

THE
PHILOSOPHICAL
TRANSACTIONS
AND
COLLECTIONS,

To the End of the Year 1700.

ABRIDG'D

AND

Dispos'd under GENERAL HEADS.

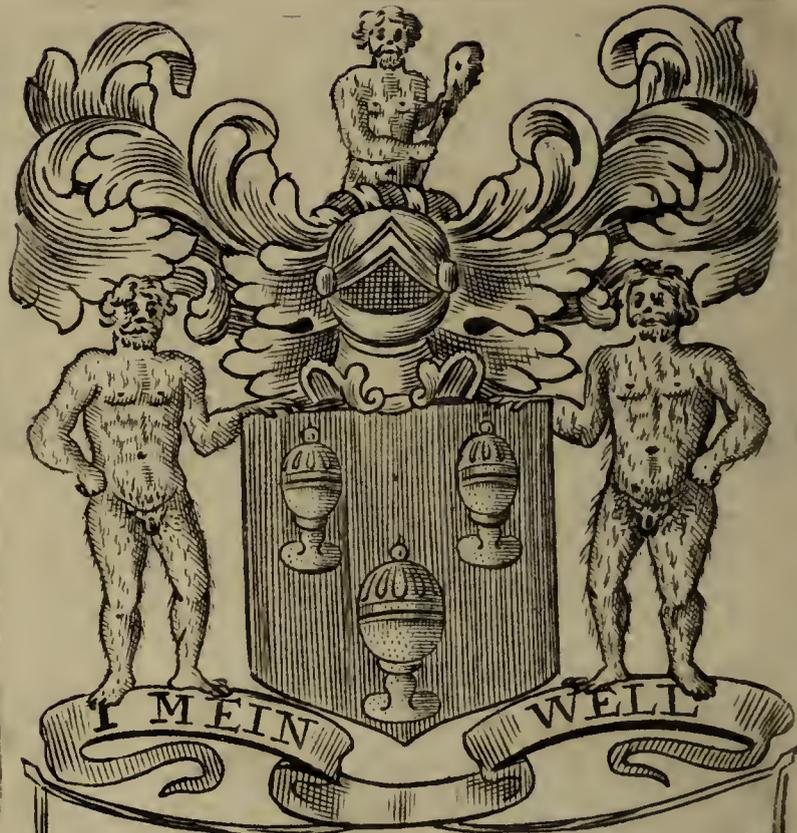
VOL. II.

Containing all the
Physiological Papers.

By JOHN LOWTHORP, M. A.
and F. R. S.

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S^r John Schaw of Greenoak
Baronet



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To His GRACE
The D U K E
O F
O R M O N D,
L O R D L I E U T E N A N T
O F
I R E L A N D, &c.

T H E S E

Physiological Papers,

A B R I D G D

A N D

Dispos'd under G E N E R A L H E A D S,

Are with all Possible

Humility and Gratitude,

Dedicated, by

John Lowthorp.

THE DUBLIN

THE DUBLIN

OF R. M. O. N. D.

LORD CLIFFERTON

IRISH LITERATURE

Physiological Papers

A B R I D G E D

Disposed under General Heads

and

Illustrated with Engravings

by

John Lapthorn

THE
Physiological Papers,
 PUBLISHED and DISPERS'D
 IN THE
 PHILOSOPHICAL
Transactions and Collections,
 ABRIDG'D;
 AND
 Dispos'd under GENERAL HEADS.

C H A P. I.

Physiology.

Meteorology. Pneumaticks.

I. **T**HE *Academie des Sciences* has lately received great Splendour by the Regulations, Incouragement, and Orders, M. L'abbé Bignon has obtained to it from the King. That *Academy* is now compos'd of 10 *Honorary Academicians*, which are chosen Learned and Eminent Gentlemen; of 8 *Strangers Associates*, which are distinguished by their Learning; Twenty *Pensioners* Fellows, Twenty *Eleves*, and Twelve *French Associates*, who are divided into 6 Classes, viz. Geometricians, Astronomers, Mechanicians, Anatomists, Chymists, and Botanists.

The New Regulation of the Academie des Sciences at Paris; by M. Geoffroy. n. 257. P. 144.

Out of the *Honorary Academicians*, two are Elected every Year, one for President, the other for Vice-President; only Twenty *Pensioners* have every Year 1500 French Livers; and after the Death of one *Pensioner*, the *Academy* will propose to the King 3 Persons *Associates*, or *Eleves*, or sometime others; and his Majesty will call one of the three for *Pensioner*.

The Cause of the present Languid State of Philosophy; by M. Leibnitz. n. 255. p. 273.

