay whether it be a male or female figure, there is reafon to conclude, I. that it has reference to fome particular perfon of fome particular country; 2. that this perfon is Atis, the firft great hierophant, or teacher of myfteries, to whom M. De la Chauffe fays the figure itfelf bears a refemblance. Mufeo. Capitol. Tom. IV. p. 402.

In the Mufeum Etrufcum, Vol. I. plate 96, there is the head of Atis with feminine features, clothed with a Phrygian cap, and rifing from very broad foliage, placed on a kind of term fupported by the paw of a lion. Goreus in his explanation of the figure fays that it is placed on a lion's foot becaufe that animal was facred to Cybele, and that it rifes from very broad leaves becaufe after he became an eunuch he determined to dwell in the groves. Thus the foliage, as well as the cap and feminine features, confirm the idea of this figure at the bottom of the vafe reprefenting the head of Atis the firft great hierophant, and that the figures on the fides of the vafe are emblems from the antient myfteries.

I beg leave to add that it does not appear to have been uncommon amongft the antients to put allegorical figures on funeral vafes. In the Pamphili palace at Rome there is an elaborate reprefentation of Life and of Death, on an antient farcophagus. In the first Prometheus is reprefented making man, and Minerva is placing a butterfly, or the foul, upon his head. In the other compartment Love extinguishes his torch in the bosom of the dying figure, and is receiving the butterfly, or Pfyche, from him, with a great number of complicated emblematic figures grouped in very bad tafte. Admir, Roman. Antiq.

NOTE XXIII.-COAL.

Whence fable Coal bis maffy couch extends, And stars of gold the sparkling Pyrite blends. CANTO II. 1. 349.

TO elucidate the formation of coal-beds I shall here describe a fountain of fossil tar, or petroleum, discovered lately near Colebrook Dale in Shropshire, the particulars of which were fent me by Dr. Robert Darwin of Shrewsbury.

About a mile and a half below the celebrated iron-bridge, conftructed by the late Mr. DARBY near Colebrook Dale, on the eaft fide of the river Severn, as the workmen in October 1786 were making a fubterranean canal into the mountain, for the more eafy acquifition and conveyance of the coals which lie under it, they found an oozing of liquid bitumen, or petroleum; and as they proceeded further cut through fmall cavities of different fizes from which the bitumen iffued. From ten to fifteen barrels of this foffil tar, each barrel containing thirty-two gallons, were at first collected in a day, which has fince however gradually diminished in quantity, fo that at prefent the product is about feven barrels in fourteen days.

The mountain, into which this canal enters, confifts of filiceous fand, in which however a few marine productions, apparently in their recent flate, have been found, and are now in the poffeffion of Mr. WILLIAM REYNOLDS of Ketly Bank. About three hundred yards from the entrance into the mountain, and about twenty-eight yards below the furface of it, the tar is found oozing from the fand-rock above into the top and fides of the canal.

Beneath the level of this canal a fhaft has been funk through a grey argillaceous fubftance, called in this country clunch, which is faid to be a pretty certain indication of coal; beneath this lies a ftratum of coal, about two or three inches thick, of an inferior kind, yielding little flame in burning, and leaving much afhes; below this is a rock of a harder texture; and beneath this are found coals of an excellent quality; for the purpofe of procuring which with greater facility the canal, or horizontal aperture, is now making into the mountain. July, 1788.

Beneath these coals in some places is found falt water, in other parts of the adjacent country there are beds of iron-stone, which also contain some bitumen in a less fluid state, and which are about on a level with the new canal, into which the fossil tar oozes, as above described.

There are many interesting circumstances attending the fituation and accompaniments of this fountain of fosfil tar, tending to develop the manner of its production. I. As the canal passing into the mountain runs over the beds of coals, and under the refervoir of petroleum, it appears that a *natural distillation* of this fosfil in the bowels of the earth must have taken place at fome early period of the world, fimilar to the artificial distillation

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of coal, which has many years been carried on in this place on a fmaller fcale above ground. When this refervoir of petroleum was cut into, the flownefs of its exfudation into the canal was not only owing to its vifcidity, but to the preffure of the atmosphere, or to the neceffity there was that air fhould at the fame time infinuate itfelf into the fmall cavities from which the petroleum defcended. The existence of fuch a distillation at fome antient time is confirmed by the thin stratum of coal beneath the canal, (which covers the hard rock,) having been deprived of its fossil oil, fo as to burn without flame, and thus to have become a natural coak, or fossil charcoal, while the petroleum distilled from it is found in the cavities of the rock above it.

There are appearances in other places, which favour this idea of the natural diffillation of petroleum, thus at Matlock in Derbyshire a hard bitumen is found adhering to the spar in the clefts of the lime-rocks in the form of round drops about the fize of peas; which could perhaps only be deposited there in that form by sublimation.

2. The fecond deduction, which offers itfelf, is, that these beds of coal have been *exposed to a confiderable degree of heat*, fince the petroleum above could not be separated, as far as we know, by any other means, and that the good quality of the coals beneath the hard rock was owing to the impermeability of this rock to the bituminous vapour, and to its preffure being too great to permit its being removed by the elasticity of that vapour. Thus from the degree of heat, the degree of preffure, and the permeability of the fuperincumbent strata, many of the phenomena attending coal-beds receive an easy explanation, which much accords with the ingenious theory of the earth by Dr. Hutton. Tranf. of Edinb. Vol. I.

In fome coal works the fufion of the ftrata of coal has been fo flight, that there remains the appearance of ligneus fibres, and the impreffion of leaves, as at Bovey near Exeter, and even feeds of vegetables, of which I have had fpecimens from the collieries near Polefworth in Warwickfhire. In fome, where the heat was not very intenfe and the incumbent ftratum not permeable to vapour, the foffil oil has only rifen to the upper part of the coal-bed, and has rendered that much more inflammable than the lower parts of it, as in the collieries near Beaudefert, the feat of the EARL OF UXBRIDGE in Staffordshire, where the upper ftratum is a perfect cannel, or candle-coal, and the lower one of an inferior quality. Over the coal-beds near Sir H. HARPUR's houfe in Derbyfhire a thin lamina of afphaltum is found in fome places near the furface of the earth, which would feem to be from a diffillation of petroleum from the coals below, the more fluid part of which had in process of time exhaled, or been confolidated by its abforption of air. In other coal-works the upper part of the firatum is of a worfe kind than the lower one, as at Alfreton and Denbigh in Derbyshire, owing to the fupercumbent firatum having permitted the exhalation of a great part of the petroleum; whilft at Widdrington in Northumberland there is first a feam of coal about fix inches thick of no value, which lies under about four fathom of clay, beneath this is a white freeftone, then a hard flone, which the workmen there call a whin, then two fathoms of clay, then another white ftone, and under that a vein of coals three feet nine inches

thick, of a fimilar nature to the Newcaftle coal. Phil. Tranf. Abridg. Vol. VI. plate II. p. 192. The fimilitude between the circumftances of this colliery, and of the coal beneath the fountain of tar above defcribed, renders it highly probable that this upper thin feam of coal has fuffered a fimilar diftillation, and that the inflammable part of it had either been received into the clay above in the form of fulphur, which when burnt in the open air would produce alum; or had been diffipated for want of a receiver, where it could be condenfed. The former opinion is perhaps in this cafe more probable as in fome other coal-beds, of which I have procured accounts, the furface of the coal beneath clunch or clay is of an inferior quality, as at Weft Hallum in Nottinghamfhire. The clunch probably from hence acquires its inflammable part, which on calcination becomes vitriolic acid. I gathered pieces of clunch converted partially into alum at a colliery near Bilfton, where the ground was ftill on fire a few years ago.

The heat, which has thus pervaded the beds of morafs, feems to have been the effect of the fermentation of their vegetable materials; as new hay fometimes takes fire even in fuch very fmall maffes from the fugar it contains, and feems hence not to have been attended with any expulsion of lava, like the deeper craters of volcanos fituated in beds of granite.

3. The marine fhells found in the loofe fand-rock above this refervoir of petroleum, and the coal-beds beneath it, together with the exiftence of fea-falt beneath thefe coals, prove that thefe coal beds have been at the bottom of the fea, during fome remote period of time, and were afterwards raifed into their prefent fituation by fubterraneous expanfions of vapour. This doctrine is further fupported by the marks of violence, which fome coal-beds received at the time they were raifed out of the fea, as in the collienes at Mendip in Somerfetfhire. In thefe there are feven ftrata of coals, equitant upon each other, with beds of clay and ftone intervening; amongft which clay are found fhells and fern branches. In one part of this hill the ftrata are disjoined, and a quantity of heterogeneous fubftances fill up the chafm which disjoins them, on one fide of this chafm the feven ftrata of coal are feen correfponding in refpect to their reciprocal thicknefs and goodnefs with the feven ftrata on the other fide of the cavity, except that they have been elevated feveral yards higher. Phil. Tranf. No. 360. abridg. Vol. V. p. 237.

The cracks in the coal-bed near Ticknall in Derbyfhire, and in the fand-ftone rock over it, in both of which fpecimens of lead-ore and fpar are found, confirm this opinion of their having been forcibly raifed up by fubterraneous fires. Over the colliery at Brown-hills near Lichfield, there is a ftratum of gravel on the furface of the ground; which may be adduced as another proof to fhew that those coals had fome time been beneath the fea, or the bed of a river. Nevertheles, these arguments only apply to the collieries above mentioned, which are few compared with those which bear no marks of having been immerfed in the fea.

On the other hand the production of coals from moraffes, as defcribed in note XX. is evinced from the vegetable matters frequently found in them, and in the firata over them; as fern-leaves in nodules of iron-ore, and from the bog-fhells or frefh water

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mufcles fometimes found over them, of both which I have what I believe to be fpecimens; and is further proved from fome parts of thefe beds being only in part tranfformed to coal; and the other part ftill retaining not only the form, but fome of the properties of wood; fpecimens of which are not unfrequent in the cabinets of the curious, procured from Loch Neigh in Ireland, from Bovey near Exeter, and other places; and from a famous cavern called the Temple of the Devil, near the town of Altorf in Franconia, at the foot of a mountain covered with pine and favine, in which are found large coals refembling trees of ebony; which are fo far mineralized as to be heavy and compact; and fo to efflorefce with pyrites in fome parts as to crumble to pieces; yet from other parts white afhes are produced on calcination, from which *fixed alcali* is procured; which evinces their vegetable origin. (Dicf. Raifonné, art. Charbon.) To thefe may be added another argument from the oil which is diftilled from coals, and which is analogous to vegetable oil, and does not exift in any bodies truly mineral. Keir's Chemical Dictionary, art. Bitumen.

Whence it would appear, that though most collieries with their attendant ftrata of clay, fand-ftone, and iron, were formed on the places where the vegetables grew, from which they had their origin; yet that other collections of vegetable matter were washed down from eminences by currents of waters into the beds of rivers, or the neighbouring feas, and were there accumulated at different periods of time, and underwent a great degree of heat from their fermentation, in the fame manner as those beds of morafs which had continued on the plains where they were produced. And that by this fermentation many of them had been raifed from the ocean with fand and fea-fhells over them; and others from the beds of rivers with accumulations of gravel upon them.

4. For the purpose of bringing this history of the products of morafles more diffinctly to the eye of the reader, I shall here subjoin two or three accounts of sinking or boring for coals, out of above twenty which I have procured from various places, though the terms are not very intelligible, being the language of the overseers of coal-works.

I. Whitfield mine near the Pottery in Staffordshire. Soil I foot. brick-clay 3 feet. fhale 4. metal which is hard brown and falls in the weather 42. coal 3. warrant clay 6. brown gritstone 36. coal $3\frac{1}{2}$. warrant clay $3\frac{1}{2}$. bass and metal $53\frac{1}{2}$. hardstone 4. shaly bass $1\frac{1}{2}$. coal 4. warrant clay, depth unknown. in all about 55 yards.

2. Coal-mine at Alfreton in Derbyshire. Soil and clay 7 feet. fragments of stone 9. bind 13. stone 6. bind 34. stone 5. bind 2. stone 2. bind 10. coal $1\frac{1}{2}$. bind $1\frac{1}{2}$. stone 37. bind 7. soft coal 3. bind 3. stone 20. bind 16. coal $7\frac{1}{2}$. in all about 61 yards.

3. A baffet coal-mine at Woolarton in Nottinghamshire. Sand and gravel 6 feet. bind 21. stone 10. smut or effete coal 1. clunch 4. bind 21. stone 18. bind 18. stonebind 15. soft coal 2. clunch and bind 21. coal 7. in all about 48 yards.

4. Coal-mine at West-Hallam in Nottinghamshire. Soil and clay 7 feet. bind 48. fmut 1¹/₂. clunch 4. bind 3. stone 2. bind 1. stone 1. bind 3. stone 1. bind 16. shale 2. bind 12. shale 3. clunch, stone, and a bed of cank 54. soft coal 4. clay and dun 1. soft coal 4¹/₂. clunch and bind 21. coal 1. broad bind 26. hard coal 6. in all about 74 yards.

GRANITE.

As these frata generally lie inclined, I fuppose parallel with the limestone on which they reft, the upper edges of them all come out to day, which is termed baffetting; when the whole mass was ignited by its fermentation, it is probable that the inflammable part of some strata might thus more easily escape than of others in the form of vapour; as dews are known to flide between such strata in the production of strings; which accounts for some coal-beds being so much worse than others. See note XX.

NOTE XXIV .---- GRANITE.

Climb the rude steeps, the Granite-cliffs surround. CANTO II. 1. 522.

THE loweft ftratum of the earth which human labour has arrived to, is granite; and of this likewife confifts the higheft mountains of the world. It is known under variety of names according to fome difference in its appearance or composition, but is now generally confidered by philosophers as a species of lava; if it contains quartz, feltspat, and mica in diffinct crystals, it is called granite; which is found in Cornwall in rocks; and in loose stores in the gravel near Drayton in Shropshire, in the road towards Newcastle. If these parts of the composition be less diffinct, or if only two of them be visible to the eye, it is termed porphyry, trap, whinstone, moorstone, flate. And if it appears in a regular angular form, it is called basaltes. The affinity of these bodies has lately been further well established by Dr. Beddoes in the Phil. Tranf. Vol. LXXX.

Thefe are all efteemed to have been volcanic productions that have undergone different degrees of heat; it is well known that in Papin's digefter water may be made red hot by confinement, and will then diffolve many bodies which otherwife are little or not at all acted upon by it. From hence it may be conceived, that under immenfe preffure of fuperincumbent materials, and by great heat, thefe maffes of lava may have undergone a kind of aqueous folution, without any tendency to vitrification, and might thence have a power of cryftallization, whence all the varieties above mentioned from the different proportion of the materials, or the different degrees of heat they may have undergone in this aqueous folution. And that the uniformity of the mixture of the original earths, as of lime, argil, filex, magnefia, and barytes, which they contain, was owing to their boiling together a longer or fhorter time before their elevation into mountains. See note XIX. art. 8.

The feat of volcanos feems to be principally, if not entirely, in these firata of granite; as many of them are fituated on granite mountains, and throw up from time to time sheets of lava which run down over the preceeding firata from the same origin; and in this they feem to differ from the heat which has separated the clay, coal, and fand in moraffes, which would appear to have risen from a kind of sementation, and thus to have pervaded the whole mass without any exputition of lava.



GRANITE.

7. On fome parts of these islands and continents of granite or limestone were gradually produced extensive morasses from the recrements of vegetables and of land animals; and from these morasses, heated by fermentation, were produced clay, marle, fandstone, coal, iron, (with the bases of variety of acids;) all which were stratified by their having been formed at different, and very distant periods of time.

8. In the elevation of the mountains very numerous and deep fiffures neceffarily were produced. In these fiffures many of the metals are formed partly from descending materials, and partly from ascending ones raised in vapour by subterraneous fires. In the fiffures of granite or porphery quartz is formed; in the fiffures of limestone calcareous spar is produced.

9. During thefe first great volcanic fires it is probable the atmosphere was either produced, or much increased; a process which is perhaps now going on in the moon; Mr. Herschell having discovered a volcanic crater three miles broad burning on her disk.

10. The fummits of the new mountains were cracked into innumerable lozenges by the cold dews or fnows falling upon them when red hot. From these fummits, which were then twice as high as at present, cubes and lozenges of granite, and bafalt, and quartz in some countries, and of marble and flints in others, descended gradually into the valleys, and were rolled together in the beds of rivers, (which were then so large as to occupy the whole valleys, which they now only interfect;) and produced the great beds of gravel, of which many valleys confist.

11. In feveral parts of the earth's furface fubfequent earthquakes, from the fermentation of moraffes, have at different periods of time deranged the polition of the matters above defcribed. Hence the gravel, which was before in the beds of rivers, has in fome places been raifed into mountains, along with clay and coal firata which were formed from moraffes and walhed down from eminences into the beds of rivers or the neighbouring feas, and in part raifed again with gravel or marine fhells over them; but this has only obtained in few places compared with the general diffribution of fuch materials. Hence there feem to have exifted two fources of earthquakes, which have occurred at great diffance of time from each other; one from the granite beds in the central parts of the earth, and the other from the moraffes on its furface. All the fubfequent earthquakes and volcanos of modern days compared with thefe are of finall extent and infignificant effect.

12. Befides the argillaceous fand-ftone produced from moraffes, which is ftratified with clay, and coal, and iron, other great beds of filiceous fand have been formed in the fea by the combination of an unknown acid from moraffes, and the calcareous matters of the ocean.

13. The warm waters which are found in many countries, are owing to fteam arifing from great depths through the fiffures of limeftone or lava, elevated by fubterranean fires, and condenfed between the ftrata of the hills over them; and not from any decomposition of pyrites or manganese near the furface of the earth.

14. The columns of bafaltes have been raifed by the congelation or expansion of granite beds in the act of cooling from their femi-vitreous fusion.

NOTE XXV. ____ EVAPORATION.

Aquatic nymphs! you lead with viewless march The winged vapour up the aerial arch.

CANTO III. 1. 13.

I. THE atmosphere will diffolve a certain quantity of moifture as a chemical menftruum, even when it is much below the freezing point, as appears from the diminution of ice fuspended in frofty air, but a much greater quantity of water is evaporated and fuspended in the air by means of heat, which is perhaps the universal cause of fluidity, for water is known to boil with less heat in vacuo, which is a proof that it will evaporate faster in vacuo, and that the air therefore rather hinders than promotes its evaporation in higher degrees of heat. The quick evaporation occasioned in vacuo by a small degree of heat is agreeably feen in what is termed a pulse-glass, which confists of an exhausted tube of glass with a bulb at each end of it and with about two thirds of the cavity filled with alcohol, in which the spirit is instantly feen to boil by the heat of the finger-end applied on a bubble of steam in the lower bulb, and is condensed again in the upper bulb by the least conceivable comparative coldness.

2. Another circumfance evincing that heat is the principal caufe of evaporation is that at the time of water being converted into fteam, a great quantity of heat is taken away from the neighbouring bodies. If a thermometer be repeatedly dipped in ether, or in rectified fpirit of wine, and exposed to a blaft of air, to expedite the evaporation by perpetually removing the faturated air from it, the thermometer will prefently fink below freezing. This warmth, taken from the ambient bodies at the time of evaporation by the fteam, is again given out when the fteam is condensed into water. Hence the water in a worm-tub during distillation fo foon becomes hot; and hence the warmth accompanying the descent of rain in cold weather.

3. The third circumstance, shewing that heat is the principal cause of evaporation, is, that some of the steam becomes again condensed when any part of the heat is withdrawn. Thus when warmer fouth-west winds replete with moisture succeed the colder northeast winds all bodies that are dense and substantial, as shore walls, brick floors, &c. absorb some of the heat from the passing air, and its moisture becomes precipitated on them, while the north-east winds become warmer on their arrival in this latitude, and are thence disposed to take up more moisture, and are termed drying winds.

4. Heat feems to be the principal caufe of the folution of many other bodies, as common falt, or blue vitriol diffolved in water, which when exposed to fevere cold are precipitated, or carried, to the part of the water last frozen; this I observed in a phial filled with a folution of blue vitriol which was frozen; the phial was burst, the ice

EVAPORATION.

thawed, and a blue column of cupreous vitriol was left ftanding upright on the bottom of the broken glafs, as defcribed in note XIX.

II. Hence water may either be diffolved in air, and may then be called an aerial folution of water; or it may be diffolved in the fluid matter of heat, according to the theory of M. Lavoifier, and may then be called fteam. In the former cafe it is probable there are many other vapours which may precipitate it, as marine acid gas, or fluor acid gas. So alcaline gas and acid gas diffored in air precipitate each other, nitrous gas precipitates vital air from its azote, and inflammable gas mixed with vital air ignited by an electric fpark either produces or precipitates the water in both of them. Are there any fubtle exhalations occafionally diffufed in the atmosphere which may thus caufe rain ?

1. But as water is perhaps many hundred times more foluble in the fluid matter of heat than in air, I fuppofe the eduction of this heat, by whatever means it is occafioned, is the principal caufe of devaporation. Thus if a region of air is brought from a warmer climate, as the S. W. winds, it becomes cooled by its contact with the earth in this latitude, and parts with fo much of its moifture as was diffolved in the quantity of calorique, or heat, which it now loofes, but retains that part which was fulpended by its attraction to the particles of air, or by aerial folution, even in the moft fevere frofts.

2. A fecond immediate caufe of rain is a ftream of N. E. wind defcending from a fuperior current of air, and mixing with the warmer S. W. wind below; or the reverfe of this, viz. a fuperior current of S. W. wind mixing with an inferior one of N. E. wind; in both these cases the whole heaven becomes instantly clouded, and the moisfure contained in the S. W. current is precipitated. This caufe of devaporation has been ingeniously explained by Dr. Hutton in the Transact. of Edinburgh, Vol. I. and feems to arise from this circumstance; the particles of air of the N. E. wind educe part of the heat from the S. W. wind, and therefore the water which was diffolved by that quantity of *heat* is precipitated; all the other part of the water, which was fusfpended by its attraction to the particles of air, or diffolved in the remainder of the heat, continues unprecipitated.

3. A third method by which a region of air becomes cooled, and in confequence depofits much of its moifture, is from the mechanical expansion of air, when part of the preffure is taken off. In this cafe the expanded air becomes capable of receiving or attracting more of the matter of heat into its interflices, and the vapour, which was previously diffolved in this heat, is deposited, as is feen in the receiver of an air-pump, which becomes dewy, as the air within becomes expanded by the eduction of part of it. See note VII. Hence when the mercury in the barometer finks without a change of the wind the air generally becomes colder. See note VII. on Elementary Heat. And it is probably from the varying preffure of the incumbent air that in fummer days fmall black clouds are often thus fuddenly produced, and again foon vanish. See a paper in Philof. Tranf. Vol. LXXVIII. intitled Frigorific Experiments on the Mechanical Expansion of Air.

NOTE XXV.

4. Another portion of atmospheric water may possibly be held in folution by the electric fluid, fince in thunder florms a precipitation of the water feems to be either the cause or the confequence of the eduction of the electricity. But it appears more probable that the water is condensed into clouds by the eduction of its heat, and that then the furplus of electricity prevents their coalescence into larger drops, which immediately fucceeds the departure of the lightning.

5. The immediate caufe why the barometer finks before rain is, firft, becaufe a region of warm air, brought to us in the place of the cold air which it had difplaced, muft weigh lighter, both fpecifically and abfolutely, if the height of the warm atmosphere be fuppofed to be equal to that of the preceeding cold one. And fecondly, after the drops of rain begin to fall in any column of air, that column becomes lighter, the falling drops only adding to the preffure of the air in proportion to the refiftance which they meet with in paffing through that fluid.

If we could fuppofe water to be diffolved in air without heat, or in very low degrees of heat, I fuppofe the air would become heavier, as happens in many chemical folutions, but if water diffolved in the matter of heat, or calorique, be mixed with an aerial folution of water, there can be no doubt but an atmosphere confifting of fuch a mixture must become lighter in proportion to the quantity of calorique. On the fame circumstance depends the visible vapour produced from the breath of animals in cold weather, or from a boiling kettle; the particles of cold air, with which it is mixed, steal a part of its heat, and become themselves raifed in temperature, whence part of the water is precipitated in visible vapour, which, if in great quantity finks to the ground; if in fmall quantity, and the furrounding air is not previously faturated, it fpreads itfelf till it becomes again diffolved.

NOTE XXVI.-SPRINGS.

Your lucid bands condense with singers chill The blue mist hovering round the gelid hill. CANTO III. 1. 19.

THE furface of the earth confifts of ftrata many of which were formed originally beneath the fea, the mountains were afterwards forced up by fubterraneous fires, as appears from the fiffures in the rocks of which they confift, the quantity of volcanic productions all over the world, and the numerous remains of craters of volcanos in mountainous countries. Hence the ftrata which compose the fides of mountains lie flanting downwards, and one or two or more of the external ftrata not reaching to the fummit when the mountain was raifed up, the fecond or third ftratum or a more inferior one is there exposed to day; this may be well represented by forceably thrusting a blunt inftrument through feveral sheets of paper, a bur will ftand up with the lowermost fheet ftanding highest in the center of it. On this uppermost ftratum, which is colder as it is more elevated, the dews are condensed in large quantities; and fliding down pass under the first or fecond or third ftratum which compose the fides of the hill; and either form a morass below, or a weeping rock, by oozing out in numerous places, or many of these lefs currents meeting together burft out in a more copious rill.

The fummits of mountains are much colder than the plains in their vicinity, owing to feveral caufes; 1. Their being in a manner infulated or cut off from the common heat of the earth, which is always of 48 degrees, and perpetually counteracts the effects of external cold beneath that degree. 2. From their furfaces being larger in proportion to their folid contents, and hence their heat more expeditioufly carried away by the ever-moving atmosphere. 3. The increasing rarity of the air as the mountain rifes. All those bodies which conduct electricity well or ill, conduct the matter of heat likewife well or ill. See note VII. Atmospheric air is a bad conductor of electricity and thence confines it on the body where it is accumulated, but when it is made very rare, as in the exhaufted receiver, the electric aura paffes away immediately to any diffance. The fame circumftance probably happens in refpect to heat, which is thus kept by the denfer air on the plains from efcaping, but is diffipated on the hills where the air is thinner. 4. As the currents of air rife up the fides of mountains they become mechanically rarefied, the preffure of the incumbent column leffening as they afcend. Hence the expanding air abforbs heat from the mountain as it afcends, as explained in note VII. 5. There is another, and perhaps more powerful caufe, I fufpect, which may occafion the great cold on mountains, and in the higher parts of the atmosphere, and which has not yet been attended to; I mean that the fluid matter of heat may prodably gravitate round the earth, and form an atmosphere on its furface, mixed with the aerial atmosphere, which may diminifh or become rarer, as it recedes from the earth's furface, in a greater proportion than the air diminifhes.

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NOTE XXVI.

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6. The great condenfation of moifture on the fummits of hills has another caufe, which is the dafhing of moving clouds againft them, in mifty days this is often feen to have great effect on plains, where an eminent tree by obftructing the mift as it moves along fhall have a much greater quantity of moifture drop from its leaves than falls at the fame time on the ground in its vicinity. Mr. White, in his Hiftory of Selborne gives an account of a large tree fo fituated, from which a ftream flowed during a moving mift fo as to fill the cart-ruts in a lane otherwife not very moift, and ingenioufly adds, that trees planted about ponds of ftagnant water contribute much by thefe means to fupply the refervoir. The fpherules which conflitute a mift or cloud are kept from uniting by fo fmall a power that a little agitation againft the leaves of a tree, or the greater attraction of a flat moift furface, condenfes or precipitates them.

If a leaf has its furface moiftened and particles of water feparate from each other as in a mift be brought near the moiftened furface of a leaf, each particle will be attracted more by that plain furface of water on the leaf than it can be by the furrounding particles of the mift, becaufe globules only attract each other in one point, whereas a plain attracts a globule by a greater extent of its furface.

The common cold fprings are thus formed on elevated grounds by the condenfed vapours, and hence are ftronger when the nights are cold after hot days in fpring, than even in the wet days of winter. For the warm atmosphere during the day has diffolved much more water than it can fupport in folution during the cold of the night, which is thus deposited in large quantities on the hills, and yet fo gradually as to foak in between the ftrata of them, rather than to flide off over their furfaces like fhowers of rain. The common heat of the internal parts of the earth is afcertained by fprings which arife from ftrata of earth too deep to be affected by the heat of fummer or the frofts of winter. Those in this country are of 48 degrees of heat, those about Philidelphia were faid by Dr. Franklin to be 52; whether this variation is to be accounted for by the difference of the fun's heat on that country, according to the ingenious theory of Mr. Kirwan, or to the vicinity of fubterranean fires is not yet, I think, decided. There are however fubterraneous ftreams of water not exactly produced in this manner, as ftreams iffuing from fiffures in the earth, communicating with the craters of old volcanoes; in the Peak of Derbyshire are many hollows, called fwallows, where the land floods fink into the earth, and come out at fome miles diftant, as at Ilam near Afhborne. See note on Fica, Vol. II.

Other ftreams of cold water arife from beneath the fnow on the Alps and Andes, and other high mountains, which is perpetually thawing at its under furface by the common heat of the earth, and gives rife to large rivers. For the origin of warm fprings fee note on Fucus, Vol. II.

NOTE XXVII.---SHELL FISH.

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You round Echinus ray his arrowy mail, Give the keel'd Nautilus his oar and fail. Firm to his rock with filver cords fufpend The anchor'd Pinna, and his Cancer-friend.

CANTO III. 1.67.

THE armour of the Echinus, or Sea-hedge Hog, confifts generally of moveable fpines; (*Linnei System. Nat.* Vol. I. p. 1102.) and in that respect refembles the armour of the land animal of the fame name. The irregular protuberances on other fea-schells, as on some species of the Purpura, and Murex, serve them as a fortification against the attacks of their enemies.

It is faid that this animal forefees tempefuous weather, and finking to the bottom of the fea adheres firmly to fea-plants, or other bodies by means of a fubftance which refembles the horns of fnails. Above twelve hundred of thefe fillets have been counted by which this animal fixes itfelf; and when afloat, it contracts thefe fillets between the bafes of its points, the number of which often amounts to two thoufand. Dict. raifonne. art. Ourfin. de mer.

There is a kind of Nautilus, called by Linneus, Argonauta, whofe fhell has but one cell; of this animal Pliny affirms, that having exonerated its fhell by throwing out the water, it fwims upon the furface, extending a web of wonderful tenuity, and bending back two of its arms and rowing with the reft, makes a fail, and at length receiving the water dives again. Plin. IX. 29. Linneus adds to his dcfcription of this animal, that like the the Crab Diogenes or Bernhard, it occupies a houfe not its own, as it is not connected to its fhell, and is therefore foreign to it; who could have given credit to this if it had not been attefted by fo many who have with their own eyes feen this argonaut in the act of failing? Syft. Nat. p. 1161.

The Nautilus, properly fo named by Linneus, has a fhell confifting of many chambers, of which cups are made in the Eaft with beautiful painting and carving on the mother-pearl. The animal is faid to inhabit only the uppermoft or open chamber, which is larger than the reft; and that the reft remain empty except that the pipe, or fiphunculus, which communicates from one to the other of them is filled with an appendage of the animal like a gut or ftring. Mr. Hook in his Philof. Exper. p. 306, imagines this to be a dilatable or compressible tube, like the air-bladders of fish, and that by contracting or permitting it to expand, it renders its shell boyant or the contrary. See Note on Ulva, Vol. II.

The Pinna, or Sea-wing, is contained in a two-valve fhell, weighing fometimes fifteen pounds, and emits a beard of fine long gloffy filk-like fibres, by which it is fufpended to the rocks twenty or thirty feet beneath the furface of the fea. In this fituation it is fo fuccefsfully attacked by the eight-footed Polypus, that the fpecies perhaps could not exift

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but for the exertions of the Cancer Pinnotheris, who lives in the fame shell as a guard and companion. Amœn. Academ. Vol. II. p. 48. Lin. Syst. Nat. Vol. I.-p. 1159, and p. 1040.

The Pinnotheris, or Pinnophylax, is a finall crab naked like Bernard the Hermit, but is furnifhed with good eyes, and lives in the fame fhell with the Pinna; when they want food the Pinna opens its fhell, and fends its faithful ally to forage; but if the Cancer fees the Polypus, he returns fuddenly to the arms of his blind hoftefs, who by clofing the fhell avoids the fury of her enemy; otherwife, when it has procured a booty, it brings it to the opening of the fhell, where it is admitted, and they divide the prey. This was obferved by Haflequift in his voyage to Paleftine.

The Byffus of the antients, according to Ariftotle, was the beard of the Pinna above mentioned, but feems to have been ufed by other writers indifcriminately for any fpun material, which was effeemed finer or more valuable than wool. Reaumur fays the threads of this Byffus are not lefs fine or lefs beautiful than the filk, as it is fpun by the filk-worm; the Pinna on the coafts of Italy and Provence (where it is fifhed up by ironhooks fixed on long poles) is called the filk-worm of the fea. The ftockings and gloves manufactured from it, are of exquisite fineness, but too warm for common wear, and are thence efteemed ufeful in rhumatifm and gout. Dict. raifonné art. Pinne-marine. The warmth of the Byffus, like that of filk, is probably owing to their being bad conductors of heat, as well as of electricity. When these fibres are broken by violence, this animal as well as the mufcle has the power to reproduce them like the common fpiders, as was obferved by M. Adanfon. As raw filk, and raw cobwebs, when fwallowed, are liable to produce great fickness (as I am informed) it is probable the part of mufcles, which fometimes difagrees with the people who eat them, may be this filky web, by which they attach themfelves to ftones. The large kind of Pinna contains fome mother-pearl of a reddifh tinge, according to M. d'Argenville. The fubftance fold under the name of Indian weed, and ufed at the bottom of fifh-lines, is probably a production of this kind; which however is fcarcely to be diffinguished by the eye from the tendons of a rat's tail, after they have been feparated by putrefaction in water, and well cleaned and rubbed; a production, which I was once fhewn as a great curiofity; it had the uppermost bone of the tail adhering to it, and was faid to have been used as an ornament in a lady's hair.

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NOTE XXVIII.--STURGEON.

With worm-like beard his toothlefs lips array, And teach the unweildy Sturgeon to betray.

CANTO III. 1.71.

THE Sturgeon, Acipenfer, Strurio. Lin. Syft. Nat. Vol. I. p. 403. is a fifh of great curiofity as well as of great importance; his mouth is placed under the head, without teeth, like the opening of a purfe, which he has the power to pufh fuddenly out or retract. Before this mouth under the beak or nofe hang four tendrils fome inches long, and which fo refemble earth-worms that at firft fight they may be miftaken for them. This clumfy toothlefs fifh is fuppofed by this contrivance to keep himfelf in good condition, the folidity of his flefh evidently fhewing him to be a fifh of prey. He is faid to hide his large body amongft the weeds near the fea-coaft, or at the mouths of large rivers, only expofing his cirrhi or tendrils, which finall fifh or fea-infects miftaking for real worms approach for plunder, and are fucked into the jaws of their enemy. He has been fuppofed by fome to root into the foil at the bottom of the fea or rivers; but the cirrhi, or tendrills abovementioned, which hang from his fnout over his mouth, muft themfelves be very inconvenient for this purpofe, and as it has no jaws it evidently lives by fuction, and during its refidence in the fea a quantity of fea-infects are found in its ftomach.

The flefh was fo valued in the time of the Emperor Severus, that it was brought to table by fervants with coronets on their heads, and preceded by mufic, which might give rife to its being in our country prefented by the Lord Mayor to the King. At prefent it is caught in the Danube, and the Walga, the Don, and other large rivers for various purpofes. The fkin makes the beft covering for carriages; ifinglafs is prepared from parts of the fkin; cavear from the fpawn; and the flefh is pickled or falted, and fent all over Europe.

NOTE XXIX.—OIL ON WATER.

Who with fine films, suspended o'er the deep, Of Oil effusive lull the waves to sleep. CAN

CANTOIII. 1. 87.

THERE is reafon to believe that when oil is poured upon water, the two furfaces do not touch each other, but that the oil is fufpended over the water by their mutual repulsion. This feems to be rendered probable by the following experiment: if one drop of oil be droped on a bason of water, it will immediately diffuse itself over the whole, for there being no friction between the two furfaces, there is nothing to prevent its fpreading itself by the gravity of the upper part of it, except its own tenacity, into a pellicle

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of the greatest tenuity. But if a fecond drop of oil be put upon the former, it does not fpread itself, but remains in the form of a drop, as the other already occupied the whole furface of the bason, and there is friction in oil passing over oil, though none in oil passing over water.

Hence when oil is diffufed on the furface of water gentle breezes have no influence in raifing waves upon it; for a fmall quantity of oil will cover a very great furface of water, (I fuppofe a fpoonful will diffufe itfelf over fome acres) and the wind blowing upon this carries it gradually forwards; and there being no friction between the two furfaces the water is-not affected. On which account oil has no effect in ftilling the agitation of the water after the wind ceafes, as was found by the experiments of Dr. Franklin.

This circumftance lately brought into notice by Dr. Franklin had been mentioned by Pliny, and is faid to be in ufe by the divers for pearls, who in windy weather take down with them a little oil in their mouths, which they occafionally give out when the inequality of the fupernatant waves prevents them from feeing fufficiently diffinctly for their purpofe.

The wonderful tenuity with which oil can be fpread upon water is evinced by a few drops projected from a bridge, where the eye is properly placed over it, paffing through all the prifmatic colours as it diffufes itfelf. And alfo from another curious experiment of Dr. Franklin's: he cut a piece of cork to about the fize of a letter-wafer, leaving a point flanding off like a tangent at one edge of the circle. This piece of cork was then dipped in oil and thrown into a large pond of water, and as the oil flowed off at the point, the cork-wafer continued to revolve in a contrary direction for feveral minutes. The oil flowing off all that time at the pointed tangent in coloured ftreams. In a fmall pond of water this experiment does not fo well fucceed, as the circulation of the cork ftops as foon as the water becomes covered with the pellicle of oil. See Additional Note, No. XIII. and Note on Fucus, Vol. II.

The eafe with which oil and water flide over each other is agreeably feen if a phial be about half filled with equal parts of oil and water, and made to ofcillate fufpended by a ftring, the upper furface of the oil and the lower one of the water will always keep fmooth; but the agitation of the furfaces where the oil and water meet, is curious; for their fpecific gravities being not very different, and their friction on each other nothing, the higheft fide of the water, as the phial defcends in its ofcillation, having acquired a greater momentum than the loweft fide (from its having defcended further) would rife the higheft on the afcending fide of the ofcillation, and thence puffes the then uppermoft part of the water amongft the oil.

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NOTE XXX .---- SHIP-WORM.

Meet fell Teredo, as he mines the keel With beaked head, and break his lips of steel. CANTO III. 1. 91.

THE Teredo, or fhip-worm, has two calcareous jaws, hemifpherical, flat before, and angular behind. The fhell is taper, winding, penetrating fhips and fubmarine wood, and was brought from India into Europe, Linnei Syftem. Nat. p. 1267. The Tarieres, or fea-worms, attack and erode fhips with fuch fury, and in fuch numbers, as often greatly to endanger them. It is faid that our veffels have not known this new enemy above fifty years, that they were brought from the fea about the Antilles to our parts of the ocean, where they have increafed prodigioufly. They bore their paffage in the direction of the fibres of the wood, which is their nourifhment, and cannot return or pafs obliquely, and thence when they come to a knot in the wood, or when two of them meet together with their ftony mouths, they perifh for want of food.

In the years 1731 and 1732 the United Provinces were under a dreadful alarm concerning these infects, which had made great depredation on the piles which support the banks of Zeland, but it was happily discovered a few years afterwards that these infects had totally abandoned that island, (Dict. Raisonné, art. Vers Rongeurs,) which might have been occasioned by their not being able to live in that latitude when the winter was rather severer than usual.

NOTE XXXI.---MAELSTROM.

Turn the broad belm, the fluttering canvas urge From Maelstrom's fierce innavigable surge.

CANTO III. 1. 93.

ON the coaft of Norway there is an extensive vortex, or eddy, which lies between the islands of Moskoe and Moskenas, and is called Moskoestrom, or Maelstrom; it occupies fome leagues in circumference, and is faid to be very dangerous and often destructive to vesseling these feas. It is not easy to understand the existence of a constant descending stream without supposing it must pass through a subterranean cavity to some other part of the earth or ocean which may lie beneath its level; as the Mediterranean feems to lie beneath the level of the Atlantic ocean, which therefore

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conflantly flows into it through the Straits; and the waters of the Gulph of Mexico lie much above the level of the fea about the Floridas and further northward, which gives rife to the Gulph-ftream, as deferibed in note on Caffia in Vol. II.

The Maelftrom is faid to be ftill twice in about twenty-four hours when the tide is up, and most violent at the opposite times of the day. This is not difficult to account for, fince when so much water is brought over the fubterraneous passage, if such exists, as compleatly to fill it and stand many feet above it, less disturbance must appear on the furface. The Maelstrom is described in the Memoires of the Swedish Academy of Sciences, and Pontoppiden's Hist. of Norway, and in Universal Museum for 1763, p. 131.

The reafon why eddies of water become hollow in the middle is becaufe the water immediately over the centre of the well, or cavity, falls fafter, having lefs friction to oppofe its defcent, than the water over the circumference or edges of the well. The circular motion or gyration of eddies depends on the obliquity of the courfe of the fream, or to the friction or opposition to it being greater on one fide of the well than the other; I have observed in water passing through a hole in the bottom of a trough, which was always kept full, the gyration of the ftream might be turned either way by increasing the opposition of one fide of the eddy with ones finger, or by turning the fpout, through which the water was introduced, a little more obliquely to the hole on one fide or on the other. Lighter bodies are liable to be retained long in eddies of water, while those rather heavier than water are foon thrown out beyond the circumference by their acquired momentum becoming greater than that of the water. Thus if equal portions of oil and water be put into a phial, and by means of a ftring be whirled in a circle round the hand, the water will always keep at the greater diftance from the centre, whence in the eddies formed in rivers during a flood a perfon who endeavours to keep above water or to fwim is liable to be detained in them, but on fuffering himfelf to fink or dive he is faid readily to efcape. This circulation of water in defcending through a hole in a veffel Dr. Franklin has ingenioufly applied to the explanation of hurricanes or eddies of air.

plant still and stimpted cold. In the bounds environe at Links Liferin in the pairs makes from

NOTE XXXII.---GLACIERS.

While round dark crags imprison'd waters bend Through rifted ice, in ivory veins descend. CANTO III. 1. 113.

THE common heat of the interior parts of the earth being always 48 degrees, both in winter and fummer, the fnow which lies in contact with it is always in a thawing flate; Hence in ice-houfes the external parts of the collection of ice is perpetually thawing and thus preferves the internal part of it; fo that it is neceffary to lay up many tons for the prefervation of one ton. Hence in Italy confiderable rivers have their fource from beneath the eternal glaciers, or mountains of fnow and ice.

In our country when the air in the course of a frost continues a day or two at very near 32 degrees, the common heat of the earth thaws the ice on its furface, while the thermometer remains at the freezing point. This circumftance is often obfervable in the rimy mornings of fpring; the thermometer shall continue at the freezing point, yet all the rime will vanish, except that which happens to lie on a bridge, a board, or on a cake of cow-dung, which being thus as it were infulated or cut off from fo free a communication with the common heat of the earth by means of the air under the bridge, or wood, or dung, which are bad conductors of heat, continues fome time longer unthawed. Hence when the ground is covered thick with fnow, though the frost continues, and the fun does not fhine, yet the fnow is observed to decrease very fensibly. For the common heat of the earth melts the under furface of it, and the upper one evaporates by its folution in the air. The great evaporation of ice was observed by Mr. Boyle, which experiment I repeated fome time ago. Having fuspended a piece of ice by a wire and weighed it with care without touching it with my hand, I hung it out the whole of a clear frofty night, and found in the morning it had loft nearly a fifth of its weight. Mr. N. Wallerius has fince obferved that ice at the time of its congelation evaporates faster than water in its fluid form; which may be accounted for from the heat given out at the inflant of freezing; (Sauffure's Effais fur Hygromet. p. 249.) but this effect is only momentary.

Thus the vegetables that are covered with fnow are feldom injured; fince, as they lie between the thawing fnow, which has 32 degrees of heat, and the covered earth which has 48, they are preferved in a degree of heat between thefe; viz. in 40 degrees of heat. Whence the mofs on which the rein-deer feed in the northern latitudes vegetates beneath the fnow; (See note on Mufchus, Vol. II.) and hence many Lapland and Alpine plants perifhed through cold in the botanic garden at Upfal, for in their native fituations, though the cold is much more intenfe, yet at its very commencement they are covered deep with fnow, which remains till late in the fpring. For this fact fee Amænit. Academ. Vol. I. No. 48. In our climate fuch plants do well covered with dried fern, under which they will grow, and even flower, till the fevere vernal frofts ceafe. For the increafe of glaciers fee Note on Canto I. 1. 529.

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NOTE XXXIII.---WINDS.

While fouthern gales o'er western oceans roll, And Eurus steals his ice-winds from the pole. CANTO IV. 1. 15.

THE theory of the winds is yet very imperfect, in part perhaps owing to the want of obfervations fufficiently numerous of the exact times and places where they begin and ceafe to blow, but chiefly to our yet imperfect knowledge of the means by which great regions of air are either fuddenly produced or fuddenly deftroyed.

The air is perpetually fubject to increafe or diminution from its combination with other bodies, or its evolution from them. The vital part of the air, called oxygene, is continually produced in this climate from the perfpiration of vegetables in the funfhine, and probably from the action of light on clouds or on water in the tropical climates, where the fun has greater power, and may exert fome yet unknown laws of luminous combination. Another part of the atmosphere, which is called azote, is perpetually fet at liberty from animal and vegetable bodies by putrefaction or combustion, from many fprings of water, from volatile alcali, and probably from fixed alcali, of which there is an exhaustless fource in the water of the ocean. Both these component parts of the air are perpetually again diminished by their contact with the foil, which covers the furface of the earth, producing nitre. The oxygene is diminished in the production of all acids, of which the carbonic and muriatic exist in great abundance. The azote is diminished in the growth of animal bodies, of which it conflitutes an important part, and in its combinations with many other natural productions.

They are both probably diminified in immenfe quantities by uniting with the inflammable air, which arifes from the mud of rivers and lakes at fome feafons, when the atmosphere is light: the oxgene of the air producing water, and the azote producing volatile alcali by their combinations with this inflammable air. At other feafons of the year these principles may again change their combinations, and the atmospheric air be reproduced.

Mr. Lavoifier found that one pound of charcoal in burning confumed two pounds nine ounces of vital air, or oxygene. The confumption of vital air in the procefs of making red lead may readily be reduced to calculation; a fmall barrel contains about twelve hundred weight of this commodity, 1200 pounds of lead by calcination abforb about 144 pounds of vital air; now as a cubic foot of water weighs 1000 averdupois ounces, and as vital air is above 800 times lighter than water, it follows that every barrel of red lead contains nearly 2000 cubic feet of vital air. If this can be performed in miniature in a fmall oven, what may not be done in the immenfe elaboratories of nature!

These great elaboratories of nature include almost all her fossil as well as her animal and vegetable productions. Dr. Priestley obtained air of greater or less purity, both vital and azotic, from almost all the fosfil fubstances he fubjected to experiment. Four ounce-weight of lava from Iceland heated in an earthen retort yielded twenty ouncemeasures of air.

4	ounce-weight of	lava	gave	20	ounce measures of air.
7		bafaltes		104	
2		toadítone		40	
II		granite		20	
I		elvain		30	
7		gypfum		230	
4		blue flate		230	
4		clay		20	
4		limeftone-fpar		830	
5		limeftone		1160	
3		chalk		630	
31		white iron-ore		560	
4		dark iron-ore		410	
12		molybdena		25	
4		ftream tin		20	
2		fteatites		40	
2		barytes		26	
2		black wad		80	
4		fand ftone		75	
3		coal		700	

In this account the fixed air was previoufly extracted from the limeftones by acids, and the heat applied was much lefs than was neceffary to extract all the air from the bodies employed. Add to this the known quantities of air which are combined with the calciform ores, as the ochres of iron, manganefe, calamy, grey ore of lead, and fome idea may be formed of the great production of air in volcanic eruptions, as mentioned in note on Chunda, Vol. II. and of the perpetual abforptions and evolutions of whole oceans of air from every part of the earth.

But there would feem to be an officina aeris, a fhop where air is both manufactured and deftroyed in the greateft abundance within the polar circles, as will hereafter be fpoken of. Can this be effected by fome yet unknown law of the congelation of aqueous or faline fluids, which may fet at liberty their combined heat, and convert a part both of the acid and alcali of fea-water into their component airs? Or on the contrary can the electricity of the northern lights convert inflammable air and oxygene into water, whilft the great degree of cold at the poles unites the azote with fome other bafe? Another officina aeris, or manufacture of air, would feem to exift within the tropics or at the line, though in a much lefs quantity than at the poles, owing perhaps to the action of the fun's light on the moifture fulpended in the air, as will alfo be fpoken of hereafter; but in all other parts of the earth thefe abforptions and evolutions of air in a greater or lefs degree are perpetually going on in inconceivable abundance; increafed probably, and diminifhed at different feafons of the year by the approach or retrocefifion of the fun's light; future difcoveries muft elucidate this part of the fubject. To this fhould be added

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that as heat and electricity, and perhaps magnetifm, are known to difplace air, that it is not impoffible but that the increased or diminished quantities of these fluids diffused in the atmosphere may increase its weight a well as its bulk; fince their specific attractions or affinities to matter are very ftrong, they probably also possible general gravitation to the earth; a subject which wants further investigation. See Note XXVI.

SOUTH-WEST WINDS.

The velocity of the furface of the earth in moving round its axis diminifhes from the equator to the poles. Whence if a region of air in this country fhould be fuddenly removed a few degrees towards the north it must constitute a western wind, because from the velocity it had previoufly acquired in this climate by its friction with the earth it would for a time move quicker than the furface of the country it was removed to; the contrary must enfue when a region of air is transported from this country a few degrees fouthward, becaufe the velocity it had acquired in this climate would be lefs than that of the earth's furface where it was removed to, whence it would appear to conflitute a wind from the eaft, while in reality the eminent parts of the earth would be carried against the too flow air. But if this transportation of air from fouth to north be performed gradually, the motion of the wind will blow in the diagonal between fouth and weft. And on the contrary if a region of air be gradually removed from north to fouth it would also blow diagonally between the north and east, from whence we may fafely conclude that all our winds in this country which blow from the north or eaft, or any point between them, confift of regions of air brought from the north; and that all our winds blowing from the fouth or weft, or from any point between them, are regions of air brought from the fouth.

It frequently happens during the vernal months that after a north-eaft wind has paffed over us for feveral weeks, during which time the barometer has flood at above $30\frac{1}{2}$ inches, it becomes fuddenly fucceeded by a fouth-weft wind, which alfo continues feveral weeks, and the barometer finks to nearly $28\frac{1}{2}$ inches. Now as two inches of the mercury in the barometer balance one-fifteenth part of the whole atmosphere, an important queftion here prefents itfelf, what is become of all this air.

I. This great quantity of air can not be carried in a fuperior current towards the line, while the inferior current flows towards the poles, becaufe then it would equally affect the barometer, which floud not therefore fubfide from $30\frac{1}{2}$ inches to $28\frac{1}{2}$ for fix weeks together.

2. It cannot be owing to the air having loft all the moifture which was previoufly diffolved in it, becaufe thefe warm fouth-weft winds are replete with moifture, and the cold north-eaft winds, which weigh up the mercury in the barometer to 31 inches, confift of dry air.

3. It can not be carried over the polar regions and be accumulated on the meridian opposite to us in its paffage towards the line, as such an accumulation would equal one-fifteenth of the whole atmosphere, and can not be supposed to remain in that fituation for fix weeks together.

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4. It can not depend on the existence of tides in the atmosphere, fince it must then correspond to lunar periods. Nor to accumulations of air from the specific levity of the upper regions of the atmosphere, fince its degree of fluidity must correspond with its tenuity, and confequently such great mountains of air can not be supposed to exist for for many weeks together as the fouth weft winds fometimes continue.

5. It remains therefore that there muft be at this time a great and fudden abforption of air in the polar circle by fome unknown operation of nature, and that the fouth wind runs in to fupply the deficiency. Now as this fouth wind confifts of air brought from a part of the earth's furface which moves fafter than it does in this climate it muft have at the fame time a direction from the weft by retaining part of the velocity it had previoufly acquired. Thefe fouth-weft winds coming from a warmer country, and becoming colder by their contact with the earth of this climate, and by their expansion, (fo great a part of the fuperincumbent atmosphere having vanished,) precipitate their moifture; and as they continue for feveral weeks to be abforbed in the polar circle would feem to receive a perpetual fupply from the tropical regions, especially over the line, as will hereafter be spoken of.

It may fometimes happen that a north-east wind having passed over us may be bent down and driven back before it has acquired any heat from the climate, and may thus for a few hours or a day have a fouth-west direction, and from its defcending from a higher region of the atmosphere may posses a greater degree of cold than an inferior north east current of air.

The extreme cold of Jan. 13, 1709, at Paris came on with a gentle fouth wind, and was diminished when the wind changed to the north, which is accounted for by Mr. Homberg from a reflux of air which had been flowing for some time from the north. Chemical Effays by R. Watson, Vol. V. p. 182.

It may happen that a north-east current may for a day or two pass over us and produce incefant rain by mixing with the inferior fouth-west current; but this as well as the former is of short duration, as its friction will soon carry the inferior current along with it, and dry or frosty weather will then succeed.

NORTH-EAST WINDS.