II. 1. Nescio quomodo remissius nunc tractantur Studia altiora, cum tamen nunquam, post tot aditus apertos, facilius potuerint tractari. Sed puto infelicia tempora intercessisse, dum bella curas Hominum alio vertere, ita pauci admodum juvenes in pristinae Gloriæ spem succrescunt. Etiam natura quampaucos nunc Observatores diligentes habet. Utinam, ut Gallica Scientiarum Academia nuper à Rege suo restituta est, etiam vestrae Regiæ Societati novus calor infunderetur.

By Dr. J. Wallis; ib. p. 281.

2. Quod tu quereris, remissius nunc tractari altiora studia; & pauciores esse naturæ Observatores diligentes; quadantenus verum esse non diffiteor. Sed mirandum non est, (ut res alias, sic) hominum Studia, suas habere vicissitudines. Præsenti Seculo (quod jam ad finem vergit) Eruditionem; in omni rerum genere, insignes (& quidem insperatos) processus obtinuisse, certum est; in re Physica, Medica, Chymica, Anatomica, Botanica, Mathematica, Geometrica, Analytica, Astronomica, Geographica, Nautica, Mechanica, ipsaque (quod minus lætor) Bellica. Et quidem longe majores quam per multa retro secula obtinuerat: Quippe quibus vix aliud sibi proposuisse videntur homines, quam ut intelligere videantur quæ ab Euclide, Aristotele, cæterisque ex antiquis jam olim fuerint tradita; de Progressu porro faciendo haud solliciti; quasi Scientiarum Metas posuerunt illi, quas transcendere sit nefas. Cum vero ausi sint aliqui (& quidem pauci) ultra prospicere; facti sunt aliis animi, late patentem campum ingredi. Et res novas aggredi, novus Ardor, novus Impetus impulit; nec infeliciter. Sed, postquam hæc desiit esse res nova; hic novus Ardor deferbuit. Mortui sunt ex sedulis indagatoribus non pauci, alii morituri: juvenesque non accendebat (ut antea) rerum Novitas.

Sed & ipsa materia erat magna ex parte exhausta; ut non tam Messis jam speranda sit, quam Spicilegium. Et quidem, jam fessis & fatigatis permittendum videatur, ut quadantenus quiescant: atque hinc factum (pro variabili natura hominum,) quod severiora studia negligantur, fierique forte potest, (quod tamen ominari nollem) ut præsentis seculi diligentia succedat desidia sequentis.

Optas tu (& quidem ego pariter) ut, sicut Gallorum Academia Scientiarum jam videatur restituta, sic nostræ Societati Regiæ novus Calor infunderetur. Atque hoc ipsum jam modo monui tuis Verbis. Sed & ipsi (quod tibi non displicebit) reapse me monentem prævenerant; qui jam nuper sibi novas Leges posuerunt, varias hujusmodi Inquisitiones viritim promovendi. Sed & inter Gallorum illam Academiam, nostramque Societatem, hoc interest Discriminis; Fruuntur illi Sumptibus Regis, suisque gaudent singulatim Salariais. Nostri suis sumptibus agunt omnia.

III. In the Royal Observatory at *Paris* there is, besides many other rooms fit for Philosophical Uses and purposes, a very deep Cave, having 170 Steps of Descent; wherein many sorts of Experiments are intended to be made, being of that Nature, that they require to be remote from the *Sun Beams* and the open Air; such as are *Thermometrical* ones, and such as concern *Refrigerations, Coagulations, Indurations, and Conservations of Bodies, &c.*

A deep Cave in the Observatory at Paris; by M. ----- n. 74. p. 2217.

Barometers, and Observations made with them. n. 9. p. 153.

IV. 1. The Barometer or Baroscope was first made publick by that noble searcher of Nature, *Mr. Boyle*, and imployed by him and others, to detect

fect all the minute variations in the pressure and weight of Air. With this Instrument he made divers Observations in the year 1659, and 1660, before any others were publick, or by him so much as heard of.

2. Dr. *J. Beal* is so much pleased with the discovery already made by the help of this Instrument, that he thinks it to be one of the most wonderful that ever was in the world. For (saith he) who could ever expect, that we men should find an Art, to weigh all the Air that hangs over our heads, in all the changes of it, and as it were to weigh, and to distinguish by weight, the Winds and the Clouds? Or who did believe, that by palpable evidence, we should be able to prove, the serenest Air to be the most heavy, and the thickest Air, and when darkest Clouds hang neerest to us, ready to dissolve, or dropping, then to be lightest?

By Dr. J. Beal.
ib. p. 154.

1. My Wheel Barometer I could never fill so exactly with Mercury, as to exclude all Air; and therefore I trust more to a Mercurial Cane, and take all my Notes from it, this Cane is but 35 Inches long, of a very slender Cavity, and thick Glafs.

ib. p. 155.

2. In all my Observations from *May 28. 1664.* to this present (*December 9. 1665.*) the Quick Silver never ascended but very little above $30\frac{1}{4}$ Inches.

3. It ascended very seldom so high (viz. to $30\frac{1}{4}$ Inches) chiefly in *December 13. 1664.* the weather being fickle fair, Evening.

4. I find by my Calender of *June 22. 1664.* at 5 in the Morning, in a time of long settled fair weather, that the Mercury had ascended about half an Inch higher than 30: but I fear some mistake, because I then took no impression of wonder at it; yet for 3 or 4 days, at that time it continued high, in well settled fair and warm weather; most part above 30 Inches. So that I may note the Mercury to rise as high in the hottest Summer, as in the coldest Winter-weather.

5. Yet surely I have noted it ascend a little higher for the coldness of the Weather; and very frequently, both in Winter and Summer, to be higher in the cold Mornings and Evenings, than in the warmer mid-day.

6. Generally in settled and fair Weather both of Winter and Summer, the Mercury is higher than a little before, or after, or in rainy weather.

7. Again, generally it descended lower after Rain, than it was before Rain.

8. Generally also it falls in great winds; and somewhat it seemed to sink, when I opened a wide door to it, to let in stormy winds; yet I have found it to continue very high in a long stormy wind of three or four days.

9. Again, generally it is higher in an East and North Wind (*cæteris paribus*) than in a South and West Wind.

10. I tryed several times, by strong Fumes, and thick Smoaks, to alter the Air in my Closet; but I cannot affirm, that the Mercury yielded any more, than might be expected from some increase of heat. Such as have exact Wheel Barometers, may try whether Odors or Fumes do alleviate the Air.

11. I have not in all this time found the extreameſt changes of the Quick-ſilver to amount to more, than to $2\frac{3}{4}$, or to $2\frac{7}{8}$ Inches, at moſt.

12. Very often I have found great Changes in the Air, without any perceptible change in the Barometer; as in the dewy Nights, when the moiſture deſcends in a great quantity, and the thickneſs ſometimes ſeems to hide the Stars from us: In the days foregoing and following, the vapours have been drawn up ſo inviſibly, that the Air and Sky ſeemed very clear all day long. This I account a great Change between aſcending and deſcending Dews and Vapours (which import Levity and Weight) and between thick Air and clear Air: which changes do ſometimes continue, in the alternative courſe of day and night, for a week or fortnight together; and yet the Baroſcope holding the ſame.

13. Sometimes (I ſay not often) the Baroſcope yields not to other very great changes of the Air. As lately (*Dec.* 18.) an extraordinary bright and clear day; and the next following quite darkned, ſome Rain and Snow falling; but the Mercury the ſame: So on high Winds and Calms the ſame.

14. I do conceive, that ſuch as do converſe much *ſub dio*, and walk much abroad, may find many particulars much more exactly than I, who have no leiſure for it, can undertake. To inſtance in one of many, *Dec.* 16. 1665. was a clear cold day, very ſharp and ſtrong Eaſt Wind, the Mercury very near 30 Inches high, about 3 in the Afternoon I ſaw a large Black Cloud drawing near us from the Eaſt and South-Eaſt, with the Eaſt Wind. The Mercury changed not that day, nor the day following; the Stars and moſt of the Sky were very bright and clear till Nine of the Clock; and then ſuddenly all the Sky was darkned, yet no Change of Weather happened; *Dec.* 17. the Froſt held, and 'twas a clear day, till about Two of the Clock in the Afternoon; and then many thick Clouds appeared low in the Weſt; yet no Change of the Weather here; the Wind, Froſt, and Quickſilver, the ſame, *Dec.* 18. the Mercury fell almoſt $\frac{1}{4}$ of an inch, and the Sky and Air ſo clear and bright and cold with an Eaſt Wind, that I wondred what cou'd cauſe the Mercury to deſcend. I expected it ſhould have aſcended, as uſually it does in ſuch clear Skies. Caſually I ſent my Servant abroad, and he diſcovered the remote Hills, about 20 Miles off, covered with Snow. This ſeemed to manifeſt that the Air, being diſcharged of the Clouds by Snow, became lighter.

15. I have ſeldom ſeen the Change to be very great at any one time, ſo that I once wondred to ſee, that in one day it ſubſided about $\frac{3}{4}$ of an Inch.