The north eaft-winds of this country confift of regions of air from the north, travelling fometimes at the rate of about a mile in two minutes during the vernal months for feveral weeks together from the polar regions toward the fouth, the mercury in the barometer ftanding above 30. These winds confiss of air greatly cooled by the evaporation of the ice and fnow over which it passes, and as they become warmer by their contact with the earth of this climate are capable of diffolving more moisfure as they pass along, and are thence attended with frosts in winter and with dry hot weather in fummer.

1. This great quantity of air can not be fupplied by fuperior currents paffing in a contrary direction from fouth to north, becaufe fuch currents must as they arife into the atmosphere a mile or two high become exposed to fo great cold as to occasion them
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to deposit their moisture, which would fall through the inferior current upon the earth in some part of their passage.

2. The whole atmosphere must have increased in quantity, because it appears by the barometer that there exists one-fifteenth part more air over us for many weeks together, which could not be thus accumulated by difference of temperature in respect to heat, or by any aerostatic laws at present known, or by any lunar influence.

From whence it would appear that immenfe maffes of air were fet at liberty from their combinations with folid bodies, along with a fufficient quantity of combined heat, within the polar circle, or in fome region to the north of us; and that they thus perpetually increafe the quantity of the atmosphere; and that this is again at certain times re-abforbed, or enters into new combinations at the line or tropical regions. By which wonderful contrivance the atmosphere is perpetually renewed and rendered fit for the fupport of animal and vegetable life.

SOUTH-EAST WINDS.

The fouth-eaft winds of this country confift of air from the north which had paffed by us, or over us, and before it had obtained the velocity of the earth's furface in this climate had been driven back, owing to a deficiency of air now commencing at the polar regions. Hence these are generally dry or freezing winds, and if they fucceed north-east winds should prognosticate a change of wind from north-east to fouth-west; the barometer is generally about 30. They are fometimes attended with cloudy weather, or rain, owing to their having acquired an increased degree of warmth and moisture before they became retrograde; or to their being mixed with air from the fouth.

2. Sometimes these south-east winds confist of a vertical eddy of north-east air, without any mixture of south-west air; in that case the barometer continues above 30, and the weather is dry or frosty for sour or five days together.

It fhould here be obferved, that air being an elaftic fluid muft be more liable to eddies than water, and that thefe eddies muft extend into cylinders or vortexes of greater diameter, and that if a vertical eddy of north-eaft air be of fmall diameter or has paffed but a little way to the fouth of us before its return, it will not have gained the velocity of the earth's furface to the fouth of us, and will in confequence become a fouth-eaft wind.—But if the vertical eddy be of large diameter, or has paffed much to the fouth of us, it will have acquired velocity from its friction with the earth's furface to the fouth of us, and will in confequence on its return become a fouth-weft wind, producing great cold.

NORTH-WEST WINDS.

There feem to be three fources of the north-weft winds of this hemifphere of the earth. I. When a portion of fouthern air, which was paffing over us, is driven back by accumulation of new air in the polar regions. In this cafe I fuppofe they are generally moift or rainy winds, with the barometer under 30, and if the wind had previoufly been in the fouth-weft, it would feem to prognofticate a change to the north-eaft.

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2. If a current of north wind is paffing over us but a few miles high, without any eafterly direction; and is bent down upon us, it must immediately posses a westerly direction, because it will now move faster than the furface of the earth where it arrives; and thus becomes changed from a north-east to a north-west wind. This defcent of a north-east current of air producing a north-west wind may continue fome days with clear or freezing weather, as it may be fimply owing to a vertical eddy of northeast air, as will be spoken of below. It may otherwise be forced down by a current of fouth-west wind passing over it, and in this case it will be attended with rain for a few days by the mixture of the two airs of different degrees of heat; and will prognosticate a change of wind from north-east to fouth-west if the wind was previously in the northeast quarter.

3. On the eaftern coaft of North America the north-well winds bring froft, as the north-eaft winds do in this country, as appears from variety of tellimony. This feems to happen from a vertical fpiral eddy made in the atmosphere between the fhore and the ridge of mountains which form the fpine or back-bone of that continent. If a current of water runs along the hypothenuse of a triangle an eddy will be made in the included angle, which will turn round like a water-wheel as the ftream passes in contact with one edge of it. The fame must happen when a fheet of air flowing along from the north-east rifes from the flore in a ftraight line to the fummit of the Apalachian mountains, a part of the ftream of north-east air will flow over the mountains, another part will revert and circulate spirally between the fummit of the country and the eastern fhore, continuing to move toward the fouth; and thus be changed from a north-east to a north-welf wind.

This vertical fpiral eddy having been in contact with the cold fummits of thefe mountains, and defeending from higher parts of the atmosphere will lose part of its heat, and thus conflitute one cause of the greater coldness of the eastern fides of North America than of the European shores opposite to them, which is faid to be equal to twelve degrees of north latitude, which is a wouderful fact, not otherwise easy to be explained, fince the heat of the springs at Philadelphia is faid to be 52, which is greater than the medium heat of the earth in this country.

The exiftence of vertical eddies, or great cylinders of air rolling on the furface of the earth, is agreeable to the obfervations of the conftructors of windmills; who on this idea place the area of the fails leaning backwards, inclined to the horizon; and believe that then they have greater power than when they are placed quite perpendicularly. The fame kind of rolling cylinders of water obtain in rivers owing to the friction of the water against the earth at their bottoms; as is known by bodies having been obferved to float upon their furfaces quicker than when immerfed to a certain depth. These vertical eddies of air probably exist all over the earth's furface, but particularly at the bottom or fides of mountains; and more fo probably in the course of the fouth-west than of the north-east winds; because the former fall from an eminence, as it were, on a part of the earth where there is a deficiency of the quantity of air; as is shewn by the finking of the barometer: whereas the latter are pushed or

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fqueezed forward by an addition to the atmosphere behind them, as appears by the rifing of the barometer.

TRADE-WINDS.

A column of heated air becomes lighter than before, and will therefore afcend, by the prefiure of the cold air which furrounds it, like a cork in water, or like heated fmoke in a chimney.

Now as the fun paffes twice over the equator for once over either tropic, the equator has not time to become cool; and on this account it is in general hotter at the line than at the tropics; and therefore the air over the line, except in fome few inflances hereafter to be mentioned, continues to afcend at all feafons of the year, preffed upwards by regions of air brought from the tropics.

This air thus brought from the tropics to the equator, would conflitute a north wind on one fide of the equator, and a fouth wind on the other; but as the furface of the earth at the equator moves quicker than the furface of the earth at the tropics, it is evident that a region of air brought from either tropic to the equator, and which had previoufly only acquired the velocity of the earth's furface at the tropics, will now move too flow for the earth's furface at the equator, and will thence appear to move in a direction contrary to the motion of the earth. Hence the trade-winds, though they confift of regions of air brought from the north on one fide of the line, and from the fouth on the other, will appear to have the diagonal direction of north-eaft and fouth-weft winds.

Now it is commonly believed that there are fuperior currents of air paffing over thefe north-eaft and fouth-weft currents in a contrary direction, and which defcending near the tropics produce vertical whirlpools of air. An important queftion here again prefents itfelf, *What becomes of the moiflure which this heated air ought to deposit*; as it cools in the upper regions of the atmosphere in its journey to the tropics? It has been fhewn by Dr. Prieftley and Mr. Ingenhouz that the green matter at the bottom of cifterns, and the fresh leaves of plants immerfed in water, give out confiderable quantities of vital air in the fun-fhine; that is, the perspirable matter of plants (which is water much divided in its egress from their minute pores) becomes decomposed by the fun's light, and converted into two kinds of air, the vital and inflammable airs. The moifture contained or diffolved in the afcending heated air at the line must exist in great tenuity; and by being exposed to the great light of the fun in that climate, the water may be decomposed, and the new airs fpread on the atmosphere from the line to the poles.

I. From there being no conftant deposition of rains in the usual course of the tradewinds, it would appear that the water rising at the line is decomposed in its ascent.

2. From the observations of M. Bougner on the mountain Pinchinca, one of the Cordelieres immediately under the line, there appears to be no condensible vapour above three or four miles high. Now though the atmosphere at that height may be cold to a very confiderable degree; yet its total deprivation of condensible vapour would feem to shew, that its water was decomposed; as there are no experiments to evince that any degree of cold hitherto known has been able to deprive air of its moifture; and great

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abundance of fnow is deposited from the air that flows to the polar regions, though it is exposed to no greater degrees of cold in its journey thither than probably exists at four miles height in the atmosphere at the line.

3. The hygrometer of Mr. Sauffure also pointed to dryness as he alcended into rarer air; the fingle hair of which it was constructed, contracting from deficiency of moisture. Effais fur l'Hygromet. p. 143.

From these observations it appears either that rare and cold air requires more moisture to faturate it than dense air; or that the moisture becomes decomposed and converted into air, as it ascends into these cold and rare regions of the atmosphere.

4. There feems fome analogy between the circumstance of air being produced or generated in the cold parts of the atmosphere both at the line and at the poles.

MONSOONS AND TORNADOES.

1. In the Arabian and Indian feas are winds, which blow fix months one way, and fix months the other, and are called Monfoons; by the accidental difpofitions of land and fea it happens, that in fome places the air near the tropic is fuppofed to become warmer when the fun is vertical over it, than at the line. The air in these places confequently afcends preffed upon one fide by the north-east regions of air, and on the other fide by the fouth-weft regions of air. For as the air brought from the fouth has previoufly obtained the velocity of the earth's furface at the line, it moves fafter than the earth's furface near the tropic where it now arrives, and becomes a fouth-west wind, while the air from the north becomes a north-east wind as before explained. These two winds do not fo quietly join and afcend as the north-eaft and fouth-eaft winds, which meet at the line with equal warmth and velocity and form the trade-winds; but as they meet in contrary directions before they afcend, and cannot be fuppofed accurately to balance each other, a rotatory motion will be produced as they afcend like water falling through a hole, and an horizontal or fpiral eddy is the confequence; thefe eddies are more or lefs rapid, and are called Tornadoes in their most violent state, raising water from the ocean in the weft or fand from the deferts of the eaft, in lefs violent degrees they only mix together the two currents of north-eaft and fouth-weft air, and produce by this means inceffant rains, as the air of the north-east acquires fome of the heat from the fouth-weft wind, as explained in Note XXV. This circumftance of the eddies produced by the monfoon-winds was feen by Mr. Bruce in Abyffinia; he relates that for many fucceffive mornings at the commencement of the rainy monfoon, he observed a cloud of apparently fmall dimensions whirling round with great rapidity, and in a few minutes the heavens became covered with dark clouds with confequent great rains. See Note on Canto III. 1. 125.

2. But it is not only at the place where the air afcends at the northern extremity of the rainy monfoon, and where it forms tornadoes, as obferved above by Mr. Bruce, but over a great tract of country feveral degrees in length in certain parts as in the Arabian fea, a perpetual rain for feveral months defcends, fimilar to what happens for weeks together in our own climate in a lefs degree during the fouth-weft winds. Another im-

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portant queftion prefents itfelf here, if the climate to which this fouth-west wind arrives, is not colder than that it comes from, why should it deposit its moisture during its whole journey? if it be a colder climate, why does it come thither? The tornadoes of air above defcribed can extend but a little way, and it is not easy to conceive that a fuperior cold current of air can mix with an inferior one, and thus produce showers over ten degrees of country, fince at about three miles high there is perpetual frost; and what can induce these narrow and shallow currents to flow over each other so many hundred miles?

Though the earth at the northren extremity of this monfoon may be more heated by certain circumftances of fituation than at the line, yet it feems probable that the intermediate country between that and the line, may continue colder than the line (as in other parts of the earth) and hence that the air coming from the line to fupply this afcent or deftruction of air at the northern extremity of the monfoon will be cooled all the way in its approach, and in confequence deposit its water. It feems probable that at the northern extremity of this monfoon, where the tornadoes or hurricanes exist, that the air not only afcends but is in part converted into water, or otherwife diministed in quantity, as no account is given of the existence of any superior currents of it.

As the fouth-weft winds are always attended with a light atmosphere, an incipient vacancy, or a great diminution of air muft have taken place to the northward of them in all parts of the earth wherever they exift, and a deposition of their moisfure fucceeds their being cooled by the climate they arrive at, and not by a contrary current of cold air over them, fince in that cafe the barometer would not fink. They may thus in our own country be termed monfoons without very regular periods.

3. Another caufe of TORNADOES independent of the monfoons is ingenioufly explained by Dr. Franklin, when in the tropical countries a ftratum of inferior air becomes fo heated by its contact with the warm earth, that its expansion is increased more than is equivalent to the preffure of the ftratum of air over it; or when the fuperior ftratum becomes more condenfed by cold than the inferior one by preffure, the upper region will defcend and the lower one afcend. In this fituation if one part of the atmofphere be hotter from fome fortuitous circumstances, or, has less pressure over it, the lower stratum will begin to afcend at this part, and refemble water falling through a hole as mentioned above. If the lower region of air was going forwards with confiderable velocity, it will gain an eddy by rifing up this hole in the incumbent heavy air, fo that the whirlpool or tornado has not only its progreffive velocity, but its circular one alfo, which thus lifts up or overturns every thing within its fpiral whirl. By the weaker whirlwinds in this country the trees are fometimes thrown down in a line of only twenty or forty yards in breadth, making a kind of avenue through a country. In the Weft Indies the fea rifes like a cone in the whirl, and is met by black clouds produced by the cold upper air and the warm lower air being rapidly mixed; whence are produced the great and fudden rains called water-fpouts; while the upper and lower airs exchange their plus or minus electricity in perpetual lightenings.

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LAND AND SEA-BREEZES.

The fea being a transparent mass is less heated at its furface by the fun's rays than the land, and its continual change of furface contributes to preferve a greater uniformity in the heat of the air which hangs over it. Hence the furface of the tropical islands is more heated during the day than the fea that furrounds them, and cools more in the night by its greater elevation: whence in the afternoon when the lands of the tropical islands have been much heated by the fun, the air over them ascends prefied upwards by the cooler air of the incircling ocean, in the morning again the land becoming cooled more than the fea, the air over it descends by its increased gravity, and blows over the ocean near its shores.

CONCLUSION.

1. There are various irregular winds befides those above described, which confiss of horizontal or vertical eddies of air owing to the inequality of the earth's furface, or the juxtaposition of the fea. Other irregular winds have their origin from increased evaporation of water, or its sudden devaporation and descent in showers; others from the partial expansion and condensation of air by heat and cold; by the accumulation or desect of electric fluid, or to the air's new production or absorption occasioned by local causes not yet discovered. See Notes VII. and XXV.

2. There feem to exift only two original winds: one confifting of air brought from the north, and the other of air brought from the fouth. The former of these winds has also generally an apparent direction from the east, and the latter from the west, arising from the different velocities of the earth's furface. All the other winds above described are deflections or retrogressions of some parts of these currents of air from the north or fouth.

3. One fifteenth part of the atmosphere is occasionally deftroyed, and occasionally reproduced by unknown causes. These causes are brought into immediate activity over a great part of the furface of the earth at nearly the same time, but always act more powerful to the northward than to the southward of any given place; and would hence seem to have their principal effect in the polar circles, existing nevertheless though with less power toward the tropics or at the line.

For when the north-eaft wind blows the barometer rifes, fometimes from $28\frac{1}{2}$ inches to $30\frac{1}{2}$, which fhews a great new generation of air in the north; and when the fouthweft wind blows the barometer finks as much, which fhews a great deftruction of air in the north. But as the north-eaft winds fometimes continue for five or fix weeks, the newly-generated air muft be deftroyed at those times in the warmer climates to the fouth of us, or circulate in fuperior currents, which has been fhewn to be improbable from its not depositing its water. And as the fouth-weft winds fometimes continue for fuperior currents, which laft has been fhewn to be improbable.

4. The north-east winds being generated about the poles are pushed forwards towards the tropics or line, by the preffure from behind, and hence they become warmer, as

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explained in Note VII. as well as by their coming into contact with a warmer part of the earth which contributes to make these winds greedily absorb moisture in their passage. On the contrary, the fouth-weft winds, as the atmosphere is fuddenly diminished in the polar regions, are drawn as it were into an incipient vacancy, and become therefore expanded in their paffage, and thus generate cold, as explained in Note VII. and are thus induced to part with their moifture, as well as by their contact with a colder part of the earth's furface. Add to this, that the difference in the found of the north-eaft and fouth-west winds may depend on the former being pushed forwards by a preffure behind, and the latter falling as it were into a partial or incipient vacancy before; whence the former becomes more condenfed, and the latter more rarefied as it paffes. There is a whiftle, termed a lark-call, which confifts of a hollow cylinder of tin-plate, clofed at each end, about half an inch in diameter and a quarter of an inch high, with opposite holes about the fize of a goofe-quill through the centre of each end; if this larkwhiftle be held between the lips the found of it is manifeftly different when the breath is forceably blown through it from within outwards, and when it is fucked from without inwards. Perhaps this might be worthy the attention of organ-builders.

5. A ftop is put to this new generation of air, when about a fifteenth of the whole is produced, by its increasing preffure; and a fimilar boundary is fixed to its abforption or deftruction by the decrease of atmospheric preffure. As water requires more heat to convert it into vapour under a heavy atmosphere than under a light one, fo in letting off the water from muddy fish-ponds great quantities of air-bubbles are seen to ascend from the bottom, which were previously confined there by the preffure of the water. Similar bubbles of inflammable air are seen to arise from lakes in many seasons of the year, when the atmosphere fuddenly becomes light.

6. The increased absorptions and evolutions of air must, like its simple expansions, depend much on the prefence or absence of heat and light, and will hence, in respect to the times and places of its production and destruction, be governed by the approach or retrocession of the sun, and on the temperature, in regard to heat, of various latitudes, and parts of the same latitude, so well explained by Mr. Kirwan.

7. Though the immediate caufe of the deftruction or reproduction of great maffes of air at certain times, when the wind changes from north to fouth, or from fouth to north can not yet be afcertained; yet as there appears greater difficulty in accounting for this change of wind for any other known caufes, we may ftill fufpect that there exifts in the arctic and antarctic circles a BEAR or DRAGON yet unknown to philofophers, which at times fuddenly drinks up, and as fuddenly at other times vomits out one-fifteenth part of the atmosphere: and hope that this or fome future age will learn how to govern and domefticate a monster which might be rendered of fuch important fervice to mankind.

INSTRUMENTS.

IF along with the ufual registers of the weather observations were made on the winds in many parts of the earth with the three following instruments, which might be constructed at no great expence, fome useful information might be acquired.

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1. To mark the hour when the wind changes from north-east to fouth-west, and the contrary. This might be managed by making a communication from the vane of a weathercock to a clock; in such a manner, that if the vane should revolve quite round, a tooth on its revolving axis should flop the clock, or put back a small bolt on the edge of a wheel revolving once in twenty-four hours.

2. To different whether in a year more air paffed from north to fouth, or the contrary. This might be effected by placing a windmill-fail of copper about nine inches diameter in a hollow cylinder about fix inches long, open at both ends, and fixed on an eminent fituation exactly north and fouth. Thence only a part of the north-east and fouth-west currents would affect the fail fo as to turn it; and if its revolutions were counted by an adapted machinery, as the fail would turn one way with the north currents of air, and the contrary one with the fouth currents, the advance of the counting finger either way would shew which wind had prevailed most at the end of the year.

3. To difcover the rolling cylinders of air, the vane of a weathercock might be fo fufpended as to dip or rife vertically, as well as to have its horizontal rotation.

RECAPITULATION.

NORTH-EAST WINDS confift of air flowing from the north, where it feems to be occafionally produced; has an apparent direction from the eaft owing to its not having acquired in its journey the increafing velocity of the earth's furface; thefe winds are analogous to the trade-winds between the tropics, and frequently continue in the vernal months for four and fix weeks together, with a high barometer, and fair or frofty weather. 2. They fometimes confift of fouth-weft air, which had paffed by us or over us, driven back by a new accumulation of air in the north. Thefe continue but a day or two, and are attended with rain. See Note XXV.

SOUTH-WEST WIND confifts of air flowing from the fouth, and feems occafionally abforbed at its arrival to the more northern latitudes. It has a real direction from the weft owing to its not having loft in its journey the greater velocity it had acquired from the earth's furface from whence it came. Thefe winds are analogous to the monfoons between the tropics, and frequently continue for four or fix weeks together, with a low barometer and rainy weather. 2. They fometimes confift of north-eaft air, which had paffed by us or over us, which becomes retrograde by a commencing deficiency of air in the north. Thefe winds continue but a day or two, attended with feverer froft with a finking barometer; their cold being increafed by their expansion, as they return, into an incipient vacancy.

NORTH-WEST WINDS confift, first, of fouth-west winds, which have passed over us, bent down and driven back towards the fouth by newly generated northern air. They continue but a day or two, and are attended with rain or clouds. 2. They confist of north-east winds bent down from the higher parts of the atmosphere, and having there acquired a greater velocity than the earth's surface; are frosty or fair. 3. They confist of north-east winds formed into a vertical spiral eddy, as on the eastern coasts of North America, and bring fevere frost.

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SOUTH-EAST WINDS confift, first, of north-east winds become retrograde, continue for a day or two, frosty or fair, sinking barometer. 2. They confist of north-east winds formed into a vertical eddy not a spiral one, frost or fair.

NORTH WINDS confift, first, of air flowing flowly from the north, fo that they acquire the velocity of the earth's furface as they approach, are fair or frosty, feldom occur. 2. They confist of retrograde fouth winds; these continue but a day or two, are preceded by fouth-west winds; and are generally succeeded by north-east winds, cloudy or rainy, barometer rifing.

SOUTH WINDS confift, first, of air flowing flowly from the fouth, loofing their previous western velocity by the friction of the earth's furface as they approach, moift, feldom occur. 2. They confist of retrograde north winds; these continue but a day or two, are preceded by north-east winds, and generally succeeded by fouth-west winds, colder, barometer finking.

EAST WINDS confift of air brought haftily from the north, and not impelled farther fouthward, owing to a fudden beginning abforption of air in the northern regions, very cold, barometer high, generally fucceeded by fouth-weft wind.

WEST WINDS confift of air brought haftily from the fouth, and checked from proceeding further to the north by a beginning production of air in the northern regions, warm and moift, generally fucceeded by north-eaft wind. 2. They confift of air bent down from the higher regions of the atmosphere, if this air be from the fouth, and brought haftily it becomes a wind of great velocity, moving perhaps 60 miles an hour, is warm and rainy; if it confifts of northern air bent down it is of less velocity and colder.

Application of the preceding Theory to some Extracts from a Journal of the Weather.

Dec. 1, 1790. The barometer funk fuddenly, and the wind, which had been fome days north-eaft with froft, changed to fouth-eaft with an inceffant though moderate fall of fnow. A part of the northern air, which had paffed by us I fuppofe, now became retrograde before it had acquired the velocity of the earth's furface to the fouth of us, and being attended by fome of the fouthern air in its journey, the moifture of the latter became condenfed and frozen by its mixture mith the former.

Dec. 2, 3. The wind changed to north-weft and thawed the fnow. A part of the fouthern air, which had paffed by us or over us, with the retrograde northern air above defcribed, was now in its turn driven back, before it had loft the velocity of the furface of the earth to the fouth of us, and confequently became a north-weft wind; and not having loft the warmth it brought from the fouth produced a thaw.

Dec. 4, 5. Wind changed to north-east with frost and a rising barometer. The air from the north continuing to blow, after it had driven back the fouthern air as above described, became a north-east wind, having less velocity than the furface of the earth in, this climate, and produced frost from its coldness.

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Dec. 6, 7. Wind now changed to the fouth-weft with inceffant rain and a finking barometer. From unknown caufes I fuppofe the quantity of air to be diminished in the polar regions, and the fouthern air cooled by the earth's furface, which was previously frozen, deposits its moisture for a day or two; afterwards the wind continued fouth-weft without rain, as the furface of the earth became warmer.

March 18, 1785. There has been a long froft; a few days ago the barometer funk to $29\frac{1}{2}$, and the froft became more fevere. Because the air being expanded by a part of the preffure being taken off became colder. This day the mercury role to 30, and the frost ceased, the wind continuing as before between north and east. March 19. Mercury above 30, weather still milder, no frost, wind north-east. March 20. The same, for the mercury rising shews that the air becomes more compressed by the weight above. and in confequence gives out warmth.

April 4, 5. Froft, wind north-eaft, the wind changed in the middle of the day to the north-weft without rain, and has done fo for three or four days, becoming again northeaft at night. For the fun now giving greater degrees of heat, the air afcends as the fun paffes the zenith, and is fupplied below by the air on the weftern fide as well as on the eaftern fide of the zenith during the hot part of the day; whence for a few hours, on the approach of the hot part of the day, the air acquires a wefterly direction in this longitude. If the north-weft wind had been caufed by a retrograde motion of fome fouthern air, which had paffed over us, it would have been attended with rain or clouds.

April 10. It rained all day yesterday, the wind north-west, this morning there was a sharp frost. The evaporation of the moisture, (which fell yesterday) occasioned by the continuance of the wind, produced fo much cold as to freeze the dew.

May 12. Frequent flowers with a current of colder wind preceding every flower. The finking of the rain or cloud preffed away the air from beneath it in its defcent, which having been for a time fladed from the fun by the floating cloud, became cooled in fome degree.

June 20. The barometer funk, the wind became fouth-weft, and the whole heaven was inftantly covered with clouds. A part of the incumbent atmosphere having vanished, as appeared by the finking of the barometer, the remainder became expanded by its elasticity, and thence attracted some of the matter of heat from the vapour intermixed with it, and thus in a few minutes a total devaporation took place, as in exhausting the receiver of an air-pump. See note XXV. At the place where the air is destroyed, currents both from the north and south flow in to supply the deficiency, (for it has been shewn that there are no other proper winds but these two) and the mixture of these winds produces so fudden condensation of the moisture, both by the coldness of the northern air and the expansion of both of them, that lightning is given out, and an incipient tornado takes place; whence thunder is faid frequently to approach against the wind.

August 28, 1732. Barometer was at 31, and Dec. 30, in the fame year, it was at 28 2-tenths. Medical Effays, Edinburgh, Vol. II. p. 7. It appears from these journals that the mercury at Edinburgh varies fometimes nearly three inches, or one tenth of

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the whole atmosphere. From the journals kept by the Royal Society at London it appears feldom to vary more than two inches, or one-fifteenth of the whole atmosphere. The quantity of the variation is faid ftill to decrease nearer the line, and to increase in the more northern latitudes; which much confirms the idea that there exists at certain times a great destruction or production of air within the polar circle.

July 2, 1732. The westerly winds in the journal in the Medical Effays, Vol. II. above referred to, are frequently marked with the number three to fhew their greater velocity, whereas the eafterly winds feldom approach to the number two. The greater velocity of the wefterly winds than the eafterly ones is well known I believe in every climate of the world; which may be thus explained from the theory above delivered. I. When the air is ftill, the higher parts of the atmosphere move quicker than those parts which touch the earth, becaufe they are at a greater diftance from the axis of motion. 2. The part of the atmosphere where the north or fouth wind comes from is higher than the part of it where it comes to, hence the more elevated parts of the atmosphere continue to defcend towards the earth as either of those winds approach. 3. When fouthern air is brought to us it poffeffes a wefterly direction alfo, owing to the velocity it had previoufly acquired from the earth's furface; and if it confifts of air from the higher parts of the atmosphere descending nearer the earth, this westerly velocity becomes increafed. But when northern air is brought to us, it poffeffes an apparent eafterly direction alfo, owing to the velocity which it had previoufly acquired from the earth's furface being lefs than that of the earth's furface in this latitude; now if the north-east wind confists of air descending from higher parts of the atmosphere, this deficiency of velocity will be lefs, in confequence of the fame caufe, viz. The higher parts of the atmosphere defcending, as the wind approaches, increases the real velocity of the western winds, and decreases the apparent velocity of the eastern ones.

October 22. Wind changed from fouth-eaft to fouth-weft. There is a popular prognoftication that if the wind changes from the north towards the fouth paffing through the eaft, it is more likely to continue in the fouth, than if it paffes through the weft, which may be thus accounted for. If the north-eaft wind changes to a north-weft wind, it fhews either that a part of the northern air defcends upon us in a fpiral eddy, or that a fuperior current of fouthern air is driven back; but if a north-eaft wind be changed into a fouth-eaft wind it fhews that the northern air is become retrograde, and that in a day or two, as foon as that part of it has paffed, which has not gained the velocity of the earth's furface in this latitude, it will become a fouth wind for a few hours, and then a fouth-weft wind.

The writer of this imperfect fketch of anemology wifhes it may incite fome perfon of greater leizure and ability to attend to this fubject, and by comparing the various meteorological journals and obfervations already publifhed, to conftruct a more accurate and methodical treatife on this interefting branch of philofophy.

NOTE XXXIV.----VEGETABLE PERSPIRATION.

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And wed the enamoured Oxygene to Light.

CANTO IV. 1. 34.

WHEN points or hairs are put into fpring-water, as in the experiments of Sir B. Thompfon, (Philof. Tranf. Vol. LXXVII.) and exposed to the light of the fun, much air, which loofely adhered to the water, rifes in bubbles, as explained in note on Fucus, Vol. II. A ftill greater quantity of air, and of a purer kind, is emitted by Dr. Prieftley's green matter, and by vegetable leaves growing in water in the fun-fhine, according to Mr. Ingenhouze's experiments; both which I fuspect to be owing to a decomposition of the water perspired by the plant, for the edge of a capillary tube of great tenuity may be confidered as a circle of points, and as the oxygene, or principle of vital air, may be expanded into a gas by the fun's light; the hydrogene or inflammable air may be detained in the pores of the vegetable.

Hence plants growing in the fhade are white, and become green by being exposed to the fun's light; for their natural colour being blue, the addition of hydrogene adds yellow to this blue, and *tans* them green. I fuppofe a fimilar circumftance takes place in animal bodies; their perfpirable matter as it efcapes in the fun-fhine becomes decomposed by the edges of their pores as in vegetables, though in lefs quantity, as their perfpiration is lefs, and by the hydrogene being retained the fkin becomes *tanned* yellow. In proof of this it must be observed that both vegetable and animal fubftances become bleached white by the fun-beams when they are dead, as cabbage-ftalks, bones, ivory, tallow, bees-wax, linen and cotton cloth; and hence I fuppofe the copper-coloured natives of funny countries might become etiolated or blanched by being kept from their infancy in the dark, or removed for a few generations to more northerly climates.

It is probable that on a funny morning much pure air becomes feparated from the dew by means of the points of vegetables on which it adheres, and much inflammable air imbibed by the vegetable, or combined with it; and by the fun's light thus decomposing water the effects of it in bleaching linen feems to depend (as defcribed in Note X.): the water is decompofed by the light at the ends or points of the cotton or thread, and the vital air unites with the phlogiftic or colouring matters of the cloth, and produces a new acid, which is either itfelf colourlefs or wathes out, at the fame time the inflammable part of the water efcapes. Hence there feems a reafon why cotton bleaches fo much fooner than linen, viz. becaufe its fibres are three or four times fhorter, and therefore protrude fo many more points, which feem to facilitate the liberation of the vital air from the inflammable part of the water.

Bee's wax becomes bleached by exposure to the fun and dews in a fimilar manner as metals become calcined or rufty, viz. by the water on their furface being decomposed; and hence the inflammable material which caused the colour becomes united with vital air forming a new acid, and is washed away.

NOTE XXXIV. VEGETABLE PERSPIRATION.

Oil clofe ftopped in a phial not full, and expofed long to the fun's light, becomes bleached, as I fuppofe, by the decomposition of the water it contains; the inflammable air rifing above the furface, and the vital air uniting with the colouring matter of the oil. For it is remarkable, that by flutting up a phial of bleached oil in a dark drawer, it in a little time becomes coloured again.

The following experiment fhews the power of light in feparating vital air from another bafis, viz. from azote. Mr. Scheel inverted a glafs veffel filled with colourlefs nitrous acid into another glafs containing the fame acid, and on expofing them to the fun's light, the inverted glafs became partly filled with pure air, and the acid at the fame time became coloured. Scheel in Crell's Annal. 1786. But if the veffel of colourlefs nitrous acid be quite full and ftopped, fo that no fpace is left for the air produced to expand itfelf into, no change of colour takes place. Prieftley's Exp. VI. p. 344. See Keir's very excellent Chemical Dictionary, p. 99. new edition.

A fun-flower three feet and half high according to the experiment of Dr. Hales, perfpired two pints in one day (Vegetable Statics.) which is many times as much in proportion to its furface, as is perfpired from the furface and lungs of animal bodies; it follows that the vital air liberated from the furfaces of plants by the funfhine muft much exceed the quantity of it abforbed by their refpiration, and that hence they improve the air in which they live during the light part of the day, and thus blanched vegetables will fooner become *tanned into green* by the fun's light, than etiolated animal bodies will become *tanned yellow* by the fame means.

It is hence evident, that the curious difcovery of Dr. Prieftley, that his green vegetable matter and other aquatic plants gave out vital air when the fun fhone upon them, and the leaves of other plants did the fame when immerfed in water, as obferved by Mr. Ingenhouze, refer to the perfpiration of vegetables not to their refpiration. Becaufe Dr. Prieftley obferved the pure air to come from both fides of the leaves and even from the falks of a water-flag, whereas one fide of the leaf only ferves the office of lungs, and certainly not the ftalks. Exper. on Air, Vol. III. And thus in refpect to the circumfance in which plants and animals feemed the furthereft removed from each other, I mean in their fuppofed mode of refpiration, by which one was believed to purify the air which the other had injured, they feem to differ only in degree, and the analogy between them remains unbroken.

Plants are faid by many writers to grow much fafter in the night than in the day; as is particularly obfervable in feedlings at their rifing out of the ground. This probably is a confequence of their fleep rather than of the abfence of light; and in this I fuppofe they also refemble animal bodies.

NOTE XXXV.----VEGETABLE PLACENTATION.

While in bright veins the filvery fap afcends. CANTO IV. 1. 419.

A S buds are the viviparous offspring of vegetables, it becomes neceffary that they fhould be furnished with placental vessels for their nourishment, till they acquire lungs or leaves for the purpose of elaborating the common juices of the earth into nutriment. These vessels exist in bulbs and in feeds, and supply the young plant with a fweet juice till it acquires leaves, as is seen in converting barley into malt, and appears from the fweet taste of onions and potatoes, when they begin to grow.

The placental veffels belonging to the buds of trees are placed about the roots of moîl, as the vine; fo many roots are furnifhed with fweet or mealy matter as fern-root, bryony, carrot, turnip, potatoe, or in the alburnum or fap-wood as in those trees which produce manna, which is deposited about the month of August, or in the joints of fugar cane, and graffes; early in the fpring the absorbent mouths of these veffels drink up moifture from the earth, with a faccharine matter lodged for that purpose during the preceding autumn, and push this nutritive fluid up the veffels of the alburnum to every individual bud, as is evinced by the experiments of Dr. Hales, and of Mr. Walker in the Edinburgh Philosophical Transact. The former observed that the fap from the ftump of a vine, which he had cut off in the beginning of April, arose twenty-one feet high in tubes affixed to it for that purpose, but in a few weeks it ceased to bleed at all, and Dr. Walker marked the progress of the afcending fap, and found likewife that as foon as the leaves became expanded the fap ceased to rife; the afcending juice of fome trees is fo copious and fo fweet during the fap-feason that it is used to make wine, as the birch, betula, and fycamore, acer pseudo-platinus, and particularly the palm.

During this afcent of the fap-juice each individual leaf-bud expands its new leaves, and fhoots down new roots, covering by their intertexture the old bark with a new one; and as foon as thefe new roots (or bark) are capable of abforbing fufficient juices from the earth for the fupport of each bud, and the new leaves are capable of performing their office of exposing thefe juices to the influence of the air; the placental veffels ceafe to act, coalefce, and are transformed from fap-wood, or alburnum, into inert wood; ferving only for the fupport of the new tree, which grows over them.

Thus from the pith of the new bud of the horfe-chefnut five veffels pafs out through the circle of the placental veffels above defcribed, and carry with them a minuter circle of thofe veffels; thefe five bundles of veffels unite after their exit, and form the footftalk or petiole of the new five-fingered leaf, to be fpoken of hereafter. This ftructure is well feen by cutting off a leaf of the horfe-chefnut (Æfculus Hippocaftanum) in September before it falls, as the buds of this tree are fo large that the flower may be feen in them with the naked eye.

NOTE XXXV. VEGETABLE PLACENTATION.

After a time, perhaps about midfummer, another bundle of veffels paffes from the pith through the alburnum or fap-veffels in the bofom of each leaf, and unites by the new bark with the leaf, which becomes either a flower-bud or a leaf-bud to be expanded in the enfuing fpring, for which purpofe an apparatus of placental veffels are produced with proper nutriment during the progrefs of the fummer and autumn, and thus the vegetable becomes annually increafed, ten thoufand buds often exifting on one tree, according to the effimate of Linneus. Phil. Bot.

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The vafcular connection of vegetable buds with the leaves in whofe bofoms they are formed is confirmed by the following experiment, (Oct. 20, 1781.) On the extremity of a young bud of the Mimofa (fenfitive plant) a fmall drop of acid of vitriol was put by means of a pen, and, after a few feconds, the leaf in whofe axilla it dwelt clofed and opened no more, though the drop of vitriolic acid was fo fmall as apparently only to injure the fummit of the bud. Does not this feem to fhew that the leaf and its bud have connecting veffels though they arife at different times and from different parts of the medulla or pith? And, as it exifts previoufly to it, that the leaf is the parent of the bud?

This placentation of vegetable buds is clearly evinced from the fweetnefs of the rifing fap, and from its ceafing to rife as foon as the leaves are expanded, and thus compleats the analogy between buds and bulbs. Nor need we wonder at the length of the umbilical cords of buds fince that muft correspond with their fituation on the tree, in the fame manner as their lymphatics and arteries are proportionally elongated.

It does not appear probable that any umbilical artery attends these placental abforbents, fince, as there feems to be no fystem of veins in vegetables to bring back the blood from the extremities of their arteries, (except their pulmonary veins,) there could not be any vegetable fluids to be returned to their placenta, which in vegetables feems to be simply an organ for nutrition, whereas the placenta of the animal foctus feems likewife to ferve as a respiratory organ like the gills of fishes.

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NOTE XXXVI.----VEGETABLE CIRCULATION.

And refluent blood in milky eddies bends. CANTO IV. 1. 420.

THE individuality of vegetable buds was spoken of before, and is confirmed by the method of raising all kinds of trees by Mr. Barnes. (Method of propagating Fruit Trees. 1759. Lond. Baldwin.) He cut a branch into as many pieces as there were buds or leaves upon it, and wiping the two wounded ends dry he quickly applied to each a cement, previously warmed a little, which confisted principally of pitch, and planted them in the earth. The use of this cement I suppose to confist in its preventing the bud from bleeding to death, though the author as it to its antisceptic quality.

Thefe buds of plants, which are thus each an individual vegetable, in many circumftances refemble individual animals, but as animal bodies are detached from the earth, and move from place to place in fearch of food, and take that food at confiderable intervals of time, and prepare it for their nourifhment within their own bodies after it is taken, it is evident they muft require many organs and powers which are not neceffary to a flationary bud. As vegetables are immoveably fixed to the foil from whence they draw their mourifhment ready prepared, and this uniformly not at returning intervals, it follows that in examining their anatome we are not to look for mufcles of locomotion, as arms and legs; nor for organs to receive and prepare their nourifhment, as a ftomach and bowels; nor for a refervoir for it after it is prepared, as a general fyftem of veins, which in locomotive animals contains and returns the fuperfluous blood which is left after the various organs of fecretion have been fupplied, by which contrivance they are enabled to live a long time without new fupplies of food.

The parts which we may expect to find in the anatome of vegetables correspondent to those in the animal economy are, 1. A fystem of absorbent vessels to imbibe the moisture of the earth similar to the lacteal vessels, as in the roots of plants; and another fystem of absorbents similar to the lymphatics of animal bodies, opening its mouths on the internal cells and external furfaces of vegetables; and a third system of abforbent vessels correspondent with those of the placentation of the animal fortus. 2. A pulmonary system correspondent to the lungs or gills of quadrupeds and fish, by which the fluid absorbed by the lacteals and lymphatics may be exposed to the influence of the air, this is done by the green leaves of plants, those in the air refembling lungs, and those in the water resembling gills; and by the petals of flowers. 3. Arterial systems to convey the fluid thus elaborated to the various glands of the vegetable for the purposes of its growth, nutrition, and various fecretions. 4. The various glands which separate from the vegetable blood the honey, wax, gum, resin, starch, sugar, effential oil, &c. 5. The organs adapted for their propagation or reproduction. 6. Muscles to perform feveral motions of their parts.

NOTE XXXVI. VEGETABLE CIRCULATION.

I. The existence of that branch of the absorbent vessels of vegetables which refembles the lacteals of animal bodies, and imbibes their nutriment from the moist earth, is evinced by their growth so long as moisture is applied to their roots, and their quickly withering when it is withdrawn.

Befides these absorbents in the roots of plants there are others which open their mouths on the external furfaces of the bark and leaves, and on the internal furfaces of all the cells, and between the bark and the alburnum or fap-wood; the exiftence of thefe is fhewn, becaufe a leaf plucked off and laid with its under fide on water will not wither fo foon as if left in the dry air,- the fame if the bark alone of a branch which is feparated from a tree be kept moift with water,-and laftly, by moiftening the alburnum or fap-wood alone of a branch detached from a tree it will not fo foon wither as if left in the dry air. By the following experiment these vefiels were agreeably visible by a common magnifying glafs, I placed in the fummer of 1781 the footstalks of fome large fig-leaves about an inch deep in a decoction of madder, (rubia tinctorum,) and others in a decoction of logwood, (hæmatoxylum campechenfe,) along with fome fprigs cut off from a plant of picris, thefe plants were chofen becaufe their blood is white, after fome hours, and on the next day, on taking out either of thefe and cutting off from its bottom about a quarter of an inch of the ftalk an internal circle of red points appeared, which were the ends of abforbent veffels coloured red with the decoction, while an external ring of arteries was feen to bleed out haftily a milky juice, and at once evinced both the abforbent and arterial fyftem. Thefe abforbent veffels have been called by Grew, and Malphigi, and fome other philofophers, bronchi, and erroneoufly fuppofed to be air-veffels. It is probable that these veffels, when cut through, may effuse their fluids, and receive air, their fides being too fliff to collapfe; fince dry wood emits airbubles in the exhausted receiver in the fame manner as moift wood.

The ftructure of these vegetable absorbents confists of a spiral line, and not of a vessel interrupted with valves like the animal lymphatics, fince on breaking almost any tender leaf and drawing out some of the fibres which adhere longest this spiral structure becomes visible even to the naked eye, and distinctly so by the use of a common lens. See Grew, Plate 51.

In fuch a fructure it is eafy to conceive how a vermicular or periflatic motion of the veffel beginning at the loweft part of it, each fpiral ring fucceffively contracting itfelf till it fills up the tube, muft forcibly puft forwards its contents, as from the roots of vines in the bleeding feafon; and if this vermicular motion fhould begin at the upper end of the veffel it is as eafy to fee how it muft carry its contained fluid in a contrary direction. The retrograde motion of the vegetable abforbent veffels is fhewn by cutting a forked branch from a tree, and immerfing a part of one of the forks in water, which will for many days prevent the other from withering; or it is fhewn by planting a willow branch with the wrong end upwards. This ftructure in fome degree obtains in the efophagus or throat of cows, who by fimilar means convey their food firft downwards

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and afterward upwards by a retrograde motion of the annular mulcles or cartilages for the purpole of a fecond maltication of it.

II. The fluids thus drank up by the vegetable abforbent veffels from the earth, or from the atmosphere, or from their own cells and interflices, are carried to the foot-flak of every leaf, where the abforbents belonging to each leaf unite into branches, forming fo many pulmonary arteries, and are thence disperfed to the extremities of the leaf, as may be feen in cutting away flice after flice the footflak of a horfe-chefnut in September before the leaf falls. There is then a compleat circulation in the leaf, a pulmonary vein receiving the blood from the extremities of each artery on the upper fide of the leaf, and joining again in the footflak of the leaf thefe veins produce fo many arteries, or aortas, which disperfe the new blood over the new bark, elongating its veffels, or producing its fecretions; but as a refervoir of blood could not be wanted by a vegetable bud which takes in its nutriment at all times, I imagine there is no venous fystem, no veins properly fo called, which receive the blood which was to fpare, and return it into the pulmonary or arterial fystem.

The want of a fyftem of veins was countenanced by the following experiment; I cut off feveral ftems of tall fpurge, (Euphorbia heliofcopia) in autumn, about the centre of the plant, and obferved tenfold the quantity of milky juice ooze from the upper than from the lower extremity, which could hardly have happened if there had been a venous fyftem of veffels to return the blood from the roots to the leaves.

Thus the vegetable circulation, complete in the lungs, but probably in the other part of the fyftem deficient in refpect to a fyftem of returning veins, is carried forwards without a heart, like the circulation through the livers of animals where the blood brought from the inteflines and melentery by one vein is difperfed through the liver by the vena portarum, which affumes the office of an artery. See Note XXXVII.

At the fame time fo minute are the veffels in the intertexture of the barks of plants, which belong to each individual bud, that a general circulation may poffibly exift, though we have not yet been able to difcover the venous part of it.

There is however another part of the circulation of vegetable juices visible to the naked eye, and that is in the corol or petals of flowers, in which a part of the blood of the plant is exposed to the influence of the air and light in the fame manner as in the foliage, as will be mentioned more at large in Notes XXXVII and XXXIX.

Thefe circulations of their refpective fluids feem to be carried on in the veffels of plants precifely as in animal bodies by their irritability to the fumulus of their adapted fluids, and not by any mechanical or chemical attraction, for their abforbent veffels propel the juice upwards, which they drink up from the earth, with great violence; I fuppofe with much greater than is exerted by the lacteals of animals, probably owing to the greater minuteness of these veffels in vegetables and the greater rigidity of their coats. Dr. Hales in the fpring feason cut off a vine near the ground, and by fixing tubes on the remaining fump of it, found the fap to rise twenty-one feet in the tube by the propulsive

NOTE XXXVII. VEGETABLE RESPIRATION.

power of thefe abforbents of the roots of it. Veget. Stat. p. 102. Such a power can not be produced by capillary attraction, as that could only raife a fluid nearly to the upper edge of the attracting cylinder, but not enable it to flow over that edge, and much lefs to rife 21 feet above it. What then can this power be owing to? Doubtlefs to the living activity of the abforbent veffels, and to their increased vivacity from the influence of the warmth of the fpring fucceeding the winter's cold, and their thence greater fufceptibility to irritation from the juices which they abforb, refembling in all circumftances the action of the living veffels of animals.

NOTE XXXVII.-----VEGETABLE RESPIRATION.

While spread in air the leaves respiring play.

CANTO IV. 1. 421.

I. THERE have been various opinions concerning-the use of the leaves of plants in the vegetable œconomy. Some have contended that they are perspiratory organs; this does not seem probable from an experiment of Dr. Hales, Veg. Stat. p. 30. He found by cutting off branches of trees with apples on them, and taking off the leaves, that an apple exhaled about as much as two leaves, the surfaces of which were nearly equal to the apple; whence it would appear that apples have as good a claim to be termed perfpiratory organs as leaves. Others have believed them excretory organs of excrementious juices; but as the vapour exhaled from vegetables has no taste, this idea is no more probable than the other; add to this that in moist weather, they do not appear to perfpire or exhale at all.

The internal furface of the lungs or air-veffels in men, are faid to be equal to the external furface of the whole body, or about fifteen fquare feet; on this furface the blood is exposed to the influence of the refpired air through the medium however of a thin pellicle; by this exposure to the air it has its colour changed from deep red to bright fearlet, and acquires fomething fo neceffary to the existence of life, that we can live fearcely a minute without this wonderful process.

The analogy between the leaves of plants and the lungs or gills of animals feems to embrace fo many circumftances, that we can fearcely withhold our affent to their performing fimilar offices.

I. The great furface of the leaves compared to that of the trunk and branches of trees is fuch, that it would feem to be an organ well adapted for the purpofe of exposing the vegetable juices to the influence of the air; this however we shall fee afterwards is probably performed only by their upper furfaces, yet even in this case the furface of the leaves in general bear a greater proportion to the furface of the tree, than the lungs of animals to their external furfaces.

2. In the lungs of animal, the blood after having been exposed to the air in the extremities of pulmonary artery, is changed in colour from deep red to bright fcarlet, and certainly in fome of its effential properties; it is then collected by the pulmonary vein and returned to the heart. To fhew a fimilarity of circumftance in the leaves of plants the following experiment was made, June 24, 1781 : A ftalk with leaves and feedveffels of large fpurge (Euphorbia heliofcopia) had been feveral days placed in a decoction of madder (Rubia tinctorum) fo that the lower part of the ftem, and two of the undermost leaves were immerfed in it. After having wafhed the immerfed leaves in clear water, I could readily difcern the colour of the madder paffing along the middle rib of each leaf. This red artery was beautifully visible both on the under and upper furface of the leaf; but on the upper fide many red branches were feen going from it to the extremities of the leaf, which on the other fide were not vifible except by looking through it againft the light. On this under fide a fyftem of branching veffels carrying a pale milky fluid were feen coming from the extremities of the leaf, and covering the whole underfide of it, and joining into two large veins, one on each fide of the red artery in the middle rib of the leaf, and along with it defcending to the footftalk or petiole. On flitting one of thefe leaves with fciffars, and having a common magnifying lens ready, the milky blood was feen oozing out of the returning veins on each fide of the red artery in the middle rib, but none of the red fluid from the artery.

All these appearances were more easily seen in a leaf of Picris treated in the same manner; for in this milky plant the stems and middle rib of the leaves are sometimes naturally coloured reddish, and hence the colour of the madder seemed to pass further into the ramifications of their leaf-arteries, and was there beautifully visible with the returning branches of milky veins on each side.

3. From these experiments the upper furface of the leaf appeared to be the immediate organ of respiration, because the coloured fluid was carried to the extremities of the leaf by vessels most confpicuous on the upper furface, and there changed into a milky fluid, which is the blood of the plant, and then returned by concomitant veins on the under furface, which were seen to ooze when divided with feisfars, and which in Pieris, particularly render the under furface of the leaves greatly whiter than the upper one.

4. As the upper furface of leaves conflitutes the organ of refpiration, on which the fap is expoled in the terminations of arteries beneath a thin pellicle to the action of the atmosphere, these furfaces in many plants flrongly repel moiflure, as cabbage-leaves, whence the particles of rain lying over their furfaces without touching them, as observed by Mr. Melville (Effays Literary and Philosop. Edinburgh) have the appearance of globules of quickfilver. And hence leaves laid with the upper furfaces on water, wither as foon as in the dry air, but continue green many days, if placed with the under furfaces on water, as appears in the experiments of Monf. Bonnet (Ufage des Fevilles.) Hence fome aquatic plants, as the Water-lily (Nymphœa) have the lower fides of their leaves floating on the water, while the upper furfaces remain dry in the air.

5. As those infects, which have many spiracula, or breathing apertures, as wasps and flies, are immediately suffocated by pouring oil upon them, I carefully covered with

NOTE XXXVII. VEGETABLE RESPIRATION.

oil the furfaces of feveral leaves of Phlomis, of Portugal Laurel, and Balfams, and though it would not regularly adhere, I found them all die in a day or two.

Of aquatic leaves, fee Note on Trapa and on Fucus, in Vol. II. to which muft be added that many leaves are furnished with muscles about their footftalks, to turn their upper furfaces to the air or light, as Mimofa and Hedysarum gyrans. From all these analogies I think there can be no doubt but that leaves of trees are their lungs, giving out a phlogiftic material to the atmosphere, and absorbing oxygene or vital air.

6. The great use of light to vegetation would appear from this theory to be by difengaging vital air from the water which they perspire, and thence to facilitate its union with their blood exposed beneath the thin surface of their leaves; fince when pure air is thus applied, it is probable, that it can be more readily absorbed. Hence in the curious experiments of Dr. Priestley and Mr. Ingenhouze, fome plants purified air less than others, that is, they perspired less in the funshine; and Mr. Scheele found that by putting peas into water, which about half-covered them, that they converted the vital air into fixed air, or carbonic acid gas, in the fame manner as in animal respiration. See Note XXXIV.

7. The circulation in the lungs or leaves of plants is very fimilar to that of fifh. In fifh the blood after having paffed through their gills does not return to the heart as from the lungs of air-breathing animals, but the pulmonary vein taking the ftructure of an artery after having received the blood from the gills, which there gains a more florrid colour, diffributes it to the other parts of their bodies. The fame ftructure occurs in the livers of fifh, whence we fee in those animals two circulations independent of the power of the heart, viz. that beginning at the termination of the veins of the gills, and branching through the muscles; and that which paffes through the liver; both which are carried on by the action of those respective arteries and veins. Monro's Physiology of Fish, p. 19.

The course of the fluids in the roots, leaves, and buds of vegetables feems to be performed in a manner fimilar to both these. First the absorbent vessels of the roots and furfaces unite at the footstalk of the leaf; and then, like the Vena Portarum, an artery commences without the intervention of a heart, and spreads the spin its numerous ramifications on the upper furface of the leaf; here it changes its colour and properties, and becomes vegetable blood; and is again collected by a pulmonary vein on the under furface of the leaf. This vein, like that which receives the blood from the gills of fish, assure the office and name of an artery, and branching again disperses the blood upward to the bud from the footstalk of the leaf, and downward to the roots; where it is all expended in the various secretions, the nouris and growth of the plant, as fast as it is prepared.

II. The organ of refpiration already fpoken of belongs particularly to the fhoots or buds, but there is another pulmonary fyftem, perhaps totally independent of the green foliage, which belongs to the fructification only, I mean the corol or petals. In this there is an artery belonging to each petal, which conveys the vegetable blood to its extremities, exposing it to the light and air under a delicate membrane covering the internal furface of the petal, where it often changes its colour, as is beautifully feen in fome partycoloured poppies; though it is probable fome of the iridefcent colours of flowers may be owing to the different degrees of tenuity of the exterior membrane of the leaf refracting the light like foap-bubbles, the vegetable blood is then returned by correspondent vegetable veins, exactly as in the green foliage; for the purposes of the important fecretions of honey, wax, the finer effential oil, and the prolific dust of the anthers.

1. The vafcular ftructure of the corol as above defcribed, and which is visible to the naked eye, and its exposing the vegetable juices to the air and light during the day, evinces that it is a pulmonary organ.

2. As the glands which produce the prolific duft of the anthers, the honey, wax, and frequently fome odoriferous effential oil, are generally attached to the corol, and always fall off and perifh with it, it is evident that the blood is elaborated or oxygenated in this pulmonary fyftem for the purpofe of these important fecretions.

3. Many flowers, as the Colchicum, and Hamamelis arife naked in autumn, no green leaves appearing till the enfuing fpring; and many others put forth their flowers and complete their impregnation early in the fpring before the green foliage appears, as Mezereon, cherries, pears, which fhews that these corols are the lungs belonging to the fructification.

4. This organ does not feem to have been neceffary for the defence of the ftamens and piftils, fince the calyx of many flowers, as Tragopogon, performs this office; and in many flowers these petals themselves are fo tender as to require being shut up in the calyx during the night, for what other use then can such an apparatus of vessels be designed?

5. In the Helleborus-niger, Chriftmas-rofe, after the feeds are grown to a certain fize, the nectaries and flamens drop off, and the beautiful large white petals change their colour to a deep green, and gradually thus become a calyx inclofing and defending the ripening feeds, hence it would feem that the white veffels of the corol ferved the office of expofing the blood to the action of the air, for the purpofes of feparating or producing the honey, wax, and prolific duft, and when thefe were no longer wanted, that thefe veffels coalefced like the placental veffels of animals after their birth, and thus ceafed to perform that office and loft at the fame time their white colour. Why fhould they loofe their white colour, unlefs they at the fame time loft fome other property befides that of defending the feed-veffel, which they ftill continue to defend?

6. From thefe obfervations I am led to doubt whether green leaves be abfolutely neceffary to the progrefs of the fruit-bud after the laft year's leaves are fallen off. The green leaves ferve as lungs to the fhoots and fofter the new buds in their bofoms, whether thefe buds be leaf-buds or fruit-buds; but in the early fpring the fruit-buds expand their corols, which are their lungs, and feem no longer to require green leaves; hence the vine bears fruit at one joint without leaves, and puts out a leaf-bud at another joint without fruit. And I fuppofe the green leaves which rife out of the earth in the fpring from the Colchicum are for the purpofe of producing the new bulb, and its placenta, and not for the giving maturity to the feed. When currant or goofberry trees lofe their leaves by the depredation of infects the fruit continues to be formed, though lefs fweet and lefs in fize.

NOTE XXXVIII. VEGETABLE IMPREGNATION.

7. From these facts it appears that the flower-bud after the corol falls off, (which is its lungs,) and the stamens and nectary along with it, becomes simply an uterus for the purpose of supplying the growing embryon with nourishment, together with a system of absorbent vessels which bring the juices of the earth to the footstalk of the fruit, and which there changes into an artery for the purpose of distributing the sap for the fecretion of the faccharine or farinaceous or acessent materials for the use of the embryon. At the same time as all the vessels of the different buds of trees inosculate or communicate with each other, the fruit becomes sweeter and larger when the green leaves continue on the tree, but the mature flowers themselves, (the succeeding fruit not considered) perhaps fuffer little injury from the green leaves being taken off, as fome florists have observed.

8. That the veffels of different vegetable buds inofculate in various parts of their circulation is rendered probable by the increafed growth of one bud, when others in its vicinity are cut away; as it thus feems to receive the nourifhment which was before divided amongft many.

NOTE XXXVIII.----VEGETABLE IMPREGNATION.

Love out their hour and leave their lives in air. CANTO IV. 1. 456.

FROM the accurate experiments and obfervations of Spallanzani it appears that in the Spartium Junceum, rufh-broom, the very minute feeds were difcerned in the pod at leaft twenty days before the flower is in full bloom, that is twenty days before fecundation. At this time alfo the powder of the anthers was vifible, but glued faft to their fummits. The feeds however at this time, and for ten days after the bloffom had fallen off, appeared to confift of a gelatinous fubftance. On the eleventh day after the falling of the bloffom the feeds became heart-fhape, with the bafis attached by an appendage to the pod, and a white point at the apex; this white point was on preffure found to be a cavity including a drop of liquor.

On the 25th day the cavity which at first appeared at the apex was much enlarged and ftill full of liquor, it also contained a very small semi-transparent body, of a yellowish colour, gelatinous, and fixed by its two opposite ends to the fides of the cavity.

In a month the feed was much enlarged and its fhape changed from a heart to a kidney, the little body contained in the cavity was increased in bulk and was less transparent, and gelatinous, but there yet appeared no organization.

ones are produce

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On the 40th day the cavity now grown larger was quite filled with the body, which was covered with a thin membrane; after this membrane was removed the body appeared of a bright green, and was eafily divided by the point of a needle into two portions, which manifeftly formed the two lobes, and within these attached to the lower part the exceedingly small plantule was eafily perceived.

The foregoing observations evince, I. That the feeds exist in the ovarium many days before fecundation. 2. That they remain for some time solid, and then a cavity containing a liquid is formed in them. 3. That after fecundation a body begins to appear within the cavity fixed by two points to the fides, which in process of time proves to be two lobes containing a plantule. 4. That the ripe feed confiss of two lobes adhering to a plantule, and furrounded by a thin membrane which is itself covered with a husk or cuticle. Spalanzani's Differtations, Vol. II. p. 253.

The analogy between feeds and eggs has long been obferved, and is confirmed by the mode of their production. The egg is known to be formed within the hen long before its impregnation; C. F. Wolf afferts that the yolk of the egg is nourifhed by the veffels of the mother, and that it has from those its arterial and venous branches, but that after impregnation these veffels gradually become impervious and obliterated, and that new ones are produced from the fetus and dispersed into the yolk. Haller's Physiolog. Tom. VIII. p. 94. The young feed after fecundation, I suppose, is nourifhed in a similar manner from the gelatinous liquor, which is previously deposited for that purpose; the uterus of the plant producing or fecreting it into a refervoir or amnios in which the embryon is lodged, and that the young embryon is furnished with vessels to abforb a part of it, as in the very early embryon in the animal uterus.

The fpawn of frogs and of fifh is delivered from the female before its impregnation. M. Bonnet fays that the male falamander darts his femen into the water, where it forms a little whitifh cloud which is afterwards received by the fwoln anus of the female, and fhe is fecundated.—He adds that marine plants approach near to thefe animals, as the male does not project a fine powder but a liquor which in like manner forms a little cloud in the water.—And further adds, who knows but the powder of the ftamina of certain plants may not make fome imprefion on certain germs belonging to the animal kingdom ! Letter XLIII. to Spalanzani, Oevres Philof.

Spalanzani found that the feminal fluid of frogs and dogs even when diluted with much water retained its prolific quality. Whether this quality be fimply a ftimulus exciting the egg into animal action, which may be called a vivifying principle, or whether part of it be actually conjoined with the egg is not yet determined, though the latter feems more probable from the frequent refemblance of the fetus to the male parent. A conjunction however of both the male and female influence feems neceffary for the purpofe of reproduction throughout all organized nature, as well in hermaphrodite infects, microfcopic animals, and polypi, and exifts as well in the formation of the buds of vegetables as in the production of their feeds, which is ingenioufly conceived and explained by Linneus. After having compared the flower to the larva of a butterfly,

NOTE XXXIX. VEGETABLE GLANDULATION.

confifting of petals inftead of wings, calyxes inftead of wing-fheaths, with the organs of reproduction, and having fhewn the ufe of the farina in fecundating the egg or feed, he proceeds to explain the production of the bud. The calyx of a flower, he fays, is an expansion of the outer bark, the petals proceed from the inner bark or rind, the ftamens from the alburnum or woody circle, and the ftyle from the pith. In the production and impregnation of the feed a commixture of the fecretions of the ftamens and ftyle are neceffary; and for the production of a bud he thinks the medulla or pith burfts its integuments and mixes with the woody part or alburnum, and thefe forcing their paffage through the rind and bark confitute the bud or viviparous progeny of the vegetable. System of Vegetables translated from Linneus, p. 8.

It has been fuppofed that the embryon vegetable after fecundation, by its living activity or ftimulus exerted on the veffels of the parent plant, may produce the fruit or feed-lobes, as the animal fetus produces its placenta, and as vegetable buds may be fuppofed to produce their umbilical veffels or roots down the bark of the tree. This in refpect to the production of the fruit furrounding the feeds of trees has been affimilated to the gall-nuts on oak-leaves, and to the bedeguar on briars, but there is a powerful objection to this doctrine, viz. that the fruit of figs, all which are female in this country, grow nearly as large without fecundation, and therefore the embryon has in them no felf-living principle.

NOTE XXXIX.-----VEGETABLE GLANDULATION.

Contraction of the second

Seeks, where fine pores their dulcet balm diftil. CANTO IV. 1. 503.

THE glands of vegetables which feparate from their blood the mucilage, flarch, or fugar for the placentation or fupport of their feeds, bulbs, and buds; or thofe which deposit their bitter, acrid, or narcotic juices for their defence from depredations of infects or larger animals; or thofe which fecrete refins or wax for their protection from moifture or frofts, confift of veffels too fine for the injection or abforption of coloured fluids, and have not therefore yet been exhibited to the infpection even of our glaffes, and can therefore only be known by their effects, but one of the most curious and important of all vegetable fecretions, that of honey, is apparent to our naked eyes, though before the difcoveries of Linneus the nectary or honey-gland had not even acquired a name.

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VEGETABLE GLANDULATION. NOTE XXXIX.

The odoriferous effential oils of feveral flowers feem to have been defigned for their defence against the depredations of infects, while their beautiful colours were a neceffary confequence of the fize of the particles of their blood, or of the tenuity of the exterior membrane of the petal. The ufe of the prolific dust is now well afcertained, the wax which covers the anthers prevents this dust from receiving moissure, which would make it burst prematurely and thence prevent its application to the stigma, as fometimes happens in moist years and is the cause of deficient fecundation both of our fields and orchards.

The univerfality of the production of honey in the vegetable world, and the very complicated apparatus which nature has confructed in many flowers, as well as the acrid or deleterious juices fhe has furnished those flowers with (as in the Aconite) to protect this honey from rain and from the depredations of infects, feem to imply that this fluid is of very great importance in the vegetable economy; and also that it was neceffary to expose it to the open air previous to its reabforption into the vegetable vessel.

In the animal fyftem the lachrymal gland feparates its fluid into the open air for the purpofe of moiftening the eye, of this fluid the part which does not exhale is abforbed by the puncta lachrymalia and carried into the noftrils; but as this is not a nutritive fluid the analogy goes no further than its fecretion into the open air and its reabforption into the fyftem; every other fecreted fluid in the animal body is in part abforbed again into the fyftem, even those which are efteemed excrementitious, as the urine and perfpirable matter, of which the latter is fecreted, like the honey, into the external air. That the honey is a nutritious fluid, perhaps the most fo of any vegetable production, appears from its great fimilarity to fugar, and from its affording fuftenance to fuch numbers of infects, which live upon it folely during fummer, and lay it up for their winter provision. These proofs of its nutritive nature evince the necessity of its reabforption into the vegetable fyftem for fome ufeful purpofe.

This purpofe however has as yet efcaped the refearches of philofophical botanifts. M. Pontedera believes it defigned to lubricate the vegetable uterus, and compares the horn-like nectaries of fome flowers to the appendicle of the cæcum inteftinum of animals. Antholog. p. 49.) Others have fuppofed that the honey, when reabforbed, might ferve the purpofe of the liquor amnii, or white of the egg, as a nutriment for the young embryon or fecundated feed in its early flate of existence. But as the nectary is found equally general in male flowers as in female ones; and as the young embryon or feed grows before the petals and nectary are expanded, and after they fall off; and, thirdly, as the nectary fo foon falls off after the fecundation of the piftillum; thefe feem to be infurmountable objections to both the above-mentioned opinions.

In this flate of uncertainty conjectures may be of use for far as they lead to further experiment and investigation. In many tribes of infects, as the filk-worm, and perhaps in all the moths and butterflies, the male and female parents die as foon as the eggs are

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impregnated and excluded; the eggs remaining to be perfected and hatched at fome future time. The fame thing happens in regard to the male and female parts of flowers; the anthers and filaments, which conftitute the male parts of the flower, and the fligma and ftyle, which conftitute the female part of the flower, fall off and die as foon as the feeds are impregnated, and along with thefe the petals and nectary. Now the moths and butterflies above-mentioned, as foon as they acquire the paffion and the apparatus for the reproduction of their fpecies, loofe the power of feeding upon leaves as they did before, and become nourifhed by what?---by honey alone.

Hence we acquire a flrong analogy for the ufe of the nectary or fecretion of honey in the vegetable economy, which is, that the male parts of flowers, and the female parts, as foon as they leave their fetus-flate, expanding their petals, (which conflitute their lungs,) become fenfible to the paffion, and gain the apparatus for the reproduction of their fpecies, and are fed and nourifhed with honey like the infects above defcribed ; and that hence the nectary begins its office of producing honey, and dies or ceafes to produce honey at the fame time with the birth and death of the flamens and the piftils ; which, whether exifting in the fame or in different flowers, are feparate and diffinct animated beings.

Previous to this time the anthers with their filaments, and the fligmas with their ftyles, are in their fetus-flate fuffained by their placental veffels, like the unexpanded leaf-bud; with the feeds exifting in the vegetable womb yet unimpregnated, and the duft yet unripe in the cells of the anthers. After this period they expand their petals, which have been flewn above to conflitute the lungs of the flower; the placental veffels, which before nourifhed the anthers and the fligmas, coalefce or ceafe to nourifh them; and they now acquire blood more oxygenated by the air, obtain the paffion and power of reproduction, are fenfible to heat, and cold, and moifture, and to mechanic flimulus, and become in reality infects fed with honey, fimilar in every refpect except their being attached to the tree on which they were produced.

Some experiments I have made this fummer by cutting out the nectaries of feveral flowers of the aconites before the petals were open, or had become much coloured, fome of these flowers near the fummit of the plants produced no feeds, others lower down produced feeds; but they were not fufficiently guarded from the farina of the flowers in their vicinity; nor have I had opportunity to try if these feeds would vegetate.

I am acquainted with a philofopher, who contemplating this fubject thinks it not impoffible, that the first infects were the anthers or sligmas of flowers; which had by fome means loofed themfelves from their parent plant, like the male flowers of Vallisseria; and that many other infects have gradually in long process of time been formed from these; fome acquiring wings, others fins, and others claws, from their ceaseless efforts to procure their food, or to secure themfelves from injury. He contends, that none of these changes are more incomprehensible than the transformation of tadpoles into frogs, and caterpillars into butterflies.

There are parts of animal bodies, which do not require oxygenated blood for the purpole of their fecretions, as the liver; which for the production of bile takes its blood from the mefenteric veins, after it must have lost the whole or a great part of its oxygenation, which it had acquired in its passage through the lungs. In like manner the pericarpium, or womb of the flower, continues to fecrete its proper juices for the present nourishment of the newly animated embryon-feed; and the faccharine, acescent, or flarchy matter of the fruit or feed-lobes for its future growth; in the fame manner as these things went on before fecundation; that is, without any circulation of juices in the petals, or production of honey in the nectary; these having perished and fallen off with the male and female apparatus for impregnation.

It is probable that the depredations of infects on this nutritious fluid muft be injurious to the products of vegetation, and would be much more fo, but that the plants have either acquired means to defend their honey in part, or have learned to make more than is abfolutely neceflary for their own economy. In the fame manner the honey-dew on trees is very injurions to them; in which difeafe the nutritive fluid, the vegetable-fapjuice, feems to be exfuded by a retrograde motion of the cutaneous lymphatics, as in the fweating ficknefs of the laft century. To prevent the depredation of infects on honey a wealthy man in Italy is faid to have poifoned his neighbour's bees perhaps by mixing arfnic with honey, againft which there is a moft flowery declamation in Quintilian. No. XIII. As the ufe of the wax is to preferve the duft of the anthers from moifture, which would prematurely burft them, the bees which collect this for the conftruction of the combs or cells, muft on this account alfo injure the vegetation of a country where they too much abound.

It is not eafy to conjecture why it was neceffary that this fecretion of honey fhould be exposed to the open air in the nectary or honey-cup, for which purpole fo great an apparatus for its defence from infects and from flowers became neceffary. This difficulty increases when we recollect that the fugar in the joints of grass, in the fugar-cane, and in the roots of beets, and in ripe fruits is produced without the exposure to the air. On supposition of its ferving for nutriment to the anthers and ftigmas it may thus acquire greater oxygenation for the purpose of producing greater powers of fensibility, according to a doctrine lately advanced by a French philosopher, who has endeavoured to shew that the oxygene, or base of vital air, is the constituent principle of our power of fensibility.

From this provision of honey for the male and female parts of flowers, and from the provision of fugar, flarch, oil, and mucilage, in the fruits, feed-cotyledons, roots, and buds of plants laid up for the nutriment of the expanding fetus, not only a very numerous class of infects, but a great part of the larger animals procure their food; and thus enjoy life and pleafure without producing pain to others, for these feeds or eggs with the nutriment laid up in them are not yet endued with fensitive life.

The fecretions from various vegetable glands hardened in the air produce gums, refins, and various kinds of faccharine, faponaceous, and wax-like fubftances, as the gum of cherry or plumb-trees, gum tragacanth from the aftragalus tragacantha, camphor from the laurus camphora, elemi from amyris elemifera, aneme from hymenœa courbaril, turpentine from piftacia terebinthus, balfam of Mecca from the buds of amyris opobal-

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famum, branches of which are placed in the temples of the East on account of their fragrance, the wood is called xylobalfamum, and the fruit carpobalfamum; aloe from a plant of the fame name; myrrh from a plant not yet defcribed; the remarkably elaftic refin is brought into Europe principally in the form of flafks, which look like black leather, and are wonderfully elastic, and not penetrable by water, rectified ether diffolves it; its flexibility is encreafed by warmth and deftroyed by cold ; the tree which yields this juice is the jatropha elaftica, it grows in Guaiana and the neighbouring tracts of America; its juice is faid to refemble wax in becoming foft by heat, but that it acquires no elafticity till that property is communicated to it by a fecret art, after which it is poured into moulds and well dried and can no longer be rendered fluid by heat. Mr. de la Borde phyfician at Cayenne has given this account. Manna is obtained at Naples from the fraxinus ornus, or manna-afh, it partly iffues fpontaneoufly, which is preferred, and partly exfudes from wounds made purpofely in the month of August, many other plants yield manna more fparingly; fugar is properly made from the faccharum officinale, or fugar-cane, but is found in the roots of beet and many other plants; American wax is obtained from the myrica cerifera, candle-berry myrtle, the berries are boiled in water and a green wax feparates, with luke-warm water the wax is yellow: the feed of croton febiferum are lodged in tallow; there are many other vegetable exfudations ufed in the various arts of dyeing, varnifhing, tanning, lacquering, and which fupply the fhop of the druggift with medicines and with poifons.

There is another analogy, which would feem to affociate plants with animals, and which perhaps belongs to this Note on Glandulation, I mean the fimilarity of their digeftive powers. In the roots of growing vegetables, as in the procefs of making malt, the farinaceous part of the feed is converted into fugar by the vegetable power of digeftion in the fame manner as the farinaceous matter of feeds are converted into fweet chyle by the animal digeftion. The fap-juice which rifes in the vernal months from the roots of trees through the alburnum or fap-wood, owes its fweetnefs I fuppofe to a fimilar digeftive power of the abforbent fyftem of the young buds. This exifts in many vegetables in great abundance as in vines, fycamore, birch, and moft abundantly in the palm-tree, (Ifert's Voyage to Guinea,) and feems to be a fimilar fluid in all plants, as chyle is fimilar in all animals.

Hence as the digefted food of vegetables confifts principally of fugar, and from that is produced again their mucilage, flarch, and oil, and fince animals are fuftained by thefe vegetable productions, it would feem that the fugar-making procefs carried on in vegetable veffels was the great fource of life to all organized beings. And that if our improved chemistry fhould ever difcover the art of making fugar from foffile or aerial matter without the affiftance of vegetation, food for animals would then become as plentiful as water, and mankind might live upon the earth as thick as blades of grafs, with no reftraint to their numbers but the want of local room.

It would feem that roots fixed in the earth, and leaves innumerable waving in the air were neceffary forthe decomposition of water, and the conversion of it into faccharine matter, which would have been not only cumberous but totally incompatible with the locomotion of animal bodies. For how could a man or quadruped have carried on his head or back a foreft of leaves, or have had long branching lacteal or abforbent veffels terminating in the earth? Animals therefore fubfift on vegetables; that is, they take the matter fo far prepared, and have organs to prepare it further for the purpofes of higher animation, and greater fenfibility. In the fame manner the apparatus of green leaves and long roots were found inconvenient for the more animated and fenfitive parts of vegetable-flowers, I mean the anthers and ftigmas, which are therefore feparate beings, endued with the paffion and power of reproduction, with lungs of their own, and fed with honey, a food ready prepared by the long roots and green leaves of the plant, and pre-fented to their abforbent mouths.

From this outline a philosopher may catch a glimpse of the general economy of nature; and like the mariner cast upon an unknown shore, who rejoiced when he faw the print of a human foot upon the fand, he may cry out with rapture, "A GOD DWELLS "HERE."

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The following is an Addition to the Note on Coal, No. XXIII.

FROM this account of the production of coals from moraffes it would appear, that coal-beds are not to be expected beneath maffes of lime-ftone. Neverthelefs I have been lately informed by my friend Mr. Michell of Thornhill, who I hope will foon favour the public with his geological inveftigations, that the beds of chalk are the uppermoft of all the limeftones; and that they reft on the granulated limeftone, called ketton-ftone; which I fuppofe is fimilar to that which covers the whole country from Leadenham to Sleaford, and from Sleaford to Lincoln; and that, thirdly, coal-delphs are frequently found beneath thefe two uppermoft beds of limeftone.

Now as the beds of chalk and of granulated limeftone may have been formed by alluviation, on or beneath the fhores of the fea, or in vallies of the land; it would feem, that fome coal countries, which in the great commotions of the earth had been funk beneath the water, were thus covered with alluvial limeftone, as well as others with alluvial bafaltes, or common gravel-beds. Very extensive plains which now confift of alluvial materials, were in the early times covered with water; which has fince diminifhed, as the folid parts of the earth have increafed. For the folid parts of the earth confifting chiefly of animal and vegetable recrements must have originally been formed or produced from the water by animal and vegetable proceffes; and as the folid parts of the earth may be fuppofed to be thrice as heavy as water, it follows that thrice the quantity of water muft have vanished compared with the quantity of earth thus produced. This may account for many immense beds of alluvial materials, as gravel, rounded fand, granulated limeftone, and chalk, covering fuch extensive plains as Lincoln-heath, having become dry without the fuppolition of their having been again elevated from the ocean. At the fame time we acquire the knowledge of one of the uses or final causes of the organized world, not indeed very flattering to our vanity, that it converts water into earth, forming iflands and continents by its recrements or exuviæ.

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NOTES OMITTED.

Expiring groans. p. 98. l. 451. Mr. Savery or Mr. Volney in their Travels through Egypt has given a curious defcription of one of the pyramids, with the operofe method of clofing them, and immuring the body, (as they fuppofed) for fix thoufand years. And has endeavoured from thence to fhew, that, when a monarch died, feveral of his favourite courtiers were inclofed alive with the mummy in these great masses of ftonework; and had food and water conveyed to them, as long as they lived, proper apertures being left for this purpose, and for the admission of air, and for the exclusion of any thing offensive.

Unfolds bis larva-form. p. 197. l. 458. The flower burfts forth from its larva, the herb, naked and perfect like a butterfly from its chryfolis; winged with its corol; wing-fheathed by its calyx; confifting alone of the organs of reproduction. The males, or flamens, have their anthers replete with a prolific powder containing the vivifying fovilla: in the females, or piftils, exifts the ovary, terminated by the tubular fligma. When the anthers burft and fled their bags of duft, the male fovilla is received by the prolific lymph of the fligma, and produces the feed or egg, which is nourifled in the ovary. Syftem of Vegetables translated from Linneus by the Lichfield Society. p. 10.

Wound them ye Sylphs ! p. 198. 1. 463. It is cuftomary to debark oak-trees in the fpring, which are intended to be felled in the enfuing autumn; becaufe the bark comes off eafier at this feafon, and the fap-wood, or alburnum, is believed to become harder and more durable, if the tree remains till the end of fummer. The trees thus ftripped of their bark put forth fhoots as ufual with acorns on the 6th 7th and 8th joint, like vines; but in the branches I examined, the joints of the debarked trees were much fhorter than those of other oak-trees; the acorns were more numerous; and no new buds were produced above the joints which bore acorns. From hence it appears that the branches of debarked oak-trees produce fewer leaf-buds, and more flower-buds, which laft circumftance I suppose must depend on their being sooner or later debarked in the vernal months. And, fecondly, that the new buds of debarked oak-trees continue to obtain moifture from the alburnum after the feafon of the afcent of fap in other vegetables ceafes; which in this unnatural flate of the debarked tree may act as capillary tubes, like the alburnum of the fmall debarked cylinder of a pear-tree abovementioned; or may continue to act as placental veffels, as happens to the animal embryon in cafes of fuperfetation; when the fetus continues a month or two in the womb beyond its ufual time, of which fome inftances have been recorded, the placenta continues to fupply perhaps the double office both of nutrition and of refpiration.

With new prolific power. p. 199. l. 467. About Midfummer the new buds are formed, but it is believed by fome of the Linnean fchool, that these buds may in their early flate be either converted into flower-buds or leaf-buds according to the vigour of the vegetating branch. Thus if the upper part of a branch be cut away, the buds near the extremity of the remaining flem, having a greater proportional fupply of nutriment, or posseffing a greater facility of flooting their roots, or absorbent vessels, down the bark, will become leaf-buds, which might otherwise have been flower-buds. And the contrary as explained in note on l. 463. of this Canto.

Clofed in the flyle. p. 199. l. 469. " I conceive the medulla of a plant to confift of a bundle of nervous fibres, and that the propelling vital power feparates their uppermoft extremities. Thefe, diverging, penetrate the bark, which is now gelatinous, and become multiplied in the new gem, or leaf-bud. The afcending veffels of the bark being thus divided by the nervous fibres, which perforate it, and the afcent of its fluids being thus impeded, the bark is extended into a leaf. But the flower is produced, when the protruction of the medulla is greater than the retention of the including cortical part; whence the fubftance of the bark is expanded in the calyx; that of the rind, (or interior bark,) in the corol; that of the wood in the flamens, that of the medulla in the piftil. Vegetation thus terminates in the production of new life, the ultimate medullary and cortical fibres being collected in the feeds." Linnei Syftema Veget. p. 6. edit. 14.

Diana's trees. p. 206. l. 552. The chemifts and aftronomers from the earlieft antiquity have used the fame characters to represent the metals and the planets, which were most probably outlines or abstracts of the original hieroglyphic figures of Egypt. These afterwards acquired niches in their temples, and represented Gods as well as metals and planets; whence filver is called Diana, or the moon, in the books of alchemy.

The process for making Diana's filver tree is thus described by Lemeri. Diffolve one ounce of pure filver in acid of nitre very pure and moderately ftrong; mix this folution with about twenty ounces of diffilled water; add to this two ounces of mercury, and let it remain at reft. In about four days there will form upon the mercury a tree of filver with branches imitating vegetation.

1. As the mercury has a greater affinity than filver with the nitrous acid, the filver becomes precipitated; and, being deprived of the nitrous oxygene by the mercury, finks down in its metallic form and luftre. 2. The attraction between filver and mercury, which caufes them readily to amalgamate together, occafions the precipitated filver to adhere to the furface of the mercury in preference to any other part of the veffel. 3. The attraction of the particles of the precipitated filver to each other caufes the beginning branches to thicken and elongate into trees and fhrubs rooted on the mercury. For other circumftances concerning this beautiful experiment fee Mr. Keir's Chemical Dictionary, art. Arbor Dianæ; a work perhaps of greater utility to mankind than the loft Alexandrian Library; the continuation of which is fo eagerly expected by all, who are occupied in the arts, or attached to the fciences.



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OF THE

ADDITIONAL NOTES.

NOTE I.....METEORS.

THERE are four ftrata of the atmosphere, and four kinds of meteors. 1. Lightning is electric, exists in visible clouds, its short course, and red light. 2. Shooting stars exist in invisible vapour, without sound, white light, have no luminous trains. 3. Twilight; fire-balls move thirty miles in a fecond, and are about fixty miles high, have luminous trains, occasioned by an electric spark passing between the aerial and inflammable strata of the atmosphere, and mixing them and setting them on fire in its passing; attracted by volcanic eruptions; one thousand miles through such a medium resists less than the tenth of an inch of glass. 4. Northern lights not attracted to a point but diffused; their colours; passing of electric fire in vacuo dubious; Dr. Franklin's theory of of northern lights countenanced in part by the supposition of a superior atmosphere of inflammable air; antiquity of their appearance; described in Maccabees.

NOTE II PRIMARY COLOURS.

THE rainbow was in part underftood before Sir Ifaac Newton; the feven colours were difcovered by him; Mr. Galton's experiments on colours; manganese and lead produce colourles glass.

NOTE III COLOURED CLOUDS.

THE rays refracted by the convexity of the atmosphere; the particles of air and of water are blue; fhadow by means of a candle in the day; halo round the moon in a fog; bright spot in the cornea of the eye; light from cat's eyes in the dark, from a horse's eyes in a cavern, coloured by the choroid coat within the eye.

NOTE IV COMETS.

TAILS of comets from rarified vapour, like northern lights, from electricity; twenty millions of miles long; expected comet.

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NOTE V.....SUN'S RAYS.

DISPUTE about phlogiston; the fun the fountain from whence all phlogiston is derived; its rays not luminous till they arrive at our atmosphere; light owing to their combustion with air, whence an unknown acid; the fun is on fire only on its furface; the dark spots on it are excavations through its luminous crust.

NOTE VI CENTRAL FIRES.

SUN's heat much lefs than that from the fire at the earth's centre; fun's heat penetrates but a few feet in fummer; fome mines are warm; warm fprings owing to fubterraneous fire; fituations of volcanos on high mountains; original nucleus of the earth; deep vallies of the ocean; diftant perception of earthquakes; great attraction of mountains; variation of the compass; countenance the existence of a cavity or fluid lava within the earth.

NOTE VII ELEMENTARY HEAT.

COMBINED and fenfible heat; chemical combinations attract heat, folutions reject heat; ice cools boiling water fix times as much as cold water cools it; cold produced by evaporation; heat by devaporation; capacities of bodies in refpect to heat, I. Existence of the matter of heat shewn from the mechanical condensation and rarefaction of air, from the steam produced in exhausting a receiver, fnow from rarefied air, cold from discharging an air-gun, heat from vibration or friction; 2. Matter of heat analogous to the electric fluid in many circumstances, explains many chemical phenomena.

NOTE VIII MEMNON'S LYRE.

MECHANICAL impulse of light dubious; a glass tube laid horizontally before a fire revolves; pulse-glass sufpended on a centre; black leather contracts in the sufficience; Memnon's statue broken by Cambyses.

NOTE IX LUMINOUS INSECTS.

EIGHTEEN fpecies of glow-worm, their light owing to their refpiration in transparent lungs; Acudia of Surinam gives light enough to read and draw by, use of its light to the infect; luminous fea-infects adhere to the skin of those who bathe in the ports of Languedoc, the light may arise from putrescent flime.

NOTE X PHOSPHORUS.

DISCOVERED by Kunkel, Brandt, and Boyle; produced in refpiration, and by luminous infects, decayed wood, and calcined fhells; bleaching a flow combuftion in which the water is decomposed; rancidity of animal fat owing to the decomposition of water on its furface; aerated marine acid does not whiten or bleach the hand.
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NOTE XI STEAM-ENGINE.

HERO of Alexandria first applied steam to machinery, next a French writer in 1630, the Marquis of Worcester in 1655, Capt. Savery in 1689, Newcomen and Cawley added the piston; the improvements of Watt and Boulton; power of one of their large engines equal to two hundred horses.

NOTE XII FROST.

EXPANSION of water in freezing; injury done by vernal frofts; fifh, eggs, feeds, refift congelation; animals do not refift the increase of heat; frofts do not meliorate the ground, nor are in general falubrious; damp air produces cold on the fkin by evaporation; fnow lefs pernicious to agriculture than heavy rains for two reasons.

NOTE XIII ELECTRICITY.

1. Points preferable to knobs for defence of buildings; why points emit the electric fluid; diffusion of oil on water; mountains are points on the earth's globe; do they produce ascending currents of air? 2. Fairy-rings explained; advantage of paring and burning ground.

NOTE XIV BUDS AND BULBS.

A TREE is a fwarm of individual plants; vegetables are either oviparous or viviparous; are all annual productions like many kinds of infects? Hybernacula, a new bark annually produced over the old one in trees and in fome herbaceous plants, whence their roots feem end-bitten; all bulbous roots perifh annually; experiment on a tuliproot; both the leaf-bulbs and the flower-bulbs are annually renewed.

NOTE XV SOLAR VOLCANOS.

THE fpots in the fun are cavities, fome of them four thoufand miles deep and many times as broad; internal parts of the fun are not in a ftate of combuftion; volcanos vifible in the fun; all the planets together are lefs than one fix hundred and fiftieth part of the fun; planets were ejected from the fun by volcanos; many reafons fhewing the probability of this hypothefis; Mr. Buffon's hypothefis that planets were ftruck off from the fun by comets; why no new planets are ejected from the fun; fome comets and the georgium fidus may be of later date; Sun's matter decreafed; Mr. Ludlam's opinion, that it is poffible the moon might be projected from the earth.

NOTE XVI CALCAREOUS EARTH.

HIGH mountains and deep mines replete with fhells; the earth's nucleus covered with limeftone; animals convert water into limeftone; all the calcareous earth in the world formed in animal and vegetable bodies; folid parts of the earth increafe; the water decreafes; tops of calcareous mountains diffolved; whence fpar, marbles, chalk, falactites; whence alabafter, fluor, flint, granulated limeftone, from folution of their angles, and by attrition; tupha deposited on mofs; limeftones from fhells with animals

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in them; liver-ftone from frefh-water muscles; calcareous earth from land-animals and vegetables, as marl; beds of marble foftened by fire; whence Bath-ftone contains lime as well as limeftone.

NOTE XVII MORASSES.

THE production of moraffes from fallen woods; account by the Earl Cromartie of a new morafs; moraffes lofe their falts by folution in water; then their iron; their vegetable acid is converted into marine, nitrous, and vitriolic acids; whence gypfum, alum, fulphur; into fluor-acid, whence fluor; into filiceous acid, whence flint, the fand of the fea, and other ftrata of filiceous fand and marl; fome moraffes ferment like new hay, and, fubliming their phlogiftic part, form coal-beds above and clay below, which are alfo produced by elutriation; fhell-fifh in fome moraffes, hence fhells fometimes found on coals and over iron-ftone.

NOTE XVIII.....IRON

CALCIFORM ores; combustion of iron in vital air; steel from deprivation of vital air; welding; hardnefs; brittlenefs like Rupert's drops; specific levity; hardnefs and brittlenefs compared; steel tempered by its colours; modern production of iron, manganese, calamy; septaria of iron-store ejected from volcanos; red-hot cannon balls.

NOTE XIX FLINT.

I. Siliceous rocks from moraffes; their cements. 2. Siliceous trees; coloured by iron or manganefe; Peak-diamonds; Briftol-ftones; flint in form of calcareous fpar; has been fluid without much heat; obtained from powdered quartz and fluor-acid by Bergman and by Achard. 3. Agates and onyxes found in fand-rocks ; of vegetable origin ; have been in complete fufion; their concentric coloured circles not from fuperinduction but from congelation; experiment of freezing a folution of blue vitriol; iron and manganefe repelled in fpheres as the nodule of flint cooled; circular ftains of marl in faltmines; fome flint nodules refemble knots of wood or roots. 4. Sand of the fea; its acid from moraffes; its bafe from shells. 5. Chert or petrofilex stratified in cooling; their colour and their acid from fea-animals; labradore-ftone from mother-pearl. 6. Flints in chalk-beds; their form, colour, and acid, from the flefh of fea-animals; fome are hollow and lined with cryftals; contain iron; not produced by injection from without; coralloids converted to flint; French-millftones; flints fometimes found in folid ftrata. 7. Angles of fand deftroyed by attrition and folution in fteam; filiceous breccia cemented by folution in red-hot water. 8. Bafaltes and granites are antient lavas; bafaltes raifed by its congelation not by fubterraneous fire.

NOTE XX.....CLAY.

FIRE and water two great agents; firatification from precipitation; many firatified materials not foluble in water. I. Stratification of lava from fucceffive accumulation. 2. Stratifications of limeftone from the different periods of time in which the fhells were

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depofited. 3. Stratifications of coal, and clay, and fandftone, and iron-ores, not from currents of water, but from the production of morafs-beds at different periods of time; morafs-beds become ignited; their bitumen and fulphur is fublimed; the clay, lime, and iron remain; whence fand, marle, coal, white clay in valleys, and gravel-beds, and fome ochres, and fome calcareous depofitions owing to alluviation; clay from decompofed granite; from the lava of Vefuvius; from vitreous lavas.

NOTE XXI ENAMELS.

ROSE-COLOUR and purple from gold; precipitates of gold by alcaline falt preferable to those by tin; aurum fulminans long ground; tender colours from gold or iron not diffolved but fuspended in the glass; cobalts; calces of cobalt and copper require a ftrong fire; Ka-o-lin and Pe-tun-tfe the fame as our own materials.

NOTE XXII PORTLAND VASE.

ITS figures do not allude to private hiftory; they reprefent a part of the Elufinian myfteries; marriage of Cupid and Pfyche; proceffion of torches; the figures in one compartment reprefent MORTAL LIFE in the act of expiring, and HUMANKIND attending to her with concern; Adam and Eve hyeroglyphic figures; Abel and Cain other hyero-glyphic figures; on the other compartment is reprefented IMMORTAL LIFE, the Manes or Ghoft defcending into Elifium is led on by DIVINE LOVE, and received by IMMORTAL LIFE, and conducted to Pluto; Tree of Life and Knowledge are emblematical; the figure at the bottom is of Atis, the firft great Hierophant, or teacher of myfteries.

NOTE XXIII.....COAL.

I. A fountain of foffile tar in Shropfhire; has been diftilled from the coal-beds beneath, and condenfed in the cavities of a fand-rock; the coal beneath is deprived of its bitumen in part; bitumen fublimed at Matlock into cavities lined with fpar. 2. Coal has been expoled to heat; woody fibres and vegetable feeds in coal at Bovey and Polefworth; upper part of coal-beds more bituminous at Beaudefert; thin ftratum of afphaltum near Caulk; upper part of coal-bed worfe at Alfreton; upper ftratum of no value at Widdrington; alum at Weft-Hallum; at Bilfton. 3. Coal at Coalbrooke-Dale has been immerfed in the fea, fhewn by fea-fhells; marks of violence in the colliery at Mendip and at Ticknal; Lead-ore and fpar in coal-beds; gravel over coal near Lichfield; Coal produced from moraffes fhewn by fern-leaves, and bog-fhells, and mufcle-fhells; by fome parts of coal being ftill woody; from Lock Neagh and Bovey, and the Temple of the devil; fixed alcali; oil.

NOTE XXIV GRANITE.

GRANITE the lowest stratum of the earth yet known; porphory, trap, Moorstone, Whin-stone, slate, basaltes, all volcanic productions disfolved in red-hot water; volcanos in granite strata; differ from the heat of morasses from fermentation; the

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nucleus of the earth ejected from the fun? was the fun originally a planet? fuppofed fection of the globe.

NOTE XXV EVAPORATION.

I. Solution of water in air; in the matter of heat; pulfe-glafs. 2. Heat is the principal caufe of evaporation; thermometer cooled by evaporation of ether; heat given from fteam to the worm-tub; warmth accompanying rain. 3. Steam condenfed on the eduction of heat; moifture on cold walls; fouth-weft and north-eaft winds. 4. Solution of falt and of blue vitriol in the matter of heat. II. Other vapours may precipitate fteam and form rain. I. Cold the principal caufe of devaporation; hence the fteam diffolved in heat is precipitated, but that diffolved in air remains even in frofts; fouthweft wind. 2. North-eaft winds mixing with fouth-weft winds produce rain; becaufe the cold particles of air of the north-east acquire fome of the matter of heat from the fouth-weft winds. 3. Devaporation from mechanical expansion of air, as in the receiver of an air-pump; fummer-clouds appear and vanish; when the barometers fink without change of wind the weather becomes colder. 4. Solution of water in electric fluid dubious. 5. Barometer finks from the leffened gravity of the air, and from the rain having lefs preffure as it falls; a mixture of a folution of water in calorique with an aerial folution of water is lighter than dry air; breath of animals in cold weather why condenfed into visible vapour and diffolved again.

NOTE XXVI Springs.

LOWEST strata of the earth appear on the highest hills; springs from dews sliding between them; mountains are colder than plains; I. from their being infulated in the air; 2. from their enlarged surface; 3. from the rarety of the air it becomes a better conductor of heat; 4. by the air on mountains being mechanically rarefied as it as a better 5. gravitation of the matter of heat; 6. the dashing of clouds against hills; of fogs against trees; springs stronger in hot days with cold nights; streams from subterranean caverns; from beneath the stream on the Alps.

NOTE XXVII SHELL-FISH.

THE armour of the Echinus moveable; holds itfelf in florms to flones by 1200 or 2000 ftrings: Nautilus rows and fails; renders its fhell buoyant: Pinna and Cancer; Byffus of the antients was the beard of the Pinna; as fine as the filk is fpun by the filk-worm; gloves made of it; the beard of mufcles produces ficknefs; Indian weed; tendons of rats tails.

NOTE XXVIII STURGEON.

STURGEON'S mouth like a purfe; without teeth; tendrils like worms hang before his lips, which entice fmall fifh and fea-infects miftaking them for worms; his fkin ufed for covering carriages; ifinglafs made from it; caviare from the fpawn.

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NOTE XXIX OIL ON WATER.

OIL and water do not touch; a fecond drop of oil will not diffuse itself on the preceeding one; hence it ftills the waves; divers for pearl carry oil in their me ths; oil on water produces prismatic colours; oiled cork circulates on water; a phial of oil and water made to ofcillate.

NOTE XXX SHIP-WORM.

THE Teredo has calcareous jaws; a new enemy; they perifh when they meet together in their ligneous canals; United Provinces alarmed for the piles of the banks of Zeland; were deftroyed by a fevere winter.

NOTE XXXI MAELSTROM.

A WHIRLPOOL on the coaft of Norway; paffes through a fubterraneous cavity; lefs violent when the tide is up; eddies become hollow in the middle; heavy bodies are thrown out by eddies; light ones retained; oil and water whirled in a phial; hurricanes explained.

NOTE XXXII.....GLACIERS.

Snow in contact with the earth is in a flate of thaw; ice-houfes; rivers from beneath the fnow; rime in fpring vanishes by its contact with the earth; and fnow by its evaporation and contact with the earth; moss vegetates beneath the fnow; and Alpine plants perish at Upfal for want of fnow.

NOTE XXXIII WINDS.

AIR is perpetually fubject to increase and to diminution ; Oxygene is perpetually produced from vegetables in the funfhine, and from clouds in the light, and from water; Azote is perpetually produced from animal and vegetable putrefaction, or combustion; from fprings of water; volatile alcali; fixed alcali; fea-water; they are both perpetually diminished by their contact with the foil, producing nitre; Oxygene is diminished in the production of all acids; Azote by the growth of animal bodies; charcoal in burning confumes double its weight of pure air; every barrel of red-lead abforbes 2000 cubic feet of vital air; air obtained from variety of fubftances by Dr. Prieftley; Officina aeris in the polar circle, and at the Line. Souh-weft winds; their westerly direction from the lefs velocity of the earth's furface; the contrary in refpect to north-eaft winds; Southweft winds confift of regions of air from the fouth; and north-eaft winds of regions of air from the north; when the fouth-weft prevails for weeks and the barometer finks to 28, what becomes of above one fifteenth part of the atmosphere; I. It is not carried back by fuperior currents; 2. Not from its lofs of moifture; 3. Not carried over the pole; 4. Not owing to atmospheric tides or mountains; 5. It is absorbed at the polar circle; hence fouth-weft winds and rain; fouth-weft fometimes cold. North-east winds confift of air from the north; cold by the evaporation of ice; are dry winds; I. Not fup-

plied by fuperior currents; 2. The whole atmosphere increased in quantity by air fet at liberty from its combinations in the polar circles. South-east winds confift of north winds driven back. North-weft winds confift of fouth-weft winds driven back ; northweft winds of America bring froft; owing to a vertical fpiral eddy of air between the eaftern coaft and the Apalachian mountains; hence the greater cold of North America. Trade-winds; air over the Line always hotter than at the tropics; trade-winds gain their eafterly direction from the greater velocity of the earth's furface at the line; not fupplied by fuperior currents; fupplied by decomposed water in the fun's great light; I. Becaufe there are no conftant rains in the tract of the trade-winds; 2. Becaufe there is no condenfible vapour above three or four miles high at the line. Monfoons and tornadoes; fome places at the tropic become warmer when the fun is vertical than at the line; hence the air afcends, fupplied on one fide by the north-east winds, and on the other by the fouth-weft; whence an afcending eddy or tornado, raifing water from the fea, or fand from the defert, and inceffant rains; air diminished to the northward produces fouthweft winds; tornadoes from heavier air above finking through lighter air below, which rifes through a perforation; hence trees are thrown down in a narrow line of twenty or forty yards broad, the fea rifes like a cone, with great rain and lightning. Land and fea breezes; fea lefs heated than land; tropical islands more heated in the day than the fea, and are cooled more in the night. Conclusion; irregular winds from other caufes; only two original winds north and fouth; different founds of north-eaft and fouthweft winds; a Bear or Dragon in the arctic circle that fwallows at times and difembogues again above one fifteenth part of the atmosphere; wind-instruments; recapitulation.

NOTE XXXIV VEGETABLE PERSPIRATION.

PURE air from Dr. Prieftley's vegetable matter, and from vegetable leaves, owing to decomposition of water; the hydrogene retained by the vegetables; plants in the shade are *tanned* green by the fun's light; animal skins are *tanned* yellow by the retention of hydrogene; much pure air from dew on a funny morning; bleaching why some performed on cotton than linen; bees wax bleached; metals calcined by decomposition of water; oil bleached in the light becomes yellow again in the dark; nitrous acid coloured by being exposed to the fun; vegetables perspire more than animals, hence in the suffhine they purify air more by their perspiration than they injure it by their respiration; they grow fastes in their steps.

NOTE XXXV VEGETABLE PLACENTATION.

BUDS the viviparous offspring of vegetables; placentation in bulbs and feeds; placentation of buds in the roots, hence the rifing of fap in the fpring, as in vines, birch, which ceafes as foon as the leaves expand; production of the leaf of Horfe-chefnut, and of its new bud; oil of vitriol on the bud of Mimofa killed the leaf alfo; placentation thewn from the fweetnefs of the fap; no umbilical artery in vegetables.

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NOTE XXXVI VEGETABLE CIRCULATION.

Bubs fet in the ground will grow if prevented from bleeding to death by a cement; vegetables require no muscles of locomotion, no ftomach or bowels, no general fyftem of veins; they have, I. Three fyftems of abforbent veffels; 2. Two pulmonary fyftems; 3. Arterial fyftems; 4. Glands; 5. Organs of reproduction; 6. muscles. I. Abforbent fyftem evinced by experiments by coloured abforptions in fig-tree and picris; called airveffels erroneously; fpiral ftructure of abforbent veffels; retrograde motion of them like the throats of cows. II. Pulmonary arteries in the leaves, and pulmonary veins; no general fyftem of veins shewn by experiment; no heart; the arteries act like the vena portarum of the liver; pulmonary fystem in the petals of flowers; circulation owing to living irritability; vegetable abforption more powerful than animal, as in vines; not by capillary attraction.

NOTE XXXVII VEGETABLE RESPIRATION.

I. Leaves not perfpiratory organs, nor excretory ones; lungs of animals. I. Great furfaces of leaves. 2. Vegetable blood changes colour in the leaves; experiment with fpurge; with picris. 3. Upper furface of the leaf only acts as a refpiratory organ. 4. Upper furface repels moifture; leaves laid on water. 5. Leaves killed by oil like infects; mufcles at the foot-ftalks of leaves. 6. Ufe of light to vegetable leaves; experiments of Prieftley, Ingenhouze, and Scheel. 7. Vegetable circulation fimilar to that of fifh. II. Another pulmonary fyftem belongs to flowers; colours of flowers. I. Vafcular ftructure of the corol. 2. Glands producing honey, wax, &c. perifh with the corol. 3. Many flowers have no green leaves attending them, as Colchicum. 4. Corols not for the defence of the flamens. 5. Corol of Helleborus Niger changes to a calyx. 6. Green leaves not neceffary to the fruit-bud; green leaves of Colchicum belong to the new bulb not to the flower. 7. Flower-bud after the corol falls is fimply an uterus; mature flowers not injured by taking of the green leaves. 8. Inofculation of vegetable veffels.

NOTE XXXVIII VEGETABLE IMPREGNATION.

SEEDS in broom difcovered twenty days before the flower opens; progrefs of the feed after impregnation; feeds exift before fecundation; analogy between feeds and eggs; progrefs of the egg within the hen; fpawn of frogs and of fifh; male Salamander; marine plants project a liquor not a powder; feminal fluid diluted with water, if a ftimulus only? Male and female influence neceffary in animals, infects, and vegetables, both in production of feeds and buds; does the embryon feed produce the furrounding fruit, like infects in gall-nuts?

NOTE XXXIX VEGETABLE GLANDULATION.

VEGETABLE glands cannot be injected with coloured fluids; effential oil; wax; honey; nectary, its complicate apparatus; exposes the honey to the air like the lacrymal gland; honey is nutritious; the male and female parts of flowers copulate and die like moths and butterflies, and are fed like them with honey; anthers fuppofed to become infects; depredation of the honey and wax injurious to plants; honey-dew; honey oxygenated by exposure to air; neceffary for the production of fensibility; the provision for the embryon plant of honey, fugar, flarch, &c. fupplies food to numerous claffes of animals; various vegetable fecretions as gum tragacanth, camphor, elemi, anime, turpentine, balfam of Mecca, aloe, myrrh, elaftic refin, manna, fugar, wax, tallow, and many other concrete juices; vegetable digeftion; chemical production of fugar would multiply mankind; economy of nature.

THE END.

Errata in Part I.

Page	34. 1. 354. for the read her.	Page	76.	inftead of III. put 3.
-	37. 1. 379. for burfls read burfl.	-	80.	inftead of IV. put 4.
	41. 1. 423. for wirb read with.		144.	1. 376. for fbut read fbuts.
	58. At the end of the Argument, inftead of		147.	1. 423. for finking read for inking.
	" Departure of the Gnomes" pleafe to		170.	1. 110. for ber read its.
	add Transmigration of matter, 575.		190.	1. 359. for decry'd read defery'd.
	Death and refuscitation of Adonis, 585.		204.	1. 530. for nectarous read nectarcous.
	Departure of the Gnomes, 611.			ments and the

In the Additional Notes.

Page 44. l. 12. for frigorific read frigorefcent. 45. l. 6. for congelating read congealing.

Page 46. 1. 4. for concholoide read conchoide. 49. 1. 20. for word read world.

DIRECTIONS TO THE BINDER.

Pleafe to place the print of Flora attired by the Elements opposite to the Title-page. Place all the four prints of the Portland Vafe opposite to Page 88, in the following order:

I. The print of the whole Vafe.

II. The first compartment of it.

III. The fecond compartment of it.

IV. The bottom and handles.

Cyprepedium fronting Page 202. Erythrina fronting Page 205. Section of the earth fronting Page 65 of the Additional Notes.

BOOKS

PUBLISHED BY The Botanic Society at Lichfield.

THE SYSTEM OF VEGETABLES,

TRANSLATED FROM THE SYSTEMA VEGETABILIUM OF LINNEUS,

Two Volumes Octavo. Sold by Leigh and Sotheby, York-Street, Covent Garden. EIGHTEEN SHILLINGS IN BOARDS.

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.....

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BOTANIC GARDEN.

PART II.







THE

BOTANIC GARDEN.

PART II.

CONTAINING

THE LOVES OF THE PLANTS.

A POEM.

WITH

Philosophical Notes.

VIVUNT IN VENEREM FRONDES; NEMUS OMNE PER ALTUM Felix arbor amat; nutant ad mutua Palmæ Fædera, populeo suspirat Populus ictu, Et Platani Platanis, Alnoque assibilat Alnus.

CLAUD. EPITH.

THE THIRD EDITION.

LONDON, PRINTED FOR J. JOHNSON, ST. PAUL'S CHURCH-YARD. MDCCXCI. Entered at Stationers Hall.



LINNEUS has divided the vegetable world into 24 Claffes; thefe Claffes into about 120 Orders; thefe Orders contain about 2000 Families, or Genera; and thefe Families about 20,000 Species; befides the innumerable Varieties, which the accidents of climate or cultivation have added to thefe Species.