16. *Jan.* 13. 1668 the Mercury ſtood (as it did alſo the day before) a quarter above 30 Inches; yet both days very dark and Cloudy, ſometimes very Thick and Miſty Air; which ſeldom falls out. For, for the moſt part I ſee it higher in cleareſt ſetled weather, than in ſuch cloudy and miſty Fogs. This thick Air and darkneſs hath laſted above a Week; lately more cold, and Eaſt and North Eaſt Wind.

of Weather, which do follow a long serenity, or settled Weather. And perchance in brighter Climates it may be constantly infallible. I have store of Hygrosopes of divers kinds; and I do remark them, and the Sweatings of Marble, and as many other famed Prognosticks as I can hear of; but can find nothing so neerly indicative of the Change of Weather, as this Ballance. And the open Weather-Glass is known to signifie nothing at certainty, having a double Obedience to two Masters, sometimes to the weight of the Air, sometimes to Heat, as the Service is commanded.

18. In *Jan.* 1662. for many days it continued very dark, so that all Men expected daily great rain; and though sometimes thick Mists arose, and some small Rain fell, yet the Quicksilver held at a great height; which did indicate to me, there could then be no great change of weather, and I was not disappointed.

19. If the Mercury ascends to a good height after the fall of Rain (as sometimes, but less often it does) then I look for a settled serenity; but if it proceeds after Rain in a descending Motion, then I expect a continuance of broken and showry Weather.

20. That we find the Weather and our Bodies more chill, Cold, and Drooping, when the Mercury is lowest, and the Air lightest, besides other causes, I guess that as Air is to us the breath of Life, as Water is to Fishes; so when we are deprived of the usual Measure of this our Food, 'tis the same to us as when the Water is drawn Ebb from the Fishes.

21. The lowest descent of the Mercury in all the time since I have observed it, was *Oct.* 26. 1665. in the Evening, when it was very near at $27\frac{1}{2}$ Inches. Which I find thus circumstanced with the Weather in my Notes.

Oct. 25. Morning; Mercury at $28\frac{1}{2}$ Inches, great Storms and much Rain.

Oct. 26. Morning; Mercury at 28, Winds quiet, thick dark Clouds.

Oct. 26. Evening; Mercury at $27\frac{1}{2}$, That day, and some days following, the Weather was variable, frequent Rain, and as you see the Mercury lower than usual.

22. Over the place, where this Mercurial Cane Stands, I have set a Wind-vane, with purpose of exactness, of a Streamer in Brass so large, and pointing to a Board indented in the Margine, that I can at a sure level upon the Vane, take every of the 32 Points of the wind, Half-points and Quarter-points, at a good distance. It were good to have an Index of Winds, that discovered as well their Ascent and Descent, as their side Coastings.

23. By Change of weather and wind the Mercury sunk since *Mar.* n. 11. p. 185. 12. more than an Inch, and this last Night of *Mar.* 18. by Rain and South wind 'tis sunk half an Inch.

24. I found the Quick-silver *Dec.* 13. 1669. higher than I dare n. 55. p. 1113. positively affirm that it was ever since I had it in my Custody, viz. since *May* 28. 1664. It was compleatly and apparently above half an Inch more than 30 Inches high. It continued the 14th, and some part of the 15th, at about that height; sometimes manifestly higher to an Eighth or Tenth part of an inch. For this Baroscope I have two Glass-Canes in one Vessel of stagnant

stagnant Quick-silver: and both of them agreed in this indication: The weather was at first discovery very bright and clear, a gentle Frost, by the Sun's Heat melting. The Air was very silent, no wind stirring, and the curious Wind-vane noting, that the wind was directly in the East all the first day, *viz.* Dec. 13. On Dec. 14. the wind had a short swing from the North-west, and hastened again towards the East, yet so as to be North-east. During this agitation, or change of Winds, the Mercury descended a little; and after, upon the resetting of the wind, the Mercury ascended a little higher, than it had been the day before.

My House and Study where I keep this Baroscope, is on the side of an Hill; on the higher side of this Country, as I guess near a Level with the Head of a River: which River running slowly, and falling into the *Severn* Sea about 20 or 30 Miles westward of *Bristol*, we cannot be very much above the Level of the Sea. My Thermoscope, standing close by my said Barometer, was at the just height of ordinary dissolving weather. In the following days it was colder. Whether the late Summer drought, or what else might incline this winter-air to have more than ordinary weight, or a stronger Spring, I must refer to the consideration of the more Skilful.

By Dr. J. Wallis.
p. 10. p. 169.

3. In my Baroscope I never found the Quicksilver higher than 30 inches, nor lower than 28, (at least scarce discernably, not $\frac{1}{2}$ of an inch higher than that, or lower than this:) which I mention, not only to shew the Limits, within which I have observed mine to keep, *viz.* full 2 inches, but likewise as an Estimate of the Clearness of the Quicksilver from Air. For though my Quicksilver were with good care cleansed from the Air, yet I find that which Mr. Boyle useth, much better: For, comparing his with mine at the same times, and both in *Oxford*, at no great distance; I find his Quicksilver to stand always somewhat higher than mine (sometimes near a quarter of an inch;) which I know not how to give a more probable account of, than that my Quicksilver is either heavier than his; or else that his is better cleansed from the Air; (unless, possibly, the difference of the Bore; or other Circumstances of the Tube, may cause the alteration; mine being a taller Tube, and a bigger Bore than his.) And upon like Reason, as his stands higher than mine; so another, less cleansed from Air, may at the same time be considerably lower, and consequently under 28 inches at the lowest.

In thick foggy weather, I find my Quicksilver to rise; which I ascribe to the heaviness of the Vapours in the Air.

In Sun shiny weather, it riseth also (and commonly the clearer, the more;) which I think, may be imputed partly to the Vapours raised by the Sun, and making the Air heavier; and partly to the Heat, increasing the Elastick or Springy Power of the Air. Which later I the rather add, because I have sometimes observed in Sun-shiny weather, when there have come Clouds for some considerable time (suppose an hour or two) the Quicksilver has fallen; and then, upon the Sun's breaking out again, it has risen as before.

In Rainy weather, it useth to fall (of which the Reason is obvious, because

cause the Air is lightned, by so much as falls:) in snowy weather likewise, but not so much as in Rain. And sometimes I have observed it, upon a Hoar-frost, falling in the Night.

For windy weather, I find it generally to fall; and that more universally, and more discernably, than upon Rain: (which I attribute to the wind's moving the Air collaterally, and thereby not suffering it to press so much directly downwards: the like of which we see in swimming, &c.) And I have never found it lower than in high winds.

I have divers times, upon discerning my Quicksilver to fall without any visible Cause at home, looked abroad; and found (by the appearance of broken Clouds, or otherwise) that it had rained not far off, though not with us: whereupon, the Air being then lightned, our heavier Air (where it rained not) may have in part discharged it self on that lighter.

Whereas I formerly observed, that in hot weather, the Quicksilver n. 55. p. 1116. in the Baroscope did use to rise observably, especially in Sunshine and the Heat of the day; I now find (having kept the same Barometer for the space of 5 Years unaltered) the Case, for these two Years last past, to be somewhat otherwise: And that in hot Sun-shiny weather the Quicksilver doth rather subside a little; and in extream Cold and Frosty weather it riseth. I judge the cause of these contrary Observations to be this, *viz.* That the Quicksilver, at its first putting into the Tube or Baroscope, was not so perfectly cleansed from Air, but that some small quantity of it did remain undiscerned in the Quicksilver: which latent particles of Air, though so small as not to be at all discernable to the Eye by bubbles, yet by the external heat (adding new strength, as it useth to do, to its Elastick or Springy Power) were so much expanded as to make the Quicksilver specifically lighter, and consequently to rise somewhat higher, and upon the recess of the External Heat the Spring of the Air again slackning, suffered the Quicksilver to be again contracted into its former lesser dimensions, and so to become heavier, and not to rise so high as before, when it was hotter. But now, the Quicksilver having continued in the Tube for five Years and upwards, hath by its own weight cleansed it self better from that little Air that was in it; and that Air, freed from its intanglement with the Quicksilver, being got up into the void part of the Tube above the Quicksilver, doth act contrary-wise; that is, when it is by heat (upon the strengthening of its spring) expanded, it presseth downward upon the Quicksilver, and doth a little depress it; and on the contrary, when by Frost or very Cold weather this Air (by the abatement of its spring) is contracted, the Quicksilver, freed from that Pressure, riseth a little. But the rising and sinking upon this account, (as well that formerly, when this Air was in the Quicksilver, as that now, when it is gotten above it,) is not very considerable; hardly exceeding the 12th part of an inch.

I shall add another Accident which I lately took notice of. I observed in the late hard Frost, that a little drop of water, (which was at first made use of for the cleansing of the Quicksilver from the Air, and which hath ever since remain-

ed on the top of the Quicksilver within the Tube, was frozen fast to the Glass.

Where-

Whereupon I did a little shake the Tube by moving it up and down, so as to make the Quicksilver undulate and strike against it. The noise upon these strokes; was not such a dull noise, as Quicksilver or other Liquids use to make in the open Air, by dashing against Glass or Ice, or other such hard Bodies; but such a hard smart noise, as hard Metals use to make by knocking one against the other; or, as if this Ice had been so knocked by a solid piece of Iron or other Metal of such a bigness. Which difference of noise from what would have been in the open Air (where the intermediate Air must first have been beat away, before the Quicksilver could strike the Ice, and thereby the stroke of the liquid Body obtunded or broken,) I attribute to that voidness of Air, which was between the Ice and the distant Quicksilver.