The Claffes are diffinguished from each other in this ingenious fystem, by the number, fituation, adhesion, or reciprocal proportion of the males in each flower. The Orders, in many of these Claffes, are diffinguished by the number, or other circumstances of the females. The Families, or Genera, are characterized by the analogy of all the parts of the flower or fructification. The Species are diffinguished by the foliage of the plant; and the Varieties by any accidental circumstance of colour, taste, or odour; the feeds of these do not always produce plants similar to the parent; as in our numerous fruit-trees and garden flowers; which are propagated by grafts or layers.

The first eleven Claffes include the plants, in whose flowers both the fexes refide; and in which the Males or Stamens are neither united, nor unequal in height when at maturity; and are therefore distinguished from each other simply by the number of males in each flower, as is seen in the annexed PLATE, copied from the Dictionaire Botanique of M. BULLIARD, in which the numbers of each division refer to the Botanic Claffes.

A

CLASS I. ONE MALE, Monandria; includes the plants which poffefs but One Stamen in each flower.

II. Two MALES, Diandria. Two Stamens.

III. THREE MALES, Triandria. Three Stamens.

IV. FOUR MALES, Tetrandria. Four Stamens.

V. FIVE MALES, Petandria. Five Stamens.

VI. SIX MALES, Hexandria. Six Stamens.

VII. SEVEN MALES, Heptandria. Seven Stamens.

VIII. EIGHT MALES, Octandria. Eight Stamens.

IX. NINE MALES, Enneandria. Nine Stamens.

X. TEN MALES, Decandria. Ten Stamens.

XI. TWELVE MALES, Dodecandria. Twelve Stamens.

The next two Claffes are diffinguished not only by the number of equal and difunited males, as in the above eleven Claffes, but require an additional circumstance to be attended to, viz. whether the males or stamens be situated on the calyx, or not.

XII. TWENTY MALES, Icofandria. Twenty Stamens inferted on the calyx or flower-cup; as is well feen in the last Figure of No. xii. in the annexed Plate.

XIII. MANY MALES, *Polyandria*. From 20 to 100 Stamens, which do not adhere to the calyx; as is well feen in the first Figure of No. xiii. in the annexed Plate.

In the next two Claffes, not only the number of stamens are to be observed, but the reciprocal proportions in respect to height.

XIV. Two Powers, *Didynamia*. Four Stamens, of which two are lower than the other two; as is feen in the two first Figures of No. xiv.

XV. FOUR POWERS, Tetradynamia. Six Stamens; of which four are taller, and the two lower ones opposite to each other; as is feen in the third Figure of the upper row in No. xv.

The five fubfequent Classes are diffinguished not by the number of the males, or stamens, but by their union or adhesion, either by their anthers, or filaments, or to the female or pistil.

XVI. ONE BROTHERHOOD, Monadelphia. Many Stamens united by their filaments into one company; as in the fecond Figure below of No. xvi.

XVII. Two BROTHERHOODS, *Diadelphia*. Many Stamens united by their filaments into two Companies; as in the uppermoft Fig. No. xvii.

XVIII. MANY BROTHERHOODS, Polyadelphia. Many Stamens united by their filaments into three or more companies, as in No. xviii.

XIX. CONFEDERATE MALES, Syngenefia. Many Stamens united by their anthers; as in the first and second Figures, No. xix.

XX. FEMININE MALES, Gynandria. Many Stamens attached to the piftil.

The next three Claffes confift of plants, whofe flowers contain but one of the fexes; or if fome of them contain both fexes, there are other flowers accompanying them of but one fex.

XXI. ONE HOUSE, Monæcia. Male flowers and female flowers feparate, but on the fame plant.

XXII. Two Houses, Diacia. Male flowers and female flowers feparate, on different plants.

XXIII. POLYGAMY, Polygamia. Male and female flowers on one or more plants, which have at the fame time flowers of both fexes.

The last Class contains the plants whose flowers are not discernible. XXIV. CLANDESTINE MARRIAGE, Cryptogamia.

The Orders of the first thirteen Classes are founded on the number of Females, or Pistils, and distinguished by the names, ONE

A 2

FEMALE, Monogynia. Two FEMALES, Digynia. THREE FEMALES, Trigynia, &c. as is feen in No. i. which reprefents a plant of one male, one female; and in the first Figure of No. xi. which reprefents a flower with twelve males, and three females; (for, where the pistils have no apparent styles, the summits, or stigmas, are to be numbered) and in the first Figure of No. xii. which represents a flower with twenty males and many females; and in the last Figure of the same No. which has twenty males and one female; and in No. xiii. which represents a flower with many males and many females.

The Clafs of Two POWERS, is divided into two natural Orders; into fuch as have their feeds naked at the bottom of the calyx, or flower cup; and fuch as have their feeds covered; as is feen in No. xiv. Fig. 3. and 5.

The Clafs of FOUR POWERS, is divided alfo into two Orders; in one of these the seeds are inclosed in a filicule, as in *Shepherd's purse*. No. xiv. Fig. 5. In the other they are inclosed in a filique, as in *Wall-flower*. Fig. 4.

In all the other Claffes, excepting the Claffes Confederate Males, and Clandeftine Marriage, as the character of each Clafs is diftinguifhed by the fituations of the males; the character of the Orders is marked by the numbers of them. In the Clafs ONE BROTHER-HOOD, No. xvi. Fig. 3. the Order of ten males is reprefented. And in the Clafs Two BROTHERHOODS, No. xvii. Fig. 2. the Order ten males is reprefented.

In the Clafs CONFEDERATE MALES, the Orders are chiefly diffinguifhed by the fertility or barrennefs of the florets of the difk, or ray of the compound flower.

iv

And in the Clafs of CLANDESTINE MARRIAGE, the four Orders are termed FERNS, Mosses, FLAGS, and FUNGUSSES.

The Orders are again divided into Genera, or Families, which are all natural affociations, and are defcribed from the general refemblances of the parts of fructification, in refpect to their number, form, fituation, and reciprocal proportion. Thefe are the Calyx, or Flower-cup, as feen in No. iv. Fig. 1. No. x. Fig. 1. and 3. No. xiv. Fig. 1. 2. 3. 4. Second, the Carol, or Bloffom, as feen in No. i. ii. &cc. Third, the Males or Stamens; as in No. iv. Fig. 1. and No. viii. Fig. 1. Fourth, the Females, or Piftils; as in No. i. No. xii. Fig. 1. No. xiv. Fig. 3. No. xv. Fig. 3. Fifth, the Pericarp or Fruit-veffel; as No. xv. Fig. 4. 5. No. xvii. Fig. 2. Sixth, the Seeds.

The illuftrious author of the Sexual Syftem of Botany, in his preface to his account of the Natural Orders, ingenioufly imagines, that one plant of each Natural Order was created in the beginning; and that the intermarriages of these produced one plant of every Genus, or Family; and that the intermarriages of these Generic, or Family plants, produced all the Species: and lastly, that the intermarriages of the individuals of the Species produced the Varieties.

In the following POEM, the name or number of the Clafs or Order of each plant is printed in italics; as "*Two* brother fwains." "*One* Houfe contains them." and the word "*fecret*." expresses the Clafs of Clandestine Marriage.

The Reader, who wifnes to become further acquainted with this delightful field of fcience, is advifed to ftudy the works of the Great Mafter, and is apprized that they are exactly and literally translated into English, by a Society at LICHFIELD, in four Volumes Octavo.

To the SYSTEM OF VEGETABLES * is prefixed a copious explanation of all the Terms used in Botany, translated from a thefis of Dr. ELMSGREEN, with the plates and references from the Philosophia Botanica of LINNEUS.

To the FAMILIES OF PLANTS + is prefixed a Catalogue of the names of plants, and other Botanic Terms, carefully accented, to fhew their proper pronunciation; a work of great labour, and which was much wanted, not only by beginners, but by proficients in BOTANY.

* The SYSTEM OF VEGETABLES translated from the Systema Vegetabilium, in two Vols. is fold by LEIGH and SOTHEBY, York Street, Covent Garden: Price eighteen Shillings, in Boards.

† The FAMILIES OF PLANTS translated from the Genera Plantarum, in two Vols. by JOHNSON, St. Paul's Church-Yard, London: Price fixteen Shillings, in Boards.









PROEM.

Women, and even Gode and Goddelfes, into

Trees and Flowers; I have undertaken by

inv .

GENTLE READER!

LO, here a CAMERA OBSCURA is prefented to thy view, in which are lights and fhades dancing on a whited canvas, and magnified into apparent life!---if thou art perfectly at leafure for fuch trivial amufement, walk in,

(viii)

and view the wonders of my INCHANTED GARDEN.

Whereas P. OVIDIUS NASO, a great Necromancer in the famous Court of AUGUSTUS CÆSAR, did by art poetic tranfmute Men, Women, and even Gods and Goddeffes, into Trees and Flowers; I have undertaken by fimilar art to reftore fome of them to their original animality, after having remained prifoners fo long in their refpective vegetable manfions; and have here exhibited them before thee. Which thou may'ft contemplate as diverfe little pictures fulpended over the chimney of a Lady's dreffing-room, connected only by a flight festoon of ribbons. And which, though thou may'ft not be acquainted with the originals, may amuse thee by the beauty of their persons, their graceful attitudes, or the brilliancy of their dress.

(ix)

FAREWELL.





THE

LOVES OF THE PLANTS.

CANTO I.

DESCEND, ye hovering Sylphs! aerial Quires, And fweep with little hands your filver lyres; With fairy footfteps print your graffy rings, Ye Gnomes! accordant to the tinkling ftrings; While in foft notes I tune to oaten reed Gay hopes, and amorous forrows of the mead.— From giant Oaks, that wave their branches dark, To the dwarf Mofs, that clings upon their bark,

B 2

5

What Beaux and Beauties crowd the gaudy groves, And woo and win their vegetable Loves. 10 How Snowdrops cold, and blue-eyed Harebels blend Their tender tears, as o'er the ftream they bend; The lovefick Violet, and the Primrofe pale Bow their fweet heads, and whifper to the gale; With fecret fighs the Virgin Lily droops, 15 And jealous Cowflips hang their tawny cups. How the young Rofe in beauty's damafk pride Drinks the warm blufhes of his bafhful bride; With honey'd lips enamour'd Woodbines meet, Clafp with fond arms, and mix their kiffes fweet.— 20

Stay thy foft-murmuring waters, gentle Rill; Hufh, whifpering Winds, ye ruftling Leaves, be ftill; Reft, filver Butterflies, your quivering wings; Alight ye Beetles, from your airy rings;

[2]

Vegetable Loves. 1. 10. Linneus, the celebrated Swedish naturalist, has demonstrated, that all flowers contain families of males or females, or both; and on their marriages has constructed his invaluable fystem of Botany.

Ye painted Moths, your gold-eyed plumage furl, Bow your wide horns, your fpiral trunks uncurl; Glitter, ye Glow-worms, on your moffy beds; Defcend, ye Spiders, on your lengthened threads; Slide here, ye horned Snails, with varnifh'd fhells; Ye Bee-nymphs, liften in your waxen cells!

BOTANIC MUSE! who in this latter age Led by your airy hand the Swedifh fage, Bade his keen eye your fecret haunts explore On dewy dell, high wood, and winding fhore; Say on each leaf how tiny Graces dwell; How laugh the Pleafures in a bloffom's bell; How infect Loves arife on cobweb wings, Aim their light fhafts, and point their little ftings.

"First the tall CANNA lifts his curled brow Erect to heaven, and plights his nuptial vow; 40

Canna. 1. 39. Cane, or Indian Reed. One male and one female inhabit each flower. It is brought from between the tropics to our hot-houfes, and bears a beautiful crimfon flower; the feeds are used as shot by the Indians, and are strung for prayer-beads in some catholic countries.

25

30

35

The virtuous pair, in milder regions born, Dread the rude blaft of Autumn's icy morn; Round the chill fair he folds his crimfon veft, And clafps the timorous beauty to his breaft.

Thy love, CALLITRICHE, two Virgins fhare, Smit with thy ftarry eye and radiant hair ;— On the green margin fits the youth, and laves His floating train of treffes in the waves ; Sees his fair features paint the ftreams that pafs, And bends for ever o'er the watery glafs.

Two brother fwains, of COLLIN's gentle name, The fame their features, and their forms the fame,

Callitriche. 1.45. Fine-Hair, Stargrafs. One male and two females inhabit each flower. The upper leaves grow in form of a flar, whence it is called Stellaria Aquatica by Ray and others; its flems and leaves float far on the water, and are often fo matted together, as to bear a perfon walking on them. The male fometimes lives in a feparate flower.

Collinfonia. 1. 51. Two males one female. I have lately observed a very fingular circumftance in this flower; the two males stand widely diverging from each other, and the female bends herself into contact first with one of them, and after some time leaves this and applies herself to the other. It is probable one of the anthers may be mature before

[4]

45

50

[5]

55

With rival love for fair COLLINIA figh,

Knit the dark brow, and roll the unfteady eye. With fweet concern the pitying beauty mourns, And fooths with fmiles the jealous pair by turns.

Sweet blooms GENISTA in the myrtle shade, And *ten* fond brothers woo the haughty maid.

the other? See note on Gloriofa, and Genifta. The females in Nigella, devil in the bufh, are very tall compared to the males; and bending over in a circle to them, give the flower fome tefemblance to a regal crown. The female of the epilobium auguftifolium, rofe bay willow herb, bends down amongft the males for feveral days, and becomes upright again when impregnated.

Genifta. 1. 57. Dyer's broom. Ten males and one female inhabit this flower. The males are generally united at the bottom in two fets, whence Linneus has named the clafs "two brotherhoods." In the Genifta, however, they are united in but one fet. The flowers of this clafs are called papilionaceous, from their refemblance to a butterfly, as the pea-bloffom. In the Spartium Scoparium, or common broom, I have lately obferved a curious circumflance, the males or flamens are in two fets, one fet rifing a quarter of an inch above the other; the upper fet does not arrive at their maturity fo foon as the lower, and the fligma, or head of the female, is produced amongft the upper or immature fet; but as foon as the piftil grows tall enough to burft open the keel-leaf, or hood of the flower, it bends itfelf round in an inftant, like a french horn, and inferts its head, or fligma, amongft the lower or mature fet of males. The piftil, or female, continues to grow in length; and in a few days the fligma arrives again amongft the upper fet, by the time they become mature. This wonderful contrivance is readily feen by opening the keelleaf of the flowers of broom before they burft fpontaneonfly. See note on Collinfonia, Gloriofa, Draba.

[6]

Two knights before thy fragrant altar bend, Adored MELISSA! and two fquires attend. MEADIA'S foft chains five fuppliant beaux confefs, And hand in hand the laughing belle addrefs; Alike to all, fhe bows with wanton air, Rolls her dark eye, and waves her golden hair.

Meliffa. 1. 60. Balm. In each flower there are four males and one female; two of the males fland higher than the other two; whence the name of the clafs " two powers." I have observed in the Ballota, and others of this clafs, that the two lower flamens, or males become mature before the two higher. After they have shed their dust, they turn themselves away outwards; and the pistil, or female, continuing to grow a little taller, is applied to the upper flamens. See Gloriofa, and Genista.

All the plants of this clafs, which have naked feeds, are aromatic. The Marum, and Nepeta are particularly delightful to cats; no other brute animals feem delighted with any odours but those of their food or pray.

Meadia. 1. 61. Dodecatheon, American Cowflip. Five males and one female. The males, or anthers, touch each other. The uncommon beauty of this flower occafioned Linneus to give it a name fignifying the twelve heathen gods; and Dr. Mead to affix his own name to it. The piftil is much longer than the flamens, hence the flower-flaks have their elegant bend, that the fligma may hang downwards to receive the fecundating duft of the anthers. And the petals are fo beautifully turned back to prevent the rain or dew drops from fliding down and wafhing off this duft prematurely; and at the fame time expofing it to the light and air. As foon as the feeds are formed, it erects all the flower-flaks to prevent them from falling out; and thus lofes the beauty of its figure. Is this a mechanical effect, or does it indicate a vegetable florgé to preferve its offspring? See note on Ilex, and Gloriofa.

In the Meadia, the Borago, Cyclamen, Solanum, and many others, the filaments are yery flort compared with the ftyle. Hence it became neceffary, 1ft, to furnish the flamens

60




65

Woo'd with long care, CURCUMA cold and fhy Meets her fond hufband with averted eye: *Four* beardlefs youths the obdurate beauty move With foft attentions of Platonic love.

with long anthers. 2d. To lengthen and bend the peduncle or flower-ftalk, that the flower might hang downwards. 3d. To reflect the petals. 4th. To erect these peduncles when the germ was fecundated. We may reason upon this by observing, that all this apparatus might have been spared, if the filaments alone had grown longer; and that thence in these flowers that the filaments are the most unchangeable parts; and that thence their comparative length, in respect to the style, would afford a most permanent mark of their generic character.

Curcuma. 1.65. Turmeric. One male and one female inhabit this flower; but there are befides four imperfect males, or filaments without anthers upon them, called by Linneus eunuchs. The flax of our country has ten filaments, and but five of them are terminated with anthers; the Portugal flax has ten perfect males, or flamens; the Verbena of our country has four males; that of Sweden has but two; the genus Albuca, the Bignonia Catalpa, Gratiola, and hemlock-leaved Geranium have only half their filaments crowned with anthers. In like manner the florets, which form the rays of the flowers of the order fruftraneous polygamy of the clafs fyngenefia, or confederate males, as the fun-flower, are furnifhed with a ftyle only, and no ftigma: and are thence barren. There is alfo a ftyle without a ftigma in the whole order diæcia gynandria; the male flowers of which are thence barren. The Opulus is another plant, which contains fome unprolific flowers. In like manner fome tribes of infects have males, females, and neuters among them: as bees, wafps, ants.

There is a curious circumftance belonging to the class of infects which have two wings, or diptera, analogous to the rudiments of ftamens above defcribed; viz. two little knobs are found placed each on a ftalk or peduncle, generally under a little arched fcale; which appear to be rudiments of hinder wings; and are called by Linneus, halteres, or poifers, a term of his introduction. A. T. Bladh. Amæn. Acad. V. 7. Other animals have marks of having in a long process of time undergone changes in some parts of their bodies, which may have been effected to accommodate them to new ways of procuring their food. The existence of teats on the breasts of male animals, and which are generally

С

With vain defires the penfive ALCEA burns, And, like fad ELOISA, loves and mourns. The freckled IRIS owns a fiercer flame, And *three* unjealous hufbands wed the dame.

replete with a thin kind of milk at their nativity, is a wonderful inftance of this kind. Perhaps all the productions of nature are in their progrefs to greater perfection? an idea countenanced by the modern difcoveries and deductions concerning the progreffive formation of the folid parts of the terraqueous globe, and confonant to the dignity of the Creator of all things.

Alcea. 1. 69. Flore pleno. Double hollyhock. The double flowers, fo much admired by the florifts, are termed by the botanift vegetable monfters; in fome of thefe the petals are multiplied three or four times, but without excluding the flamens, hence they produce fome feeds, as Campanula and Stramoneum; but in others the petals become fo numerous as totally to exclude the flamens, or males: as Caltha, Peonia, and Alcea; thefe produce no feeds, and are termed eunuchs. Philof. Botan. No. 150.

These vegetable monfters are formed in many ways. If. By the multiplication of the petals and the exclusion of the nectaries, as in larkspur. 2d. By the multiplication of the nectaries and exclusion of the petals; as in columbine. 3d. In fome flowers growing in cymes, the wheel-shape flowers in the margin are multiplied to the exclusion of the bell-shape flowers in the centre; as in gelder-rose. 4th. By the elongation of the florets in the centre. Instances of both these are found in daify and feversew; for other kinds of vegetable monsters, fee Plantago.

The perianth is not changed in double flowers, hence the genus or family may be often difcovered by the calyx, as in Hepatica, Ranunculus, Alcea. In those flowers, which have many petals, the lowest feries of the petals remains unchanged in respect to number; hence the natural number of the petals is easily difcovered. As in poppies, roses, and Nigella, or devil in a bush. Phil. Bot. p. 128.

Iris. 1.71. Flower de Luce. Three males, one female. Some of the fpecies have a beautifully freckled flower; the large fligma or head of the female covers the three males, counterfeiting a petal with its divisions.

[8]

70

[9]

CUPRESSUS dark difdains his dufky bride, One dome contains them, but two beds divide. The proud OSYRIS flies his angry fair, 75 Two houfes hold the fashionable pair.

Cupreffus. 1. 73. Cyprefs. One houfe. The males live in feparate flowers, but on the fame plant. The males of fome of these plants, which are in separate flowers from the females, have an elastic membrane; which disperses their dust to a confiderable diftance, when the anthers burft open. This duft, on a fine day, may often be feen like a cloud hanging round the common nettle. The males and females of all the cone-bearing plants are in feparate flowers, either on the fame or on different plants; they produce refins, and many of them are fuppofed to fupply the moft durable timber: what is called Venice-turpentine is obtained from the larch by wounding the bark about two feet from the ground, and catching it as it exfudes; Sandarach is procured from common juniper; and incense from a juniper with yellow fruit. The unperishable chefts, which contain the Egyptian mummies, were of Cyprefs; and the Cedar, with which black lead pencils are covered, is not liable to be eaten by worms. See Miln's Bot. Dict. art. coniferæ. The gates of St. Peter's church at Rome, which had lafted from the time of Conftantine to that of Pope Eugene the fourth, that is to fay, eleven hundred years, were of Cyprefs, and had in that time fuffered no decay. According to Thucydides, the Athenians buried the bodies of their heroes in coffins of Cyprefs, as being not fubject to decay. A fimilar durability has also been ascribed to Cedar. Thus Horace,

Posse linenda cedro & lævi servanda cupresso.

Ofyris. 1.75. Two houfes. The males and females are on different plants. There are many inftances on record, where female plants have been impregnated at very great diffance from their male; the duft difcharged from the anthers is very light, fmall, and copious, fo that it may foread very wide in the atmosphere, and be carried to the diffant piftils, without the fuppofition of any particular attraction; these plants refemble fome infects, as the ants, and cochineal infect, of which the males have wings, but not the female.

C 2

[10]

With ftrange deformity PLANTAGO treads, A Monfter-birth ! and lifts his hundred heads; Yet with foft love a gentle belle he charms, And clafps the beauty in his hundred arms. So haplefs DESDEMONA, fair and young, Won by OTHELLO'S captivating tongue, Sigh'd o'er each ftrange and piteous tale, diftrefs'd, And funk enamour'd on his footy breaft.

80

85

Two gentle shepherds and their fifter-wives With thee, ANTHOXA! lead ambrofial lives;

Plantago. 1. 77. Rofea. Rofe-Plantain. In this vegetable monfter the bractes, or divisions of the fpike, become wonderfully enlarged; and are converted into leaves. The chaffy fcales of the calyx in Xeranthemum, and in a fpecies of Dianthus, and the glume in fome alpine graffes, and the fcales of the ament in the falix rofea, rofe willow, grow into leaves; and produce other kinds of monfters. The double flowers become monfters by the multiplication of their petals or nectaries. See note on Alcea.

Anthoxanthum. 1.83. Vernal grafs. Two males, two females. The other graffes have three males and two females. The flowers of this grafs give the fragrant fcent to hay. I am informed it is frequently viviparous, that is, that it bears fometimes roots or bulbs inftead of feeds, which after a time drop off and ftrike root into the ground. This circumftance is faid to obtain in many of the alpine graffes, whofe feeds are perpetually devoured by fmall birds. The Feftuca Dumetorum, fefcue grafs of the bufhes, produces bulbs from the fheaths of its ftraw. The Allium Magicum, or magical onion, produces

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Where the wide heath in purple pride extends, And fcatter'd furze its golden luftre blends, Clofed in a green recefs, unenvy'd lot ! The blue fmoak rifes from their turf-built cot ; 90 Bofom'd in fragrance blufh their infant train, Eye the warm fun, or drink the filver rain.

The fair OSMUNDA feeks the filent dell, The ivy canopy, and dripping cell; There hid in fhades *clandeftine* rites approves, 95 Till the green progeny betrays her loves.

onions on its head, inftead of feeds. The Polygonum Viviparum, viviparous bifort, rifes about a foot high, with a beautiful fpike of flowers, which are fucceeded by buds or bulbs, which fall off and take root. There is a bufh frequently feen on birch-trees, like a bird's neft, which feems to be a fimiliar attempt of nature, to produce another tree; which falling off might take root in fpongy ground.

There is an inftance of this double mode of production in the animal kingdom, which is equally extraordinary, the fame fpecies of Aphis is viviparous in fummer, and oviparous in autumn. A. T. Bladh. Amœn. Acad. V. 7.

Ofmunda. 1.93. This plant grows on moift rocks; the parts of its flower or its feeds are fcarce difcernible; whence Linneus has given the name of clandeftine marriage to this clafs. The younger plants are of a beautiful vivid green.

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With charms defpotic fair CHONDRILLA reigns O'er the foft hearts of *five* fraternal fwains; If fighs the changeful nymph, alike they mourn; And, if fhe fmiles, with rival raptures burn. 100 So, tun'd in unifon, Eolian Lyre! Sounds in fweet fymphony thy kindred wire; Now, gently fwept by Zephyr's vernal wings, Sink in foft cadences the love-fick ftrings; And now with mingling chords, and voices higher, 105 Peal the full anthems of the aerial choir.

Five fifter-nymphs to join Diana's train With thee, fair LYCHNIS! vow,—but vow in vain;

Chondrilla. 1. 97. Of the clafs Confederate Males. The numerous florets, which conftitute the difk of the flowers in this clafs, contain in each five males furrounding one female, which are connected at top, whence the name of the clafs. An Italian writer, in a difcourfe on the irritability of flowers, afferts, that if the top of the floret be touched, all the filaments which fupport the cylindrical anther will contract themfelves, and that by thus raifing or depreffing the anther the whole of the prolific duft is collected on the fligma. He adds, that if one filament be touched after it is feparated from the floret, that it will contract like the mufcular fibres of animal bodies; his experiments were tried on the Centauréa Calcitrapoides, and on artichokes, and globe-thiftles. Difcourfe on irritability of plants. Dodfley.

Lychnis. 1. 108. Ten males and five females. The flowers which contain the five females, and those which contain the ten males, are found on different plants; and often

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Beneath one roof refides the virgin band, Flies the fond fwain, and fcorns his offer'd hand; 110 But when foft hours on breezy pinions move, And fmiling May attunes her lute to love, Each wanton beauty, trick'd in all her grace, Shakes the bright dew-drops from her blufhing face; In gay undrefs difplays her rival charms, 115 And calls her wondering lovers to her arms.

When the young Hours amid her tangled hair Wove the fresh rose-bud, and the lily fair, Proud GLORIOSA led *three* chosen swains, The blushing captives of her virgin chains.— 120

at a great diftance from each other. Five of the ten males arrive at their maturity fome days before the other five, as may be feen by opening the corol before it naturally expands itfelf. When the females arrive at their maturity, they rife above the petals, as if looking abroad for their diftant hufbands; the fcarlet ones contribute much to the beauty of our meadows in May and June.

Gloriofa. 1. 119. Superba. Six males, one female. The petals of this beautiful flower with three of the stamens, which are first mature, stand up in apparent diforder; and the

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----When Time's rude hand a bark of wrinkles fpread Round her weak limbs, and filver'd o'er her head, *Three* other youths her riper years engage, The flatter'd victims of her wily age.

So, in her wane of beauty, NINON won 125 With fatal fimiles her gay unconficious fon.— Clafp'd in his arms fhe own'd a mother's name,— "Defift, rafh youth! reftrain your impious flame,

piftil bends at nearly a right angle to infert its ftigma amongft them. In a few days, as thefe decline, the other three ftamens bend over, and approach the piftil. In the Fritillaria Perfica, the fix ftamens are of equal lengths, and the anthers lie at a diffance from the piftil, and three alternate ones approach firft; and, when thefe decline, the other three approach: in the Lithrum Salicaria, (which has twelve males and one female) a beautiful red flower, which grows on the banks of rivers, fix of the males arrive at maturity, and furround the female fome time before the other fix; when thefe decline, the other fix rife up, and fupply their places. Several other flowers have in a fimilar manner two fets of ftamens of different ages, as Adoxa, Lychnis, Saxifraga. See Genifta. Perhaps a difference in the time of their maturity obtains in all thefe flowers, which have numerous ftamens. In the Kalmia the ten ftamens lie round the piftil like the radii of a wheel; and each anther is concealed in a nich of the corol to protect it from cold and moifture; thefe anthers rife feparately from their niches, and approach the piftil for a time, and then recede to their former fituations.









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Firft on that bed your infant form was prefs'd,
Born by my throes, and nurtured at my breaft." - 130
Back as from death he fprung, with wild amaze
Fierce on the fair he fix'd his ardent gaze;
Dropp'd on one knee, his frantic arms outfpread,
And ftole a guilty glance toward the bed;
Then breath'd from quivering lips a whifper'd vow, 135
And bent on heaven his pale repentant brow;
Thus, thus !" he cried, and plung'd the furious dart,
And life and love gufh'd mingled from his heart.

The fell SILENE and her fifters fair, Skill'd in deftruction, fpread the vifcous fnare. 140 The harlot-band *ten* lofty bravoes fcreen, And frowning guard the magic nets, unfeen.—

Silene. 1. 139. Catchfly. Three females and ten males inhabit each flower; the vifcous material, which furrounds the ftalks under the flowers of this plant, and of the Cucubalus Otites, is a curious contrivance to prevent various infects from plundering the honey, or devouring the feed. In the Dionæa Mufcipula there is a ftill more wonderful contrivance to prevent the depredations of infects: The leaves are armed with long teeth, like the antennæ of infects, and lie fpread upon the ground round the ftem; and

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Hafte, glittering nations, tenants of the air, Oh, fteer form hence your viewlefs courfe afar ! If with foft words, fweet blufhes, nods, and fmiles, 145 The *three* dread Syrens lure you to their toils, Limed by their art in vain you point your ftings, In vain the efforts of your whirring wings !— Go, feek your gilded mates and infant hives, Nor tafte the honey purchas'd with your lives ! 150

When heaven's high vault condenfing clouds deform, Fair AMARYLLIS flies the incumbent florm,

are fo irritable, that when an infect creeps upon them, they fold up, and crufh or pierce it to death. The laft profeffor Linneus, in his Supplementum Plantarum, gives the following account of the Arum Mufcivorum. The flower has the fmell of carrion; by which the flies are invited to lay their eggs in the chamber of the flower, but in vain endeavour to efcape, being prevented by the hairs pointing inwards; and thus perifh in the flower, whence its name of fly-eater. P. 411. In the Dypfacus is another contrivance for this purpofe, a bafon of water is placed round each joint of the flem. In the Drofera is another kind of fly-trap. See Dypfacus and Drofera; the flowers of Siléne and Cucúbalus are clofed all day, but are open and give an agreeable odour in the night. See Cerea. See additional notes at the end of the poem.

Amaryllis. 1. 152. Formofifima. Most beautiful Amaryllis. Six males, one female. Some of the bell-flowers close their apertures at night, or in rainy or in cold weather, as the convolvulus, and thus protect their included stamens and piftils. Other bell-flowers





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Seeks with unfteady ftep the fhelter'd vale, And turns her blufhing beauties from the gale.— Six rival youths, with foft concern imprefs'd, 155 Calm all her fears, and charm her cares to reft.— So fhines at eve the fun-illumin'd fane, Lifts its bright crofs, and waves its golden vane;

hang their apertures downwards, as many of the lillies; in those the piftil, when at maturity, is longer than the ftamens; and by this pendant attitude of the bell, when the anthers burft, their duft falls on the ftigma: and these are at the fame time sheltered as with an umbrella from rain and dews. But, as a free exposure to the air is necessary for their fecundation, the style and filaments in many of these flowers continue to grow longer after the bell is open, and hang down below its rim. In others, as in the martagon, the bell is deeply divided, and the divisions are reflected upwards, that they may not prevent the access of air, and at the fame time afford fome shelter from perpendicular rain or dew. Other bell-flowers, as the hemerocallis and amaryllis, have their bells nodding only, as it were, or hanging obliquely toward the horizon; which, as their sters are flender, turn like a weathercock from the wind; and thus very effectually preferve their inclosed ster their feason of fecundation, erect their heads perpendicular to the horizon, like the Meadia, which cannot be explained from meer mechanism.

The Amaryllis formofifima is a flower of the laft mentioned kind, and affords an agreeable example of art in the vegetable economy. I. The piftil is of great length compared with the flamens; and this I fuppofe to have been the most unchangeable part of the flower, as in Meadia, which fee. 2. To counteract this circumflance, the piftil and ftamens are made to decline downwards, that the prolific dust might fall from the anthers on the fligma. 3. To produce this effect, and to fecure it when produced, the corol is lacerated, contrary to what occurs in other flowers of this genus, and the lowest division with the two next lowest ones are wrapped closely over the ftyle and filaments, binding them forcibly down lower toward the horizon than the usual inclination of the bell in this genus, and thus conflitutes a most elegant flower. There is another contrivance for this purpose in the Hemerocallis flava: the long piftil often is bent fomewhat like the capital letter N, with defign to florten it, and thus to bring the fligma amongst the anthers.

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From every breeze the polifh'd axle turns, And high in air the dancing meteor burns. 160

Four of the giant brood with ILEX ftand, Each grafps a thoufand arrows in his hand; A thoufand fteely points on every fcale Form the bright terrors of his briftly mail.— So arm'd, immortal Moore uncharm'd the fpell, 165 And flew the wily dragon of the well.— Sudden with rage their *injur'd* bofoms burn, Retort the infult, or the wound return; Unwrong'd, as gentle as the breeze that fweeps The unbending harvefts or undimpled deeps, 170 They guard, the Kings of Needwood's wide domains, Their fifter-wives and fair infantine trains;

Ilex. 1. 161. Holly. Four males, four females. Many plants, like many animals, are furnished with arms for their protection; these are either aculei, prickles, as in role and barberry, which are formed from the outer bark of the plant; or fpinæ, thorns, as in hawthorn, which are an elongation of the wood, and hence more difficult to be torn off than the former; or ftimuli, ftings, as in the nettles, which are armed with a

Lead the lone pilgrim through the trackless glade, Or guide in leafy wilds the wandering maid.

So WRIGHT's bold pencil from Vefuvio's hight 175 Hurls his red lavas to the troubled night; From Calpè ftarts the intolerable flash, Skies burft in flames, and blazing oceans dash;—

venomous fluid for the annoyance of naked animals. The fhrubs and trees, which have prickles or thorns, are grateful food to many animals, as goofberry and gorfe; and would be quickly devoured, if not thus armed; the ftings feem a protection against fome kinds of infects, as well as the naked mouths of quadrupeds. Many plants lofe their thorns by cultivation, as wild animals lofe their ferocity; and fome of them their horns. A curious circumftance attends the large hollies in Needwood-foreft, they are armed with thorny leaves about eight feet high, and have fmooth leaves above; as if they were confcious that horfes and cattle could not reach their upper branches. See note on Meadia, and on Mancinella. The numerous clumps of hollies in Needwoodforeft ferve as land-marks to direct the travellers acrofs it in various directions; and as a fhelter to the deer and cattle in winter; and in fcarce feafons fupply them with much food. For when the upper branches, which are without prickles, are cut down, the deer crop the leaves and peel off the bark. The bird-lime made from the bark of hollies feems to be a very fimilar material to the elastic gum, or Indian rubber, as it is called. There is a foffile elastic bitumen found at Matlock in Derbyshire, which much refembles thefe fubstances in its elasticity and inflammability. The thorns of the mimofa cornigera refemble cow's horns in appearance as well as in ufe. Syftem of Vegetables, p. 782.

Hurls his red lavas. 1. 176. Alluding to the grand paintings of the eruptions of Vefuvius, and of the deftruction of the Spanish veffels before Gibraltar; and to the beautiful landscapes and moonlight scenes, by Mr. Wright of Derby.

Or bids in fweet repofe his shades recede, Winds the still vale, and slopes the velvet mead; 180 On the pale stream expiring Zephyrs sink, And Moonlight sleeps upon its hoary brink.

Gigantic Nymph! the fair KLEINHOVIA reigns, The grace and terror of Orixa's plains; O'er her warm cheek the blufh of beauty fwims, And nerves Herculean bend her finewy limbs; With frolic eye fhe views the affrighted throng, And fhakes the meadows, as fhe towers along, 190 With playful violence difplays her charms, And bears her trembling lovers in her arms.

Kleinhovia. 1. 183. In this clafs the males in each flower are fupported by the female. The name of the clafs may be translated "Viragoes," or "Feminine Males."

The largeft tree perhaps in the world is of the fame natural order as Kleinhovia, it is the Adanfonia, or Ethiopian Sour-gourd, or African Calabaſh-tree. Mr. Adanfon fays the diameter of the trunk frequently exceeds 25 feet, and the horizontal branches are from 45 to 55 feet long, and fo large that each branch is equal to the largeft trees of Europe. The breadth of the top is from 120 to 150 feet. And one of the roots bared only in part by the waſhing away of the earth from the river, near which it grew, meafured 110 feet long; and yet theſe ſtupendous trees never exceed 70 feet in height. Voyage to Senegal.

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So fair THALESTRIS fhook her plumy creft, And bound in rigid mail her jutting breaft; Poifed her long lance amid the walks of war, And Beauty thunder'd from Bellona's car; Greece arm'd in vain, her captive heroes wove The chains of conqueft with the wreaths of love.

When o'er the cultured lawns and dreary waftesRetiring Autumn flings her howling blafts,200Bends in tumultuous waves the ftruggling woods,200And fhowers their leafy honours on the floods,200In withering heaps collects the flowery fpoil,200And each chill infect finks beneath the foil ;200Quick flies fair TULIPA the loud alarms,205And folds her infant clofer in her arms ;205

Tulipa. 1. 205. Tulip. What is in common language called a bulbous root, is by Linneus termed the Hybernacle, or Winter-lodge of the young plant. As thefe bulbs in every refpect refemble buds, except in their being produced under ground, and include the leaves and flower in miniature, which are to be expanded in the enfuing fpring. By cautioufly cutting in winter through the concentric coats of a tulip-root, longitudinally from the top to the bafe, and taking them off fucceffively, the whole In fome lone cave, fecure pavillion, lies, And waits the courtfhip of ferener fkies.— So, fix cold moons, the Dormoufe charm'd to reft, Indulgent Sleep! beneath thy eider breaft, 210 In fields of Fancy climbs the kernel'd groves, Or fhares the golden harveft with his loves.— But bright from earth amid the troubled air Afcends fair COLCHICA with radiant hair,

flower of the next fummer's tulip is beautifully feen by the naked eye, with its petals, piftil, and flamens; the flowers exift in other bulbs, in the fame manner, as in Hyacinths, but the individual flowers of thefe being lefs, they are not fo eafily diffected, or fo confpicuous to the naked eye.

In the feeds of the Nymphæa Nelumbo, the leaves of the plant are feen fo diftinctly, that Mr. Ferber found out by them to what plant the feeds belonged. Amœn. Acad. V. vi. No. 120. He fays that Mariotte first observed the future flower and foliage in the bulb of a Tulip; and adds, that it is pleasant to fee in the buds of the Hepatica, and Pedicularis hirfuta, yet slying in the earth; and in the gems of Daphne Mezereon; and at the base of Osmunda Lunaria, a perfect plant of the future year compleat in all its parts. Ibid.

Colchicum autumnale. 1. 214. Autumnal Meadow-faffron. Six males, three females, The germ is buried within the root, which thus feems to conflitute a part of the flower. Families of Plants. p. 242. Thefe fingular flowers appear in the autumn without any leaves, whence in fome countries they are called Naked Ladies : in the March following the green leaves fpring up, and in April the feed-veffel rifes from the ground; the feeds ripen in May, contrary to the ufual habits of vegetables, which flower in the fpring, and ripen their feeds in the autumn. Miller's Dict. The juice of the root of this plant is fo acrid as to produce violent effects on the human conflitution, which alfo prevents it from being eaten by fubterranean infects, and thus guards the feed-veffel during the winter.

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Warms the cold bofom of the hoary year, 215
And lights with Beauty's blaze the dufky fphere.
Three blufhing Maids the intrepid Nymph attend,
And fix gay Youths, enamour'd train ! defend.
So fhines with filver guards the Georgian ftar,
And drives on Night's blue arch his glittering car; 220
Hangs o'er the billowy clouds his lucid form,
Wades through the mift, and dances in the ftorm.

GREAT HELIANTHUS guides o'er twilight plains In gay folemnity his Dervife-trains;

The defoliation of deciduous trees is announced by the flowering of the Colchicum; of thefe the afh is the laft that puts forth its leaves, and the first that loses them. Phil. Bot. p. 275.

The Hamamelis, Witch Hazle, is another plant which flowers in autumn; when the leaves fall off, the flowers come out in clufters from the joints of the branches, and in Virginia ripen their feed in the enfuing fpring; but in this country their feeds feldom ripen. Lin. Spec. Plant. Miller's Dict.

Helianthus. 1. 223. Sun flower. The numerous florets, which conftitute the difk of this flower, contain in each five males furrounding one female, the five flamens have their anthers connected at top, whence the name of the clafs, "confederate males;" fee note on Chondrilla. The fun-flower follows the course of the fun by nutation, not by twifting its ftem. (Hales veg. ftat.) Other plants, when they are confined in a room, turn the fhining furface of their leaves, and bend their whole branches to the light. See Mimofa.

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Marfhall'd in *fives* each gaudy band proceeds, 225 Each gaudy band a plumed Lady leads ; With zealous ftep he climbs the upland lawn, And bows in homage to the rifing dawn ; Imbibes with eagle-eye the golden ray, And watches, as it moves, the orb of day. 230

QUEEN of the marsh, imperial DROSERA treads Rush-fringed banks, and moss-embroider'd beds;

A plumed Lady leads. I. 226. The feeds of many plants of this clafs are furnished with a plume, by which admirable mechanism they are diffeminated by the winds far from their parent stem, and look like a shuttlecock, as they fly. Other seeds are diffeminated by animals; of these fome attach themselves to their hair or feathers by a gluten, as misletoe; others by hooks, as cleavers, burdock, hounds-tongue; and others are swallowed whole for the stew of the fruit, and voided uninjured, as the hawthorn, juniper, and some graffes. Other feeds again disperse themselves by means of an elastic feed vessel, as Oats, Geranium, and Impatiens; and the seeds of aquatic plants, and of those which grow on the banks of rivers, are carried many miles by the currents, into which they fall. See Impatiens. Zostera. Castia. Carlina.

Drofera. I. 231. Sun-dew. Five males, five females. The leaves of this marfhplant are purple, and have a fringe very unlike other vegetable productions. And, which is curious, at the point of every thread of this erect fringe ftands a pellucid drop of mucilage, refembling a ducal coronet. This mucus is a fecretion from certain glands, and like the vifcous material round the flower-ftalks of Silene (catchfly) prevents fmall infects from infefting the leaves. As the ear-wax in animals feems to be in part defigned to prevent fleas and other infects from getting into their ears. See Silene. Mr. Wheatly, an eminent furgeon in Cateaton-ftreet, London, obferved thefe leaves to bend upwards, when an infect fettled on them, like the leaves of the mufcipula veneris, and pointing

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Redundant folds of gloffy filk furround Her flender waift, and trail upon the ground; *Five* fifter-nymphs collect with graceful eafe, 235 Or fpread the floating purple to the breeze; And *five* fair youths with duteous love comply With each foft mandate of her moving eye. As with fweet grace her fnowy neck fhe bows, A zone of diamonds trembles round her brows; 240 Bright fhines the filver halo, as fhe turns; And, as fhe fteps, the living luftre burns.

Fair LONICERA prints the dewy lawn, And decks with brighter blush the vermil dawn;

all their globules of mucus to the centre, that they completely intangled and deftroyed it. M. Brouffonet, in the Mem. de l'Acad. des Sciences for the year 1784. p. 615. after having defcribed the motion of the Dionæa, adds, that a fimilar appearance has been obferved in the leaves of two fpecies of Drofera.

Lonicera. 1. 243. Caprifolium, Honeyfuckle. Five males, one female. Nature has in many flowers ufed a wonderful apparatus to guard the nectary, or honey-gland, from infects. In the honey-fuckle the petal terminates in a long tube like a cornucopiæ, or horn of plenty; and the honey is produced at the bottom of it. In Aconitum, monkshood, the nectaries ftand upright like two horns covered with a hood, which abounds E 2 Winds round the fhadowy rocks, and pancied vales, 245
And fcents with fweeter breath the fummer-gales.
With artlefs grace and native eafe fhe charms,
And bears the horn of plenty in her arms. *Five* rival Swains their tender cares unfold,
And watch with eye afkance the treafured gold. 250

with fuch acrid matter that no infects penetrate it. In Helleborus, hellebore, the many nectaries are placed in a circle like little pitchers, and add much to the beauty of the flower. In the columbine, Aquilegia, the nectary is imagined to be like the neck and body of a bird, and the two petals ftanding upon each fide to reprefent wings; whence its name of columbine, as if refembling a neft of young pigeons fluttering whilf their parent feeds them. The importance of the nectary in the economy of vegetation is explained at large in the notes on part the firft.

Many infects are provided with a long and pliant probofcis for the purpofe of acquiring this grateful food, as a variety of bees, moths, and butterflies: but the Sphinx Convolvuli, or unicorn moth, is furnished with the most remarkable probofcis in this climate. It carries it rolled up in concentric circles under its chin, and occasionally extends it to above three inches in length. This trunk confists of joints and muscles, and feems to have more verfatile movements than the trunk of the elephant; and near its termination is fplit into two capillary tubes. The excellence of this contrivance for robbing the flowers of their honey, keeps this beautiful infect fat and bulky; though it flies only in the evening, when the flowers have closed their petals, and are thence more difficult of access; and at the fame time the brilliant colours of the moth contribute to its fafety, by making it mistaken by the late fleeping birds for the flower it refts on.

Befides thefe there is a curious contrivance attending the Ophrys, commonly called the Bee-orchis, and the Fly-orchis, with fome kinds of the Delphinium, called Beelarkfpurs, to preferve their honey; in thefe the nectary and petals refemble in form and colour the infects, which plunder them: and thus it may be fuppofed, they often efcape thefe hourly robbers, by having the appearance of being pre-occupied. See note on Rubia, and Conferva polymorpha.

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Where rears huge Tenerif his azure creft, Afpiring DRABA builds her eagle neft; Her pendant eyry icy caves furround, Where erft Volcanos min'd the rocky ground. Pleafed round the Fair *four* rival Lords afcend The fhaggy fteeps, *two* menial youths attend. High in in the fetting ray the beauty ftands, And her tall fhadow waves on diftant lands.

Oh, ftay, bright habitant of air, alight, Ambitious VISCA, from thy angel-flight !-- 260

Draba. 1. 252. Alpina. Alpine Whitlow-grafs. One female and fix males. Four of these males stand above the other two; whence the name of the class, "four powers." I have observed in several plants of this class, that the two lower males arise, in a few days after the opening of the flower, to the same height as the other four, not being mature as soon as the higher ones. See note on Gloriosa. All the plants of this class posses posses fimilar virtues; they are termed acrid and antifcorbutic in their raw state, as mustard, watercress; when cultivated and boiled, they become a mild wholesome food, as cabbage, turnep.

There was formerly a Volcano on the Peake of Tenereif, which became extinct about the year 1684. Philof. Tranf. In many excavations of the mountain, much below the fummit, there is now found abundance of ice at all feafons. Tench's Expedition to Botany Bay, p. 12. Are thefe congelations in confequence of the daily folution of the hoar-froft, which is produced on the fummit during the night?

Viscum. 1. 260. Misleto. Two houses. This plant never grows upon the ground; the foliage is yellow, and the berries milk-white; the berries are so viscous, as to serve

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——Scorning the fordid foil, aloft fhe fprings, Shakes her white plume, and claps her golden wings; High o'er the fields of boundlefs ether roves, And feeks amid the clouds her foaring loves!

Stretch'd on her moffy couch, in trackless deeps, 265 Queen of the coral groves, ZOSTERA fleeps; The filvery fea-weed matted round her bed, And diftant furges murmuring o'er her head.—

for bird-lime; and when they fall, adhere to the branches of the tree, on which the plant grows, and ftrike root into its bark; or are carried to diftant trees by birds. The Tillandfia, or wild pine, grows on other trees, like the Mifletoe, but takes little or no nourifhment from them, having large buckets in its leaves to collect and retain the rain water. See note on Dypfacus. The moffes, which grow on the bark of trees, take much nourifhment from them; hence it is obferved that trees, which are annually cleared from mofs by a brufh, grow nearly twice as faft. (Phil. Tranfact.) In the cyder countries the peafants brufh their apple-trees annually.

Zoftera. 1. 266. Grafs-wrack. Clafs, Feminine Males. Order, Many Males. It grows at the bottom of the fea, and rifing to the furface, when in flower, covers many leagues: and is driven at length to the fhore. During its time of floating on the fea, numberlefs animals live on the under furface of it; and being fpecifically lighter than the fea-water, or being repelled by it, have legs placed as it were on their backs for the purpofe of walking under it. As the Scyllœa. See Barbut's Genera Vermium. It feems neceffary that the marriages of plants fhould be celebrated in the open air, either becaufe the powder of the anther, or the mucilage on the ftigma, or the refervoir of honey might receive injury from the water. Mr. Needham obferved, that in the ripe duft of every flower, examined by the microfcope, fome veficles are perceived, from which a fluid had High in the flood her azure dome afcends, The cryftal arch on cryftal columns bends; 270 Roof d with tranflucent fhell the turrets blaze, And far in ocean dart their colour'd rays; O'er the white floor fucceffive fhadows move, As rife and break the ruffled waves above.— Around the nymph her mermaid-trains repair, 275 And weave with orient pearl her radiant hair ; With rapid fins fhe cleaves the watery way, Shoots like a filver meteor up to day ; Sounds a loud conch, convokes a fcaly band, Her fea-born lovers, and afcends the ftrand. 280

E'en round the pole the flames of Love afpire, And icy bosoms feel the *fecret* fire !---

efcaped; and that thofe, which ftill retain it, explode if they be wetted, like an eolopile fuddenly exposed to a ftrong heat. These observations have been verified by Spallanzani and others. Hence rainy feasons make a fcarcity of grain, or hinder its fecundity, by burfting the pollen before it arrives at the moift ftigma of the flower. Spallanzani's Differtations, v. 11. p. 321. Thus the flowers of the male Vallisseria are produced under water, and when ripe detach themselves from the plant, and rising to the furface are wafted by the air to the female flowers. See Vallisseria. [30]

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Cradled in fnow and fann'd by arctic air Shines, gentle BAROMETZ! thy golden hair; Rooted in earth each cloven hoof defcends, And round and round her flexile neck fhe bends; Crops the grey coral mofs, and hoary thyme, Or laps with rofy tongue the melting rime;

Barometz. i. 284. Polypodium Barometz. Tartarian Lamb. Clandeftine Marriage. This fpecies of Fern is a native of China, with a decumbent root, thick, and every where covered with the most foft and dense wool, intensely yellow. Lin. Spec. Plant.

This curious ftem is fometimes pufhed out of the ground it its horizontal fituation by fome of the inferior branches of the root, fo as to give it fome refemblance to a Lamb ftanding on four legs; and has been faid to deftroy all other plants in its vicinity. Sir Hans Sloane defcribes it under the name of Tartarian Lamb, and has given a print of it. Philof. Tranf. abridged, v. 11. p. 646. but thinks fome art had been ufed to give it an animal appearance. Dr. Hunter, in his edition of the Terra of Evelyn, has given a more curious print of it, much refembling a fheep. The down is ufed in India externally for ftopping hemorrhages, and is called golden mofs.

The thick downy clothing of fome vegetables feems defigned to protect them from the injuries of cold, like the wool of animals. Those bodies, which are bad conductors of electricity, are also bad conductors of heat, as glass, wax, air. Hence either of the two former of these may be melted by the flame of a blow-pipe very near the fingers which hold it without burning them; and the laft, by being confined on the furface of animal bodies, in the interflices of their fur or wool, prevents the efcape of their natural warmth; to which fhould be added, that the hairs themfelves are imperfect conductors. The fat or oil of whales, and other northern animals, feems defigned for the fame purpofe of preventing the too fudden efcape of the heat of the body in cold climates. Snow protects vegetables which are covered by it from cold, both becaufe it is a bad conductor of heat itfelf, and contains much air in its pores. If a piece of camphor be immerfed in a fnowball, except one extremity of it, on fetting fire to this, as the fnow melts, the water becomes abforbed into the furrounding fnow by capillary attraction; on this account, when living animals are buried in fnow, they are not moiftened by it; but the cavity enlarges as the fnow diffolves, affording them both a dry and warm habitation.

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Eyes with mute tendernefs her diftant dam, Or feems to bleat, a Vegetable Lamb. 290 —So, warm and buoyant in his oily mail, Gambols on feas of ice the unwieldy Whale; Wide-waving fins round floating iflands urge His bulk gigantic through the troubled furge ; With hideous yawn the flying floals he feeks, 295 Or clafps with fringe of horn his maffy cheeks ; Lifts o'er the toffing wave his noftrils bare, And fpouts pellucid columns into air ; The filvery arches catch the fetting beams, And tranfient rainbows tremble o'er the ftreams. 300

Weak with nice fenfe, the chafte MIMOSA flands, From each rude touch withdraws her timid hands;

Mimofa. 1. 321. The fenfitive plant. Of the clafs Polygamy, one houfe. Naturalifts have not explained the immediate caufe of the collapfing of the fenfitive plant; the leaves meet and clofe in the night during the fleep of the plant, or when exposed to much cold in the day-time, in the fame manner as when they are affected by external violence, folding their upper furfaces together, and in part over each other like fcales or tiles; fo as to expose as little of the upper furface as may be to the air; but do not indeed collapse quite

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Oft as light clouds o'er-pafs the Summer-glade, Alarm'd fhe trembles at the moving fhade ; And feels, alive through all her tender form, 305 The whifper'd murmurs of the gathering florm ; Shuts her fweet eye-lids to approaching night, And hails with frefhen'd charms the rifing light. Veil'd, with gay decency and modeft pride, Slow to the mofque fhe moves, an eaftern bride ; 310 There her foft vows unceafing love record, Queen of the bright feraglio of her Lord.— So finks or rifes with the changeful hour The liquid filver in its glaffy tower.

fo far, fince I have found, when touched in the night during their fleep, they fall ftill further; efpecially when touched on the foot-ftalks between the ftems and the leaflets, which feems to be their moft fenfitive or irritable part. Now as their fituation after being expoled to external violence refembles their fleep, but with a greater degree of collapfe, may it not be owing to a numbnels or paralyfis confequent to too violent irritation, like the faintings of animals from pain or fatigue? I kept a fenfitive plant in a dark room till fome hours after day-break : it's leaves and leaf-ftalks were collapfed as in its moft profound fleep, and on exposing it to the light, above twenty minutes paffed before the plant was thoroughly awake and had quite expanded itfelf. During the night the upper or fmoother furfaces of the leaves are apprefied together; this would feem to fhew that the office of this furface of the leaf was to expole the fluids of the plant to the light as well as to the air. See note on Helianthus. Many flowers clofe up their petals during the night. See note on vegetable refpiration in Part I.

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So turns the needle to the pole it loves, 315 With fine librations quivering, as it moves.

Anemone. 1. 318. Many males, many females. Pliny fays this flower never opens its petals but when the wind blows; whence its name: it has properly no calix, but two or three fets of petals, three in each fet, which are folded over the ftamens and piftil in a fingular and beautiful manner, and differs also from ranunculus in not having a melliferous pore on the claw of each petal.

The Swallow. 1. 322. There is a wonderful conformity between the vegetation of fome plants, and the arrival of certain birds of paffage. Linneus obferves that the wood anemone blows in Sweden on the arrival of the fwallow; and the marfh mary-gold, Caltha, when the cuckoo fings. Near the fame coincidence was obferved in England by Stillingfleet. The word Coccux in Greek fignifies both a young fig and a cuckoo, which is fuppofed to have arifen from the coincidence of their appearance in Greece. Perhaps a fimilar coincidence of appearance in fome part of Afia gave occafion to the ftory of the love of the rofe and nightingale, fo much celebrated by the eaftern poets. See Dianthus. The times however of the appearance of vegetables in the fpring feem occafionally to be influenced by their acquired habits, as well as by their fenfibility to heat: for the roots of potatoes, onions, &c. will germinate with much lefs heat in the fpring than in the autumn: as is eafily obfervable where thefe roots are flored for ufe;

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" Breathe, gentle AIR! from cherub-lips impart
" Thy balmy influence to my anguifh'd heart; 324
" Thou, whofe foft voice calls forth the tender blooms,
" Whofe pencil paints them, and whofe breath perfumes;
" O chafe the Fiend of Froft, with leaden mace
" Who fears in death-like fleep my haplefs race;
" Melt his hard heart, releafe his iron hand,
" And give my ivory petals to expand. 330

and hence malt is beft made in the fpring. 2d. The grains and roots brought from more fouthern latitudes germinate here fooner than thofe which are brought from more northern ones, owing to their acquired habits. Fordyce on Agriculture. 3d. It was obferved by one of the fcholars of Linneus, that the apple-trees fent from hence to New England bloffomed for a few years too early for that climate, and bore no fruit; but afterwards learnt to accommodate themfelves to their new fituation. (Kalm's Travels). 4th. The parts of animals become more fenfible to heat after having been previoufly expofed to cold, as our hands glow on coming into the houfe after having held fnow in them; this feems to happen to vegetables; for vines in grape-houfes, which have been expofed to the winter's cold, will become forwarder and more vigorous than thofe which have been kept during the winter in the houfe. (Kennedy on Gardening.) This accounts for the very rapid vegetation in the northern latitudes after the folution of the fnows.

The increase of the irritability of plants in respect to heat, after having been previously exposed to cold, is further illustrated by an experiment of Dr. Walker's. He cut apertures into a birch-tree at different hights; and on the 26th of March some of these apertures bled, or oozed with the fap-juice, when the thermometer was at 39; which fame apertures did not bleed on the 13th of March, when the thermometer was at 44. The reason of this I apprehend was, because on the night of the 25th the thermometer was as low as 34; whereas on the night of the 12th it was at 41; though the ingenious author aferibes it to another cause. Trans. of Royal Soc. of Edinburgh, v. 1. p. 19
" So may each bud, that decks the brow of fpring, " Shed all its incenfe on thy wafting wing !"-To her fond prayer propitious Zephyr yields, Sweeps on his fliding fhell through azure fields, O'er her fair manfion waves his whifpering wand, 335 And gives her ivory petals to expand; Gives with new life her filial train to rife, And hail with kindling fmiles the genial fkies. So fhines the Nymph in beauty's blufhing pride, When Zephyr wafts her deep calash afide, 340 Tears with rude kifs her bofom's gauzy veil, And flings the fluttering kerchief to the gale. So bright, the folding canopy undrawn, Glides the gilt Landau o'er the velvet lawn, Of beaux and belles difplays the glittering throng, 345 And foft airs fan them, as they roll along.

Where frowning Snowden bends his dizzy brow O'er Conway, liftening to the furge below;

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Retiring LICHEN climbs the topmoft ftone, And drinks the aerial folitude alone.— 350 Bright fhine the ftars unnumber'd o'er her head, And the cold moon-beam gilds her flinty bed; While round the rifted rocks hoarfe whirlwinds breathe, And dark with thunder fail the clouds beneath.— The fteepy path her plighted fwain purfues, 355 And tracks her light fteps o'er th' imprinted dews; Delighted Hymen gives his torch to blaze, Winds round the craggs, and lights the mazy ways; Sheds o'er their *fecret* vows his influence chafte, And decks with rofes the admiring wafte. 360

High in the front of heaven when Sirius glares, And o'er Britannia shakes his fiery hairs;

Lichen. l. 349. Calcareum. Liver-wort. Clandeftine Marriage. This plant is the first that vegetates on naked rocks, covering them with a kind of tapestry, and draws its nourishment perhaps chiefly from the air; after it perishes, earth enough is left for other mosses to root themselves; and after some ages a foil is produced sufficient for the growth of more succulent and large vegetables. In this manner perhaps the whole earth has been gradually covered with vegetation, after it was raised out of the primeval ocean by subterraneous fires. When no foft fhower defcends, no dew diftills, Her wave-worn channels dry, and mute her rills; When droops the fickening herb, the bloffom fades, 365 And parch'd earth gapes beneath the withering glades; ——With languid ftep fair DYPSACA retreats, "Fall gentle dews!" the fainting nymph repeats, Seeks the low dell, and in the fultry fhade Invokes in vain the Naiads to her aid.— 370 Four filvan youths in cryftal goblets bear The untafted treafure to the grateful fair; Pleafed from their hands with modeft grace fhe fips, And the cool wave reflects her coral lips.

Dypfacus. 1. 367. Teafel. One female, and four males. There is a cup around every joint of the ftem of this plant, which contains from a fpoonful to half a pint of water; and ferves both for the nutriment of the plant in dry feafons, and to prevent infects from creeping up to devour its feed. See Silene. The Tillandfia, or wild pine, of the Weft Indies has every leaf terminated near the ftalk with a hollow bucket, which contains from half a pint to a quart of water. Dampier's Voyage to Campeachy. Dr. Sloane mentions one kind of aloe furnifhed with leaves, which, like the wild pine and Banana, hold water; and thence afford neceffary refreshment to travellers in hot countries. Nepenthes has a bucket for the fame purpose at the end of every leaf. Burm. Zeyl. 42. 17.

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With nice felection modeft RUBIA blends375Her vermil dyes, and o'er the cauldron bends;Warm 'mid the rifing fleam the Beauty glows,As blufhes in a mift the dewy rofe.With chemic art *four* favour'd youths aloofStain the white fleece, or ftretch the tinted woof; 380

Rubia. 1. 375. Madder. Four males and one female. This plant is cultivated in very large quantities for dying red. If mixed with the food of young pigs or chickens, it colours their bones red. If they are fed alternate fortnights, with a mixture of madder, and with their ufual food alone, their bones will confift of concentric circles of white and red. Belchier. Phil. Tranf. 1736. Animals fed with madder for the purpose of these experiments were found upon diffection to have thinner gall. Comment. de rebus. Lipfiæ. This circumftance is worth further attention. The colouring materials of vegetables, like those which ferve the purpose of tanning, varnishing, and the various medical purpofes, do not feem effential to the life of the plant; but feem given it as a defence against the depredations of infects or other animals, to whom these materials are nauseous or deleterious. The colours of infects and many fmaller animals contribute to conceal them from the larger ones which prey upon them. Caterpillars which feed on leaves are generally green; and earth-worms the colour of the earth which they inhabit; Butter-flies, which frequent flowers, are coloured like them; finall birds which frequent hedges have greenish backs like the leaves, and light coloured bellies like the fky, and are hence lefs visible to the hawk, who passes under them or over them. Those birds birds which are much amongft flowers, as the gold-finch (Fringil la carduelis), are furnifhed with vivid colours. The lark, partridge, hare, are the colour of dry vegetables or earth on which they reft. And frogs vary their colour with the mud of the ftreams which they frequent; and those which live on trees are green. Fifh, which are generally fufpended in water, and fwallows, which are generally fufpended in air, have their backs the colour of the diftant ground, and their bellies of the fky. In the colder climates many of these become white during the existence of the snows. Hence there is apparent defign in the colours of animals, whilf those of vegetables feem confequent to the other properties of the materials which poffers them,

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O'er Age's cheek the warmth of youth diffufe, Or deck the pale-eyed nymph in rofeate hues. So when MEDEA to exulting Greece From plunder'd COLCHIS bore the golden fleece; On the loud fhore a magic pile fhe rais'd, 385 The cauldron bubbled, and the faggots blaz'd; Pleafed on the boiling wave old Æson fwims, And feels new vigour ftretch his fwelling limbs : Through his thrill'd nerves forgotten ardors dart, And warmer eddies circle round his heart ; 390 With fofter fires his kindling eye-balls glow, And darker treffes wanton round his brow.

Pleafed on the boiling wave. 1. 387. The ftory of Æfon becoming young, from the medicated bath of Medea, feems to have been intended to teach the efficacy of warm bathing in retarding the progrefs of old age. The words relaxation and bracing, which are generally thought exprefive of the effects of warm and cold bathing, are mechanical terms, properly applied to drums or ftrings; but are only metaphors when applied to the effects of cold or warm bathing on animal bodies. The immediate caufe of old age feems to refide in the inirritability of the finer veffels or parts of our fyftem; hence thefe ceafe to act, and collapfe or become horny or bony. The warm bath is peculiarly adapted to prevent thefe circumftances by its increasing our irritability, and by moiftening and foftening the fkin, and the extremities of the finer veffels, which terminate in it. To those who are past the meridian of life, and have dry fkins, and begin to be emaciated, the warm bath, for half an hour twice a week, I believe to be eminently ferviceable in retarding the advances of age.

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As dafh the waves on India's breezy ftrand, Her flufh'd check prefs'd upon her lily hand, VALLISNER fits, up-turns her tearful eyes, 395 Calls her loft lover, and upbraids the fkies; For him fhe breathes the filent figh, forlorn, Each fetting-day; for him each rifing morn.— "Bright orbs, that light yon high etherial plain, "Or bathe your radiant treffes in the main; 400 "Pale moon, that filver'ft o'er night's fable brow;— "For ye were witnefs to his parting vow !— "Ye fhelving rocks, dark waves, and founding fhore,— "Ye echoed fweet the tender words he fwore !—

Vallifieria. 1. 395. This extraordinary plant is of the clafs Two Houfes. It is found in the Eaft Indies, in Norway, and various parts of Italy. Lin. Spec. Plant. They have their roots at the bottom of the Rhone, the flowers of the female plant float on the furface of the water, and are furnifhed with an elaftic fpiral ftalk, which extends or contracts as the water rifes and falls; this rife or fall, from the rapid defcent of the river, and the mountain torrents which flow into it, often amounts to many feet in a few hours. The flowers of the male plant are produced under water, and as foon as their farina, or duft, is mature; they detach themfelves from the plant, and rife to the furface, continue to flourifh, and are wafted by the air, or borne by the currents to the female flowers. In this refembling those tribes of infects, where the males at certain feasons acquire wings, but not the females, as ants, Coccus, Lampyris, Phalæna, Brumata, Lichanella. These male flowers are in fuch numbers, though very minute, as frequently to cover the furface of the river to confiderable extent. See Families of Plants translated from Linneus, p. 677.





" Can ftars or feas the fails of love retain?

" O guide my wanderer to my arms again !"

Her buoyant skiff intrepid ULVA guides, And seeks her Lord amid the trackless tides;

Ulva. 1. 407. Clandeftine marriage. This kind of fea-weed is buoyed up by bladders of air, which are formed in the duplicatures of its leaves; and forms immenfe floating fields of vegetation; the young ones, branching out from the larger ones, and borne on fimilar little air-veffels. It is also found in the warm baths of Patavia; where the leaves are formed into curious cells or labyrinths for the purpole of floating on the water. See ulva labyrinthi-formis Lin. Spec. Plant. The air contained in thefe cells was found by Dr. Prieftley to be fometimes purer than common air, and fometimes lefs pure; the air-bladders of fifh feem to be fimilar organs, and ferve to render them buoyant in the water. In fome of thefe, as in the Cod and Haddock, a red membrane, confifting of a great number of leaves or duplicatures, is found within the air-bag, which probably fecrets this air from the blood of the animal. (Monro. Physiol. of Fish. p. 28.) To determine whether this air, when first feparated from the blood of the animal or plant, be dephlogifticated air, is worthy inquiry. The bladder-fena (Colutea), and bladder-nut (Staphylæa), have their feed-veffels diffended with air; the Ketmia has the upper joint of the ftem immediately under the receptacle of the flower much diffended with air; thefe feem to be analogous to the air-veffel at the broad end of the egg, and may probably become lefs pure as the feed ripens; fome, which I tried, had the purity of the furrounding atmosphere. The air at the broad end of the egg is probably an organ ferving the purpole of refpiration to the young chick, fome of whole veffels are fpread upon it like a placenta, or permeate it. Many are of opinion that even the placenta of the human fetus, and cotyledons of quadrupeds, are refpiratory organs rather than nutritious ones.

The air in the hollow ftems of graffes, and of fome unbelliferous plants, bears analogy to the air in the quills, and in fome of the bones of birds; fupplying the place of the pith, which fhrivels up after it has performed its office of protruding the young ftem or feather. Some of thefe cavities of the bones are faid to communicate with the lungs in birds. Phil. Tranf.

The air-bladders of fifh are nicely adapted to their intended purpofe; for though they render them buoyant near the furface without the labour of using their fins, yet, when they reft at greater depths, they are no inconvenience, as the increased preffure of the water condenses the air which they contain into less space. Thus, if a cork or bladder

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Her fecret vows the Cyprian Queen approves, And hovering Halcyons guard her infant-loves; 410 Each in his floating cradle round they throng, And dimpling Ocean bears the fleet along .--Thus o'er the waves, which gently bend and fwell, Fair GALATEA fleers her filver fhell; Her playful Dolphins ftretch the filken rein, 415 Hear her fweet voice, and glide along the main. As round the wild meandering coaft fhe moves By gushing rills, rude cliffs, and nodding groves; Each by her pine the Wood-nymphs wave their locks, And wondering Naiads peep amid the rocks; 420 Pleafed trains of Mermaids rife from coral cells; Admiring Tritons found their twifted fhells; Charm'd o'er the car purfuing Cupids fweep, Their fnow-white pinions twinkling in the deep;

of air was immerfed a very great depth in the ocean, it would be fo much compreffed, as to become fpecifically as heavy as the water, and would remain there. It is probable the unfortunate Mr. Day, who was drowned in a diving-fhip of his own conftruction, mifcarried from not attending to this circumftance: it is probable the quantity of air he took down with him, if he defcended much lower than he expected, was condenfed into fo fmall a fpace as not to render the fhip buoyant when he endeavoured to afcend.

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And, as the luftre of her eye fhe turns, 425 Soft fighs the Gale, and amorous Ocean burns.

On Dove's green brink the fair TREMELLA flood, And view'd her playful image in the flood; To each rude rock, lone dell, and echoing grove Sung the fweet forrows of her *fecret* love.

Tremella. 1. 427. Clandestine marriage. I have frequently observed fungusses of this Genus on old rails and on the ground to become a transparent jelly, after they had been frozen in autumnal mornings; which is a curious property, and diftinguisses them from fome other vegetable mucilage; for I have observed that the passe, made by boiling wheat-flour in water, ceases to be adhersive after having been frozen. I supported that the Tremella Nostoc, or star-gelly, also had been thus produced; but have fince been well informed, that the Tremella Nostoc is a mucilage voided by Herons after they have eaten frogs; hence it has the appearance of having been pressed through a hole; and limbs of frogs are faid fometimes to be found amongst it; it is always feen upon plains or by the fides of water, places which Herons generally frequent.

Some of the funguffes are fo acrid, that a drop of their juice blifters the tongue; others intoxicate those who eat them. The Ofliacks in Siberia use them for the latter purpose; one Fungus of the species, Agaricus muscarum, eaten raw; or the decoction of three of them, produces intoxication for 12 or 16 hours. History of Russia. V. I. Nichols. 1780. As all acrid plants become less so, if exposed to a boiling heat, it is probable the common mushroom may sometimes disagree from being not sufficiently ftewed. The Ofliacks blifter their skin by a fungus sound on Birch-trees; and use the Agaricus officin. for Soap. ib.

There was a difpute whether the funguffes fhould be claffed in the animal or vegetable department. Their animal taffe in cookery, and their animal fmell when burnt, together with their tendency to putrefaction, infomuch that the Phallus impudicus has gained the name of flink-horn; and laftly, their growing and continuing healthy without light, as the Licoperdon tuber or truffle, and the fungus vinofus or mucor in dark cellars, and the efculent mufhrooms on beds covered thick with fraw, would feem to fhew that they approach towards the animals, or make a kind of ifthmus connecting the two mighty kingdoms of animal and of vegetable nature.

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" Oh, ftay !--- return !"--- along the founding fhore Cry'd the fad Naiads, --- fhe return'd no more !---Now girt with clouds the fullen Evening frown'd, And withering Eurus fwept along the ground ; The mifty moon withdrew her horned light, 435 And funk with Hefper in the fkirt of night; No dim electric ftreams, (the northern dawn) With meek effulgence quiver'd o'er the lawn ; No ftar benignant fhot one transient ray To guide or light the wanderer on her way. 440 Round the dark craggs the murmuring whirlwinds blow, Woods groan above, and waters roar below; As o'er the steeps with paufing foot she moves, The pitying Dryads shriek amid their groves. She flies,-fhe ftops,-fhe pants,-fhe looks behind, 445 And hears a demon howl in every wind. -As the bleak blaft unfurls her fluttering veft, Cold beats the fnow upon her fhuddering breaft; Through her numb'd limbs the chill fenfations dart, And the keen ice-bolt trembles at her heart. 459

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" I fink, I fall ! oh, help me, help !" fhe cries, Her fliffening tongue the unfinish'd found denies; Tear after tear adown her cheek fucceeds, And pearls of ice beftrew the glittering meads; Congealing fnows her lingering feet furround, 455 Arreft her flight, and root her to the ground ; With fuppliant arms fhe pours the filent prayer; Her fuppliant arms hang crystal in the air; Pellucid films her fhivering neck o'erfpread, Seal her mute lips, and filver o'er her head, 460 Veil her pale bofom, glaze her lifted hands, And shrined in ice the beauteous statue stands. -Dove's azure nymphs on each revolving year For fair TREMELLA fhed the tender tear; With rufh-wove crowns in fad proceffion move, 465 And found the forrowing fhell to haplefs love."

Here paused the MUSE,—across the darken'd pole Sail the dim clouds, the echoing thunders roll;

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The trembling Wood-nymphs, as the tempeft lowers, Lead the gay Goddess to their inmost bowers; 470 Hang the mute lyre the laurel fhade beneath, And round her temples bind the myrtle wreath. -Now the light fwallow with her airy brood Skims the green meadow, and the dimpled flood; Loud shrieks the lone thrush from his leafless thorn, 475 Th' alarmed beetle founds his bugle horn ; Each pendant fpider winds with fingers fine His ravel'd clue, and climbs along the line; Gay Gnomes in glittering circles stand aloof Beneath a fpreading mushroom's fretted roof; 480 Swift bees returning feek their waxen cells, And Sylphs cling quivering in the lily's bells. Through the still air defcend the genial showers. And pearly rain-drops deck the laughing flowers.

INTERLUDE.

Bookfeller. YOUR verses, Mr. Botanist, consist of pure description, I hope there is sense in the notes.

Poet. I am only a flower-painter, or occafionally attempt a landskip; and leave the human figure with the subjects of history to abler artists.

B. It is well to know what fubjects are within the limits of your pencil; many have failed of fuccefs from the want of this felf-knowledge. But pray tell me, what is the effential difference between Poetry and Profe? is it folely the melody or measure of the language?

P. I think not folely; for fome profe has its melody, and even meafure. And good verfes, well fpoken in a language unknown to the hearer, are not eafily to be diffinguished from good profe.

B. Is it the fublimity, beauty, or novelty of the fentiments?

P. Not fo; for fublime fentiments are often better expressed in profe. Thus when Warwick in one of the plays of Shakespear, is left wounded on the field after the loss of the battle, and his friend fays to him, "O could you but fly!" what can be more fublime than his answer, "Why then, I would not fly." No measure of verse, I imagine, could add dignity to this sentiment.

Η

And it would be eafy to felect examples of the beautiful or new from profe writers, which I fuppofe no measure of verse could improve.

B. In what then confifts the effential difference between Poetry and Profe?

P. Next to the measure of the language, the principle diftinction appears to me to confift in this: that Poetry admits of but few words expressive of very abstracted ideas, whereas Profe abounds with them. And as our ideas derived from visible objects are more distinct than those derived from the objects of our other fenses, the words expressive of these ideas belonging to vision make up the principal part of poetic language. That is, the Poet writes principally to the eye, the Profe-writer uses more abstracted terms. Mr. Pope has written a bad verse in the Windfor Forest:

" And Kennet fwift for filver Eels renown'd."

The word renown'd does not prefent the idea of a visible object to the mind, and is thence profaic. But change this line thus,

" And Kennet fwift, where filver Graylings play."

and it becomes poetry, becaufe the fcenery is then brought before the eye.

B. This may be done in profe.

P. And when it is done in a fingle word, it animates the profe; fo it is more agreeable to read in Mr. Gibbon's Hiftory, "Germany was at this time over-fhadowed with extensive forefts; than Germany was at this time *full* of extensive forefts. But where this mode of expression occurs too frequently, the profe approaches to poetry: and in graver works, where we expect to be instructed rather than amused, it becomes tedious and impertinent. Some parts of Mr. Burke's eloquent orations become intricate and enervated by superfluity of poetic ornament; which quantity of ornament would have been agreeable in a poem, where much ornament is expected.

B. Is then the office of Poetry only to amufe?

P. The Muses are young Ladies, we expect to see them dreffed; though not like some modern beauties with so much gauze and feather, that "the Lady herself is the least part of her." There are however didactic pieces of poetry, which are much admired, as the Georgics of Virgil, Mason's English Garden, Hayley's Epistles; nevertheless Science is best delivered in Prose, as its mode of reasoning is from stricter analogies than metaphors or fimilies.

B. Do not Perfonifications and Allegories diffinguifh poetry?

P. These are other arts of bringing objects before the eye; or of expressing fentiments in the language of vision; and are indeed better fuited to the pen than the pencil.

B. That is strange, when you have just faid they are used to bring their objects before the eye.

P. In poetry the perfonitication or allegoric figure is generally indiffinct, and therefore does not ftrike us fo forcibly as to make us attend to its improbability; but in painting, the figures being all much more diffinct, their improbability becomes apparent, and feizes our attention to it. Thus the perfon of Concealment is very indiftinct, and therefore does not compel us to attend to its improbability, in the following beautiful lines of Shakespear:

> " —— She never told her love; But let Concealment, like a worm i' th' bud, Feed on her damafk cheek."—

But in these lines below the person of Reason obtrudes itself into our company, and becomes disagreeable by its distinctness, and confequent improbability.

> " To Reafon I flew, and intreated her aid, Who paufed on my cafe, and each circumftance weigh'd; Then gravely reply'd in return to my prayer, That Hebe was the faireft of all that were fair. That's a truth, reply'd I, I've no need to be taught, I came to you, Reafon, to find out a fault. If that's all, fays Reafon, return as you came, To find fault with Hebe would forfeit my name."

Allegoric figures are on this account in general lefs manageable in painting and in ftatuary than in poetry : and can feldom be introduced in the two former arts in company with natural figures, as is evident from the ridiculous effect of many of the paintings of Reubens in the Luxemburgh gallery; and for this reafon, becaufe their improbability becomes more ftriking, when there are the figures of real perfons by their fide to compare them with.

Mrs. Angelica Kauffman, well apprifed of this circumstance, has introduced no mortal figures amongst her Cupids and her Graces. And the great Roubiliac, in his unrivalled monument of Time and Fame struggling for the trophy of General Wade, has only hung up a medallion of the head of the hero of the piece. There are however fome allegoric figures, which we have fo often heard defcribed or feen delineated, that we almost forget that they do not exist in common life; and thence view them without astonishment; as the figures of the heathen mythology, of angels, devils, death and time; and almost believe them to be realities, even when they are mixed with representations of the natural forms of man. Whence I conclude, that a certain degree of probability is necessary to prevent us from revolting with distaste from unnatural images; unless we are otherwise fo much interested in the contemplation of them as not to perceive their improbability.

B. Is this reafoning about degrees of probability juft?—When Sir Jofhua Reynolds, who is unequalled both in the theory and practice of his art, and who is a great mafter of the pen as well as the pencil, has afferted in a difcourfe delivered to the Royal Academy, December 11, 1786, that " the higher ftyles of painting, like the " higher kinds of the Drama, do not aim at any thing like deception; " or have any expectation, that the fpectators fhould think the events " there reprefented are really paffing before them." And he then accufes Mr. Fielding of bad judgment, when he attempts to compliment Mr. Garrick in one of his novels, by introducing an ignorant man, miftaking the reprefentation of a fcene in Hamlet for a reality; and thinks, becaufe he was an ignorant man, he was lefs liable to make fuch a miftake.

P. It is a metaphyfical queftion, and requires more attention than Sir Jofhua has beftowed upon it.—You will allow, that we are perfectly deceived in our dreams; and that even in our waking reveries, we are often fo much abforbed in the contemplation of what paffes in our imaginations, that for a while we do not attend to the lapfe of time or to our own locality; and thus fuffer a fimilar kind of deception as in our dreams. That is, we believe things prefent before our eyes, which are not fo. There are two circumftances, which contribute to this compleat deception in our dreams. Firft, becaufe in fleep the organs of fenfe are clofed or inert, and hence the trains of ideas affociated in our imaginations are never interrupted or diffevered by the irritations of external objects, and can not therefore be contrafted with our fenfations. On this account, though we are affected with a variety of paffions in our dreams; as anger, love, joy; yet we never experience furprize.—For furprize is only produced when any external irritations fuddenly obtrude themfelves, and diffever our paffing trains of ideas.

Secondly, becaufe in fleep there is a total fufpenfion of our voluntary power, both over the mufcles of our bodies, and the ideas of our minds; for we neither walk about, nor reafon in compleat fleep. Hence, as the trains of our ideas are paffing in our imaginations in dreams, we cannot compare them with our previous knowledge of things, as we do in our waking hours; for this is a voluntary exertion; and thus we cannot perceive their incongruity.

Thus we are deprived in fleep of the only two means by which we can diffinguifh the trains of ideas paffing in our imaginations, from those excited by our fensations; and are led by their vivacity to believe them to belong to the latter. For the vivacity of these trains of ideas, passing in the imagination, is greatly increased by the causes above-mentioned; that is, by their not being disturbed or diffevered either by the appulses of external bodies, as in furprize; or by our voluntary exertions in comparing them with our previous knowledge of things, as in reasoning upon them.

B. Now to apply.

P. When by the art of the Painter or Poet a train of ideas is fuggefted to our imaginations, which interefts us fo much by the pain

or pleafure it affords, that we ceafe to attend to the irritations of common external objects, and ceafe alfo to ufe any voluntary efforts to compare thefe interefting trains of ideas with our previous knowledge of things, a compleat reverie is produced : during which time, however fhort, if it be but for a moment, the objects themfelves appear to exift before us. This, I think, has been called by an ingenious critic, " the ideal prefence," of fuch objects. (Elements of Criticifm by Lord Kaimes). And in refpect to the compliment intended by Mr. Fielding to Mr. Garrick, it would feem that an ignorant Ruftic at the play of Hamlet, who has fome previous belief in the appearance of Ghofts, would fooner be liable to fall into a reverie, and continue in it longer, than one who poffeffed more knowledge of the real nature of things, and had a greater facility of exercifing his reafon.

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B. It must require great art in the Painter or Poet to produce this kind of deception ?

P. The matter muft be interefting from its fublimity, beauty, or novelty; this is the fcientific part; and the art confifts in bringing these diffinctly before the eye, so as to produce (as above-mentioned) the ideal prefence of the object, in which the great Shakespear particularly excells.

B. Then it is not of any confequence whether the reprefentations correspond with nature?

P. Not if they fo much intereft the reader or fpectator as to induce the reverie above defcribed. Nature may be feen in the marketplace, or at the card-table; but we expect fomething more than this in the play-houfe or picture-room. The further the artifts recedes from nature, the greater novelty he is likely to produce; if he rifes above nature, he produces the fublime; and beauty is probably a felection and new combination of her most agreeable parts. Yourfelf will be fenfible of the truth of this doctrine by recollecting over in your mind the works of three of our celebrated artifts. Sir Jofhua Reynolds has introduced fublimity even into its portraits; we admire the reprefentation of perfons, whole reality we should have paffed by unnoticed. Mrs. Angelica Kauffman attracts our eyes with beauty, which I fuppofe no where exifts; certainly few Grecian faces are feen in this country. And the daring pencil of Fufeli transports us beyond the boundaries of nature, and ravishes us with the charm of the most interesting novelty. And Shakespear, who excells in all these together, so far captivates the spectator, as to make him unmindful of every kind of violation of Time, Place, or Existence. As at the first appearance of the Ghost of Hamlet, "his " ear must be dull as the fat weed, which roots itself on Lethe's " brink," who can attend to the improbability of the exhibition. So in many fcenes of the Tempest we perpetually believe the action paffing before our eyes, and relapfe with fomewhat of diftate into common life at the intervals of the reprefentation.

B. I suppose a poet of less ability would find fuch great machinery difficult and cumbersome to manage?

P. Just fo, we fhould be fhocked at the apparent improbabilities. As in the gardens of a Sicilian nobleman, defcribed in Mr. Brydone's and in Mr. Swinburn's travels, there are faid to be fix hundred statues of imaginary monsters, which so difgust the spectators, that the state had once a ferious defign of destroying them; and yet the very improbable monsters in Ovid's Metamorphoses have entertained the world for many centuries.

B. The monfters in your Botanic Garden, I hope, are of the latter kind?

P. The candid reader must determine.

THE

LOVES OF THE PLANTS.

CANTO II.

AGAIN the Goddefs ftrikes the golden lyre, And tunes to wilder notes the warbling wire; With foft fufpended ftep Attention moves, And Silence hovers o'er the liftening groves; Orb within orb the charmed audience throng, And the green vault reverberates the fong.

I

5

"Breathe foft, ye Gales !" the fair CARLINA cries, "Bear on broad wings your Votrefs to the fkies. "How fweetly mutable yon orient hues, "As Morn's fair hand her opening rofes ftrews; 10 "How bright, when Iris blending many a ray "Binds in embroider'd wreath the brow of Day; "Soft, when the pendant Moon with luftres pale "O'er heaven's blue arch unfurls her milky veil; "While from the north long threads of filver light 15 "Dart on fwift fhuttles o'er the tiffued night !

Carlina. 1. 7. Carline Thiftle. Of the clafs Confederate Males. The feeds of this and of many other plants of the fame clafs are furnished with a plume, by which admirable mechanism they perform long aerial journeys, croffing lakes and deferts, and are thus different far from the original plant, and have much the appearance of a Shuttle-cock as they fly. The wings are of different confiruction, fome being like a divergent tuft of hairs, others are branched like feathers, fome are elevated from the crown of the feed by a flender foot-stalk, which gives them a very elegant appearance, others fit immemediately on the crown of the feed.

Nature has many other curious vegetable contrivances for the differition of feeds: fee note on Helianthus. But perhaps none of them has more the appearance of defign than the admirable apparatus of Tillandfia for this purpofe. This plant grows on the branches of trees, like the mifleto, and never on the ground; the feeds are furnifhed with many long threads on their crowns; which, as they are driven forwards by the winds, wrap round the arms of trees, and thus hold them faft till they vegetate. This is very analogous to the migration of Spiders on the goffamer, who are faid to attach themfelves to the end of a long thread, and rife thus to the tops of trees or buildings, as the accidental breezes carry them.

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" Breathe foft, ye Zephyrs! hear my fervent fighs,
" Bear on broad wings your Votrefs to the fkies!"—
—Plume over plume in long divergent lines
On whale-bone ribs the fair Mechanic joins;
20
Inlays with eider down the filken ftrings,
And weaves in wide expanse Dædalian wings;
Round her bold fons the waving pennons binds,
And walks with angel-ftep upon the winds.

So on the fhorelefs air the intrepid Gaul 25 Launch'd the vaft concave of his buoyant ball.— Journeying on high, the filken caftle glides Bright as a meteor through the azure tides ; O'er towns and towers and temples wins it's way, Or mounts fublime, and gilds the vault of day. 30 Silent with upturn'd eyes unbreathing crowds Purfue the floating wonder to the clouds ; And, flufh'd with transport or benumb'd with fear, Watch, as it rifes, the diminifh'd fphere.

-Now lefs and lefs-and now a fpeck is feen !--35 And now the fleeting rack obtrudes between ! With bended knees, raifed arms, and fuppliant brow To every fhrine with mingled cries they vow .--"Save him, ye Saints ! who o'er the good prefide; " Bear him, ye Winds ! ye Stars benignant ! guide." 40 -The calm Philosopher in ether fails, Views broader ftars, and breathes in purer gales; Sees, like a map, in many a waving line Round Earth's blue plains her lucid waters fhine; Sees at his feet the forky lightnings glow, 45 And hears innocuous thunders roar below. -----Rife, great MONGOLFIER! urge thy venturous flight High o'er the Moon's pale ice-reflected light; High o'er the pearly Star, whofe beamy horn Hangs in the eaft, gay harbinger of morn; 50 Leave the red eye of Mars on rapid wing, Jove's filver guards, and Saturn's crystal ring; Leave the fair beams, which, iffuing from afar, Play with new luftres round the Georgian ftar;

Shun with ftrong oars the Sun's attractive throne,55The fparkling Zodiack, and the milky zone;Where headlong Comets with increafing forceThro' other fyftems bend their blazing courfe.For thee Caffiope her chair withdraws,For thee Caffiope her chair withdraws,For thee the Bear retracts his fhaggy paws;60High o'er the North thy golden orb fhall roll,And blaze eternal round the wondering pole.So Argo, rifing from the fouthern main,Lights with new ftars the blue etherial plain;With favouring beams the mariner protects,65And the bold courfe, which firft it fteer'd, directs.

Inventrefs of the Woof, fair LINA flings The flying fhuttle through the dancing ftrings;

For thee the Bear. 1. 60. Tibi jam brachia contrahit ardens Scorpius. Virg. Georg. I. 1. 34. A new ftar appeared in Caffiope's chair in 1572. Herfchel's Conftruction of the Heavens. Phil. Tranf. V. 75. p. 266.

Linum. 1. 67. Flax. Five males and five females. It was first found on the banks of the Nile. The Linum Lusitanicum, or Portugal flax, has ten males: see the note on Curcuma. It is was faid to invent fpinning and weaving: mankind before that time were clothed with the skins of animals. The sable of Arachne was to compliment this new art of spinning and weaving, supposed to suppose in fineness the web of the Spider.

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Inlays the broider'd weft with flowery dyes, Quick beat the reeds, the pedals fall and rife; 70 Slow from the beam the lengths of warp unwind, And dance and nod the maffy weights behind .--Taught by her labours, from the fertile foil Immortal Isis clothed the banks of Nile; And fair ARACHNE with her rival loom 75 Found undeferved a melancholy doom .---Five Sifter-nymphs with dewy fingers twine The beamy flax, and ftretch the fibre-line; Quick eddying threads from rapid fpindles reel, Or whirl with beating foot the dizzy wheel. 80 -Charm'd round the bufy Fair five fhepherds prefs, Praife the nice texture of their fnowy drefs, Admire the Artifts, and the art approve, And tell with honey'd words the tale of love.

So now, where Derwent rolls his dufky floods 85 Through vaulted mountains, and a night of woods,

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The Nymph, Gossypia, treads the velvet fod, And warms with rofy finiles the watery God; His ponderous oars to flender fpindles turns, And pours o'er maffy wheels his foamy urns! With playful charms her hoary lover wins, And wields his trident,—while the Monarch fpins. —Firft with nice eye emerging Naiads cull From leathery pods the vegetable wool;

Goffypia. 1.87. Goffypium. The cotton plant. On the river Derwent near Matlock in Derbyfhire, Sir RICHARD ARKWRIGHT has erected his curious and magnificent machinery for fpinning cotton; which had been in vain attempted by many ingenious artifts before him. The cotton-wool is first picked from the pods and feeds by women. It is then carded by *cylindrical cards*, which move against each other, with different velocities. It is taken from these by an *iron-hand* or comb, which has a motion similar to that of feratching, and takes the wool off the cards longitudinally in respect to the fibres or staple, producing a continued line loosely cohering, called the *Rove* or *Roving*. This Rove, yet very loosely twisted, is then received or drawn into a *whirling canisser*, and is rolled by the centrifugal force in spiral lines within it; being yet too tender for the spindle. It is then passed between *two pairs of rollers*; the fecond pair moving faster than the first elongate the thread with greater equality than can be done by the hand; and is then twisted on spoles or bobbins.

The great fertility of the Cotton-plant in thefe fine flexile threads, whilf thofe from Flax, Hemp, and Nettles, or from the bark of the Mulberry-tree, require a previous putrefaction of the parenchymatous fubftance, and much mechanical labour, and afterwards bleaching, renders this plant of great importance to the world. And fince Sir Richard Arkwright's ingenious machine has not only greatly abbreviated and fimplified the labour and art of carding and fpinning the Cotton-wool, but performs both thefe circumftances *better* than can be done by hand, it is probable, that the clothing of this fmall feed will become the principal clothing of mankind; though animal wool and filk may be preferable in colder climates, as they are more imperfect conductors of heat, and are thence a warmer clothing.

Emerging Naiads. 1.93. — eam circum Milefia vellera Nymphæ Carpebant, hyali faturo fucata colore. Vir. Georg. IV. 334.

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With wiry teeth revolving cards release The tanged knots, and fmooth the ravell'd fleece; Next moves the iron-hand with fingers fine, Combs the wide card, and forms the eternal line; Slow, with foft lips, the whirling Can acquires The tender skeins, and wraps in rising spires; 100 With quicken'd pace fucceffive rollers move, And thefe retain, and those extend the rove; Then fly the fpoles, the rapid axles glow, And flowly circumvolves the labouring wheel below.

PAPYRA, throned upon the banks of Nile, 105 Spread her fmooth leaf, and waved her filver ftyle.

Cyprus. Papyrus. 1. 105. Three males, one female. The leaf of this plant was first used for paper; whence the word paper; and leaf, or folium, for a fold of a book. Afterwards the bark of a fpecies of mulberry was ufed ; whence liber fignifies a book, and the bark of a tree. Before the invention of letters mankind may be faid to have been perpetually in their infancy, as the arts of one age or country generally died with their inventors. Whence arofe the policy, which ftill continues in Indoftan, of obliging the fon to practife the profession of his father. After the discovery of letters, the facts of Aftronomy and Chemiftry became recorded in written language, though the antient hieroglyphic characters for the planets and metals continue in use at this day. The antiquity of the invention of mufic, of aftronomical obfervations, and the manufacture of Gold and Iron, are recorded in Scripture.

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-The ftoried pyramid, the laurel'd buft, The trophy'd arch had crumbled into duft; The facred fymbol, and the epic fong, (Unknown the character, forgot the tongue,) IIO With each unconquer'd chief, or fainted maid, Sunk undiftinguish'd in Oblivion's shade. Sad o'er the fcatter'd ruins Genius figh'd, And infant Arts but learn'd to lifp and died. Till to aftonish'd realms PAPYRA taught IIS To paint in mystic colours Sound and Thought. With Wifdom's voice to print the page fublime, And mark in adamant the fteps of Time. -Three favour'd youths her foft attention share, The fond difciples of the fludious Fair,

About twenty letters, ten cyphers, and feven crotchets, reprefent by their numerous combinations all our ideas and fenfations ! the mufical characters are probably arrived at their perfection, unlefs emphafis, and tone, and fwell could be expreffed, as well as note and time. Charles the Twelfth of Sweden had a defign to have introduced a numeration by fquares, inftead of by decimation, which might have ferved the purpofes of philofophy better than the prefent mode, which is faid to be of Arabic invention. The alphabet is yet in a very imperfect flate; perhaps feventeen letters could express all the fimple founds in the European languages. In China they have not yet learned to divide their words into fyllables, and are thence neceffitated to employ many thousand characters; it is faid above eighty thousand. It is to be wished, in this ingenious age, that the European nations would accord to reform our alphabet.

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Hear her fweet voice, the golden process prove; Gaze, as they learn ; and, as they liften, love. The first from Alpha to Omega joins The letter'd tribes along the level lines; Weighs with nice ear the vowel, liquid, furd, 125 And breaks in fyllables the volant word. Then forms the next upon the marshal'd plain In deepening ranks his dexterous cypher-train; And counts, as wheel the decimating bands, The dews of Ægypt, or Arabia's fands. 130 And then the third on four concordant lines Prints the lone crotchet, and the quaver joins; Marks the gay trill, the folemn paufe infcribes, And parts with bars the undulating tribes. 134 Pleafed round her cane-wove throne, the applauding crowd Clap'd their rude hands, their fwarthy foreheads bow'd ; With loud acclaim "a prefent God!" they cry'd, "A prefent God !" rebellowing fhores reply'd .--Then peal'd at intervals with mingled fwell The echoing harp, fhrill clarion, horn, and fhell; 140

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While Bards ecftatic, bending o'er the lyre, Struck deeper chords, and wing'd the fong with fire. Then mark'd Aftronomers with keener eyes The Moon's refulgent journey through the fkies; Watch'd the fwift Comets urge their blazing cars, 145 And weigh'd the Sun with his revolving Stars. High raifed the Chemifts their Hermetic wands, (And changing forms obey'd their waving hands,) Her treafur'd Gold from Earth's deep chambers tore, Or fused and harden'd her chalybeate ore. 150 All with bent knee from fair PAPYRA claim Wove by her hands the wreath of deathlefs fame. -----Exulting Genius crown'd his darling child, The young Arts clasp'd her knees, and Virtue fmiled.

So now DELANY forms her mimic bowers, 155 Her paper foliage, and her filken flowers;

So now Delany. 1. 155. Mrs. Delany has finished nine hundred and seventy accurate and elegant representations of different vegetables with the parts of their flowers, fructication, &c. according with the classification of Linneus, in what she terms paper-mosaic. She began this work at the age of 74, when her sight would no longer ferve her to paint,

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Her virgin train the tender fciffars ply, Vein the green leaf, the purple petal dye : Round wiry ftems the flaxen tendril bends, Mofs creeps below, and waxen fruit impends. 160 Cold Winter views amid his realms of fnow DELANY'S vegetable flatutes blow ; Smooths his ftern brow, delays his hoary wing, And eyes with wonder all the blooms of fpring.

The gentle LAPSANA, NYMPHÆA fair, 165 And bright CALENDULA with golden hair,

in which fhe much excelled: between her age of 74 and 82, at which time her eyes quite failed her, fhe executed the curious Hortus ficcus above-mentioned, which I fuppofe contains a greater number of plants than were ever before drawn from the life by any one perfon. Her method confifted in placing the leaves of each plant with the petals, and all the other parts of the flowers on coloured paper, and cutting them with fciffars accurately to the natural fize and form, and then pafting them on a dark ground; the effect of which is wonderful, and their accuracy lefs liable to fallacy than drawings. She is at this time (1788) in her 89th year, with all the powers of a fine underftanding ftill unimpaired. I am informed another vety ingenious lady, Mrs. North, is conftructing a fimilar Hortus ficcus, or Paper-garden; which fhe executes on a ground of vellum with fuch elegant tafte and fcientific accuracy, that it cannot fail to become a work of ineffimable value.

Lapfana, Nymphæa alba, Calendula. 1. 165. And many other flowers clofe and open their petals at certain hours of the day; and thus conflitute what Linneus calls the Horologe, or Watch of Flora. He enumerates 46 flowers, which poffers this kind of fentibility. I shall mention a few of them with their respecting hours of rising and setting,

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Watch with nice eye the Earth's diurnal way, Marking her folar and fidereal day, Her flow nutation, and her varying clime, And trace with mimic art the march of Time; 170 Round his light foot a magic chain they fling, And count the quick vibrations of his wing.— Firft in its brazen cell reluctant roll'd Bends the dark fpring in many a fteely fold;

as Linneus terms them. He divides them first into *meteoric* flowers, which lefs accurately observe the hour of unfolding, but are expanded sooner or later, according to the cloudiness, moisture, or preffure of the atmosphere. 2d. *Tropical* flowers open in the morning and close before evening every day; but the hour of the expanding becomes earlier or later, as the length of the day increases or decreases. 3dly. *ÆquinoEtial* flowers, which open at a certain and exact hour of the day, and for the most part close at another determinate hour.

Hence the Horologe or Watch of Flora is formed from numerous plants, of which the following are thole molt common in this country. Leontodon taraxacum, Dandelion, opens at 5-6, clofes at 8-9. Hieracium pilofella, moule-ear hawkweed, opens at 8, clofes at 2. Sonchus lævis, finooth Sow-thiftle, at 5 and at 11-12. Lactuca fativa, cultivated Lettice, at 7 and 10. Tragopogon luteum, yellow Goatíbeard, at 3-5 and at 9-10. Lapfana, nipplewort, at 5-6 and at 10-11. Nymphæa alba, white water lily, at 7 and 5. Papaver nudicaule, naked poppy, at 5 and at 7. Hemerocallis fulva, tawny Day-lily, at 5 and at 7-8. Convolvulus, at 5-6. Malva, Mallow, at 9-10, and at 1. Arenarea purpurea, purple Sandwort, at 9-10, and at 2-3. Anagallis, pimpernel, at 7-8. Portulaca hortenfis, garden Purflain, at 9-10, and at 11-12. Dianthus prolifer, proliferous Pink, at 8 and at 1. Cichoreum. Succory, at 4-5. Hypochæris, at 6-7, and at 4-5. Crepis, at 4-5, and at 10-11. Picris, at 4-5, and at 12. Calendula field, at 9, and at 3. Calendula African, at 7, and at 3-4.

As these observations were probably made in the botanic gardens at Upfal, they must require further attention to fuit them to our climate. See Stillingfleet's Calendar of Flora.

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On fpiral brafs is ftretch'd the wiry thong, Tooth urges tooth, and wheel drives wheel along; In diamond-eyes the polifh'd axles flow, Smooth flides the hand, the balance pants below. Round the white circlet in relievo bold A Serpent twines his fcaly length in gold; 180 And brightly pencil'd on the enamel'd fphere Live the fair trophies of the paffing year. -Here Time's huge fingers grafp his giant mace, And dash proud Superstition from her base, Rend her ftrong towers and gorgeous fanes, and fhed 185 The crumbling fragments round her guilty head. There the gay Hours, whom wreaths of rofes deck, Lead their young trains amid the cumberous wreck, And, flowly purpling o'er the mighty wafte, Plant the fair growths of Science and of Tafte. 190 While each light Moment, as it dances by With feathery foot and pleafure-twinkling eye, Feeds from its baby-hand, with many a kifs, The callow neftlings of domeftic Blifs.
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As yon gay clouds, which canopy the fkies, 195 Change their thin forms, and lofe their lucid dyes; So the foft bloom of Beauty's vernal charms Fades in our eyes, and withers in our arms. -Bright as the filvery plume, or pearly fhell, The fnow-white rofe, or lily's virgin bell, 200 The fair HELLEBORAS attractive fhone, Warm'd every Sage, and every Shepherd won .---Round the gay fifters prefs the enamour'd bands, And feek with foft folicitude their hands. -Erewhile how chang'd !--- in dim fuffusion lies 205 The glance divine, that lighten'd in their eyes; Cold are those lips, where fmiles feductive hung, And the weak accents linger on their tongue :

Helleborus. 1. 201. Many males, many females. The Helleborus niger; or Chriftmas rofe, has a large beautiful white flower, adorned with a circle of tubular two-lipp'd nectaries. After impregnation the flower undergoes a remarkable change, the nectaries drop off, but the white corol remains, and gradually becomes quite green. This curious metamorphofe of the corol, when the nectaries fall off, feems to flew that the white juices of the corol were before carried to the nectaries, for the purpofe of producing honey: becaufe when thefe nectaries fall off, no more of the white juice is fecreted in the corol, but it becomes green, and degenerates into a calyx. See note on Lonicera. The nectary of the Tropæolum, garden nafturtion, is a coloured horn growing from the calyx.

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Each rofeate feature fades to livid green,— —Difguft with face averted fhuts the fcene.

So from his gorgeous throne, which awed the world, The mighty Monarch of Affyria hurl'd, Sojourn'd with brutes beneath the midnight ftorm, Changed by avenging Heaven in mind and form. -Prone to the earth He bends his brow fuperb, 215 Crops the young floret and the bladed herb; Lolls his red tongue, and from the reedy fide Of flow Euphrates laps the muddy tide. Long eagle plumes his arching neck inveft, Steal round his arms, and clafp his fharpen'd breaft; 220 Dark brinded hairs in briftling ranks, behind, Rife o'er his back, and ruftle in the wind, Clothe his lank fides, his fhrivel'd limbs furround, And human hands with talons print the ground. Silent in fhining troops the Courtier-throng 225 Purfue their monarch, as he crawls along;

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E'en Beauty pleads in vain with fmiles and tears, Nor Flattery's felf can pierce his pendant ears.

Two Sifter-Nymphs to Ganges' flowery brink Bend their light fteps, the lucid water drink, 230 Wind through the dewy rice, and nodding canes, (As eight black Eunuchs guard the facred plains), With playful malice watch the fcaly brood, And shower the inebriate berries on the flood .--Stay in your cryftal chambers, filver tribes! 235 Turn your bright eyes, and fhun the dangerous bribes; The tramel'd net with lefs deftruction fweeps Your curling fhallows, and your azure deeps; With lefs deceit, the gilded fly beneath, Lurks the fell hook unfeen,-to tafte is death ! 240 -Dim your flow eyes, and dull your pearly coat, Drunk on the waves your languid forms shall float,

Two Sifter-Nymphs. 1. 229. Menifpermum, Cocculus. Indian berry. Two houfes, twelve males. In the female flower there are two ftyles and eight filaments without anthers on their fummits; which are called by Linneus eunuchs. See the note on Curcuma. The berry intoxicates fifth. Saint Anthony of Padua, when the people refused to hear him, preached to the fifth, and converted them. Addifon's travels in Italy.

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On ufeles fins in giddy circles play, And Herons and Otters seize you for their prey.—

So, when the Saint from Padua's graceless land 245 In filent anguish fought the barren strand, High on the fhatter'd beech fublime He ftood, Still'd with his waving arm the babbling flood; "To Man's dull ear," He cry'd, "I call in vain, "Hear me, ye fealy tenants of the main !"-Mifshappen Seals approach in circling flocks, 250 In dufky mail the Tortoife climbs the rocks, Torpedoes, Sharks, Rays, Porpus, Dolphins, pour Their twinkling fquadrons round the glittering fhore; With tangled fins, behind, huge Phocæ glide, 255 And Whales and Grampi fwell the diftant tide. Then kneel'd the hoary Seer, to heaven addrefs'd His fiery eyes, and fmote his founding breaft; " Blefs ye the Lord," with thundering voice he cry'd, " Blefs ye the Lord !" the bending fhores reply'd ;

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The winds and waters caught the facred word, And mingling echoes fhouted "Blefs the Lord !" The liftening fhoals the quick contagion feel, Pant on the floods, inebriate with their zeal, Ope their wide jaws, and bow their flimy heads, 265 And dafh with frantic fins their foamy beds.

Sopha'd on filk, amid her charm-built towers Her meads of afphodel, and amaranth bowers, Where Sleep and Silence guard the foft abodes, In fullen apathy PAPAVER nods. 270 Faint o'er her couch in fcintillating ftreams Pafs the thin forms of Fancy and of Dreams;

Papaver. 1. 207. Poppy. Many males, many females. The plants of this clafs are almost all of them poifonous; the finest opium is procured by wounding the heads of large poppies with a three-edged knife, and tying muscle-shells to them to catch the drops. In small quantities it exhilarates the mind, raises the passions, and invigorates the body: in large ones it is succeeded by intoxication, languor, stupor and death. It is customary in India for a messenger to travel above a hundred miles without rest or food, except an appropriated bit of opium for himself, and a larger one for his horse at certain stages. The emaciated and decrepid appearance, with the ridiculous and idiotic gestures, of the opium-eaters in Constantinople is well descirbed in the Memoirs of Baron de Tott.