Jan. 7. $16\frac{69}{70}$, the Baroscope was at 29, but for some days before about $28\frac{3}{4}$, (the weather having been windy and rainy;) and so it was in the Frost about *Dec.* 25. but then continued to rise till about *Jan.* 2. to $29\frac{3}{8}$; but had been *Dec.* 13. at $30\frac{1}{8}$; which is the highest I have ever known it in my Baroscope; $27\frac{1}{8}$ being the lowest, that I have ever observed it in (*Oct.* 26. 1665;) the most usual height being about 29, or somewhat higher.

By Mr. Boyle. n.
II. p. 181.

4 It will be very convenient that Observers give notice of the situation of the place, where their Barometers stand, not only, because it will assist Men to judge, whether the Instruments were duly perfected, but principally because, that though the Baroscope be good (nay because it is so) the Observations will much disagree, even when the Atmosphere is in the same state, as to weight, if one of the Instruments stand in a considerably higher part of the Country, than the other.

To confirm the foregoing Admonition, I must now inform you, that having in these parts two Lodgings, the one at *Oxford*, which you know stands in a bottom by the *Thames* side, and the other at a place 4 Miles thence, seated upon a moderate Hill, I found by comparing two Baroscopes, that I made, the one at *Oxford*, the other at *Stanton St. Johns*, that, though the former be very good, and hath been noted for such, during some Years, and the latter was very carefully fill'd; yet by reason, that in the higher place, the incumbent part of the Atmosphere must be lighter, than in the lower, there is almost always between two and three eights of an inch difference betwixt them: and having sometimes ordered my Servants to take notice of the disparity, and divers times carefully observed it my self, when I passed to and fro between *Oxford* and *Stanton*, I generally found, that the *Oxford Barometer* and the other, did, as it were by common consent, rise and fall together so, as that in the former the Mercury was usually $\frac{3}{8}$ higher than in the latter. Which Observations may teach us, that the subterraneous Steams which ascend into the Air, or the other causes of the varying weight of the Atmosphere, do many times, and at least in some places, uniformly enough affect the Air to a greater height, than, till I had made this Tryal, I durst conclude.

But as most of the Barometrical Observations are subject to Exception, so I found the formerly mentioned to be. For (to omit lesser Variations) riding

riding one Evening from *Oxford* to *Stanton*, and having before I took Horse look'd on the Baroscope in the former of these two places, I was somewhat surprized, to find at my coming to the latter, that in places no farther distant, and notwithstanding the shortness of the time (which was but an Hour and a Half, if so much) the Barometer at *Stanton* was short of its usual distance from the other near a quarter of an Inch, though the Weather being fair and calm, there appeared nothing of manifest change in the Air, to which I could ascribe so great a Variation; and tho' also since that time the Mercury in the two Instruments hath, for the most part, proceeded to rise and fall as before.

The Quicksilver has been of late for the most part so high, as to invite me to take notice of it: And about *March 12. 1668* at *Oxford*, the Quicksilver was higher than for ought I know has been yet observed in *England*, viz. above $\frac{1}{16}$ above 30 inches; but upon the first considerable Showers, that have interrupted our long Drought, as I foretold divers Hours before that the Quicksilver would be very low, (a blustering wind concurring with the Rain) so I found it at *Stanton* to fall $\frac{3}{8}$ beneath 29 inches.

It is difficult enough to settle any general Rule about the rising and falling of the Quicksilver; yet in these parts one of those that seem to hold ofteneft is, that when high winds blow the Mercury is the lower; and yet that it self does sometimes fail.

5. At my first Arrival I fixt my Weather Glass, and found the *Argentum Vivum* to ascend 29 inches, and in a Tornado 29 $\frac{1}{10}$: But a stranger by Accident broke the Cane, so that I could make no further Tryal.

At Cabo Cora in Guinea; by Mr. Heathcot. n. 158. p. 578.

6. When my Barometer was first set up, the Mercury stood one Degree below Changeable; I diligently observed it every Day, and found that in the Mornings before the Sun arose it would be there; and as the Heat increased with the Day, it sunk to within one Degree above Rain; there it continued several Days, and never altered above 3 Degrees, tho' sometimes fair, sometimes rain, and sometimes cloudy; and one Morning leaving open my Window, and the Sun having South Declination, it shone in on the visible part of the Tube, and in half an Hour it sunk 3 Degrees; (which I never observ'd it to do with heat in *England*) I presently shut the Window, and in one hour it arose again to within one Degree of Changeable; after it had kept this Course in several Weathers, for 6 weeks together, I began to doubt if it were well adjusted, and therefore took it down, new filled the Tube, turned it 3 or 4 times up and down, to let out the Air, and put it up with great Care, and ever since it continues the same, never by one degree to Changeable, nor down by one degree to Rain; so that the whole Progress of the Mercury is but $\frac{3}{10}$ of an inch.

In Jamaica; by Sir Will. Beefton. n. 220. p. 225.