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Froze by inchantment on the velvet ground Fair youths and beauteous ladies glitter round; On cryftal pedeftals they feem to figh, 275 Bend the meek knee, and lift the imploring eye. -And now the Sorcerefs bares her fhrivel'd hand, And circles thrice in air her ebon wand; Flush'd with new life defcending statues talk, The pliant marble foftening as they walk; 280 With deeper fobs reviving lovers breathe, Fair bofoms rife, and foft hearts pant beneath; With warmer lips relenting damfels fpeak, And kindling blufhes tinge the Parian cheek; To viewless lutes aerial voices fing, 285 And hovering loves are heard on ruftling wing. -She waves her wand again !- fresh horrors feize Their stiffening limbs, their vital currents freeze; By each cold nymph her marble lover lies, And iron flumbers feal their glaffy eyes. 290 So with his dread Caduceus HERMES led From the dark regions of the imprison'd dead,

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Or drove in filent shoals the lingering train To Night's dull shore, and PLUTO's dreary reign.

So with her waving pencil CREWE commands 295 The realms of Tafte, and Fancy's fairy lands; Calls up with magic voice the fhapes, that fleep In earth's dark bofom, or unfathom'd deep; That fhrined in air on viewlefs wings afpire, Or blazing bathe in elemental fire. 300 As with nice touch her plaiftic hand fhe moves, Rife the fine forms of Beauties, Graces, Loves; Kneel to the fair Inchantrefs, fmile or figh, And fade or flourifh, as fhe turns her eye.

Fair CISTA, rival of the rofy dawn, 305 Call'd her light choir, and trod the dewy lawn;

So with her waving pencil. 1. 295. Alluding to the many beautiful paintings by Mifs EMMA CREWE; to whom the author is indebted for the very elegant Frontifpiece, where Flora, at play with Cupid, is loading him with garden-tools.

Ciftus labdaniferus. 1. 305. Many males, one female. The petals of this beautiful and fragrant fhrub, as well as of the Enothera, tree primrofe, and others, continue ex-

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Hail'd with rude melody the new-born May, As cradled yet in April's lap fhe lay.

I.

" Born in yon blaze of orient fky,

"Sweet MAY! thy radiant form unfold, 310 "Unclose thy blue voluptuous eye,

" And wave thy fhadowy locks of gold.

II. alwelt no the al benin

" For Thee the fragrant zephyrs blow,

" For Thee defcends the funny fhower;

" The rills in fofter murmurs flow, 315

" And brighter bloffoms gem the bower.

panded but a few hours, falling off about noon, or foon after, in hot weather. The most beautiful flowers of the Cactus grandiflorus (fee Cerea) are of equally short duration, but have their existence in the night. And the flowers of the Hibifcus trionum are faid to continue but a single hour. The courtship between the males and females in these flowers might be easily watched; the males are faid to approach and recede from the females alternately. The flowers of the Hibifcus finensis, mutable rose, live in the West Indies, their native climate, but one day; but have this remarkable property, they are white at their first expansion, then change to deep red, and become purple as they decay.

The gum or refin of this fragrant vegetable is collected from extensive underwoods of it in the East by a fingular contrivance. Long leathern thongs are tied to poles and cords, and drawn over the tops of these fhrubs about noon; which thus collect the dust of the anthers, which adheres to the leather, and is occasionally scraped off. Thus in fome degree is the manner imitated, in which the bee collects on his thighs and legs the fame material for the conftruction of his combs.

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III.

" Light Graces drefs'd in flowery wreaths

"And tiptoe Joys their hands combine; "And Love his fweet contagion breathes,

" And laughing dances round thy fhrine. 320

IV.

Warm with new life the glittering throngsOn quivering fin and ruftling wingDelighted join their votive fongs,

" And hail thee, GODDESS OF THE SPRING."

O'er the green brinks of Severn's oozy bed, 325 In changeful rings, her fprightly troops She led ; PAN tripp'd before, where Eudnefs fhades the mead, And blew with glowing lip his fevenfold reed ; Emerging Naiads fwell'd the jocund ftrain, And aped with mimic ftep the dancing train.— 330

Sevenfold reed. 1. 328. The fevenfold reed, with which Pan is frequently defcribed, feems to indicate, that he was the inventor of the mufical gamut.

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" I faint, I fall !"-at noon the Beauty cried, "Weep o'er my tomb, ye Nymphs!"-and funk and died. -Thus, when white Winter o'er the fhivering clime Drives the still fnow, or showers the filver rime; As the lone shepherd o'er the dazzling rocks 335 Prints his steep step, and guides his vagrant flocks; Views the green holly veil'd in net-work nice, Her vermil clufters twinkling in the ice; Admires the lucid vales, and flumbering floods, Fantaftic cataracts, and cryftal woods, 340 Transparent towns, with feas of milk between, And eyes with transport the refulgent fcene :---If breaks the funfhine o'er the fpangled trees, Or flits on tepid wing the western breeze, In liquid dews defcends the transient glare, 345 And all the glittering pageant melts in air.

Where Andes hides his cloud-wreath'd creft in fnow, And roots his bafe on burning fands below; [79]

CINCHONA, faireft of Peruvian maids, To Health's bright Goddefs in the breezy glades 350 On Quito's temperate plain an altar rear'd, Trill'd the loud hymn, the folemn prayer preferr'd : Each balmy bud fhe cull'd, and honey'd flower, And hung with fragrant wreaths the facred bower; Each pearly fea fhe fearch'd, and fparkling mine, 355 And piled their treafures on the gorgeous fhrine; Her fuppliant voice for fickening Loxa raifed, Sweet breath'd the gale, and bright the cenfor blazed. "-Divine HYGEIA! on thy votaries bend " Thy angel-looks, oh, hear us, and defend! 360 "While ftreaming o'er the night with baleful glare " The ftar of Autumn rays his mifty hair; " Fierce from his fens the Giant AGUE fprings, " And wrapp'd in fogs defcends on vampire wings;

Cinchona. 1. 349. Peruvian bark-tree. Five males, and one female. Several of thefe trees were felled for other purposes into a lake, when an epidemic fever of a very mortal kind prevailed at Loxa in Peru, and the woodmen, accidentally drinking the water, were cured; and thus were discovered the virtues of this famous drug.

" Before, with fhuddering limbs cold Tremor reels, 365 " And Fever's burning noftril dogs his heels ; " Loud claps the grinning Fiend his iron hands, " Stamps with his marble feet, and fhouts along the lands ; "Withers the damafk cheek, unnerves the ftrong, " And drives with fcorpion-lash the shrieking throng. 370 " Oh, Goddefs ! on thy kneeling votaries bend " Thy angel-looks, oh, hear us, and defend !" -HYGEIA, leaning from the bleft abodes, Thy cryftal manfions of the immortal gods, Saw the fad Nymph uplift her dewy eyes, 375 Spread her white arms, and breathe her fervid fighs; Call'd to her fair affociates, Youth and Joy, And fhot all radiant through the glittering fky; Loofe waved behind her golden train of hair, Her fapphire mantle swam diffus'd in air .---380 O'er the grey matted mofs, and panfied fod, With ftep fublime the glowing Goddefs trod, Gilt with her beamy eye the confcious shade, And with her fmile celeftial blefs'd the maid.

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" Come to my arms," with feraph voice fhe cries, 385 " Thy vows are heard, benignant Nymph! arife; "Where yon afpiring trunks fantaftic wreath " Their mingled roots, and drink the rill beneath, "Yield to the biting axe thy facred wood, " And ftrew the bitter foliage on the flood." 390 In filent homage bow'd the blufhing maid,-Five youths athletic haften to her aid, O'er the fcar'd hills re-echoing strokes refound, And headlong forefts thunder on the ground. Round the dark roots, rent bark, and fhatter'd boughs, 395 From ocherous beds the fwelling fountain flows; With streams auftere its winding margin laves, And pours from vale to vale its dufky waves. -As the pale fquadrons, bending o'er the brink, View with a figh their alter'd forms, and drink ; 400 Slow-ebbing life with refluent crimfon breaks O'er their wan lips, and paints their haggard cheeks : Through each fine nerve rekindling transports dart, Light the quick eye, and fwell the exulting heart.

M 2

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—Thus ISRAEL'S heav'n-taught chief o'er tracklefs fands Led to the fultry rock his murmuring bands. 406 Bright o'er his brows the forky radiance blazed, And high in air the rod divine He raifed.— Wide yawns the cliff!—amid the thirfty throng Rufh the redundant waves, and fhine along ; 410 With gourds and fhells and helmets prefs the bands, Ope their parch'd lips, and fpread their eager hands, Snatch their pale infants to the exuberant fhower, Kneel on the fhatter'd rock, and blefs the Almighty Power.

Bolfter'd with down, amid a thoufand wants, 415 Pale Dropfy rears his bloated form, and pants; "Quench me, ye cool pellucid rills !" he cries, Wets his parch'd tongue, and rolls his hollow eyes. So bends tormented TANTALUS to drink, While from his lips the refluent waters fhrink; 420 Again the rifing ftream his bofom laves, And Thirft confumes him 'mid circumfluent waves.

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—Divine HYGEIA, from the bending fky Defcending, liftens to his piercing cry; Affumes bright DIGITALIS' drefs and air, 425 Her ruby cheek, white neck, and raven hair; *Four* youths protect her from the circling throng, And like the Nymph the Goddefs fteps along.— O'er Him She waves her ferpent-wreathed wand, Cheers with her voice, and raifes with her hand, 430 Warms with rekindling bloom his vifage wan, And charms the fhapelefs monfter into man.

Digitalis. 1. 425. Of the class Two Powers. Four males, one female, Foxglove. The effect of this plant in that kind of Dropfy, which is termed analarca, where the legs and thighs are much fwelled, attended with great difficulty of breathing, is truly aftonishing. In the afcites accompanied with anafarca of people past the meridian of life it will also fometimes fucceed. The method of administering it requires fome caution, as it is liable, in greater dofes, to induce very violent and debilitating ficknefs, which continues one or two days, during which time the dropfical collection however difappears. One large fpoonful, or half an ounce, of the following decoction, given twice a day, will generally fucceed in a few days. But in more robust people, one large fpoonful every two hours, till four fpoonfuls are taken, or till ficknefs occurs, will evacuate the dropfical fwellings with greater certainty, but is liable to operate more violently. Boil four ounces of the fresh leaves of purple Foxglove (which leaves may be had at all feafons of the year) from two pints of water to twelve ounces; add to the strained liquor, while yet warm, three ounces of rectified spirit of wine. A theory of the effects of this medicine, with many fuccefsful cafes, may be feen in a pamphlet, called "Experiments on Mucilaginous and Purulent Matter," published by Dr. Darwin, in 1780. Sold by Cadell, London.

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So when Contagion with mephitic breath And wither'd Famine urged the work of death; Marfeilles' good Bifhop, London's generous Mayor, 435 With food and faith, with medicine and with prayer, Raifed the weak head, and ftayed the parting figh, Or with new life relumed the fwimming eye.— —And now, PHILANTHROPY! thy rays divine Dart round the globe from Zembla to the Line; 440 O'er each dark prifon plays the cheering light, Like northern luftres o'er the vault of night.—

Marfeille's good Bifhop. 1. 435. In the year 1720 and 1722 the Plague made dreadful havock at Marfeilles; at which time the Bifhop was indefatigable in the execution of his paftoral office, vifiting, relieving, encouraging, and abfolving the fick with extreme tendernefs; and though perpetually exposed to the infection, like Sir John Lawrence mentioned below, they both are faid to have escaped the difease.

London's generous Mayor. 1. 435. During the great Plague at London in the year 1665, Sir John Lawrence, the then Lord Mayor, continned the whole time in the city; heard complaints and redreffed them; enforced the wifeft regulations then known, and faw them executed. The day after the difeafe was known with certainty to be the Plague, above 40,000 fervants were difmiffed, and turned into the ftreets to perifh, for no one would receive them into their houfes; and the villages near London drove them away with pitch-forks and fire-arms. Sir John Lawrence fupported them all, as well as the needy who were fick, at first by expending his own fortune, till fubscriptions could be folicited and received from all parts of the nation. Journal of the Plague-year. Printed for E. Nutt, &c. at the R. Exchange. 1722.

From realm to realm, with crofs or crefcent crown'd, Where'er Mankind and Mifery are found, O'er burning fands, deep waves, or wilds of fnow, 445 Thy HOWARD journeying feeks the houfe of woe. Down many a winding ftep to dungeon's dank, Where anguish wails aloud, and fetters clank; To caves beftrew'd with many a mouldering bone, And cells, whofe echoes only learn to groan ; 450 Where no kind bars a whifpering friend difclofe, No funbeam enters, and no zephyr blows, HE treads, inemulous of fame or wealth, Profuse of toil, and prodigal of health, With foft affuafive eloquence expands 455 Power's rigid heart, and opes his clenching hands; Leads stern-ey'd Justice to the dark domains, If not to fever, to relax the chains; Or guides awaken'd Mercy through the gloom, And fhews the prifon, fifter to the tomb !---

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Gives to her babes the felf-devoted wife, To her fond hufband liberty and life !— —The Spirits of the Good, who bend from high Wide o'er thefe earthly fcenes their partial eye, When firft, array'd in VIRTUE's pureft robe, 465 They faw her HOWARD traverfing the globe ; Saw round his brows her fun-like Glory blaze In arrowy circles of unwearied rays ; Miftook a Mortal for an Angel-Gueft, And afk'd what Seraph-foot the earth impreft. 470 —Onward he moves !—Difeafe and Death retire, And murmuring Demons hate him, and admire."

Here paufed the Goddefs—on HygelA's fhrine Obfequious Gnomes repofe the lyre divine; Defcending Sylphs relax the trembling ftrings, 475 And catch the rain-drops on their fhadowy wings. —And now her vafe a modeft Naiad fills With liquid cryftal from her pebbly rills;

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Piles the dry cedar round her filver urn, (Bright climbs the blaze, the crackling faggots burn), 480 Culls the green herb of China's envy'd bowers, In gaudy cups the fteamy treafure pours; And, fweetly-fmiling, on her bended knee Prefents the fragrant quinteffence of Tea.

N



INTERLUDE II.

Bookfeller. THE monfters of your Botanic Garden are as furprifing as the bulls with brazen feet, and the fire-breathing dragons, which guarded the Hefperian fruit; yet are they not difgufting, nor mifchievous: and in the manner you have chained them together in your exhibition, they fucceed each other amufingly enough, like prints of the London Cries, wrapped upon rollers, with a glafs before them. In this at leaft they refemble the monfters in Ovid's Metamorphofes; but your fimilies, I fuppofe, are Homeric?

Poet. The great Bard well underftood how to make use of this kind of ornament in Epic Poetry. He brings his valiant heroes into the field with much parade, and fets them a fighting with great fury; and then, after a few thrusts and parries, he introduces a long string of fimilies. During this the battle is supposed to continue; and thus the time necessary for the action is gained in our imaginations; and a degree of probability produced, which contributes to the temporary deception or reverie of the reader.

But the fimilies of Homer have another agreeable characteriftic; they do not quadrate, or go upon all fours (as it is called), like the more formal fimilies of fome modern writers; any one refembling feature feems to be with him a fufficient excufe for the introduction of this kind of digreffion; he then proceeds to deliver fome agreeable poetry on this new fubject, and thus converts every fimilie into a kind of fhort epifode.

B. Then a fimile fhould not very accurately refemble the fubject?

P. No; it would then become a philosophical anology, it would be ratiocination instead of poetry: it need only so far refemble the fubject, as poetry itfelf ought to refemble nature. It fhould have fo much fublimity, beauty, or novelty, as to intereft the reader; and fhould be expressed in pictures for language, fo as to bring the fcenery before his eye; and should lastly bear fo much veri-fimilitude as not to awaken him by the violence of improbability or incongruity.

B. May not the reverie of the reader be diffipated or diffurbed by difagreeable images being prefented to his imagination, as well as by improbable or incongruous ones?

P. Certainly; he will endeavour to roufe himfelf from a difagreeable reverie, as from the night-mare. And from this may be difcovered the line of boundary between the Tragic and the Horrid; which line, however, will veer a little this way or that, according to the prevailing manners of the age or country, and the peculiar affociation of ideas, or idiofyncracy of mind, of individuals. For instance, if an artist should represent the death of an officer in battle, by fhewing a little blood on the bofom of his fhirt, as if a bullet had there penetrated, the dying figure would affect the beholder with pity; and if fortitude was at the fame time expressed in his countenance, admiration would be added to our pity. On the contrary, if the artift fhould chufe to reprefent his thigh as fhot away by a cannon ball, and fhould exhibit the bleeding flefh and fhattered bone of the ftump, the picture would introduce into our minds ideas from a butcher's fhop, or a furgeon's operation room, and we should turn from it with difgust. So if characters were brought upon the ftage with their limbs disjointed by torturing inftruments, and the floor covered with clotted blood and fcattered brains, our theatric reverie would be deftroyed by difguft, and we fhould leave the play-houfe with deteftation.

The Painters have been more guilty in this refpect than the Poets; the cruelty of Apollo in flaying Marcias alive is a favourite fubject with the antient artifts: and the tortures of expiring martyrs have difgraced the modern ones. It requires little genius to exhibit the muscles in convulsive action either by the pencil or the chiffel, because the interflices are deep, and the lines ftrongly defined: but those tender gradations of muscular action, which conflitute the graceful attitudes of the body, are difficult to conceive or to execute, except by a master of nice different and cultivated tafte.

B. By what definition would you diftinguish the Horrid from the Tragic?

P. I fuppofe the latter confift of Diffrefs attended with Pity, which is faid to be allied to Love, the moft agreeable of all our paffions; and the former in Diffrefs, accompanied with Difguft, which is allied to Hate, and is one of our moft difagreeable fenfations. Hence, when horrid fcenes of cruelty are reprefented in pictures, we wifh to difbelieve their exiftence, and voluntarily exert ourfelves to efcape from the deception: whereas the bitter cup of true Tragedy is mingled with fome fweet confolatory drops, which endear our tears, and we continue to contemplate the interefting delufion with a delight, which is not eafy to explain.

B. Has not this been explained by Lucretius, where he defcribes a fhipwreck; and fays, the Spectators receive pleafure from feeling themfelves fafe on land? and by Akenfide, in his beautiful poem on the Pleafures of Imagination, who afcribes it to our finding objects for the due exertion of our paffions?

P. We must not confound our fensations at the contemplation of real misery with those which we experience at the scenical representations of tragedy. The spectators of a shipwreck may be attracted by the dignity and novelty of the object; and from these may be faid to receive pleasure; but not from the distress of the fufferers. An ingenious writer who has criticised this dialogue in the English Review for August, 1789, adds, that one great source of our pleafure from fcenical diffrefs arifes from our, at the fame time, generally contemplating one of the nobleft objects of nature, that of Virtue triumphant overy difficulty and oppression, or fupporting its votary under every fuffering: or, where this does not occur, that our minds are relieved by the justice of fome fignal punishment awaiting the delinquent. But, befides this, at the exhibition of a good tragedy, we are not only amufed by the dignity and novelty, and beauty, of the objects before us; but, if any diftrefsful circumstances occur too forcibly for our fensibility, we can voluntarily exert ourfelves, and recollect, that the fcenery is not real: and thus not only the pain, which we had received from the apparent diftrefs, is leffened, but a new fource of pleafure is opened to us, fimilar to that which we frequently have felt on awaking from a diftrefsful dream; we are glad that it is not true. We are at the fame time unwilling to relinquish the pleafure which we receive from the other interesting circumstances of the drama; and on that account quickly permit ovrfelves to relapfe into the delufion; and thus alternately believe and difbelieve, almost every moment, the existence of the objects represented before us.

B. Have those two fovereigns of poetic land, HOMER and SHAKESPEAR, kept their works entirely free from the Horrid?—or even yourfelf in your third Canto?

P. The defcriptions of the mangled carcafes of the companions of Ulyffes, in the cave of Polypheme, is in this refpect certainly objectionable, as is well obferved by Scaliger. And in the play of Titus Andronicus, if that was written by Shakefpear (which from its internal evidence I think very improbable,) there are many horrid and difguftful circumftances. The following Canto is fubmitted to the candour of the critical reader, to whofe opinion I fhall fubmit in filence.

LOVES OF THE PLANTS.

THE

CANTO III.

AND now the Goddefs founds her filver fhell, And fhakes with deeper tones the inchanted dell; Pale, round her graffy throne, bedew'd with tears, Flit the thin forms of Sorrows, and of Fears; Soft Sighs refponfive whifper to the chords, And Indignations half-unfheath their fwords.

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"Thrice round the grave CIRCÆA prints her tread, And chaunts the numbers, which difturb the dead; Shakes o'er the holy earth her fable plume, Waves her dread wand, and ftrikes the echoing tomb! 10 —Pale fhoot the ftars acrofs the troubled night, The tim'rous moon withholds her confcious light; Shrill fcream the famifh'd bats, and fhivering owls, And loud and long the dog of midnight howls !—

Circæa. 1. 7. Enchanters Nightshade. Two males, one female. It was much celebrated in the mysteries of witchcraft, and for the purpose of raising the devil, as its name imports. It grows amid the mouldering bones and decayed coffins in the ruinous vaults of Sleaford church in Lincolnshire. The fuperstitious ceremonies or histories belonging to fome vegetables have been truly ridiculous; thus the Druids are faid to have cropped the Mifleto with a golden axe or fickle; and the Bryony, or Mandrake, was faid to utter a fcream when its root was drawn from the ground; and that the animal which drew it up became difeafed and foon died: on which account, when it was wanted for the purpole of medicine, it was ufual to loofen and remove the earth about the root, and then to tie it by means of a cord to a dog's tail, who was whipped to pull it up, and was then supposed to fuffer for the impiety of the action. And even at this day bits of dried root of Peony are rubbed fmooth, and ftrung, and fold under the name of Anodyne necklaces, and tied round the necks of children, to facilitate the growth of their teeth ! add to this, that in Price's Hiftory of Cornwall, a book published about ten years ago, the Virga Divinatoria, or Divining Rod, has a degree of credit given to it. This rod is of hazle, or other light wood, and held horizontally in the hand, and is faid to bow towards the ore whenever the Conjuror walks over a mine. A very few years ago, in France, and even in England, another kind of divining rod has been uled to difcover fprings of water in a fimilar manner, and gained fome credit. And in this very year, there were many in France, and fome in England, who underwent an enchantment without any divining rod at all, and believed themfelves to be affected by an invisible agent, which the Enchanter called Animal Magnetifm !

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-Then yawns the burfting ground !- two imps obscene 15 Rife on broad wings, and hail the baleful queen; Each with dire grin falutes the potent wand, And leads the Sorcerefs with his footy hand ; Onward they glide, where sheds the fickly yew O'er many a mouldering bone its nightly dew; 20 The ponderous portals of the church unbar,-Hoarfe on their hinge the ponderous portals jar; As through the colour'd glafs the moon-beam falls, Huge shapeles spectres quiver on the walls; Low murmurs creep along the hollow ground, 25 And to each ftep the pealing ailes refound ; By glimmering lamps, protecting faints among, The fhrines all trembling as they pass along, O'er the still choir with hideous laugh they move, (Fiends yell below, and angels weep above !) 30 Their impious march to God's high altar bend, With feet impure the facred fteps afcend ; With wine unblefs'd the holy chalice ftain, Affume the mitre, and the cope profane;

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To heaven their eyes in mock devotion throw, 35 And to the crofs with horrid mummery bow; Adjure by mimic rites the powers above, And plight alternate their Satanic love.

Avaunt, ye Vulgar! from her facred groves With maniac ftep the Pythian LAURA moves; 40 Full of the God her labouring bofom fighs, Foam on her lips, and fury in her eyes, Strong writhe her limbs, her wild difhrevell'd hair Starts from her laurel-wreath, and fwims in air.— While *twenty* Priefts the gorgeous fhrine furround 45 Cinctur'd with ephods, and with garlands crown'd,

Laura. 1. 40. Prunus. Lauro-cerafus. Twenty males, one female. The Pythian prieftefs is fuppofed to have been made drunk with infufion of laurel-leaves when the delivered her oracles. The intoxication or infpiration is finely deferibed by Virgil Æn. L. vi. The diftilled water from laurel-leaves is, perhaps, the moft fudden poifon we are acquainted with in this country. I have feen about two fpoonfuls of it deftroy a large pointer dog in lefs than ten minutes. In a finaller dofe it is faid to produce intoxication : on this account there is reafon to believe it acts in the fame manner as opium and vinous fpirit; but that the dofe is not fo well afcertained. See note on Tremella. It is ufed in the Ratafie of the Diftillers, by which fome dram-drinkers have been fuddenly killed. One pint of water, diftilled from fourteen pounds of black cherry ftones bruifed, has the fame deleterious effect, deftroying as fuddenly as laurel-water. It is probable Apricot-kernels, Peach-leaves, Walnut-leaves, and whatever poffeffes the kernelflavour, may have fimiliar qualities.

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Contending hofts and trembling nations wait The firm immutable behefts of Fate; —She fpeaks in thunder from her golden throne With words *unwill'd*, and wifdom not her own. 50

So on his NIGHTMARE through the evening fog Flits the fquab Fiend o'er fen, and lake, and bog; Seeks fome love-wilder'd Maid with fleep opprefs'd, Alights, and grinning fits upon her breaft. -Such as of late amid the murky fky 55 Was mark'd by FUSELI's poetic eye; Whofe daring tints, with SHAKESPEAR's happieft grace, Gave to the airy phantom form and place.-Back o'er her pillow finks her blufhing head, Her fnow-white limbs hang helplefs from the bed; 60 While with quick fighs, and fuffocative breath, Her interrupted heart-pulse swims in death. -Then fhrieks of captur'd towns, and widows' tears, Pale lovers stretch'd upon their blood-stain'd biers,

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The headlong precipice that thwarts her flight, The trackless defert, the cold starless night, And stern-eye'd Murderer with his knife behind, In dread fucceffion agonize her mind. O'er her fair limbs convulfive tremors fleet, Start in her hands, and ftruggle in her feet; 70 In vain to fcream with quivering lips fhe tries, And ftrains in palfy'd lids her tremulous eyes; In vain fhe wills to run, fly, fwim, walk, creep; The WILL prefides not in the bower of SLEEP. -On her fair bofom fits the Demon-Ape Erect, and balances his bloated fhape;

The Will prefides not. 1. 74. Sleep confifts in the abolition of all voluntary power, both over our mulcular motions and our ideas; for we neither walk nor reafon in fleep. But at the fame time, many of our mufcular motions, and many of our ideas continue to be excited into action in confequence of internal irritations and of internal fenfations; for the heart and arteries continue to beat, and we experience variety of paffions, and even hunger and thirft in our dreams. Hence I conclude, that our nerves of fenfe are not torpid or inert during fleep; but that they are only precluded from the perception of external objects, by their external organs being rendered unfit to transmit to them the appulses of external bodies, during the fufpenfion of the power of volition; thus the eyelids are clofed in fleep, and I fuppofe the tympanum of the ear is not ftretched, becaufe they are deprived of the voluntary exertions of the mufcles appropriated to thefe purpofes; and it is probable fomething fimilar happens to the external apparatus of our other organs of fenfe, which may render them unfit for their office of perception during fleep: for milk put into the mouths of fleeping babes occafions them to fwallow and fuck; and, if the eye-lid is a little opened in the day-light by the exertions of diffurbed fleep, the perion dreams of being much dazzled. See first Interlude.

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Rolls in their marble orbs his Gorgon-eyes, And drinks with leathern ears her tender cries.

Arm'd with her ivory beak, and talon-hands, Defcending FICA dives into the fands; 80 Chamber'd in earth with cold oblivion lies; Nor heeds, *ye Suitor-train*, your amorous fighs; Erewhile with renovated beauty blooms, Mounts into air, and moves her leafy plumes. —Where HAMPS and MANIFOLD, their cliffs among, 85 Each in his flinty channel winds along; With lucid lines the dufky Moor divides, Hurrying to intermix their fifter tides.

When there arifes in fleep a painful defire to exert the voluntary motions, it is called the Nightmare or Incubus. When the fleep becomes fo imperfect that fome mulcular motions obey this exertion of defire, people have walked about, and even performed fome domeftic offices in fleep; one of these fleep-walkers I have frequently seen: once she finelt of a tube-rose, and sung, and drank a dish of tea in this state; her awaking was always attended with prodigious surprize, and even sear; this disease had daily periods, and seemed to be of the epileptic kind.

Ficus indica. 1. 80. Indian Fig-tree. Of the class Polygamy. This large tree rifes with opposite branches on all fides, with long egged leaves; each branch emits a flender flexile depending appendage from its fummit like a cord, which roots into the earth and rifes again. Sloan. Hift. of Jamaica. Lin. Spec. Plant. See Capri-ficus.

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Where ftill their filver-bofom'd Nymphs abhor,The blood-fmear'd manfion of gigantic THOR,---90--Erft, fires volcanic in the marble wombOf cloud-wrapp'd WETTON raifed the maffy dome;Rocks rear'd on rocks in huge disjointed pilesForm the tall turrets, and the lengthen'd ailes;Broad ponderous piers fuftain the roof, and wide95Branch the vaft rain-bow ribs from fide to fide.

Gigantic Thar. 1. 90. Near the village of Wetton, a mile or two above Dove-Dale, near Afhburn in Derbyfhire, there is a fpacious cavern about the middle of the afcent of the mountain, which ftill retains the Name of Thor's houfe; below it is an extensive and romantic common, where the rivers Hamps and Manifold fink into the earth, and rife again in Ilam gardens, the feat of John Port, Efq. about three miles below. Where thefe rivers rife again there are imprefions refembling Fifh, which appear to be of Jafper bedded in Limeftone. Calcareous Spars, Shells converted into a kind of Agate, corallines in Marble, ores of Lead, Copper, and Zinc, and many ftrata of Flint, or Chert, and of Toadítone, or Lava, abound in this part of the country. The Druids are faid to have offered human facrifices inclofed in wicker idols to Thor. Thurfday had its name from this Deity.

The broken appearance of the furface of many parts of this country; with the Swallows, as they are called, or bafons on fome of the mountains, like volcanic Craters, where the rain-water finks into the earth; and the numerous large ftones, which feem to have been thrown over the land by volcanic explosions; as well as the great maffes of Toadftone or Lava; evince the existence of violent earthquakes at fome early period of the world. At this time the channels of these fubterraneous rivers feem to have been formed, when a long tract of rocks were raifed by the fea flowing in upon the central fires, and thus producing an irrefistable explosion of fteam; and when these rocks again fublided, their parts did not exactly correspond, but left a long cavity arched over in this operation of nature. The cavities at Castleton and Buxton in Derbyshire feem to have had a similar origin, as well as this cavern termed Thor's house. See Mr. Whitehurft's and Dr. Hutton's Theories of the Earth.

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While from above defcends in milky ftreams One fcanty pencil of illufive beams, Sufpended crags and gaping gulphs illumes, And gilds the horrors of the deepen'd glooms. 100 -Here oft the Naiads, as they chanced to play Near the dread Fane on THOR's returning day, Saw from red altars ftreams of guiltlefs blood Stain their green reed-beds, and pollute their flood; Heard dying babes in wicker prifons wail, 105 And fhrieks of matrons thrill the affrighted Gale; While from dark caves infernal Echoes mock, And Fiends triumphant fhout from every rock ! -So ftill the Nymphs emerging lift in air Their fnow-white shoulders and their azure hair; 110 Sail with fweet grace the dimpling ftreams along, Liftening the Shepherd's or the Miner's fong; But, when afar they view the giant-cave, On timorous fins they circle on the wave, With streaming eyes and throbbing hearts recoil, II5 Plunge their fair forms, and dive beneath the foil.---

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Clofed round their heads reluctant eddies fink, And wider rings fucceffive dafh the brink.---Three thoufand fteps in fparry clefts they ftray, Or feek through fullen mines their gloomy way; 120 On beds of Lava fleep in coral cells, Or figh o'er jafper fifh, and agate fhells. Till, where famed ILAM leads his boiling floods Through flowery meadows and impending woods, Pleafed with light fpring they leave the dreary night, 125 And 'mid circumfluent furges rife to light; Shake their bright locks, the widening vale purfue, Their fea-green mantles fringed with pearly dew; In playful groups by towering THORP they move, Bound o'er the foaming wears, and rufh into the Dove. 130

With fierce diffracted eye IMPATIENS stands, Swells her pale cheeks, and brandisches her hands,

Impatiens. l. 131. Touch me not. The feed veffel confifts of one cell with five divifions; each of these, when the feed is ripe, on being touched, suddenly folds itself into a spiral form, leaps from the stalk, and disperses the seeds to a great distance by it's elasticity. The capsule of the geranium and the beard of wild oats are twisted for a

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With rage and hate the aftonifh'd groves alarms, And hurls her infants from her frantic arms. —So when MEDÆA left her native foil 135 Unaw'd by danger, unfubdued by toil; Her weeping fire and beckoning friends withftood, And launch'd enamour'd on the boiling flood; One ruddy boy her gentle lips carefs'd, And one fair girl was pillowed on her breaft; 140 While high in air the golden treafure burns, And Love and Glory guide the prow by turns.

fimilar purpofe, and diflodge their feeds on wet days, when the ground is best fitted to receive them. Hence one of these, with its adhering capfule or beard fixed on a stand, ferves the purpose of an hygrometer, twisting itself more or less according to the moisture of the air.

The awn of barley is furnished with stiff points, which, like the teeth of a faw, are all turned towards the point of it; as this long awn lies upon the ground, it extends itfelf in the moift air of night, and puffes forwards the barley corn, which it adheres to; in the day it fhortens at it dries; and as these points prevent it from receding, it draws up its pointed end; and thus, creeping like a worm, will travel many feet from the parent ftem. That very ingenious Mechanic Philosopher, Mr. Edgworth, once made on this principle a wooden automaton; its back confifted of foft Fir-wood, about an inch fquare, and four feet long, made of pieces cut the crofs-way in respect to the fibres of the wood, and glued together: it had two feet before, and two behind, which fupported the back horizontally; but were placed with their extremities, which were armed with fharp points of iron, bending backwards. Hence, in moift weather the back lengthened, and the two foremost feet were pushed forwards; in dry weather the hinder feet were drawn after, as the obliquity of the points of the feet prevented it from receding. And thus, in a month or two, it walked across the room which it inhabited. Might not this machine be applied as an Hygrometer to fome meteorological purpofe?

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But, when Theffalia's inaufpicious plain Received the matron-heroine from the main; While horns of triumph found, and altars burn, 145 And fhouting nations hail their Chief's return; Aghaft, She faw new-deck'd the nuptial bed, And proud CREUSA to the temple led; Saw her in JASON'S mercenary arms Deride her virtues, and infult her charms; 150 Saw her dear babes from fame and empire torn, In foreign realms deferted and forlorn; Her love rejected, and her vengeance braved, By Him her beauties won, her virtues faved.-With ftern regard fhe eyed the traitor-king, 155 And felt, Ingratitude ! thy keeneft fting ; " Nor Heaven," fhe cried, " nor Earth, nor Hell can hold " A Heart abandon'd to the thirft of Gold !" Stamp'd with wild foot, and fhook her horrent brow, And call'd the furies from their dens below. 160 -Slow out of earth, before the feftive crowds, . On wheels of fire, amid a night of clouds,
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Drawn by fierce fiends arofe a magic car, Received the Queen, and hovering flam'd in air .---As with raifed hands the fuppliant traitors kneel, 165 And fear the vengeance they deferve to feel, Thrice with parch'd lips her guiltlefs babes fhe prefs'd, And thrice fhe clafp'd them to her tortur'd breaft; Awhile with white uplifted eyes fhe ftood, Then plung'd her trembling poniards in their blood. 170 "Go, kifs your fire ! go, fhare the bridal mirth !" She cry'd, and hurl'd their quivering limbs on earth. Rebellowing thunders rock the marble towers, And red tongued lightnings fhoot their arrowy fhowers; Earth yawns !- the crafhing ruin finks !- o'er all 175 Death with black hands extends his mighty Pall; Their mingling gore the Fiends of Vengeance quaff, And Hell receives them with convulfive laugh.

Round the vex'd isles where fierce tornados roar, Or tropic breezes footh the fultry shore; 180

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What time the eve her gauze pellucid fpreads O'er the dim flowers, and veils the mifty meads; Slow, o'er the twilight fands or leafy walks, With gloomy dignity DICTAMNA ftalks; In fulphurous eddies round the weird dame Plays the light gas, or kindles into flame.

Distammus. 1. 184. Fraxinella. In the ftill evenings of dry feafons this plant emits an inflammable air or gas, and flashes on the approach of a candle. There are inflances of human creatures who have taken fire spontaneously, and been totally confumed. Phil. Trans.

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The odours of many flowers, fo delightful to our fenfe of fmell, as well as the difagreeable fcents of others, are owing to the exhalation of their effential oils. Thefe effential oils have greater or lefs volatility, and are all inflammable; many of them are poifons to us, as thefe of Laurel and Tabacco; other poffefs a narcotic quality, as is evinced by the oil of cloves inftantly relieving flight tooth-achs; from oil of cinnamon relieving the hiccup; and balfam of peru relieving the pain of fome ulcers. They are all deleterious to certain infects, and hence their ufe in the vegetable economy, being produced in flowers or leaves to protect them from the depredations of their voracious enemies. One of the effential oils, that of turpentine, is recommended, by M. de Thoffe, for the purpose of destroying infects which infect both vegetables and animals. Having observed that the trees were attacked by multitudes of fmall infects of different colours (pucins ou pucerons) which injured their young branches, he deftroyed them all entirely in the following manner : he put into a bowl a few handfuls of earth, on which he poured a fmall quantity of oil of turpentine; he then beat the whole together with a fpatula, pouring on it water till it became of the confiftence of foup; with this mixture he moiftened the ends of the branches, and both the infects and their eggs were deftroyed, and other infects kept aloof by the fcent of the turpentine. He adds, that he destroyed the fleas of his puppies by once bathing them in warm water impregnated with oil of turpentine. Mem. d'Agriculture, An. 1787, Tremest. Printemp. p. 109. I fprinkled fome oil of turpentine, by means of a brufh, on fome branches of a nectarine tree, which was covered with the aphis; but it killed both the infect and the branches: a folution of arfenic much diluted did the fame. The fhops of medicine are fupplied with refins, balfams, and effential oils; and the tar and pitch, for mechanical purpofes, are produced from these vegetable fecretions.

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If refts the traveller his weary head, Grim MANCINELLA haunts the moffy bed, Brews her black hebenon, and, ftealing near, Pours the curft venom in his tortured ear.— Wide o'er the mad'ning throng URTICA flings Her barbed fhafts, and darts her poifon'd ftings.

Mancinella. 1. 188. Hyppomane. With the milky juice of this tree the Indians poifon their arrows; the dew-drops, which fall from it, are fo cauftic as to blifter the fkin, and produce dangerous ulcers; whence many have found their death by fleeping under its fhade. Variety of noxious plants abound in all countries, in our own the deadly night-fhade, henbane, hounds-tongue, and many others, are feen in almoft every high road untouched by animals. Some have afked, what is the ufe of fuch abundance of poifons? The naufeous or pungent juices of fome vegetables, like the thorns of others, are given them for their defence from the depredations of animals; hence the thorny plants are in general wholefome and agreeable food to graminivorous animals. See note on Ilex. The flowers or petals of plants are perhaps in general more acrid than their leaves; hence they are much feldomer eaten by infects. This feems to have been the ufe of the effential oil in the vegetable economy, as obferved above in the notes on Dictamnus and Ilex. The fragrance of plants is thus a part of their defence. Thefe pungent or naufeous juices of vegetables have fupplied the fcience of medicine with its principal materials, fuch as purge, vomit, intoxicate, &c.

Urtica. 1. 191. Nettle. The fting has a bag at its bafe, and a perforation near its point, exactly like the ftings of wafps and the teeth of adders; Hook, Microgr. p. 142. Is the fluid contained in this bag, and preffed through the perforation into the wound, made by the point, a cauftic effential oil, or a concentrated vegetable acid? The vegetable poifons, like the animal ones, produce more fudden and dangerous effects, when inftilled into a wound, than when taken into the ftomach; whence the families of Marfi and Pfilli, in antient Rome, fucked the poifon without injury out of wounds made by vipers, and were fuppofed to be indued with fupernatural powers for this purpofe. By the experiments related by Beccaria, it appears that four or five times the quantity, taken by the mouth, had about equal effects with that infufed into a wound. The male flowers of the nettle are feparate from the female, and the anthers are feen in fair weather to burft with force, and to difcharge a duft, which hovers about the plant like a cloud.

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And fell LOBELIA's fuffocating breath
Loads the dank pinion of the gale with death.
—With fear and hate they blaft the affrighted groves, 195
Yet own with tender care their kindred Loves!—

So, where PALMIRA 'mid her wafted plains, Her fhatter'd aqueducts, and proftrate fanes, (As the bright orb of breezy midnight pours Long threads of filver through her gaping towers, 200 O'er mouldering tombs, and tottering columns gleams, And frofts her deferts with diffufive beams),

Lobelia. 1. 193. Longiflora. Grows in the Weft Indies, and fpreads fuch deleterious exhalations around it, that an oppreflion of the breaft is felt on approaching it at many feet diftance when placed in the corner of a room or hot-houfe. Ingenhouz, Exper. on Air, p. 146. Jacquini hort. botanic. Vindeb. The exhalations from ripe fruit, or withering leaves are proved much to injure the air in which they are confined; and, it is probable, all those vegetables which emit a strong scent may do this in a greater or less degree, from the Rose to the Lobelia; whence the unwholessomeness in living perpetually in such an atmosphere of perfume as some people wear about their hair, or carry in their handkerchiefs. Either Boerhave or Dr. Mead have affirmed they were acquainted with a poisonous fluid whose vapour would prefently destroy the person who fat near it. And it is well known, that the gas from fermenting liquors, or obtained from limeftone, will destroy animals immersed in it, as well as the vapour of the Grotto del Cani near Naples.

So, where Palmira. 1. 197. Among the ruins of Palmira, which are dispersed not only over the plains but even in the deserts, there is one single colonade above 2600 yards long, the bases of the Corinthian columns of which exceed the height of a man: and yet this row is only a small part of the remains of that one edifice ! Volney's Travels.

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Sad o'er the mighty wreck in filence bends, Lifts her wet eyes, her tremulous hands extends .---If from lone cliffs a burfting rill expands 205 Its transient courfe, and finks into the fands; O'er the moift rock the fell Hyæna prowls, The Leopard hiffes, and the Panther growls; On quivering wing the famish'd Vulture screams, 210 Dips his dry beak, and fweeps the gufhing ftreams; With foaming jaws, beneath, and fanguine tongue, Laps the lean Wolf, and pants, and runs along; Stern stalks the Lion, on the ruftling brinks Hears the dread Snake, and trembles as he drinks; Quick darts the fcaly Monfter o'er the plain, 215 Fold after fold, his undulating train; And, bending o'er the lake his crefted brow, Starts at the Crocodile, that gapes below.

Where feas of glafs with gay reflections fmile Round the green coafts of Java's palmy ifle;

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A fpacious plain extends its upland fcene, Rocks rife on rocks, and fountains gufh between; Soft zephyrs blow, eternal fummers reign, And fhowers prolific blefs the foil, - in vain ! -No fpicy nutmeg fcents the vernal gales, 225 Nor towering plaintain shades the mid-day vales; No graffy mantle hides the fable hills, No flowery chaplet crowns the trickling rills; Nor tufted mofs, nor leathery lichen creeps In ruffet tapeftry o'er the crumbling fteeps. 230 -No ftep retreating, on the fand imprefs'd, Invites the vifit of a fecond gueft; No refluent fin the unpeopled ftream divides, No revolant pinion cleaves the airy tides; Nor handed moles, nor beaked worms return, 235 That mining pafs the irremeable bourn .-Fierce in dread filence on the blafted heath Fell UPAS fits, the HYDRA-TREE of death.

Upas. 1. 238. There is a poifon-tree in the island of Java, which is faid by its effluvia to have depopulated the country for 12 or 14 miles round the place of its growth. It is

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Lo! from one root, the envenom'd foil below, A thoufand vegetative ferpents grow ; 240 In fhining rays the fcaly monfter fpreads O'er ten fquare leagues his far-diverging heads ; Or in one trunk entwifts his tangled form, Looks o'er the clouds, and hiffes in the ftorm. Steep'd in fell poifon, as his fharp teeth part, 245 A thoufand tongues in quick vibration dart ; Snatch the proud Eagle towering o'er the heath, Or pounce the Lion, as he ftalks beneath ; Or ftrew, as marfhall'd hofts contend in vain, With human fkeletons the whiten'd plain. 250

called, in the Malayan language, Bohon-Upas; with the juice of it the moft poifonous arrows are prepared; and, to gain this, the condemned criminals are fent to the tree with proper direction both to get the juice and to fecure themfelves from the malignant exhalations of the tree; and are pardoned if they bring back a certain quantity of the poifon. But by the registers there kept, not one in four are faid to return. Not only animals of all kinds, both quadrupeds, fish, and birds, but all kinds of vegetables alfo are deftroyed by the effluvia of the noxious tree; fo that, in a diftrict of 12 or 14 miles round it, the face of the earth is quite barren and rocky, intermixed only with the skeletons of men and animals; affording a scene of melancholy beyond what poets have deferibed or painters delineated. Two younger trees of its own species are faid to grow near it. See London Magazine for 1784, or 1783. Translated from a description of the poifon-tree of the island of Java, written in Dutch by N. P. Foereh. For a further account of it, fee a note at the end of the work.

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-Chain'd at his root two fcion-demons dwell, Breathe the faint hifs, or try the fhriller yell; Rife, fluttering in the air on callow wings, And aim at infect-prey their little ftings. So Time's ftrong arms with fweeping fcythe erafe 255 Art's cumberous works, and empires, from their bafe: While each young Hour its fickle fine employs, And crops the fweet buds of domeftic joys!

With blufhes bright as morn fair ORCHIS charms, And lulls her infant in her fondling arms; 260

Orchis. 1. 259. The Orchis morio in the circumstance of the parent-root shrivelling up and dying, as the young one increafes, is not only analogous to other tuberous or knobby roots, but alfo to fome bulbous roots, as the tulip. The manner of the production of herbaceous plants from their various perennial roots, feems to want further inveftigation, as their analogy is not yet clearly eftablished. The caudex, or true root, in the orchis lies above the knob; and from this part the fibrous roots and the new knob are produced. In the tulip the caudex lies below the bulb; from whence proceed the fibrous roots and the new bulbs; the root, after it has flowered, dies like the orchis-root; for the ftem of the laft year's tulip lies on the outfide, and not in the center of the bulb; which I am informed does not happen in the three or four first years when raifed from feed, when it only produces a flem, and flender leaves without flowering. In the tuliproot, diffected in the early fpring, just before it begins to shoot, a perfect flower is feen in its center; and between the first and fecond coat the large next year's bulb is, I believe, produced; between the fecond and third coat, and between this and the fourth coat, and perhaps further, other lefs and lefs bulbs are visible, all adjoining to the caudex at the bottom of the mother bulb; and which, I am told, require as many years before they will flower, as the number of the coats with which they are covered. This annual repro-

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Soft plays Affection round her bofom's throne, And guards his life, forgetful of her own. So wings the wounded Deer her headlong flight, Pierced by fome ambufh'd archer of the night, Shoots to the woodlands with her bounding fawn, 265 And drops of blood bedew the confcious lawn ; There hid in fhades fhe fhuns the cheerful day, Hangs o'er her young, and weeps her life away.

duction of the tulip-root induces fome florifts to believe that tulip-roots never die naturally, as they lofe fo few of them; whereas the hyacinth-roots, I am informed, will not laft above five or feven years after they have flowered.

The hyacinth-root differs from the tulip-root, as the ftem of the laft year's flower is always found in the center of the root, and the new off-fets arife from the caudex below the bulb, but not beneath any of the concentric coats of the root, except the external one: hence Mr. Eaton, an ingenious florift of Derby, to whom I am indebted for moft of the obfervations in this note, concludes, that the hyacinth-root does not perifh annually after it has flowered like the tulip. Mr. Eaton gave me a tulip-root which had been fet too deep in the earth, and the caudex had elongated itfelf near an inch, and the new bulb was formed above the old one, and detached from it, inftead of adhering to its fide. See addit. Notes to Vol. I. No. XIV.

The caudex of the ranunculus, cultivated by the florifts, lies above the claw-like root; in this the old root or claws die annually, like the tulip and orchis, and the new claws, which are feen above the old ones, draw down the caudex lower into the earth. The fame is faid to happen to Scabiofa, or Devil's bit, and fome other plants, as valerian and greater plantain; the new fibrous roots rifing round the caudex above the old ones, the inferior end of the root becomes flumped, as if cut off, after the old fibres are decayed, and the caudex is drawn down into the earth by thefe new roots. See Arum and Tulipa.

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So ftood Eliza on the wood-crown'd height, O'er Minden's plain, spectatress of the fight, 270 Sought with bold eye amid the bloody ftrife Her dearer felf, the partner of her life; From hill to hill the rushing hoft purfued, And view'd his banner, or believed fhe view'd. Pleafed with the diftant roar, with quicker tread 275 Faft by his hand one lifping boy fhe led; And one fair girl amid the loud alarm Slept on her kerchief, cradled by her arm; While round her brows bright beams of Honour dart, And Love's warm eddies circle round her heart. 280 -Near and more near the intrepid Beauty prefs'd, Saw through the driving fmoke his dancing creft; Saw on his helm, her virgin-hands inwove, Bright stars of gold, and mystic knots of love; Heard the exulting fhout, "they run! they run!" 285 "Great God !" fhe cried, "He's fafe ! the battle's won !" -A ball now hiffes through the airy tides, (Some Fury wing'd it, and fome Demon guides!)

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Parts the fine locks, her graceful head that deck, Wounds her fair ear, and finks into her neck; 290 The red stream, iffuing from her azure veins, Dyes her white veil, her ivory bofom ftains .----" Ah me;" fhe cried, and, finking on the ground, Kifs'd her dear babes, regardlefs of the wound ; " Oh, ceafe not yet to beat, thou Vital Urn! 295 "Wait, gufhing Life, oh, wait my Love's return ! "Hoarfe barks the wolf, the vulture fcreams from far !---"The angel, Pity, fhuns the walks of war !---" Oh, fpare, ye War-hounds, fpare their tender age !---" On me, on me," fhe cried, " exhauft your rage !"--Then with weak arms her weeping babes carefs'd, 301 And fighing hid them in her blood-ftain'd veft.

From tent to tent the impatient warrior flies, Fear in his heart, and frenzy in his eyes; Eliza's name along the camp he calls, 305 Eliza echoes through the canvas walls;

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Quick through the murmuring gloom his footsteps tread, O'er groaning heaps, the dying and the dead, Vault o'er the plain, and in the tangled wood, Lo! dead Eliza weltering in her blood !--310 -Soon hears his liftening fon the welcome founds, With open arms and fparkling eyes he bounds :---" Speak low," he cries, and gives his little hand, " Eliza fleeps upon the dew-cold fand; " Poor weeping babe with bloody fingers prefs'd, 315 "And tried with pouting lips her milklefs breaft; " Alas ! we both with cold and hunger quake-"Why do ye weep, ?-Mama will foon awake." . -" She'll wake no more !" the hopelefs mourner cried, Upturn'd his eyes, and clasp'd his hands, and figh'd; 320 Stretch'd on the ground awhile entranc'd he lay, And prefs'd warm kiffes on the lifelefs clay; And then upfprung with wild convulfive ftart, And all the Father kindled in his heart; " Oh, Heavens!" he cried, my first rash vow forgive; " Thefe bind to earth, for thefe I pray to live!"-

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Round his chill babes he wrapp'd his crimfon veft, And clafp'd them fobbing to his aching breaft.

Two Harlot-Nymphs, the fair CUSCUTAS, pleafe With labour'd negligence, and ftudied eafe; 330 In the meek garb of modeft worth difguifed, The eye averted, and the fmile chaftifed, With fly approach they fpread their dangerous charms, And round their victim wind their wiry arms.

Cufcuta. 1. 329. Dodder. Four males, two females. This parafite plant (the feed fplitting without cotyledons), protrudes a fpiral body, and not endeavouring to root itfelf in the earth afcends the vegetables in its vicinity, fpirally W. S. E. or contrary to the movement of the fun; and abforbs its nourifhment by veffels apparently inferted into its fupporters. It bears no leaves, except here and there a fcale, very fmall, membraneous, and clofe under the branch. Lin. Spec. Plant. edit. a Reichard. Vol. I. p. 352. The Rev. T. Martyn, in his elegant letters on botany, adds, that, not content with fupport, where it lays hold, there it draws its nourifhment; and at length, in gratitude for all this, ftrangles its entertainer. Letter xv. A conteft for air and light obtains throughout the whole vegetable world; fhrubs rife above herbs; and, by precluding the air and light from them, injure or deftroy them; trees fuffocate or incommode fhrubs; the parafite climbing plants, as Ivy, Clematis, incommode the taller trees; and other parafites, which exift without having roots on the ground, as Mifletoe, Tillandfia, Epidendrum, and the moffes and fungufes, incommode them all.