7. *March 3. 1686* in the Evening, we had very much Thunder, and that and the next day the Mercury in the Barometer was much lower than ever I observed it, viz. but $\frac{4}{10}$ above 28 inches.

The lowest degree of the Barometer; by Bp. of Cloyne. n. 243. p. 293.

8. I have found by a whole Months Observations, Mr. *Flamsteed* was pleased to send me, the Mercury still rose and fell both at *London* and here exactly at the same time; I always found it rather more than $\frac{4}{10}$ of an inch

The Agreement of the Barometers at London and Townley; by Mr. Townley. n. 208. p. 56.

lower here than there, by reason that we are seated though in a seeming Valley, in respect of the Neighbouring Grounds, yet we are considerably higher than the other low Lands near the Sea, where the Standard differs little from that at *London*. In confirmation of what I have said, I suppose you may not be displeas'd with two remarkable Observations, made both by Mr. *Flamsteed* and me at the same time, viz. *Nov. 18. 1674.* when finding the Mercury to descend both very fast and very low, we watch'd it very nicely, and both of us observ'd, that at 2 in the Afternoon it was rather falling, and rather rising at 4; at which times the height was only here 27,63 inches, and at *London* $\frac{3}{10}$ higher.

A Portable Barometer; by Mr. Will. Derham. n. 236. p. 3.

V. Provide a strong Glass Tube. Let the Head of it be pinched at about an inch from the Top, so as to make a Narrow Neck, whose Orifice shall be as big almost as a Straw. This (which is Mr. *Quare's* way) will much bridle the blow of the Mercury against the Top, as it danceth up and down, which endangers breaking off the Top of the Tube. The Bottom of the Tube I would have ground asslant near half an inch, that the bottom of the Tube touching the bottom of the Cistern, the Orifice thereof may lye about the middle of the Mercury in the Cistern: which will prevent the Air getting into the Tube, by reason the Mercury is always about the Mouth of the Tube. The Cistern must be made wide, either of Glass, or close grained Wood; round the Brim of which, on the outside, must be a Notch to tye on the Leather that is to cover it. When the Tube is filled, cleared of Air, and plunged into the Cistern near full of Mercury, enclose the Mercury with gentle Leather tied very fast round the Tube near the bottom, which being spread over the Cistern, tie it round that also: The Tube and Cistern, thus conjoyned with Leather, must be lodged in a Case, made very fit to receive both, where they must lye very fast. Through the Case let 3 or 4 Holes be bored, to let the Air in freely to the Leather that covers the Cistern, which lying close against the Holes, will firmly enough keep the Mercury from running out at them.

To enlarge the Divisions of the Barometer; by Dr. Hook. n. 185. p. 241.

V.I. 1. To make the more minute Variations in the Air's Pressure sensible, Dr. *Hook* invented the Wheel Barometer. But this did not answer fully the designed exactness, both for that the Mercury being apt to stick against the sides of the Glass, would rise and fall *per saltum* all at once, and because it is very difficult to adjust the apparatus of this Instrument, as also that it is exceeding apt to be out of order, for which reasons it is at present almost wholly laid aside.

Upon this in *June 1668.* (as appears on the Journal of the *Royal Society*) he bethought himself of another Device to do the same thing, which was to encrease the divisions, by putting coloured Spirit of Wine, or some other Liquors not capable of freezing, on the Mercury, which Liquor was made to rise as the Mercury fell, and fall as it rose, in a narrow Cane, so as to make the utmost Limits about two foot asunder. But yet he was not satisfied, till he had found out the means of encreasing the Divisions of the Barometer *ad libitum*, which he produced before the *Royal Society* at their meeting on *Feb. 3. 1685. st. vet.* The contrivance whereof is this.

The Cylinder *A*, may be of what Diameter you please, the bigger the better, but it need not be above two inches long, the Cane *AD*, must be so long that the upper part of the Cylinder *B*, may be 29 inches \div such a part of the height of the other Cane *BC*, as the weight or specifick Gravity of the Liquor that is to fill that Cane is to the specifick Gravity of Mercury, below the line *AB*, in the Cylinder *A*. The third Cylinder *C*, may be as high as you please above the Cylinder *B*, but is most conveniently made, so as the square of the Diameter of the Cane *BC*, be to the square of the Diameter of the Cylinders *B*, or *C*, (which must be exactly equal) as the rise of the Mercury in the Cylinder *B*, is to the whole length of the Cane *BC*: for in this case there will be nothing superfluous, but the divisions enlarged to the utmost advantage.