Some of the plants with voluble ftems afcend other plants fpirally caft-fouth-weft, as Humulus, Hop, Lonicera, Honey-fuckle, Tamus, black Bryony, Helxine. Others turn their fpiral ftems weft-fouth-eaft, as Convolvulus, Corn-bind, Phofealus, Kidney-bean, Bafella, Cynanche, Euphorbia, Eupatorium. The proximate or final caufes of this difference have not been inveftigated. Other plants are furnifhed with tendrils for the purpofe of climbing: if the tendril meets with nothing to lay hold of in its firft revolu-

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So by Scamander when LAOCOON flood, Where 'Troy's proud turrets glitter'd in the flood, 335 Raifed high his arm, and with prophetic call To fhrinking realms announced her fated fall; Whirl'd his fierce fpear with more than mortal force, And pierced the thick ribs of the echoing horfe; 340 Two Serpent-forms incumbent on the main, Lashing the white waves with redundant train, Arch'd their blue necks, and fhook their towering crefts, And plough'd their foamy way with fpeckled breafts ; Then, darting fierce amid the affrighted throngs, 345 Roll'd their red eyes, and fhot their forked tongues .----Two daring Youths to guard the hoary fire Thwart their dread progrefs, and provoke their ire.

tion, it makes another revolution; and fo on till it wraps itfelf quite up like a corkfcrew; hence, to a carelefs obferver, it appears to move gradually backwards and forwards, being feen fometimes pointing eaftward and fometimes weftward. One of the Indian graffes, Panicum arborefcens, whofe ftem is no thicker than a goofe-quill, rifes as high as the talleft trees in this conteft for light and air. Spec. Plant a Riechard, Vol. I. p. 161. The tops of many climbing plants are tender from their quick growth; and, when deprived of their acrimony by boiling, are an agreeable article of food. The Hoptops are in common ufe. I have eaten the tops of white Bryony, Bryonia alba, and found them nearly as grateful as Afparagus, and think this plant might be profitably cultivated as an early garden-vegetable. The Tamus (called black Bryony), was lefs agreeable to the tafte when boiled. See Galanthus.

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Round fire and fons the fcaly monfters roll'd, Ring above ring, in many a tangled fold, Clofe and more clofe their writhing limbs furround, And fix with foamy teeth the envenom'd wound. 350 —With brow upturn'd to heaven the holy Sage In filent agony fuftains their rage; While each fond Youth, in vain, with piercing cries 355 Bends on the tortured Sire his dying eyes.

"Drink deep, fweet youths," feductive VITIS cries, The maudlin tear-drop glittering in her eyes; Green leaves and purple clufters crown her head, And the tall Thyrfus ftays her tottering tread. 360

Vitis. 1.357. Vine. Five males, one female. The juice of the ripe grape is a nutritive and agreeable food, confifting chiefly of fugar and mucilage. The chemical process of fermentation converts this fugar into fpirit, converts food into poifon! And it has thus become the curfe of the Christian world, producing more than half of our chronical difeases; which Mahomet observed, and forbade the use of it to his disciples. The Arabians invented distillation; and thus, by obtaining the spirit of fermented liquors in a less diluted state, added to its destructive quality. A Theory of the Diabætes and Dropsy, produced by drinking fermented or spirituous liquors, is explained in a Treatise on the inverted motions of the lymphatic system, published by Dr. Darwin. Cadell.

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—Five haplefs fwains with foft affuafive fmiles
The harlot mefhes in her deathful toils;
" Drink deep," fhe carols, as fhe waves in air
The mantling goblet, " and forget your care."—
O'er the dread feaft malignant Chemia fcowls, 365
And mingles poifon in the nectar'd bowls;
Fell Gout peeps grinning through the flimfy fcene,
And bloated Dropfy pants behind unfeen;
Wrapp'd in his robe white Lepra hides his ftains,
And filent Frenzy writhing bites his chains. 370

So when PROMETHEUS braved the Thunderer's ire, Stole from his blazing throne etherial fire,

Prometheus. I. 371. The antient flory of Prometheus, who concealed in his bofom the fire he had ftolen, and afterwards had a vulture perpetually gnawing his liver, affords fo apt an allegory for the effects of drinking fpirituous liquors, that one fhould be induced to think the art of diftillation, as well as fome other chemical proceffes (fuch as calcining gold), had been known in times of great antiquity, and loft again. The fwallowing drams cannot be better reprefented in hieroglyphic language than by taking fire into one's bofom; and certain it is, that the general effect of drinking fermented or fpirituous liquors is an inflamed, fchirrous, or paralytic liver, with its various critical or confequential difeafes, as leprous eruptions on the face, gout, dropfy, epilepfy, infanity. It is remarkable, that all the difeafes from drinking fpirituous or fermented liquors are liable to become hereditary, even to the third generation; gradually increafing, if the caufe be continued, till the family becomes extinct.

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And, lantern'd in his breaft, from realms of day Bore the bright treafure to his Man of clay ;— High on cold Caucafus by VULCAN bound, The lean impatient Vulture fluttering round, His writhing limbs in vain he twifts and ftrains To break or loofe the adamantine chains. The gluttonous bird, exulting in his pangs, Tears his fwoln liver with remorfelefs fangs.

The gentle CYCLAMEN with dewy eye Breathes o'er her lifelefs babe the parting figh; And, bending low to earth, with pious hands Inhumes her dear Departed in the fands.

Cyclamen. 1. 381. Shew-bread, or Sow-bread. When the feeds are ripe, the ftalk of the flower gradually twifts itfelf fpirally downwards, till it touches the ground, and forcibly penetrating the earth lodges it feeds; which are thought to receive nourifhment from the parent root, as they are faid not to be made to grow in any other fituation.

The Trifolium fubterraneum, fubterraneous trefoil, is another plant, which buries its feed, the globular head of the feed penetrating the earth; which, however, in this plant may be only an attempt to conceal its feeds from the ravages of birds; for there is another trefoil, the trifolium globofom, or globular woolly-headed trefoil, which has a curious manner of concealing its feeds; the lower florets only have corols and are fertile; the upper ones wither into a kind of wool, and, forming a head, compleatly conceal the fertile calyxes. Lin. Spec. Plant. a Riechard.

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" Sweet Nurfling ! withering in thy tender hour, 385 " Oh, fleep," She cries, " and rife a fairer flower !" -So when the Plague o'er London's gafping crowds Shook her dank wing, and fteer'd her murky clouds; When o'er the friendlefs bier no rites were read, No dirge flow-chaunted, and no pall out-fpread; 390 While Death and Night piled up the naked throng, And Silence drove their ebon cars along; Six lovely daughters, and their father, fwept To the throng'd grave CLEONE faw, and wept; Her tender mind, with meek Religion fraught, 395 Drank all-refigned Affliction's bitter draught; Alive and liftening to the whifper'd groan Of others' woes, unconfcious of her own !---One fmiling boy, her laft fweet hope, fhe warms Hushed on her bosom, circled in her arms,-400 Daughter of woe! ere morn, in vain carefs'd, Clung the cold Babe upon thy milkless breaft, With feeble cries thy laft fad aid required, Stretch'd its ftiff limbs, and on thy lap expired !---

Long with wide eye-lids on her Child fhe gazed, 405
And long to heaven their tearlefs orbs fhe raifed;
Then with quick foot and throbbing heart fhe found
Where Chartreufe open'd deep his holy ground;
Bore her laft treafure through the midnight gloom,
And kneeling dropp'd it in the mighty tomb; 410
" I follow next!" the frantic mourner faid,
And living plunged amid the feftering dead.

Where vaft Ontario rolls his brinelefs tides, And feeds the tracklefs forefts on his fides,

Where Chartreuse. 1. 408. During the plague in London, 1665, one pit to receive the dead was dug in the Charter-house, 40 feet long, 16 feet wide, and about 20 feet deep; and in two weeks received 1114 bodies. During this dreadful calamity there were inftances of mothers carrying their own children to those public graves, and of people delirious, or in despair from the loss of their friends, who threw themselves alive into these pits. Journal of the Plague-year in 1665, printed for E. Nutt, Royal-Exchange.

Rolls his brinelefs tide. 1. 413. Some philosophers have believed that the continent of America was not raifed out of the great ocean at so early a period of time as the other continents. One reason for this opinion was, because the great lakes, perhaps nearly as large as the Mediterranean Sea, consist of fresh water. And as the sea-falt seems to have its origin from the destruction of vegetable and animal bodies, washed down by rains, and carried by rivers into lakes or feas; it would seem that this source of sea-falt had not so long existed in that country. There is, however, a more fatisfactory way of ex-

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Fair CASSIA trembling hears the howling woods, And trufts her tawny children to the floods.—

plaining this circumftance; which is, that the American lakes lie above the level of the ocean, and are hence perpetually defailted by the rivers which run through them; which is not the cafe with the Mediterranean, into which a current from the main ocean perpetually paffes.

Caffia. 1. 415. Ten males, one female. The feeds are black, the ftamens gold-colour. This is one of the American fruits, which are annually thrown on the coafts of Norway; and are frequently in fo recent a flate as to vegetate, when properly taken care of, the fruit of the anacardium, cafhew-nut; of cucurbita lagenaria, bottlegourd; of the mimofa fcandens, cocoons; of the pifcidia erythrina, logwood-tree; and cocoa-nuts are enumerated by Dr. Tonning. (Amæn. Acad. 149.) amongft thefe emigrant feeds. The fact is truly wonderful, and cannot be accounted for but by the exiftence of under currents in the depths of the ocean; or from vortexes of water paffing from one country to another through caverns of the earth.

Sir Hans Sloane has given an account of four kinds of feeds, which are frequently thrown by the fea upon the coafts of the iflands of the northern parts of Scotland. Phil. Tranf. abridged, Vol. III. p. 540, which feeds are natives of the Weft Indies, and feem to be brought thither by the gulf-ftream defcribed below. One of thefe is called, by Sir H. Sloane, Phafeolus maximus perennis, which is often alfo thrown on the coaft of Kerry in Ireland; another is called, in Jamaica, Horfe-eye-bean; and a third is called Niker in Jamaica. He adds, that the Lenticula marina, or Sargoffo, grows on the rocks about Jamaica, is carried by the winds and current towards the coaft of Florida, and thence into the North-American ocean, where it lies very thick on the furface of the fea.

Thus a rapid current paffes from the gulf of Florida to the N. E. along the coaft of North-America, known to feamen by the name of the GULF-STREAM. A chart of this was published by Dr. Franklin in 1768, from the information principally of Capt. Folger. This was confirmed by the ingenious experiments of Dr. Blagden, published in 1781, who found that the water of the Gulf-stream was from fix to eleven degrees warmer than the water of the fea through which it ran; which must have been occa-fioned by its being brought from a hotter climate. He afcribes the origin of this current to the power of the trade-winds, which, blowing always in the fame direction, carry the waters of the Atlantic ocean to the westward, till they are stopped by the opposing continent on the west of the Gulf of Mexico, and are thus accumulated there, and run down the Gulf of Florida. Philof. Trans. V. 71, p. 335. Governor Pownal has given

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Cinctured with gold while *ten* fond brothers ftand, And guard the beauty on her native land, Soft breathes the gale, the current gently moves, And bears to Norway's coafts her infant-loves. 420 —So the fad mother at the noon of night From bloody Memphis ftole her filent flight ; Wrapp'd her dear babe beneath her folded veft, And clafp'd the treafure to her throbbing breaft, With foothing whifpers hufhed its feeble cry, 425 Prefs'd the foft kifs, and breathed the fecret figh.—

an elegant map of this Gulf-stream, tracing it from the Gulf of Florida north-ward as far as Cape Sable in Nova Scotia, and then across the Atlantic ocean to the coaft of Africa between the Canary-iflands and Senegal, increasing in breadth, as it runs, till it occupies five or fix degrees of latitude. The Governor likewife afcribes this current to the force of the trade-winds protruding the waters weftward, till they are oppofed by the continent, and accumulated in the Gulf of Mexico. He very ingenioufly obferves, that a great eddy must be produced in the Atlantic ocean between this Gulf-stream and the wefterly current protruded by the tropical winds, and in this eddy are found the immenfe fields of floating vegetables, called Saragofa weeds, and Gulf-weeds, and fome light woods, which circulate in thefe vaft eddies, or are occafionally driven out of them by the winds. Hydraulic and Nautical Obfervations by Governor Pownal, 1787. Other currents are mentioned by the Governor in this ingenious work, as those in the Indian Sea, northward of the line, which are afcribed to the influence of the Monfoons. It is probable, that in process of time the narrow tract of land on the west of the Gulf of Mexico may be worn away by this elevation of water dashing against it, by which this immenfe current would ceafe to exift, and a wonderful change take place in the Gulf of Mexico and Weft Indian iflands, by the fubfiding of the fea, which might probably lay all those islands into one, or join them to the continent.

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-With dauntlefs ftep fhe feeks the winding fhore, Hears unappall'd the glimmering torrents roar; With Paper-flags a floating cradle weaves, And hides the fmiling boy in Lotus-leaves; 430 Gives her white bofom to his eager lips, The falt-tears mingling with the milk he fips; Waits on the reed-crown'd brink with pious guile, And trufts the fcaly monfters of the Nile.-----Erewhile majeftic from his lone abode, 435 Embaffador of Heaven, the Prophet trod; Wrench'd the red Scourge from proud Oppreffion's hands, And broke, curft Slavery! thy iron bands.

Hark ! heard ye not that piercing cry, Which fhook the waves and rent the fky !---

E'en now, e'en now, on yonder Weftern fhores 441 Weeps pale Defpair, and writhing Anguish roars:

E'en now in Afric's groves with hideous yell Fierce SLAVERY stalks, and flips the dogs of hell; From vale to vale the gathering cries rebound, And fable nations tremble at the found !---YE BANDS OF SENATORS! whole fuffrage fways 445 Britannia's realms, whom either Ind obeys; Who right the injured, and reward the brave, Stretch your ftrong arm, for ye have power to fave ! Throned in the vaulted heart, his dread refort, Inexorable Conscience holds his court; 450 With still fmall voice the plots of Guilt alarms, Bares his mask'd brow, his lifted hand difarms; But, wrap'd in night with terrors all his own, He fpeaks in thunder, when the deed is done. Hear him, ye Senates! hear this truth fublime, 455 "He, WHO ALLOWS OPPRESSION, SHARES THE CRIME."

No radiant pearl, which crefted Fortune wears, No gem, that twinkling hangs from Beauty's ears,

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Not the bright ftars, which Night's blue arch adorn, Nor rifing funs that gild the vernal morn, 460 Shine with fuch luftre as the tear, that breaks For other's woe down Virtue's manly cheeks."

Here ceafed the MUSE, and dropp'd her tuneful fhell, Tumultuous woes her panting bofom fwell, O'er her flufh'd cheek her gauzy veil fhe throws, 465 Folds her white arms, and bends her laurel'd brows; For human guilt awhile the Goddefs fighs, And human forrows dim celeftial eyes.

No radiant pearl, which crefted Fortune wears,

INTERLUDE III.

Bookfeller. POETRY has been called a fifter-art both to Painting and to Mufic; I wish to know, what are the particulars of their relationship?

Poet. It has been already obferved, that the principal part of the language of poetry confifts of thofe words, which are expressive of the ideas, which we originally receive by the organ of fight; and in this it nearly indeed refembles painting; which can express itfelf in no other way, but by exciting the ideas or fensations belonging to the fense of vision. But besides this effential fimilitude in the language of the poetic pen and pencil, these two fisters refemble each other, if I may fo fay, in many of their habits and manners. The painter, to produce a ftrong effect, makes a few parts of his picture large, diffinct, and luminous, and keeps the remainder in shadow, or even beneath its natural fize and colour, to give eminence to the principal figure. This is fimilar to the common manner of poetic composition, where the fubordinate characters are kept down, to elevate and give confequence to the hero or heroine of the piece.

In the fouth aile of the cathedral church at Lichfield, there is an antient monument of a recumbent figure; the head and neck of which lie on a roll of matting in a kind of niche or cavern in the wall; and about five feet diftant horizontally in another opening or cavern in the wall are feen the feet and ankles, with fome folds of garment, lying alfo on a matt; and though the intermediate fpace is a folid ftone-wall, yet the imagination fupplies the deficiency, and the whole figure feems to exifts before our eyes. Does not this refemble one of the arts both of the painter and the poet? The former often fhows a mufcular arm amidft a group of figures, or an impaffioned face; and, hiding the remainder of the body behind other objects, leaves the imagination to compleat it. The latter, defcribing a fingle feature or attitude in picturefque words, produces before the mind an image of the whole.

I remember feeing a print, in which was reprefented a fhrivelled hand ftretched through an iron grate, in the ftone floor of a prifonyard, to reach at a mefs of porrage, which affected me with more horrid ideas of the diftrefs of the prifoner in the dungeon below, than could have been perhaps produced by an exhibition of the whole perfon. And in the following beautiful fcenery from the Midfummer-night's dream, (in which I have taken the liberty to alter the place of a comma), the defcription of the fwimming ftep and prominent belly bring the whole figure before our eyes with the diftinctnefs of reality.

When we have laugh'd to fee the fails conceive,
And grow big-bellied with the wanton wind;
Which fhe with pretty and with fwimming gate,
Following her womb, (then rich with my young fquire),
Would imitate, and fail upon the land.

There is a third fifter-feature, which belongs both to the pictorial and poetic art; and that is the making fentiments and paffions vifible, as it were, to the fpectator; this is done in both arts by defcribing or pourtraying the effects or changes which those fentiments or paffions produce upon the body. At the end of the unaltered play of Lear, there is a beautiful example of poetic painting; the old King is introduced as dying from grief for the loss of Cordelia; at this crifis, Shakefpear, conceiving the robe of the King to be held together by a clafp, reprefents him as only faying to an attendant courtier in a faint voice, "Pray, Sir, undo this button,—thank you, Sir," and dies. Thus by the art of the poet, the oppreffion at the bofom of the dying King is made vifible, not defcribed in words.

B. What are the features, in which these Sister-arts do not refemble each other?

P. The ingenious Bifhop Berkeley, in his Treatife on Vifion, a work of great ability, has evinced, that the colours which we fee, are only a language fuggefting to our minds the ideas of folidity and extension, which we had before received by the fense of touch. Thus when we view the trunk of a tree, our eye can only acquaint us with the colours or fhades; and from the previous experience of the fense of touch, these fuggest to us the cylindrical form, with the prominent or depressed wrinkles on it. From hence it appears, that there is the strictest analogy between colours and founds; as they are both but languages, which do not represent their correfpondent ideas, but only fuggest them to the mind from the habits or affociations of previous experience. It is therefore reasonable to conclude, that the more artificial arrangements of these two languages by the poet and the painter bear a fimilar analogy.

But in one circumftance the Pen and the Pencil differ widely from each other, and that is the quantity of Time which they can include in their refpective reprefentatious. The former can unravel a long feries of events, which may conftitute the hiftory of days or years; while the latter can exhibit only the actions of a moment. The Poet is happier in defcribing fucceffive fcenes; the Painter in reprefenting flationary ones: both have their advantages.

Where the paffions are introduced, as the Poet, on one hand, has the power gradually to prepare the mind of his reader by previous climacteric circumstances; the Painter, on the other hand, can throw ftronger illumination and distinctness on the principal moment or cataftrophe of the action; befides the advantage he has in ufing an univerfal language, which can be *read* in an inftant of time. Thus where a great number of figures are all feen together, fupporting or contrafting each other, and contributing to explain or aggrandize the principal effect, we view a picture with agreeable furprize, and contemplate it with unceafing admiration. In the reprefentation of the facrifice of Jephtha's Daughter, a print done from a painting of Ant. Coypel, at one glance of the eye we read all the interefting paffages of the laft act of a well-written tragedy; fo much poetry is there condenfed into a moment of time.

B. Will you now oblige me with an account of the relationship between Poetry, and her other fifter, Music?

P. In the poetry of our language I don't think we are to look for any thing analogous to the notes of the gamut; for, except perhaps in a few exclamations or interrogations, we are at liberty to raife or fink our voice an octave or two at pleafure, without altering the fense of the words. Hence, if either poetry or profe be read in melodious tones of voice, as is done in recitativo, or in chaunting, it must depend on the speaker, not on the writer: for though words may be felected which are lefs harfh than others, that is, which have fewer fudden ftops or abrupt confonants amongft the vowels, or with fewer fibilant letters, yet this does not conftitute melody, which confifts of agreeable fucceffions of notes referable to the gamut; or harmony, which confifts of agreeable combinations of them. If the Chinese language has many words of fimilar articulation, which yet fignify different ideas, when fpoken in a higher or lower mufical note, as fome travellers affirm, it must be capable of much finer effect, in respect to the audible part of poetry, than any language we are acquainted with.

There is however another affinity, in which poetry and mufic more nearly refemble each other than has generally been underftood, and that is in their meafure or time. There are but two kinds

of time acknowledged in modern mufic, which are called triple time, and common time. The former of thefe is divided by bars, each bar containing three crotchets, or a proportional number of their fubdivisions into quavers and femiquavers. This kind of time is analogous to the measure of our heroic or iambic verse. Thus the two following couplets are each of them divided into five bars of triple time, each bar confifting of two crotchets and two quavers ; nor can they be divided into bars analogous to common time without the bars interfering with fome of the crotchets, fo as to divide them.

- 3 Soft-warbling beaks | in each bright blof | fom move,
- 4 And vo | cal rofebuds thrill | the inchanted grove, |

In these lines there is a quaver and a crotchet alternately in every bar, except in the laft, in which the in make two femiquavers; the e is fuppofed by Grammarians to be cut off, which any one's ear will readily determine not to be true.

- 3 Life buds or breathes | from Indus to | the poles,
 4 And the | vaft furface kind | les, as it rolls. |

In thefe lines there is a quaver and a crotchet alternately in the first bar; a quaver, two crotchets, and a quaver, make the fecond bar. In the third bar there is a quaver, a crotchet, and a reft after the crotchet, that is after the word poles, and two quavers begin the next line. The fourth bar confifts of quavers and crotchets alternately. In the laft bar there is a quaver, and a reft after it, viz. after the word kindles; and then two quavers and a crotchet. You will clearly perceive the truth of this, if you prick the mufical characters above mentioned under the verfes.

The common time of muficians is divided into bars, each of which contains four crotchets, or a proportional number of their fubdivision into quavers and femiquavers. This kind of musical time is analogous to the dactyle verfes of our language, the most popular inftances of which are in Mr. Anftie's Bath-Guide. In this kind of verfe the bar does not begin till after the first or second fyllable; and where the verfe is quite complete, and written by a good ear, these first fyllables added to the last complete the bar, exactly in this also corresponding with many pieces of music;

- 2 Yet | if one may guess by the | fize of his calf, Sir,
- ⁴ He | weighs about twenty-three | stone and a half, Sir.
- 2 Master | Mamozet's head was not | finished so soon,
- 4 For it | took up the barber a | whole afternoon.

In these lines each bar confists of a crotchet, two quavers, another crotchet, and two more quavers : which are equal to four crotchets, and, like many bars of *common time* in music, may be subdivided into two in beating time without disturbing the measure.

The following verfes from Shenftone belong likewife to common time:

- 2 A | river or a fea |
- ⁴ Was to him a difh | of tea, And a king | dom bread and butter.

The first and second bars confist each of a crotchet, a quaver, a crotchet, a quaver, a crotchet. The third bar confists of a quaver, two crotchets, a quaver, a crotchet. The last bar is not complete without adding the letter A, which begins the first line, and then it confists of a quaver, a crotchet, a quaver, a crotchet, two quavers.

It must be observed, that the crotchets in triple time are in general played by musicians flower than those of common time, and hence minuets are generally pricked in triple time, and country dances generally in common time. So the verses above related, which are analogous to *triple time*; are generally read flower than those analogous to common time; and are thence generally used for graver compositions. I suppose all the different kinds of verses to be found in our odes, which have any measure at all, might be arranged under one or other of these two musical times; allowing a note or two fometimes to precede the commencement of the bar, and occasional rests, as in musical compositions: if this was attended to by those who set poetry to music, it is probable the found and fense would oftener coincide. Whether these musical times can be applied to the lyric and heroic verses of the Greek and Latin poets, I do not pretend to determine; certain it is, that the dactyle verse of our language, when it is ended with a double rhime, much refembles the measure of Homer and Virgil, except in the length of the lines.

B. Then there is no relationship between the other two of these fister-ladies, Painting and Music?

P. There is at leaft a mathematical relationship, or perhaps I ought rather to have faid a metaphysical relationship between them. Sir Isaac Newton has observed, that the breadths of the feven primary colours in the Sun's image refracted by a prism are proportional to the feven musical notes of the gamut, or to the intervals of the eight founds contained in an octave, that is, proportional to the following numbers:

Sol.	La.	Fa.	Sol.	La.	Mi.	Fa.	Sol.
Red.	Orange.	Yellow.	Green.	Blue.	Indigo.	Violet.	
I	I	I	I	I	I	I	
9	16	10	9	16	16	9	

Newton's Optics, Book I. part 2. prop. 3. and 6. Dr. Smith, in his Harmonics, has an explanatory note upon this happy difcovery, as he terms it, of Newton. Sect. 4. Art. 7.

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From this curious coincidence, it has been proposed to produce a luminous music, confisting of fuccessions or combinations of colours, analogous to a tune in respect to the proportions above mentioned. This might be performed by a strong light, made by means of Mr. Argand's lamps, passing through coloured glasses, and falling on a defined part of a wall, with moveable blinds before them, which might communicate with the keys of a harpfichord; and thus produce at the fame time visible and audible music in unifon with each other.

The execution of this idea is faid by Mr. Guyot to have been attempted by Father Caffel, without much fuccefs.

If this fhould be again attempted, there is another curious coincidence between founds and colours, difcovered by Dr. Darwin of Shrewfbury, and explained in a paper on what he calls Ocular Spectra, in the Philosophical Transactions, Vol. LXXVI. which might much" facilitate the execution of it. In this treatife the Doctor has demonftrated, that we fee certain colours, not only with greater eafe and diftinctnefs, but with relief and pleafure, after having for fome time contemplated other certain colours; as green after red, or red after green; orange after blue, or blue after orange; yellow after violet, or violet after yellow. This he fhews arifes from the ocular spectrum of the colour last viewed coinciding with the irritation of the colour now under contemplation. Now as the pleafure we receive from the fenfation of melodious notes, independent of the previous affociations of agreeable ideas with them, must arife from our hearing fome proportions of founds after others more eafily, diffinctly, or agreeably; and as there is a coincidence between the proportions of the primary colours, and the primary founds, if they may be fo called; he argues, that the fame laws must govern the fensations of both. In this circumstance, therefore, confists the fisterhood of Mufic and Painting; and hence they claim a right to borrow metaphors from each other; muficians to fpeak of the brilliancy of founds, and the light and shade of a concerto; and painters of the

harmony of colours, and the tone of a picture. Thus it is not quite fo abfurd, as was imagined, when the blind man afked if the colour fearlet was like the found of a trumpet. As the coincidence or oppofition of these ocular fpectra, (or colours which remain in the eye after we have for fome time contemplated a luminous object) are more eafily and more accurately afcertained, now their laws have been investigated by Dr. Darwin, than the relicts of evanefcent founds upon the ear; it is to be wished that fome ingenious mufician would further cultivate this curious field of science: for if visible mufic can be agreeably produced, it would be more eafy to add fentiment to it by reprefentations of groves and Cupids, and fleeping nymphs amid the changing colours, than is commonly done by the words of audible mufic.

B. You mentioned the greater length of the verfes of Homer and Virgil. Had not these poets great advantage in the superiority of their languages compared to our own?

P. It is probable, that the introduction of philosophy into a country must gradually affect the language of it; as philosophy converses in more appropriated and abstracted terms; and thus by degrees eradicates the abundance of metaphor, which is used in the more early ages of fociety. Otherwise, though the Greek compound words have more vowels in proportion to their confonants than the English ones, yet the modes of compounding them are less general; as may be seen by variety of instances given in the preface of the Translators, prefixed to the SYSTEM OF VEGETABLES by the Lichfield Society; which happy property of our own language rendered that translation of Linneus as expressive and as concise, perhaps more fo than the original.

And in one refpect, I believe, the English language ferves the purpose of poetry better than the antient ones, I mean in the greater ease of producing personifications; for as our nouns have in general no genders affixed to them in profe-compositions, and in the habits of conversation, they become easily personified only by the addition of a masculine or feminine pronoun, as,

Pale Melancholy fits, and round *her* throws A death-like filence, and a dread repofe.

Pope's Abelard.

And fecondly, as most of our noons have the article *a* or *the* prefixed to them in profe-writing and in conversation, they in general become perfonified even by the omiffion of these articles; as in the bold figure of Shipwreck in Miss Seward's Elegy on Capt. Cook:

But round the fteepy rocks and dangerous ftrand Rolls the white furf, and SHIPWRECK guards the land.

Add to this, that if the verfes in our heroic poetry be fhorter than those of the ancients, our words likewise are fhorter; and in respect to their measure or time, which has erroneously been called melody and harmony, I doubt, from what has been faid above, whether we are fo much inferior as is generally believed; fince many passages, which have been stolen from antient poets, have been translated into our language without losing any thing of the beauty of the versification. The following line translated from Juvenal by Dr. Johnson, is much superior to the original:

Slow rifes Worth by Poverty deprefs'd.

The original is as follows :

Difficile emergunt, quorum virtutibus obstat, Res angusta domi. B. I am glad to hear you acknowledge the thefts of the modern poets from the antient ones, whofe works I fuppofe have been reckoned lawful plunder in all ages. But have not you borrowed epithets, phrafes, and even half a line occafionally from modern poems?

P. It may be difficult to mark the exact boundary of what fhould be termed plagiarifm: where the fentiment and expression are both borrowed without due acknowledgment, there can be no doubt;—fingle words, on the contrary, taken from other authors, cannot convict a writer of plagiarism; they are lawful game, wild by nature, the property of all who can capture them;—and perhaps a few common flowers of speech may be gathered, as we pass over our neighbour's inclosure, without stigmatizing us with the title of thieves; but we must not therefore plunder his cultivated fruit.

The four lines at the end of the plant Upas are imitated from Dr. Young's Night Thoughts. The line in the epifode adjoined to Caffia, "The falt tear mingling with the milk he fips," is from an interefting and humane paffage in Langhorne's Juftice of Peace. There are probably many others, which, if I could recollect them, fhould here be acknowledged. As it is, like exotic plants, their mixture with the native ones, I hope, adds beauty to my Botanic Garden :—and fuch as it is, Mr. Bookfeller, I now leave it to you to defire the Ladies and Gentlemen to walk in; but pleafe to apprize them, that, like the fpectators at an unfkilful exhibition in fome village-barn, I hope they will make Good-humour one of their party; and thus theirfelves fupply the defects of the reprefentation.


LOVES OF THE PLANTS.

THE

CANTO IV.

NOW the broad Sun his golden orb unfhrouds, Flames in the weft, and paints the parted clouds; O'er heaven's wide arch refracted luftres flow, And bend in air the many-colour'd bow.— —The tuneful Goddefs on the glowing fky Fix'd in mute ecftacy her gliftening eye;

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And then her lute to fweeter tones fhe ftrung, And fwell'd with fofter chords the Paphian fong; Long ailes of Oaks return'd the filver found, And amorous Echoes talk'd along the ground; Pleas'd Lichfield liften'd from her facred bowers, Bow'd her tall groves, and fhook her ftately towers.

IO

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"Nymph! not for thee the radiant day returns, Nymph! not for thee the golden folftice burns, Refulgent CEREA!—at the dufky hour She feeks with penfive ftep the mountain-bower,

Pleas'd Lichfield. 1. 11. The fcenery defcribed at the beginning of the first part, or economy of vegetation, is taken from a botanic garden about a mile from Lichfield.

Cerea. 1. 15. Cactus grandiflorus, or Cereus. Twenty males, one female. This flower is a native of Jamaica and Veracrux. It expands a most exquisitely beautiful corol, and emits a most fragrant odour for a few hours in the night, and then closes to open no more. The flower is nearly a foot in diameter; the infide of the calyx of a fplendid yellow, and the numerous petals of a pure white: it begins to open about feven or eight o'clock in the evening, and closes before fun-rise in the morning. Martyn's Letters, p. 294. The Cistus labdaniferus and many other flowers, lose their petals after having been a few hours expanded in the day-time; for in these plants the stigma is foon impregnated by the numerous anthers: in many flowers of the Cistus labdaniferus I obferved two or three of the stamens were perpetually bent into contact with the piftil.

The Nyctanthes, called Arabian Jafmine, is another flower, which expands a beautiful corol, and gives out a most delicate perfume during the night, and not in the day, in its native country, whence its name; botanical philosophers have not yet explained

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Bright as the blufh of rifing morn, and warms The dull cold eye of Midnight with her charms. There to the fkies fhe lifts her pencill'd brows, Opes her fair lips, and breathes her virgin vows; 20 Eyes the white zenyth; counts the funs, that roll Their diftant fires, and blaze around the Pole; Or marks where Jove directs his glittering car O'er Heaven's blue vault,-Herfelf a brighter ftar. -There as foft zephyrs fweep with paufing airs 25 Thy fnowy neck, and part thy fhadowy hairs, Sweet Maid of Night! to Cynthia's fober beams Glows thy warm cheek, thy polifh'd bofom gleams. In crowds around thee gaze the admiring fwains, And guard in filence the enchanted plains; 30

this wonderful property; perhaps the plant fleeps during the day as fome animals do; and its odoriferous glands only omit their fragrance during the expansion of the petals; that is, during its waking hours: the Geranium trifte has the fame property of giving up its fragrance only in the night. The flowers of the Cucurbita lagenaria are faid to clofe when the fhun fhines upon them. In our climate many flowers, as tragopogon, and hibifu s, clofe their flowers before the hotteft part of the day comes on; and the flowers of fome species of cucubalus, and Silene, viscous campion, are closed all day; but when the fun leaves them they expand, and emit a very agreeable scent; whence such plants are termed noctiflora.

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Drop the ftill tear, or breathe the impaffion d figh, And drink inebriate rapture from thine eye. Thus when old Needwood's hoary fcenes the Night Paints with blue fhadow, and with milky light; Where MUNDY pour'd, the liftening nymphs among, 35 Loud to the echoing vales his parting fong; With meafured ftep the Fairy Sovereign treads, Shakes her high plume, and glitters o'er the meads; Round each green holly leads her fportive train, And little footfteps mark the circled plain; 40 Each haunted rill with filver voices rings, And Night's fweet bird in livelier accents fings.

Ere the bright ftar, which leads the morning fky, Hangs o'er the blufhing eaft his diamond eye, The chafte TROPÆO leaves her fecret bed ; 45 A faint-like glory trembles round her head ;

Where Mundy. 1. 35. Alluding to an unpublished poem by F. N. C. Mundy, Efq. on his leaving Needwood-Foreft. See the passage in the notes at the end of this volume.

Tropæolum. 1. 45. Majus. Garden Nasturtion, or greater Indian cress. Eight males one female. Miss E. C. Linneus first observed the Tropæolum Majus to emit sparks or

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Eight watchful fwains along the lawns of night With amorous fteps purfue the virgin light; O'er her fair form the electric luftre plays, And cold fhe moves amid the lambent blaze. So fhines the glow-fly, when the fun retires, And gems the night-air with phofphoric fires;

flashes in the mornings before fun-rife, during the months of June or July, and also during the twilight in the evening, but not after total darknefs came on; these fingular fcintillations were fhewn to her father and other philosophers; and Mr. Wilcke, a celebrated electrician, believed them to be electric. Lin. Spec. Plantar. p. 490. Swedifh Acts for the year 1762. Pulteney's View of Linneus, p. 220. Nor is this more wonderful than that the electric eel and torpedo fhould give voluntary flocks of electricity; and in this plant perhaps, as in those animals, it may be a mode of defence, by which it haraffes or deftroys the night-flying infects which infeft it; and probably it may emit the fame fparks during the day, which muft be then invifible. This curious fubject deferves further inveftigation. See Dictamnus. The ceafing to this plant after twilight might induce one to conceive, that it abforbed and emitted light, like the Bolognian Phofphorus, or calcined oyfter-fhells, fo well explained by Mr. B. Wilfon, and by T. B. Beccari. Exper. on Phofphori, by B. Wilfon, Dodíley. The light of the evening, at the fame diffance from noon, is much greater, as I have repeatedly obferved, than the light of the morning: this is owing, I fuppofe, to the phofphorefcent quality of almost all bodies, in a greater or lefs degree, which thus abforb light during the fun-fhine, and continue to emit it again for fome time afterwards, though not in fuch quantity as to produce apparent fcintillations. The nectary of this plant grows from what is fuppofed to be the calyx; but this fuppofed calyx is coloured; and perhaps, from this circumftance of its bearing the nectary, fhould rather be effeemed a part of the coral. See an additional note at the end of the poem.

So fhines the glow-fly. l. 51. In Jamaica, in fome feafons of the year, the fire-flies are feen in the evenings in great abundance. When they fettle on the ground, the bullfrog greedily devours them; which feems to have given origin to a curious, though cruel, method of deftroying these animals: if red-hot pieces of charcoal be thrown towards them in the dusk of the evening, they leap at them, and, hasfily swallowing them, are burnt to death.

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Thus o'er the marsh aerial lights betray, And charm the unwary wanderer from his way. So when thy King, Affyria, fierce and proud, Three human victims to his idol vow'd; Rear'd a vaft pyre before the golden fhrine Of fulphurous coal, and pitch-exfuding pine ;--Loud roar the flames, the iron noftrils breathe, And the huge bellows pant and heave beneath; Bright and more bright the blazing deluge flows, And white with feven-fold heat the furnace glows. And now the Monarch fix'd with dread furprize Deep in the burning vault his dazzled eyes. " Lo! Three unbound amid the frightful glare, " Unfcorch'd their fandals, and unfing'd their hair ! " And now a fourth with feraph-beauty bright " Defcends, accofts them, and outfhines the light ! " Fierce flames innocuous, as they ftep, retire ! " And flow they move amid a world of fire !" He fpoke,-to Heaven his arms repentant fpread, And kneeling bow'd his gem-incircled head.

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Two Sifter-Nymphs, the fair AVENAS, lead Their fleecy fquadrons on the lawns of Tweed; Pafs with light ftep his wave-worn banks along, And wake his Echoes with their filver tongue; Or touch the reed, as gentle Love infpires, In notes accordant to their chafte defires.

I.

" Sweet Есно! fleeps thy vocal fhell,

"Where this high arch o'erhangs the dell;

80

"While Tweed with fun-reflecting ftreams

" Chequers thy rocks with dancing beams ?---

Ovena. 1. 73. Oat. The numerous families of graffes have all three males, and two females, except Anthoxanthum, which gives the grateful fmell to hay, and has but two males. The herbs of this order of vegetables fupport the countlefs tribes of graminivorous animals. The feeds of the fmaller kinds of graffes, as of aira, poa, briza, flipa, &c. are the fuftenance of many forts of birds. The feeds of the large graffes, as of wheat, barley, rye, oats, fupply food to the human fpecies.

It feems to have required more ingenuity to think of feeding nations of mankind with fo fmall a feed, than with the potatoe of Mexico, or the bread-fruit of the fouthern illands; hence Ceres in Egypt, which was the birth-place of our European arts, was defervedly celebrated amongft their divinities, as well as Ofyris, who invented the Plough.

Mr. Wahlborn obferves, that as wheat, rye, and many of the graffes, and plantain, lift up their anthers on long filaments, and thus expose the enclosed fecundating dust to be washed away by the rains, a fearcity of corn is produced by wet summers; hence the necessfity of a careful choice of feed-wheat, as that, which had not received the dust of the anthers, will not grow, though it may appear well to the eye. The straw of the oat feems to have been the straight instrument, invented during the pastoral ages of the world, before the discovery of metals. See note on Cistus.

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II.

" Here may no clamours harfh intrude,
" No brawling hound or clarion rude;
" Here no fell beaft of midnight prowl, 85
" And teach thy tortured cliffs to howl!

III.

" Be thine to pour thefe vales along
" Some artlefs Shepherd's evening fong;
" While Night's fweet bird, from yon high fpray
" Refponfive, liftens to his lay.

IV.

90

" And if, like me, fome love-lorn Maid" Should fing her forrows to thy fhade," Oh, footh her breaft, ye rocks around !" With fofteft fympathy of found."

From ozier bowers the brooding Halcyons peep, 95 The Swans purfuing cleave the glaffy deep,

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On hovering wings the wondering Reed-larks play, And filent Bitterns liften to the lay.— *Three* fhepherd-fwains beneath the beechen fhades Twine rival garlands for the tuneful maids; 100 On each fmooth bark the myftic love-knot frame, Or on white fands inferibe the favour'd name. Green fwells the beech, the widening knots improve, So fpread the tender growths of cultured love; Wave follows wave, the letter'd lines decay, 105 So Love's foft forms neglected melt away.

From Time's remoteft dawn where China brings In proud fucceffion all her Patriot-Kings; O'er defert-fands, deep gulphs, and hills fublime, Extends her maffy wall from clime to clime; 110 With bells and dragons crefts her Pagod-bowers, Her filken palaces, and porcelain towers; With long canals a thoufand nations laves; Plants all her wilds, and peoples all her waves;

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Slow tréads fair CANNABIS the breezy ftrand, 115 The diftaff ftreams difhevell'd in her hand; Now to the left her ivory neck inclines, And leads in Paphian curves its azure lines; Dark waves the fringed lid, the warm cheek glows, And the fair ear the parting locks difclofe; 120 Now to the right with airy fweep fhe bends, Quick join the threads, the dancing fpole depends. —*Five* Swains attracted guard the Nymph, by turns Her grace inchants them, and her beauty burns; To each fhe bows with fweet affuafive fmile, 125 Hears his foft vows, and turns her fpole the while.

Cannabis. 1. 115. Chinefe Hemp. Two houfes. Five males. A new fpecies of hemp, of which an account is given by K. Fitzgerald, Efq. in a letter to Sir Jofeph Banks, and which is believed to be much fuperior to the hemp of other countries. A few feeds of this plant were fown in England on the 4th of June, and grew to fourteen feet feven inches in height by the middle of October; they were nearly feven inches in circumference, and bore many lateral branches, and produced very white and tough fibres. At fome parts of the time thefe plants grew nearly eleven inches in a week.— Philof. Tranf. Vol. LXXII. p. 46.

Paphian curves. 1. 118. In his ingenious work, entitled, The Analyfis of Beauty, Mr. Hogarth believes that the triangular glafs, which was dedicated to Venus in her temple at Paphos, contained in it a line bending fpirally round a cone with a certain degree of curviture; and that this pyramidal outline and ferpentine curve conflitute the principles of Grace and Beauty.

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So when with light and fhade, concordant ftrife! Stern CLOTHO weaves the chequer'd thread of life; Hour after hour the growing line extends, The cradle and the coffin bound its ends; 130 Soft cords of filk the whirling fpoles reveal, If fimiling Fortune turn the giddy wheel; But if fweet Love with baby-fingers twines, And wets with dewy lips the lengthening lines, Skein after fkein celeftial tints unfold, 135 And all the filken tiffue fhines with gold.

Warm with fweet blufhes bright GALANTHA glows, And prints with frolic ftep the melting fnows:

Galanthus. 1. 137. Nivalis. Snowdrop. Six males, one female. The first flower that appears after the winter folftice. See Stillingfleet's Calendar of Flora.

Some fnowdrop-roots taken up in winter, and boiled, had the infipid mucilaginous tafte of the Orchis, and, if cured in the fame manner, would probably make as good falep. The roots of the Hyacinth, I am informed, are equally infipid, and might be ufed as an article of food. Gmelin, in his Hiftory of Siberia, fays the Martigon Lily makes a part of the food of that country, which is of the fame natural order as the fnow-drop. Some roots of Crocus, which I boiled, had a difageeable flavour.

The difficulty of raifing the Orchis from feed has, perhaps, been a principal reafon of its not being cultivated in this country as an article of food. It is affirmed, by one of the Linnean fchool, in the Amœnit. Academ. that the feeds of Orchis will ripen, if

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O'er filent floods, white hills, and glittering meads Six rival fwains the playful beauty leads, 140 Chides with her dulcet voice the tardy Spring, Bids flumbering Zephyr ftretch his folded wing, Wakes the hoarfe Cuckoo in his gloomy cave, And calls the wondering Dormoufe from his grave, Bids the mute Redbreaft cheer the budding grove, 145 And plaintive Ringdove tune her notes to love.

Spring ! with thy own fweet fmile, and tuneful tongue, Delighted BELLIS calls her infant throng. Each on his reed aftride, the Cherub-train Watch her kind looks, and circle o'er the plain; 150

you deftroy the new bulb; and that Lily of the Valley, Convallaria, will produce many more feeds, and ripen them, if the roots be crowded in a garden-pot, fo as to prevent them from producing many bulbs. Vol. VI. p. 120. It is probable either of thefe methods may fucceed with thefe and other bulbous-rooted plants, as fnowdrops, and might render their cultivation profitable in this climate. The root of the afphodelus ramofus, branchy afphodel, is ufed to feed fwine in France; the ftarch is obtained from the alftromeria licta. Memoires d' Agricult.

Bellis prolifera. 1. 148. Hen and chicken Daify; in this beautiful monfter not only the impletion or doubling of the petals takes place, as deferibed in the note on Alcea; but a numerous circlet of lefs flowers on peduncles, or footflaks, rife from the fides of the calyx, and furround the proliferous parent. The fame occurs in Calendula, marigold; in Heracium, hawk-weed; and in Scabiofa, Scabious. Phil. Botan. p. 82.

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Now with young wonder touch the fliding fnail, Admire his eye-tipp'd horns, and painted mail; Chafe with quick ftep, and eager arms outfpread, The paufing Butterfly from mead to mead; Or twine green oziers with the fragrant gale, 155 The azure harebel, and the primrofe pale, Join hand in hand, and in procession gay Adorn with votive wreaths the fhrine of May. -So moves the Goddefs to the Idalian groves, And leads her gold-hair'd family of Loves. 160 Thefe, from the flaming furnace, ftrong and bold Pour the red steel in many a fandy mould; On tinkling anvils (with Vulcanian art), Turn with hot tongs, and forge the dreadful dart;

The fragrant Gale. 1. 155. The buds of the Myrica Gale poffefs an agreeable aromatic fragrance, and might be worth attending to as an article of the Materia Medica. Mr. Sparman fufpects, that the green wax-like fubftance, with which at certain times of the year the berries of the Myrica cerifera, or candle-berry Myrtle, are covered, are deposited there by infects. It is used by the Inhabitants for making candles, which he fays burn rather better than those made of tallow. Voyage to the Cape, V. I. p. 345. Du Halde gives an account of a white-wax made by fmall infects round the branches of a tree in China in great quantity, which is there collected for medical and economical purpofes. The tree is called Tong-tfin. Defcript. of China. Vol. I. p. 230.

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The barbed head on whirling jafpers grind, 165 And dip the point in poifon for the mind; Each polifh'd fhaft with fnow-white plumage wing, Or ftrain the bow reluctant to its ftring. Thofe on light pinion twine with bufy hands, Or ftretch from bough to bough the flowery bands; 170 Scare the dark beetle, as he wheels on high, Or catch in filken nets the gilded fly; Call the young Zephyrs to their fragrant bowers, And ftay with kiffes fweet the Vernal Hours.

Where, as proud Maffon rifes rude and bleak 175 And with mifshapen turrets crefts the Peak, Old Matlock gapes with marble jaws, beneath, And o'er fcar'd Derwent bends his flinty teeth; Deep in wide caves below the dangerous foil Blue fulphurs flame, imprifon'd waters boil. 180

Deep in wide caves. 1. 179. The arguments which tend to fhew that the warm fprings of this country are produced from fleam raifed by deep fubterraneous fires, and afterwards condenfed between the flrata of the mountains, appear to me much more conclufive, than the idea of their being warmed by chemical combinations near the furface of

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Impetuous fteams in fpiral columns rife Through rifted rocks, impatient for the fkies; Or o'er bright feas of bubbling lavas blow; As heave and tofs the billowy fires below; Condenfed on high, in wandering rills they glide 185 From Maffon's dome, and burft his fparry fide; Round his grey towers, and down his fringed walls, From cliff to cliff, the liquid treafure falls; In beds of ftalactite, bright ores among, O'er corals, fhells, and cryftals, winds along; 190

the earth: for, Ift, their heat has kept accurately the fame perhaps for many centuries, certainly as long as we have been poffeffed of good thermometers; which cannot be well explained, without fuppoing that they are first in a boiling flate. For as the heat of boiling water is 212, and that of the internal parts of the earth 48, it is easy to underfland, that the steam raifed from boiling water, after being condensed in some mountain, and passing from thence through a certain space of the cold earth, must be cooled always to a given degree; and it is probable the distance from the exit of the system.

2. In the dry fummer of 1780, when all other fprings were either dry or much diminifhed, those of Buxton and Matlock (as I was well informed on the fpot), had fuffered no diminution; which proves that the fources of these warm fprings are at great depths below the furface of the earth.

3. There are numerous perpendicular fiffures in the rocks of Derbyshire, in which the ores of lead and copper are found, and which pass to unknown depths; and might thence afford a passage to steam from great subterraneous fires.

4. If these waters were heated by the decomposition of pyrites, there would be some chalybeate taste or support fulphureous smell in them. See note in part I. on the existence of central fires.

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Crufts the green moffes, and the tangled wood, And fparkling plunges to its parent flood. —O'er the warm wave a fmiling youth prefides, Attunes its murmurs, its meanders guides, (The blooming Fucus), in her fparry coves 195 To amorous Echo fings his *fecret* loves, Bathes his fair forehead in the mifty ftream, And with fweet breath perfumes the rifing fteam. —So, erft, an Angel o'er Bethefda's fprings, Each morn defcending, fhook his dewy wings; 200

Fucus. 1. 195. Clandestine marriage. A species of Fucus, or of Conferva, soon appears in all bafons which contain water. Dr. Prieftley found that great quantities of pure dephlogifticated air were given up in water at the points of this vegetable, particularly in the funfhine, and that hence it contributed to preferve the water in refervoirs from becoming putrid. The minute divisions of the leaves of fubaquatic plants as mentioned in the note on Trapa, and of the gills of fifh, feem to ferve another purpofe befides that of increasing their furface, which has not, I believe, been attended to, and that is to facilitate the feparation of the air, which is mechanically mixed or chemically diffolved in water by their points or edges; this appears on immerfing a dry hairy leaf in water fresh from a pump; innumerable globules like quickfilver appear on almost every point; for the extremities of thefe points attract the particles of water lefs forcibly than those particles attract each other; hence the contained air, whose elasticity was but just balanced by the attractive power of the furrounding particles of water to each other, finds at the point of each fibre a place where the refiftance to its expansion is lefs; and in confequence it there expands, and becomes a bubble of air. It is eafy to forefee that the rays of the funshine, by being refracted and in part reflected by the two furfaces of these minute air-bubbles, must impart to them much more heat than to the transparent water; and thus facilitate their afcent by further expanding them; that the points of vegetables attract the particles of water lefs than they attract each other, is feen by the fpherical form of dew-drops on the points of grafs. See note on Vegetable Refpiration in Part I.

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And as his bright transflucent form He laves, Salubrious powers enrich the troubled waves.

Amphibious Nymph, from Nile's prolific bed Emerging TRAPA lifts her pearly head;

Trapa. 1. 204. Four males, one female. The lower leaves of this plant grow under water, and are divided into minute capillary ramifications; while the upper leaves are broad and round, and have air-bladders in their footflalks to fupport them above the furface of the water. As the aërial leaves of vegetables do the office of lungs, by expoling a large furface of veffels with their contained fluids to the influence of the air; fo thefe aquatic leaves anfwer a fimilar purpofe like the gills of fifh; and perhaps gain from water or give it to a fimilar material. As the material thus neceffary to life feems to abound more in air than in water, the fubaquatic leaves of this plant, and of fifymbrium, conanthe, ranunculus aquatilis, water crowfoot, and fome others, are cut into fine divisions to increase the furface; whilft those above water are undivided. So the plants on high mountains have their upper leaves more divided, as pimpinella, petrofelinum, and others, because here the air is thinner, and thence a larger furface of contact is required. The ftream of water also paffes but once along the gills of fish, as it is fooner deprived of its virtue; whereas the air is both received and ejected by the action of the lungs of land-animals. The whale feems to be an exception to the above, as he receives water and fpouts it out again from an organ, which I fuppofe to be a refpiratory one. As fpring-water is nearly of the fame degree of heat in all climates, the aquatic plants, which grow in rills or fountains, are found equally in the torrid, temperate, and frigid zones, as water-crefs, water-parfnip, ranunculus, and many others.

In warmer climates the watery grounds are ufefully cultivated, as with rice; and the roots of fome aquatic plants are faid to have fupplied food, as the antient Lotus in Egypt, which fome have fuppofed to be the Nymphæa. —In Siberia the roots of the Butomus, or flowering rufh, are eaten, which is well worth further enquiry, as they grow fpontaneoufly in our ditches and rivers, which at prefent produce no efculent vegetables; and might thence become an article of ufeful cultivation. Herodotus affirms, that the Egyptian Lotus grows in the Nile, and refembles a Lily. That the natives dry it in the fun, and take the pulp out of it, which grows like the head of a poppy, and bake it for bread. Enterpe. Many grit-ftones and coals, which I have feen, feem to bear an imprefion of the roots of the Nymphæa, which are often three or four inches thick, efpecially the white-flowered one,

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Fair glows her virgin cheek and modeft breaft, 205 A panoply of fcales deforms the reft; Her quivering fins and panting gills fhe hides, But fpreads her filver arms upon the tides; Slow as fhe fails, her ivory neck fhe laves, And fhakes her golden treffes o'er the waves. 210 Charm'd round the Nymph, in circling gambols glide Four Nereid-forms, or fhoot along the tide; Now all as one they rife with frolic fpring, And beat the wondering air on humid wing; Now all defcending plunge beneath the main, 215 And lash the foam with undulating train; Above, below, they wheel, retreat, advance, In air and ocean weave the mazy dance; Bow their quick heads, and point their diamond eyes, And twinkle to the fun with ever-changing dyes. 220

Where Andes, crefted with volcanic beams, Sheds a long line of light on Plata's ftreams;

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Opes all his fprings, unlocks his golden caves, And feeds and freights the immeafurable waves; Delighted OCYMA at twilight hours Calls her light car, and leaves the fultry bowers;— Love's rifing ray, and Youth's feductive dye, Bloom'd on her cheek, and brighten'd in her eye;

Ocymum falinum. 1. 225. Saline Bafil. Clafs Two Powers. The Abbe Molina, in his Hiftory of Chili, tranflated from the Italian by the Abbe Grewvel, mentions a fpecies of Bafil, which he calls Ocymum falinum: he fays it refembles the common bafil, except that the ftalk is round and jointed; and that though it grows fixty miles from the fea, yet every morning it is covered with faline globules, which are hard and fplendid, appearing at a diftance like dew; and that each plant furnifhes about half an ounce of fine falt every day, which the peafants collect, and use as common falt, but efteem it fuperior in flavour.

As an article of diet, falt feems to act fimply as a ftimulus, not containing any nourifhment, and is the only foffil fubftance which the caprice of mankind has yet taken into their ftomachs along with their food; and, like all other unnatural ftimuli, is not neceffary to people in health, and contributes to weaken our fystem; though it may be useful as a medicine. It feems to be the immediate caufe of the fea-fcurvy, as those patients quickly recover by the use of fresh provisions; and is probably a remote cause of scrophula (which confifts in the want of irritability in the abforbent veffels), and is therefore ferviceable to these patients; as wine is neceffary to those whose stomachs have been weakened by its ufe. The univerfality of the ufe of falt with our food, and in our cookery, has rendered it difficult to prove the truth of these observations. I suspect that flefh-meat cut into thin flices, either raw or boiled, might be preferved in coarfe fugar or treacle; and thus a very nourifhing and falutary diet might be prefented to our feamen. See note on Salt-rocks, in Vol. I. Canto II. If a perfon unaccuftomed to much falt fhould eat a couple of red herrings, his infenfible perfpiration will be fo much increafed by the ftimulus of the falt, that he will find it neceffary in about two hours to drink a quart of water : the effects of a continued use of falt in weakening the action of the lymphtic fyftem may hence be deduced.

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Chafte, pure, and white, a zone of filver graced Her tender breaft, as white, as pure, as chafte ;- 230 By four fond fwains in playful circles drawn, On glowing wheels fhe tracks the moon-bright lawn, Mounts the rude cliff, unveils her blufhing charms, And calls the panting zephyrs to her arms. Emerged from ocean fprings the vaporous air, 235 Bathes her light limbs, uncurls her amber hair, Incrufts her beamy form with films faline, And Beauty blazes through the cryftal fhrine .--So with pellucid ftuds the ice-flower gems Her rimy foliage and her candied ftems. 240 So from his glaffy horns, and pearly eyes, The diamond-beetle darts a thoufand dyes; Mounts with enamel'd wings the vefper gale, And wheeling fhines in adamantine mail.

Thus when loud thunders o'er Gomorrah burft, 245 And heaving earthquakes fhook his realms accurft,

Ice-flower. 1. 239. Mesembryanthemum crystallinum.

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An Angel-gueft led forth the trembling Fair With shadowy hand, and warn'd the guiltless pair; " Hafte from these lands of fin, ye Righteous! fly, " Speed the quick ftep, nor turn the lingering eye !"--Such the command, as fabling Bards indite, 251 When Orpheus charm'd the grifly King of Night; Sooth'd the pale phantoms with his plaintive lay, And led the fair Affurgent into day .--Wide yawn'd the earth, the fiery tempest flash'd, 255 And towns and towers in one vaft ruin crafh'd ;---Onward they move,-loud horror roars behind, And fhrieks of Anguish bellow in the wind. With many a fob, amid a thoufand fears, The beauteous wanderer pours her gushing tears; 260 Each foft connection rends her troubled breaft, -She turns, unconfcious of the ftern beheft !--" I faint !--- I fall !--- ah, me !--- fenfations chill "Shoot through my bones, my fhuddering bofom thrill ! " I freeze! I freeze! just Heaven regards my fault, 266 " Numbs my cold limbs, and hardens into falt !--

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" Not yet, not yet, your dying Love refign ! " This laft, laft kifs receive !--- no longer thine !"---She faid, and ceafed,-her ftiffen'd form He prefs'd, 270 And ftrain'd the briny column to his breaft; Printed with quivering lips the lifelefs fnow, And wept, and gazed the monument of woe. So when Æneas through the flames of Troy Bore his pale fire, and led his lovely boy; With loitering step the fair Creufa stay'd, 275 And Death involved her in eternal shade.---Oft the lone Pilgrim, that his road forfakes, Marks the wide ruins, and the fulphur'd lakes; On mouldering piles amid afphaltic mud Hears the hoarfe bittern, where Gomorrah ftood; 280 Recals the unhappy Pair with lifted eye, Leans on the crystal tomb, and breathes the filent figh.

With net-wove fash and glittering gorget dress'd, And scarlet robe lapell'd upon her breast,

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Stern ARA frowns, the meafured march affumes, 285 Trails her long lance, and nods her fhadowy plumes; While Love's foft beams illume her treacherous eyes, And Beauty lightens through the thin difguife. So erft, when HERCULES, untamed by toil, Own'd the foft power of DEJANIRA'S fmile; 290 His lion-fpoils the laughing Fair demands, And gives the diftaff to his awkward hands;

Arum. 1. 285. Cuckow-pint, of the class Gynandria, or masculine ladies. The pistil or female part of the flower, rifes like a club, is covered above or clothed, as it were, by the anthers or males; and some of the species have a large scarlet blotch in the middle of every leaf.

The fingular and wonderful fructure of this flower has occafioned many difputes amongft botanifts. See Tourniff. Malpig. Dillen. Rivin. &c. The receptacle is enlarged into a naked club, with the germs at its bafe; the flamens are affixed to the receptacle amidft the germs (a natural prodigy), and thus do not need the affiftance of elevating filaments: hence the flower may be faid to be inverted. *Families of Plants* tranflated from Linneus, p. 618.

The fpadix of this plant is frequently quite white, or coloured, and the leaves liable to be ftreaked with white, and to have black or fearlet blotches on them. As the plant has no corol or bloffom, it is probable the coloured juices in thefe parts of the fheath or leaves may ferve the fame purpofe as the coloured juices in the petals of other flowers; from which I fuppofe the honey to be prepared. See note on Helleborus. I am informed that those tulip-roots which have a red cuticle produce red flowers. See Rubia.

When the petals of the tulip become ftriped with many colours, the plant lofes almost half of its height; and the method of making them thus break into colours is by tranfplanting them into a meagre or fandy foil, after they have previously enjoyed a richer foil: hence it appears, that the plant is weakened when the flower becomes variegated. See note on Anemone. For the acquired habits of vegetables, fee Tulipa, Orchis.

The roots of the Arum are foratched up and eaten by thrushes in fevere showy feasons. White's Hist. of Selbourn, p. 43.

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O'er her white neck the briftly mane fhe throws, And binds the gaping whifkers on her brows; Plaits round her flender waift the fhaggy veft, 295 And clafps the velvet paws acrofs her breaft. Next with foft hands the knotted club fhe rears, Heaves up from earth, and on her fhoulder bears. Onward with loftier ftep the Beauty treads, And trails the brinded ermine o'er the meads; 300 Wolves, bears, and bards, forfake the affrighted groves, And grinning Satyrs tremble, as fhe moves.

CARYO'S fweet fmile DIANTHUS proud admires, And gazing burns with unallow'd defires;

Dianthus. 1. 303. Superbus. Proud Pink. There is a kind of pink called Fairchild's mule, which is here fuppofed to be produced between a Dianthus fuperbus, and the Caryophyllus, Clove. The Dianthus fuperbus emits a most fragrant odour, particularly at night. Vegetable mules fupply an irrefragable argument in favour of the fexual fystem of botany. They are faid to be numerous; and, like the mules of the animal kingdom, not always to continue their species of feed. There is an account of a curious mule from the Antirrhinum linaria, Toad-flax, in the Amœnit. Academ. V. I. No. 3. and many hybrid plants defcribed in No. 32. The Urtica alienata is an evergreen plant, which appears to be a nettle from the male flowers, and a Pellitory (Parietaria) from the female ones and the fruit; and is hence between both. Murray, Syst. Veg. Amongst the English indigenous plants, the veronica hybrida mule Speedwel is fuppofed to have originated from the officinal one, and the species one.

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With fighs and forrows her compation moves, 305
And wins the damfel to illicit loves.
The Monfter-offspring heirs the father's pride,
Mafk'd in the damafk beauties of the bride.
So, when the Nightingale in eaftern bowers
On quivering pinion woos the Queen of flowers; 310
Inhales her fragrance, as he hangs in air,
And melts with melody the blufhing fair ;
Half-rofe, half-bird, a beauteous Monfter fprings,
Waves his thin leaves, and claps his gloffy wings ;
Long horrent thorns his moffy legs furround, 315
And tendril-talons root him to the ground ;

for its parents the golden faxifrage and marſh pennywort. Pulteney's View of Linneus, p. 253. Mr. Graberg, Mr. Schreber, and Mr. Ramſtrom, feem of opinion, that the internal ftructure or parts of fructification in mule-plants refemble the female parent; but that the habit or external ftructure refembles the male parent. See treatifes under the above names in V. VI. Amœnit. Academic. The mule produced from a horfe and the afs refembles the horfe externally with his ears, main, and tail; but with the nature or manners of an afs: but the Hinnus, or creature produced from a male afs, and a mare, refembles the father externally in ftature, afh-colour, and the black crofs, but with the nature or manners of a horfe. The breed from Spanifh rams and Swedifh ewes refembled the Spanifh fheep in wool, ftature, and external form; but was as hardy as the Swedifh fheep; and the contrary of thofe which were produced from Swedifh rams and Spanifh ewes. The offspring from the male goat of Angora and the Swedifh female goat had long foft camel's hair; but that from the male Swedifh goat, and the female one of Angora, had no improvement of their wool. An Englifh ram without horns, and a Swedifh horned ewe, produced fheep without horns. Amœn. Academ. V. VI. p. 13.

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When from his golden urn the Solftice pours, 325 O'er Afric's fable fons the fultry hours; When not a gale flits o'er her tawny hills, Save where the dry Harmattan breathes and kills; When ftretch'd in duft her gafping panthers lie, And writh'd in foamy folds her ferpents die; 330

The dry Harmattan. 1. 328. The Harmattan is a fingular wind blowing from the interior parts of Africa to the Atlantic ocean, fometimes for a few hours, fometimes for feveral days without regular periods. It is always attended with a fog or haze, fo denfe as to render those objects invisible which are at the distance of a quarter of a mile; the fun appears through it only about noon, and then of a dilute red, and very minute particles subside from the misty air fo as to make the grass, and the skins of negroes appear whitis. The extreme dryness which attends this wind or fog, without dews, withers and quite dries the leaves of vegetables; and is faid of Dr. Lind at fome feasons to be

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Indignant Atlas mourns his leaflefs woods, And Gambia trembles for his finking floods; Contagion ftalks along the briny fand, And Ocean rolls his fickning floals to land.

fatal and malignant to mankind; probably after much preceding wet, when it may become loaded with the exhalations from putrid marfhes; at other feafons it is faid to check epidemic difeafes, to cure fluxes, and to heal ulcers and cutaneous eruptions; which is probably effected by its yielding no moifture to the mouths of the external abforbent veffels, by which the action of the other branches of the abforbent fyftem is increafed to fupply the deficiency. Account of the Harmattan. Phil. Tranf. V. LXXI.

The Reverend Mr. Sterling gives an account of a darknefs for fix or eight hours at Detroit in America, on the 19th of October, 1762, in which the fun appeared as red as blood, and thrice its ufual fize: fome rain falling, covered white paper with dark drops, like fulphur or dirt, which burnt like wet gunpowder, and the air had a very fulphureous fmell. He fuppofes this to have been emitted from fome diftant earthquake or volcano. Philof. Tranf. V. LIII. p. 63.

In many circumftances this wind feems much to refemble the dry fog which covered moft parts of Europe for many weeks in the fummer of 1780, which has been fuppofed to have had a volcanic origin, as it fucceeded the violent eruption of Mount Hecla, and its neighbourhood. From the fubfidence of a white powder, it feems probable that the Harmattan has a fimilar origin, from the unexplored mountains of Africa. Nor is it improbable, that the epidemic coughs, which occafionally traverfe immenfe tracts of country, may be the products of volcanic eruptions; nor impoffible, that at fome future time contagious miafmata may be thus emitted from fubterraneous furnaces, in fuch abundance as to contaminate the whole atmosphere, and depopulate the earth !

His fickening floals. 1. 334. Mr. Maríden relates, that in the ifland of Sumatra, during the November of 1775, the dry monfoons, or S. E. winds, continued fo much longer than ufual, that the large rivers became dry; and prodigious quantities of fea-fifh, dead and dying, were feen floating for leagues on the fea, and driven on the beach by the tides. This was fuppofed to have been caufed by the great evaporation, and the deficiency of frefh water rivers having rendered the fea too falt for its inhabitants. The feafon then became fo fickly as to deftroy great numbers of people, both foreigners and natives. Phil. Tranf. V. LXXI. p. 384.

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-Fair CHUNDA fmiles amid the burning wafte, 335 Her brow unturban'd, and her zone unbrac'd; *Ten* brother-youths with light umbrella's fhade; Or fan with bufy hands the panting maid; Loofe wave her locks, difclofing, as they break, The rifing bofom and averted cheek; 340 Clafp'd round her ivory neck with ftuds of gold Flows her thin veft in many a gauzy fold; O'er her light limbs the dim transparence plays, And the fair form, it feems to hide, betrays.

Chunda. 1. 335. Chundali Borrum is the name which the natives give to this plant; it is the Hedyfarum gyrans, or moving plant; its clafs is two brotherhoods, ten males. Its leaves are continually in fpontaneous motion; fome rifing and others falling; and others whirling circularly by twifting their ftems; this fpontaneous movement of the leaves, when the air is quite ftill and very warm, feems to be neceffary to the plant, as perpetual refpiration is to animal life. A more particular account with a good print of the Hedy-farum gyrans is given by M. Brouffonet in a paper on vegetable motions in the Hiftoire de l'Academie des Sciences. Ann. 1784. p. 609.

There are many other inftances of fpontaneous movements of the parts of vegetables. In the Marchantia polymorpha fome yellow wool proceeds from the flower-bearing anthers, which moves fpontaneoufly in the anther, while it drops its duft like atoms. Murray, Syft. Veg. See note on Collinfonia for other inftances of vegetable fpontaneity. Add to this, that as the fleep of animals confift in a fufpenfion of voluntary motion, and as vegetables are likewife fubject to fleep, there is reafon to conclude, that the various actions of opening and clofing their petals and foliage may be juftly afcribed to a voluntary power: for without the faculty of volition, fleep would not have been neceffary to them.





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Where leads the northern Star his lucid train 345 High o'er the fnow-clad earth, and icy main, With milky light the white horizon ftreams, And to the moon each fparkling mountain gleams .--Slow o'er the printed fnows with filent walk Huge fhaggy forms across the twilight stalk; 350 And ever and anon with hideous found Burft the thick ribs of ice, and thunder round.-There, as old Winter flaps his hoary wing, And lingering leaves his empire to the Spring, Pierced with quick fhafts of filver-fhooting light 355 Fly in dark troops the dazzled imps of night .--"Awake, my Love !" enamour'd Muschus cries, "Stretch thy fair limbs, refulgent Maid! arife;

Burst the thick ribs of ice. 1.352. The violent cracks of ice heard from the Glaciers feem to be caufed by fome of the fnow being melted in the middle of the day; and the water thus produced running down into vallies of ice, and congealing again in a few hours, forces off by its expansion large precipices from the ice-mountains.

Muschus. 1. 357. Corallinus, or lichen rangiferinus. Coral-mois. Clandeftine-marriage. This mois vegetates beneath the fnow, where the degree of heat is always about 40; that is, in the middle between the freezing point, and the common heat of the earth; and is for many months of the winter the fole food of the rein-deer, who digs

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" Ope thy fweet eye-lids to the rifing ray,

" And hail with ruby lips returning day. 360

" Down the white hills diffolving torrents pour,

"Green fprings the turf, and purple blows the flower;

" His torpid wing the Rail exulting tries,

" Mounts the foft gale, and wantons in the fkies;

"Rife, let us mark how bloom the awaken'd groves,

" And 'mid the banks of rofes hide our loves." 366

Night's tinfel beams on fmooth Lock-lomond dance, Impatient ÆGA views the bright expanse;—

furrows in the fnow to find it: and as the milk and flefh of this animal is almost the only fustenance which can be procured during the long winters of the higher latitudes, this moss may be faid to support fome millions of mankind.

The quick vegetation that occurs on the folution of the fnows in high latitudes appears very aftonifhing; it feems to arife from two caufes, I. the long continuance of the approaching fun above the horizon; 2. the increased irritability of plants which have been long exposed to the cold. See note on Anemone.

All the water fowl on the lakes of Siberia are faid by Profeffor Gmelin to retreat fouthwards on the commencement of the froft, except the Rail, which fleeps buried in the fnow. Account of Siberia.

 \mathcal{E}_{ga} . L 368. Conferva ægagropila. It is found loofe in many lakes in a globular form, from the fize of a walnut to that of a melon, much refembling the balls of hair found in the flomachs of cows; it adheres to nothing, but rolls from one part of the

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In vain her eyes the paffing floods explore, Wave after wave rolls freightlefs to the fhore. 370 -Now dim amid the diftant foam fhe fpies A rifing fpeck,-" 'tis! 'tis he !" fhe cries; As with firm arms he beats the ftreams afide, And cleaves with rifing cheft the toffing tide, With bended knee fhe prints the humid fands, 375 Up-turns her gliftening eyes, and fpreads her hands; -" 'Tis he, 'tis he !- My Lord, my life, my love ! "Slumber, ye winds; ye billows, ceafe to move! " Beneath his arms your buoyant plumage fpread, "Ye Swans! ye Halcyons! hover round his head!"--With eager ftep the boiling furf fhe braves, 381 And meets her refluent lover in the waves; Loofe o'er the flood her azure mantle fwims, And the clear ftream betrays her fnowy limbs.

lake to another. The Conferva vagabunda dwells on the European feas, travelling along in the midft of the waves; (Spec. Plant.) Thefe may not improperly be called itinerant vegetables. In a fimilar manner the Fucus natans (fwimming) firikes no roots into the earth, but floats on the fea in very extensive maffes, and may be faid to be a plant of paffage, as it is wafted by the winds from one flore to another.

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So on her sea-girt tower fair HERO stood 385 At parting day, and mark'd the dashing flood; While high in air, the glimmering rocks above, Shone the bright lamp, the pilot-ftar of Love. -With robe outfpread the wavering flame behind She kneels, and guards it from the fhifting wind ; 390 Breathes to her Goddefs all her vows, and guides Her bold LEANDER o'er the dufky tide; Wrings his wet hair, his briny bofom warms, And clafps her panting lover in her arms.

Deep, in wide caverns and their fhadowy ailes, 395 Daughter of Earth, the chafte TRUFFELIA fmiles; On filvery beds, of foft afbeftus wove, Meets her Gnome-hufband, and avows her love. -High o'er her couch impending diamonds blaze, And branching gold the cryftal roof inlays; 400

Truffelia. 1. 396. (Lycoperdom Tuber) Truffle. Clandeftine marriage. This fungus never appears above ground, requiring little air, and perhaps no light. It is found by dogs or fwine, who hunt it by the fmell. Other plants, which have no buds or branches on their ftems, as the graffes, fhoot out numerous ftoles or fcions under ground; and this the more, as their tops or herbs are eaten by cattle, and thus preferve themfelves.

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With verdant light the modeft emeralds glow, Blue fapphires glare, and rubies blufh, *below*; Light piers of lazuli the dome furround, And pictured mochoes teffelate the ground; In glittering threads along reflective walls The warm rill murmuring twinkles, as it falls; Now fink the Eolian ftrings, and now they fwell, And Echoes woo in every vaulted cell; While on white wings delighted Cupids play, Shake their bright lamps, and fhed celeftial day.

Clofed in an azure fig by fairy fpells, Bofom'd in down, fair CAPRI-FICA dwells;—

Caprificus. 1. 412. Wild fig. The fruit of the fig is not a feed veffel, but a receptacle inclofing the flower within it. As thefe trees bear fome male and others female flowers, immured on all fides by the fruit, the manner of their fecundation was very unintelligible, till Tournefort and Pontedera difcovered, that a kind of gnat produced in the male figs carried the fecundating duft on its wings, (Cynips Pfenes Syft. Nat. 919.), and penetrating the female fig, thus impregnated the flowers; for the evidence of this wonderful fact, fee the word Caprification, in Milne's Botanical Dictionary. The figs of this country are all female, and their feeds not prolific; and therefore they can only be propagated by layers and fuckers.

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So fleeps in filence the Curculia, fhut In the dark chambers of the cavern'd nut, Erodes with ivory beak the vaulted fhell, And quits on filmy wings its narrow cell. So the pleafed Linnet in the mofs-wove neft, Waked into life beneath its parent's breaft,

Monfieur de la Hire has shewn in the Memoir. de l'Academ. de Science, that the fummer figs of Paris, in Provence, Italy, and Malta, have all perfect stamina, and ripen not only their fruits, but their feed; from which feed other fig-trees are raifed; but that the stamina of the autumnal figs are abortive, perhaps owing to the want of due warmth. Mr. Milne, in his Botanical Dictionary (art. Caprification), fays, that the cultivated fig-trees have a few male flowers placed above the female within the fame covering or receptacle; which in warmer climates perform their proper office, but in colder ones become abortive. And Linneus observes, that fome figs have the navel of the receptacle open; which was one reason that induced him to remove this plant from the class Clandestine Marriage to the class Polygamy. Lin. Spec. Plant.

From all thefe circumftances I fhould conjecture, that those female fig flowers, which are closed on all fides in the fruit or receptacle without any male ones, are monfters, which have been propagated for their fruit, like barberries, and grapes without feeds in them; and that the Caprification is either an antient process of imaginary use, and blindly followed in fome countries, or that it may contribute to ripen the fig by decreasing its vigour, like cutting off a circle of the bark from the branch of a pear-tree. Tournefort feems inclined to this opinion; who fays, that the figs in Provence and at Paris ripen fooner, if their buds be pricked with a ftraw dipped in olive-oil. Plumbs and pears punctured by fome infects ripen fooner, and the part round the puncture is fweeter. Is not the honey-dew produced by the puncture of infects? will not wounding the branch of a pear-tree, which is too vigorous, prevent the bloffoms from falling off; as from fome fig-trees the fruit is faid to fall off unlefs they are wounded by caprification? I had last fpring fix young trees of the Ifchia fig with fruit on them in pots in a flove; on removing them into larger boxes, they protruded very vigorous fhoots, and the figs all fell off; which I afcribed to the increased vigour of the plants.

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Chirps in the gaping shell, bursts forth erelong, Shakes its new plumes, and tries its tender fong.- 420 -And now the talifman fhe ftrikes, that charms Her hufband-Sylph,-and calls him to her arms.-Quick, the light Gnat her airy Lord bestrides, With cobweb reins the flying courfer guides, From cryftal fteeps of viewlefs ether fprings, 425 Cleaves the foft air on still expanded wings; Darts like a funbeam o'er the boundlefs wave, And feeks the beauty in her fecret cave. So with quick impulse through all nature's frame Shoots the electric air its fubtle flame. 430 So turns the impatient needle to the pole, Tho' mountains rife between, and oceans roll.

Where round the Orcades white torrents roar, Scooping with ceafelefs rage the incumbent fhore, Wide o'er the deep a dufky cavern bends 435 Its marble arms, and high in air impends;

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Balfatic piers the ponderous roof fuftain, And fteep their maffy fandals in the main; Round the dim walls, and through the whifpering ailes Hoarfe breathes the wind, the glittering water boils. 440 Here the charm'd Byssus with his blooming bride Spreads his green fails, and braves the foaming tide; The ftar of Venus gilds the twilight wave, And lights her votaries to the *fecret* cave; Light Cupids flutter round the nuptial bed, 445 And each coy Sea-maid hides her blufhing head.

Where cool'd by rills, and curtain'd round by woods, Slopes the green dell to meet the briny floods,

Bafaltic piers. 1. 437. This defcription alludes to the cave of Fingal in the island of Staffa. The bafaltic columns, which compose the Giants Causeway on the coast of Ireland, as well as those which support the cave of Fingal, are evidently of volcanic origin, as is well illustrated in an ingenious paper of Mr. Keir, in the Philof. Tranf. who observed in the glass, which had been long in a fusing heat at the bottom of the pots in the glass-houses at Stourbridge, that crystals were produced of a form similar to the parts of the bafaltic columns of the Giants Causeway.

By fus. 441. Clandeftine Marriage. It floats on the fea in the day, and finks a little during the night; it is found in caverns on the northern flores, of a pale green colour, and as thin as paper.

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The fparkling noon-beams trembling on the tide, The PROTEUS-LOVER woos his playful bride, 450 To win the fair he tries a thoufand forms, Bafks on the fands, or gambols in the ftorms. A Dolphin now, his fcaly fides he laves, And bears the fportive damfel on the waves; She ftrikes the cymbal as he moves along, 455 And wondering Ocean liftens to the fong. —And now a fpotted Pard the lover ftalks, Plays round her fteps, and guards her favour'd walks; As with white teeth he prints her hand, carefs'd, And lays his velvet paw upon her breaft, 460

The Proteus-lover. 1. 446. Conferva polymorpha. This vegetable is put amongft the cryptogamia, or clandeftine marriages, by Linneus; but, according to Mr. Ellis, the males and females are on different plants. Philof. Tranf. Vol. LVII. It twice changes its colour, from red to brown, and then to black; and changes its form by lofing its lower leaves, and elongating fome of the upper ones, fo as to be miftaken by the unfkilful for different plants. It grows on the fhores of this country.

There is another plant, Medicago polymorpha, which may be faid to affume a great variety of fhapes; as the feed-veffels refemble fometimes fnail-horns, at other times caterpillars with or without long hair upon them; by which means it is probable they fometimes elude the depredations of those infects. The feeds of Calendula, Marygold, bend up like a hairy caterpillar, with their prickles briftling outwards, and may thus deter fome birds or infects from preying upon them. Salicornia alfo affumes an animal fimilitude. Phil. Bot. p. 87. See note on Iris in additional notes; and Cypripedia in Vol. I.

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O'er his round face her fnowy fingers ftrain The filken knots, and fit the ribbon-rein. —And now a Swan, he fpreads his plumy fails, And proudly glides before the fanning gales ; Pleas'd on the flowery brink with graceful hand 465 She waves her floating lover to the land ; Bright fhines his finuous neck, with crimfon beak He prints fond kiffes on her glowing cheek, Spreads his broad wings, elates his ebon creft, And clafps the beauty to his downy breaft. 470

A hundred virgins join a hundred fwains, And fond ADONIS leads the fprightly trains;

Adonis. 1. 468. Many males and many females live together in the fame flower. It may feem a folecifm in language, to call a flower, which contains many of both fexes, an individual; and the more fo to call a tree or fhrub an individual, which confifts of fo many flowers. Every tree, indeed, ought to be confidered as a family or fwarm of its refpective buds; but the buds themfelves feem to be individual plants; becaufe each has leaves or lungs appropriated to it; and the bark of the tree is only a congeries of the roots of all thefe individual buds. Thus hollow oak-trees and willows are often feen with the whole wood decayed and gone; and yet the few remaining branches flourifh with vigour; but in refpect to the male and female parts of a flower, they do not deftroy its individuality any more than the number of paps of a fow, or the number of her cotyledons, each of which includes one of her young.

The fociety, called the Areoi, in the ifland of Otaheite, confifts of about 100 males and 100 females, who form one promifcuous marriage.

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Pair after pair, along his facred groves To Hymen's fane the bright procession moves; Each finiling youth a myrtle garland fhades, 475 And wreaths of rofes veil the blufhing maids; Light Joys on twinkling feet attend the throng, Weave the gay dance, or raife the frolic fong; -Thick, as they pass, exulting Cupids fling Promiscuous arrows from the founding string; 480 On wings of goffamer foft Whifpers fly, And the fly Glance steals fide-long from the eye. -As round his fhrine the gaudy circles bow, And feal with muttering lips the faithlefs vow, Licentious Hymen joins their mingled hands, 485 And loofely twines the meretricious bands .--Thus where pleafed VENUS, in the fouthern main, Sheds all her fmiles on Otaheite's plain, Wide o'er the isle her filken net she draws, And the Loves laugh at all but Nature's laws." 490

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Here ceafed the Goddefs,-o'er the filent ftrings Applauding Zephyrs fwept their fluttering wings; Enraptur'd Sylphs arofe in murmuring crowds To air-wove canopies and pillowy clouds; Each Gnome reluctant fought his earthy cell, 495 And each bright Floret clos'd her velvet bell. Then, on foft tiptoe, NIGHT approaching near Hung o'er the tuneless lyre his fable ear; Gem'd with bright ftars the still etherial plain, And bad his Nightingales repeat the strain.

ites on Ophicity's plath, and

500

And looker trained the mentioned

ADDITIONAL NOTES.

P. 7. Additional note to Curcuma. These antherless filaments feem to be an endeavour of the plant to produce more stamens, as would appear from some experiments of M. Reynier, instituted for another purpose: he cut away the stamens, of many flowers, with design to prevent their fecundity, and in many instances the flower threw out new filaments from the wounded part of different lengths; but did not produce new anthers. The experiments were made on the guem rivale, different kinds of mallows, and the æchinops citro. Critical Review for March, 1788.

P. 8. Addition to the note on Iris. In the Persian Iris the end of the lower petal is purple, with white edges and orange streaks, creeping, as it were, into the mouth of the flower like an infect; by which deception in its native climate it probably prevents a fimilar infect from plundering it of its honey: the edges of the lower petal lap over those of the upper one, which prevents it from opening too wide on fine days, and facilitates its return at night; whence the rain is excluded, and the air admitted. See Polymorpha, Rubia, and Cypripedia in Vol. I.

P. 12. Additional note on Chondrilla. In the natural flate of the expanded flower of the barberry, the flamens lie on the petals; under the concave fummits of which the anthers fhelter themfelves, and in this fituation remain perfectly rigid; but on touching the infide of the filament near its bafe with a fine briftle, or blunt needle, the flamen inftantly bends upwards, and the anther, embracing the fligma, fleds its duft. Obfervations on the Irritation of Vegetables, by T. E. Smith, M.D.

P. 15. Addition to the note on Silene. I faw a plant of the Dionæa Muscipula, Flytrap of Venus, this day, in the collection of Sir B. Boothby at Ashburn-Hall, Derbyshire, Aug. 20th, 1788; and on drawing a straw along the middle of the rib of the leaves as they lay upon the ground round the stem, each of them, in about a second of time, closed and doubled itself up, crossing the thorns over the opposite edge of the leaf, like the teeth of a spring rat-trap: of this plant I was favoured with an elegant coloured drawing, by Miss Maria Jackson of Tarporly, in Cheshire, a Lady who adds much botanical knowledge to many other elegant acquirements. In the Apocynum Androfæmifolium, one kind of Dog's-bane, the anthers converge over the nectaries, which confift of five glandular oval corpufcles furrounding the germ ; and at the fame time admit air to the nectaries at the interffice between each anther. But when a fly inferts its probofcis between thefe anthers to plunder the honey, they converge clofer, and with fuch violence as to detain the fly, which thus generally perifhes. This account was related to me by R. W. Darwin, Efq; of Elfton, in Nottinghamfhire, who fhowed me the plant in flower, July 2d, 1788, with a fly thus held faft by the end of its probofcis, and was well feen by a magnifying lens, and which in vain repeatedly ftruggled to difengage itfelf, till the converging anthers were feparated by means of a pin: on fome days he had obferved that almost every flower of this elegant plant had a fly in it thus entangled; and a few weeks afterwards favoured me with his further obfervations on this fubject.

" My Apocynum is not yet out of flower. I have often vifited it, and have frequently found four or five flies, fome alive, and fome dead, in its flowers; they are generally caught by the trunk or probofcis, fometimes by the trunk and a leg; there is one at prefent only caught by a leg: I don't know that this plant fleeps, as the flowers remain open in the night; yet the flies frequently make their efcape. In a plant of Mr. Ordoyno's, an ingenious gardener at Newark, who is poffeffed of a great collection of plants, I faw many flowers of an Apocynum with three dead flies in each; they are a thin-bodied fly, and rather lefs than the common houfe-fly; but I have feen two or three other forts of flies thus arrefted by the plant. Aug. 12, 1788."

P. 18. Additional note on Ilex. The efficient caufe, which renders the hollies prickly in Needwood Foreft only as high as the animals can reach them, may arife from the lower branches being conftantly cropped by them, and thus fhoot forth more luxuriant foliage: it is probable the fhears in garden-hollies may produce the fame effect, which is equally curious, as prickles are not thus produced on other plants.

P. 41. Additional note on Ulva. M. Hubert made fome obfervations on the air contained in the cavities of the bambou. The ftems of these canes were from 40 to 50 feet in height, and 4 or 5 inches in diameter, and might contain about 30 pints of elastic air. He cut a bambou, and introduced a lighted candle into the cavity, which was extinguished immediately on its entrance. He tried this about 60 times in a cavity of the bambou, containing about two pints. He introduced mice at different times into these cavities, which feemed to be fomewhat affected, but foon recovered their agility. The ftem of the bambou is not hollow till it rifes more than one foot from the earth ; the divisions between the cavities are convex downwards. Observ. fur la Physique par M. Rozier, l. 33. p. 130.

P. 136. Addition to the note on Tropæolum. In Sweden a very curious phenomenon has been observed on certain flowers, by M. Haggren, Lecturer in Natural History. One evening he perceived a faint flash of light repeatedly dart from a Marigold; furprized at fuch an uncommon appearance, he resolved to examine it with attention; and,





to be affured that it was no deception of the eye, he placed a man near him, with orders to make a fignal at the moment when he observed the light. They both faw it conftantly at the fame moment.

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The light was most brilliant on Marigolds, of an orange or flame colour; but fcarcely visible on pale ones.

The flash was frequently feen on the fame flower two or three times in quick fucceffion, but more commonly at intervals of feverals minutes; and when feveral flowers in the fame place emitted their light together, it could be observed at a confiderable diftance.

This phænomenon was remarked in the months of July and August, at sun-set, and for half an hour after, when the atmosphere was clear; but after a rainy day, or when the air was loaded with vapours, nothing of it was seen.

The following flowers emitted flashes, more or less vivid, in this order :

I. The Marigold, (Calendula Officinalis).

- 2. Garden Nasturtion, (Tropæolum majus).
- 3. Orange Lily, (Lilium bulbiferum).
- 4. African Marigold. (Tagetes patula et erecta).

Sometimes it was also observed on the Sun-flowers, (*Helianthus annuus*). But bright yellow, or flame colour, seemed in general necessary for the production of this light; for it was never seen on the flowers of any other colour.

To difcover whether fome little infects, or phofphoric worms, might not be the caufe of it, the flowers were carefully examined even with a microfcope, without any fuch being found.

From the rapidity of the flash, and other circumstances, it might be conjectured, that there is fomething of electricity in this phænomenon. It is well known, that when the *pistil* of a flower is impregnated, the *pollen* bursts away by its elasticity, with which electricity may be combined. But M. Haggren, after having observed the flash from the Orange-lily, the *anthers* of which are a confiderable space distant from the *petals*, found that the light proceeded from the *petals* only; whence he concludes, that this electric light is caused by the *pollen*, which in flying off is fcattered upon the *petals*. Obser. Physique par M. Rozier, Vol. XXXIII. p. 111.

Description of the Poifon-Tree in the Island of JAVA. Translated from the original Dutch of N. P. Foersch.

THIS deftructive tree is called in the Malayan language Bohun-Upas, and has been defcribed by naturalifts; but their accounts have been fo tinctured with the marvellous, that the whole narration has been fuppofed to be an ingenious fiction by the generality of readers. Nor is this in the leaft degree furprizing, when the circumftances which we fhall faithfully relate in this defcription are confidered.

I must acknowledge, that I long doubted the existence of this tree, until a stricter enquiry convinced me of my error. I shall now only relate simple unadorned facts, of which I have been an eye-witnefs. My readers may depend upon the fidelity of this account. I the year 1774 I was flationed at Batavia, as a furgeon, in the fervice of the Dutch Eaft-India Company. During my refidence there I received feveral different accounts of the Bohon Upas, and the violent effects of its poifon. They all then feemed incredible to me, but raifed my curiofity in fo high a degree, that I refolved to inveftigate this fubject thoroughly, and to truft only to my own obfervations. In confequence of this refolution, I applied to the Governor-General, Mr. Petrus Albertus van der Parra, for a pafs to travel through the country : my requeft was granted; and, having procured every information, I fet out on my expedition. I had procured a recommendation from an old Malayan prieft to another prieft, who lives on the neareft inhabitable fpot to the tree which is about fifteen or fixteen miles diftant. The letter proved of great fervice to me in my undertaking, as that prieft is appointed by the Emperor to refide there, in order to prepare for eternity the fouls of thofe who for different crimes are fentenced to approach the tree, and to procure the poifon.

The Bohon-Upas is fituated in the island of Java, about twenty-feven leagues from Batavia, fourteen from Soura Charta, the feat of the Emperor, and between eighteen and twenty leagues from Tinkjoe, the prefent refidence of the Sultan of Java. It is furrounded on all fides by a circle of high hills and mountains; and the country round it, to the diffance of ten or twelve miles from the tree, is entirely barren. Not a tree nor a fhrub, nor even the least plant or grafs is to be feen. I have made the tour all around this dangerous spot, at about eighteen miles diffant from the centre, and I found the aspect of the country on all fides equally dreary. The easieft ascent of the hills is from that part where the old ecclessifick dwells. From his house the criminals are fent for the poison, into which the points of all warlike inftruments are dipped. It is of high value, and produces a confiderable revenue to the Emperor.

Account of the manner in which the Poison is procured.

The poifon which is procured from this tree is a gum that iffues out between the bark. and the tree itfelf, like the camphor. Malefactors, who for their crimes are fentenced to die, are the only perfons who fetch the poifon; and this is the only chance they have of faving their lives. After fentence is pronounced upon them by the judge, they are afked in court, whether they will die by the hands of the executioner, or whether they will go to the Upas tree for a box of poifon? They commonly prefer the latter propofal, as there is not only fome chance of preferving their lives, but alfo a certainty, in cafe of their fafe return, that a provision will be made for them in future by the Emperor. They are also permitted to afk a favour from the Emperor, which is generally of a triffing nature, and commonly granted. They are then provided with a filver or tortoifeshell box, in which they are to put the poifonous gum, and are properly inftructed how to proceed while they are upon their dangerous expedition. Among other particulars, they are always told to attend to the direction of the winds; as they are to go towards the tree before the wind, fo that the effluvia from the tree is always blown from them. They are told likewife, to travel with the utmost dispatch, as that is the only method of infuring a fafe return. They are afterwards fent to the houfe of the old

prieft, to which place they are commonly attended by their friends and relations. Here they generally remain fome days, in expectation of a favourable breeze. During that time the ecclefiaftic prepares them for their future fate by prayers and admonitions.

When the hour of their departure arrives, the prieft puts them on a long leather-cap, with two glaffes before their eyes, which comes down as far as their breaft; and alfo provides them with a pair of leather-gloves. They are then conducted by the prieft, and their friends and relations, about two miles on their journey. Here the prieft repeats his inftructions, and tells them where they are to look for the tree. He fhews them a hill, which they are told to afcend, and that on the other fide they will find a rivulet, which they are to follow, and which will conduct them directly to the Upas. They now take leave of each other; and amidft prayers for their fuccefs, the delinquents haften away.

The worthy old ecclefiaftic has affured me, that during his refidence there, for upwards of thirty years, he had difmiffed above feven hundred criminals in the manner which I have defcribed; and that fcarcely two out of twenty have returned. He fhewed me a catalogue of all the unhappy fufferers, with the date of their departure from his houfe annexed; and a lift of the offences for which they had been condemned : to which was added, a lift of those who had returned in fafety. I afterwards faw another lift of these culprits, at the jail-keeper's at *Soura-Charta*, and found that they perfectly corresponded with each other, and with the different informations which I afterwards obtained.

I was prefent at fome of thefe melancholy ceremonies, and defired different delinquents to bring with them fome pieces of the wood, or a fmall branch, or fome leaves of this wonderful tree. I have alfo given them filk cords, defiring them to meafure its thicknefs. I never could procure more than two dry leaves that were picked up by one of them on his return; and all I could learn from him, concerning the tree itfelf, was, that it flood on the border of a rivulet, as deferibed by the old Prieft; that it was of a middling fize; that five or fix young trees of the fame kind flood clofe by it; but that no other fhrub or plant could be feen near it; and that the ground was of a brownifh fand, full of flones, almost impracticable for travelling, and covered with dead bodies. After many conversations with the old Malayan prieft, I questioned him about the first discovery, and asked his opinion of this dangerous tree; upon which he gave me the following answer:

"We are told in our new Alcoran, that, above an hundred years ago, the country around the tree was inhabited by a people ftrongly addicted to the fins of Sodom and Gomorrah; when the great prophet Mahomet determined not to fuffer them to lead fuch deteftable lives any longer, he applied to God to punifh them : upon which God cauf d this tree to grow out of the earth, which deftroyed them all, and rendered the country for ever uninhabitable."

Such was the Malayan opinion. I shall not attempt a comment; but must observe, that all the Malayans confider this tree as an holy instrument of the great prophet to punifh the fins of mankind; and, therefore, to die of the poifon of the Upas is generally confidered among them as an honourable death. For that reafon I alfo obferved, that the delinquents, who were going to the tree, were generally dreffed in their beft apparel.

This however is certain, though it may appear incredible, that from fifteen to eighteen miles round this tree, not only no human creature can exift, but that, in that fpace of ground, no living animal of any kind has ever been difcovered. I have alfo been affured by feveral perfons of veracity, that there are no fifh in the waters, nor has any rat, moufe, or any other vermin, been feen there; and when any birds fly fo near this tree that the effluvia reaches them, they fall a facrifice to the effects of the poifon. This circumftance has been afcertained by different delinquents, who, in their return, have feen the birds drop down, and have picked them up *dead*, and brought them to the old ecclefiaftick.

I will here mention an inflance, which proves the fact beyond all doubt, and which happened during my flay at Java.

In 1775 a rebellion broke out among the fubjects of the Maffay, a fovereign prince, whofe dignity is nearly equal to that of the Emperor. They refused to pay a duty imposed upon them by their fovereign, whom they openly opposed. The Maffay fent a body of a thousand troops to disperse the rebels, and to drive them, with their families, out of his dominions. Thus four hundred families, confifting of above fixteen hundred fouls, were obliged to leave their native country. Neither the Emperor nor the Sultan would give them protection, not only becaufe they were rebels, but also through fear of difpleafing their neighbour, the Maffay. In this diffrefsful fituation, they had no other refource than to repair to the uncultivated parts round the Upas, and requefted permiffion of the emperor to fettle there. Their requeft was granted, on condition of their fixing their abode not more than twelve or fourteen miles from the tree, in order not to deprive the inhabitants already fettled there at a greater diffance of their cultivated lands. With this they were obliged to comply; but the confequence was, that in lefs than two months their number was reduced to about three hundred. The chiefs of those who remained returned to the Maffay, informed him of their loffes, and intreated his pardon, which induced him to receive them again as fubjects, thinking them fufficiently punifhed for their mifconduct. I have feen and converfed with feveral of those who furvived foon after their return. They all had the appearance of perfons tainted with an infectious diforder; they looked pale and weak, and from the account which they gave of the lofs of their comrades, and of the fymptoms and circumftances which attended their diffolution, fuch as convultions, and other figns of a violent death, I was fully convinced that they fell victims to the poifon.

This violent effect of the poifon at fo great a diffance from the tree, certainly appears furprifing, and almost incredible; and especially when we confider that it is possible for delinquents who approach the tree to return alive. My wonder, however, in a great measure, ceased, after I had made the following observations:

I have faid before, that malefactors are inftructed to go to the tree with the wind, and to return against the wind. When the wind continues to blow from the fame quarter while the delinquent travels thirty, or fix and thirty miles, if he be of a good constitution, he certainly furvives. But what proves the most destructive is, that there is no dependence on the wind in that part of the world for any length of time.—There are no regular land-winds; and the fea-wind is not perceived there at all, the fituation of the tree being at too great a diffance, and furrounded by high mountains and uncultivated forefts. Befides, the wind there never blows a frefh regular gale, but is commonly merely a current of light, foft breezes, which pafs through the different openings of the adjoining mountains. It is alfo frequently difficult to determine from what part of the globe the wind really comes, as it is divided by various obftructions in its paffage, which eafily change the direction of the wind, and often totally deftroy its effects.

I, therefore, impute the diftant effects of the poifon, in a great meafure, to the conftant gentle winds in those parts, which have not power enough to disperse the poisonous particles. If high winds were more frequent and durable there, they would certainly weaken very much, and even destroy the obnoxious effluvia of the poison; but without them, the air remains infected and pregnant with these poisonous vapours.

I am the more convinced of this, as the worthy ecclefiaftick affured me, that a dead calm is always attended with the greateft danger, as there is a continual perfpiration iffuing from the tree, which is feen to rife and fpread in the air, like the putrid fteam of a marfhy cavern.

Experiments made with the Gum of the UPAS-TREE.

IN the year 1776, in the month of February, I was prefent at the execution of thirteen of the Emperor's concubines, at *Soura-Charta*, who were convicted of infidelity to the Emperor's bed. It was in the forenoon, about eleven o'clock, when the fair criminals were led into an open fpace within the walls of the Emperor's palace. There the judge paffed fentence upon them, by which they are doomed to fuffer death by a lancet poifoned with Upas. After this the Alcoran was prefented to them, and they were, according to the law of their great prophet Mahomet, to acknowledge and to affirm by oath, that the charges brought against them, together with the fentence and their punishment, were fair and equitable. This they did, by laying their right hand upon the Alcoran, their left hands upon their breast, and their eyes listed towards heaven; the judge then held the Alcoran to their lips, and they kissed it.

Thefe ceremonies over, the executioner proceeded on his bufinefs in the following manner:—Thirteen pofts, each about five feet high, had been previoufly erected. To thefe the delinquents were faftened, and their breafts ftripped naked. In this fituation they remained a flort time in continual prayers, attended by feveral priefts, until a fignal was given by the judge to the executioner; on which the latter produced an inftrument, much like the fpring lancet ufed by farriers for bleeding horfes. With this inftrument, it being poifoned with the gum of the Upas, the unhappy wretches were lanced in the middle of their breafts, and the operation was performed upon them all in lefs than two minutes.

My aftonishment was raifed to the highest degree, when I beheld the fudden effects of that poison, for in about five minutes after they were lanced they were taken with a tremor attended with a fubfultus tendinum, after which they died in the greatest agonies, crying out to God and Mahomet for mercy. In fixteen minutes by my watch, which I held in my hand, all the criminals were no more. Some hours after their death, I obferved their bodies full of livid fpots, much like those of the *Petechiæ*, their faces swelled, their colour changed to a kind of blue, their eyes looked yellow, &c. &c.

About a fortnight after this, I had an opportunity of feeing fuch another execution at Samarang. Seven Malayans were executed there with the fame inftrument, and in the fame manner; and I found the operation of the poifon, and the fpots in their bodies exactly the fame.

These circumstances made me defirous to try an experiment with some animals, in order to be convinced of the real effects of this poison; and as I had then two young puppies, I thought them the fittest objects for my purpose. I accordingly procured with great difficulty some grains of Upas. I diffolved half a grain of that gum in a small quantity of arrack, and dipped a lancet into it. With this poisoned instrument I made an incision in the lower muscular part of the belly in one of the puppies. Three minutes after it received the wound the animal began to cry out most piteously, and ran as fast as possible from one corner of the room to the other. So it continued during fix minutes, when all its strength being exhausted, it fell upon the ground, was taken with convulfions, and died in the eleventh minute. I repeated this experiment with two other puppies, with a cat and a fowl, and found the operation of the poison in all of them the fame: none of these animals furvived above thirteen minutes.

I thought it neceffary to try alfo the effect of the poifon given inwardly, which I did in the following manner. I diffolved a quarter of a grain of the gum in half an ounce of arrack, and made a dog of feven months old drink it. In feven minutes, a retching enfued, and I obferved, at the fame time, that the animal was delirious, as it ran up and down the room, fell on the ground, and tumbled about; then it rofe again, cried out very loud, and in about half an hour after was feized with convultions, and died. I opened the body, and found the ftomach very much inflamed, as the inteftines were in fome parts, but not fo much as the ftomach. There was a fmall quantity of coagulated blood in the ftomach; but I could difcover no orifice from which it could have iffued; and therefore fuppofed it to have been fqueezed out of the lungs, by the animal's ftraining while it was vomiting.

From these experiments I have been convinced that the gum of the Upas is the most dangerous and most violent of all vegetable poisons; and I am apt to believe that it greatly contributes to the unhealthiness of that island. Nor is this the only evil attending it: hundreds of the natives of Java, as well as Europeans, are yearly destroyed and treacherously murdered by that poison, either internally or externally. Every man of quality or fashion has his dagger or other arms poisoned with it; and in times of war the Malayans poison the springs and other waters with it; by this treacherous practice the Dutch suffered greatly during the lass war, as it occasioned the loss of half their army. For this reason, they have ever since kept since her prings of which they drink the water; and fentinels are placed near them, who inspect the waters every hour, to see whether the fish are alive. If they march with an army or body of troops into an enemy's country, they always carry live fish with them, which they throw into the water fome hours before they venture to drink it; by which means they have been able to prevent their total deftruction.

This account, I flatter myfelf, will fatisfy the curiofity of my readers, and the few facts which I have related will be confidered as a certain proof of the existence of this pernicious tree, and its penetrating effects.

If it be afked why we have not yet any more fatisfactory accounts of this tree, I can only anfwer, that the object to most travellers to that part of the world confists more in commercial purfuits than in the study of Natural History and the advancement of Sciences. Besides, Java is so univerfally reputed an unhealthy island, that rich travellers feldom make any long stay in it; and others want money, and generally are too ignorant of the language to travel, in order to make enquiries. In sufficient, those who visit this island will now probably be induced to make it an object of their refearches, and will furnish us with a fuller description of this tree.

I will therefore only add, that there exists also a fort of Cajoe-Upas on the coast of Macassar, the poison of which operates nearly in the same manner, but is not half so violent or malignant as that of Java, and of which I shall likewise give a more circumstantial account in a description of that island.---London Magazine.

Fairy-scene from Mr. Mundy's Necdwood Forest. Referred to in Canto IV. 1. 35.

HERE, feen of old, the *elfin* race With fprightly vigils mark'd the place; Their gay proceffions charm'd the fight, Gilding the lucid noon of night; Or, when obfcure the midnight hour, With glow-worm lantherns hung the bower, —Hark !—the foft lute !—along the green Moves with majeftic ftep the QUEEN ! Attendant Fays around her throng, And trace the dance or raife the fong; Or touch the fhrill reed, as they trip, With finger light and ruby lip.

High, on her brow fublime, is borne One fcarlet woodbine's tremulous horn; A gaudy Bee-bird's* triple plume Sheds on her neck its waving gloom; With filvery goffamer entwin'd Stream the luxuriant locks behind.

· The bumming-bird.

Thin folds of tangled network break In airy waves adown her neck ; -Warp'd in his loom, the fpider fpread The far-diverging rays of thread, Then round and round with fhuttle fine Inwrought the undulating line;-Scarce hides the woof her bofom's fnow, One pearly nipple peeps below. One role-leaf forms her crimfon veft, The loofe edge croffes o'er her breaft; And one translucent fold, that fell From the tall lily's ample bell, Forms with fweet grace her fnow-white train, Flows, as the fteps, and fweeps the plain. Silence and Night inchanted gaze, And Hefper hides his vanquish'd rays !--

Now the waked reed-finch fwells his throat, And night-larks trill their mingled note: Yet hush'd in moss with writhed neck The blackbird hides his golden beak; Charm'd from his dream of love, he wakes, Opes his gay eye, his plumage fhakes, And, ftretching wide each ebon wing, First in low whispers tries to fing; Then founds his clarion loud, and thrills The moon-bright lawns, and fhadowy hills. Silent the choral Fays attend, And then their filver voices blend, Each fhining thread of found prolong, And weave the magic woof of fong. Pleafed Philomela takes her ftand On high, and leads the Fairy band, Pours fweet at intervals her ftrain, And guides with beating wing the train. Whilft interrupted Zephyrs bear Hoarfe murmurs from the diftant wear; And at each paufe is heard the fwell Of Echo's foft fymphonious fhell.

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Errata.

P. 27. 1. 4. for min'd read mined P. 34. 1. 6. for *fears* read feals P. 61. 1. 4. fhould have a ; inftead of an ! P. 66. 1. 6. for *flatutes* read flatues P. 74. 1. 1. fhould not begin a new paragraph P. 80. 1. 10. for Thy read The P. 116. 1. 2. for versed you

P. 116. l. 12. for ye read you P. 172. l. 8. for tide read tides.

P. 174. l. 1. for Curculia read Curculio

Emendations.

P. 22. 1. 7. and 8. alter as below THEN bright from earth amid the troubled fky Afcends fair COLCHICA with radiant eye,

P. 80. 1. 4. alter Stamps with bis marble feet, into Stamps with black hoof,

P. 149. l. 8. alter cultured into living 1. 10. alter neglected into uncultured P. 110. 1..6. alter bright into fair

Directions to the Binder.

Pleafe to place the print of Flora and Cupid oppofite

to the Title-page both facing the laft page of the preface The print of Meadia oppolite to p. 6. Gloriofa oppolite p. 14. Dionæa p. 15. Amaryllis p. 17. Vallifneria p. 40. Hedyfarum p. 168. Apocynum p. 182.