As to the method of filling this Baroscope, though the Inventor hath not as yet declared his own contrivance for the doing it, yet it will not be unnecessary to shew here how it may be done. One way, (and the best that occurs at present) is to leave a small hole at the top of the Cylinder *A*, and another near the top of the Cylinder *B*: this latter being well stoppt, pour in as much Mercury, at the other hole in *A*, as shall fill both Canes as high as the level of the said hole; which done, stop, either by Hermetically sealing it, or else by a drop of Seal-Wax (the Glass being first ground rough to make it stick) the hole in *A*; then opening the hole in *B*, draw off as much of the Mercury of the Cane *BC* till it will run no longer: which done, stop firmly the hole in *B* (which may be done as you please, there being no Pressure against you) and you will have the Cylinder *A*, evacuated of Air for your purpose; and the height of the Mercury will be as is usual in the ordinary plain and Wheel Barometers. Then pour into the Cane *BC* as much Spirit of Wine tinged with Cochineele, and Oil of Turpentine, equal parts of each, as shall stand above the surface of the Mercury so many feet as you make the enlarged scale of your Barometer, or as is between the middle of the Cylinders *B* and *C*, and you will find the Mercury sink in the Cane *BC*, and rise in the other Cane *AD*, in such proportion, that each 13 foot of Oil and Spirit, will raise the Mercury ten inches: This done, you must pour on, by the Cane *BC*, so much Mercury as may fill up the Cylinders *A*, and *B*, to such heights, considering the present weight of the Atmosphere, that the surface of the Mercury in both, may at the utmost Limits, (which have not in *England* been found to exceed 30,6 and 28,6 inches) always fall within the bodies of the Cylinders, and never enter into the Canes.

Here note, That these Liquors are chosen upon two accounts; First, they are exceeding near of a weight, and Spirit of Wine highly rectified is somewhat lighter than Oil of Turpentine, but by a very small Addition of Phlegm or Water, the Spirit will preponderate and be undermost; so that you may make them as near of a weight as you please, and consequently a Cylinder of the Oyl insensibly differing from an equal Cylinder of Spirit of Wine. Secondly, they are Liquors that will not mix; so that the Oyl of Turpentine swimming on the top will be divided by a line only from the tinged Spirit of Wine, which the Oyl will keep from evaporating.

The Effect of this Baroscope will be, that when the Atmosphere is heavy,

and the Mercury raised high in the Cylinder *A*, and retired out of *B*, the Spirit of Wine will descend into the Cylinder *B*, and the Oyl of Turpentine will fill the Cane, so as to make the partition of the two Liquors near the Cylinder *B*. But on the contrary, when the Air is light, the Mercury will sink in *A*, and rise in *B*, so as to drive the Spirit of Wine into the Cane, and the Oyl of Turpentine into the Cylinder *C*, so that the Section of the two Liquors will be near *C*, and the Variation of the height of the Mercury will be enlarged into almost the length of the Cane, without that the Counter-*pressure* from the Liquors will be in the least altered, the height and weight of the incumbent Cylinders being always the same.

That little alteration that may happen by the dilatation and contraction of the Spirit of Wine by heat and cold, which ought to be accounted for, may be best discovered by a Thermometer hanging by it, (containing the same quantity of the Spirit of Wine, and whose Cane is, as near as may be, of the same Diameter with the Cane *BC*, in the Barometer) whose Descent and Ascent must be added and subtracted to reduce it to a rigorous exactness; but it is still worth while to enquire if the Mercury it self do not shrink and swell with cold and heat, so as not to need this correction.

2. *A*. The head of the Tube, with its narrow Neck, to bridle the Blow of the Mercury, as formerly directed for a portable Barometer.

B. The bottom ground asslant.

C. The Crook.

DD. The weather Plates.

By bending the Tube more or less at *C*, an inch of perpendicular height may be made 2 or 3 inches.

3. *AA*. A Ruler with teeth on one edge of it, made to slide up and down.

b. A little Finger, fixt to the Ruler, which must be raised or depressed till it point exactly to the height of the Mercury.

CCCC. The Index Wheel containing just as many Teeth as there are Teeth in an inch of the sliding Ruler; so that by thrusting up and down this toothed Ruler, you may at every inch turn round the Index once.

DDDD. A Circle, divided into 100 parts answering to 100 parts of an inch on the sliding Ruler.

ee. The Index, which being fastned to the Arber of the Index Wheel, is driven round with it, and shows on the Circle, the parts of an inch which the Mercury riseth or falleth in the Tube.

4. *A*. A long square Table. Towards one end is erected a square Column, *BB*. Upon which there slides a square Socket *C*. From one side whereof proceeds a crooked Arm, *DE*. At *D* there is a Screw-hole to receive the Screw, and at *E* a Ring to support the Tube of the Microscope *F*. From the other side the Socket comes a short Arm *G*, having a Screw-hole to receive the long Screw *II*, whose length may be about 6 or 7 inches: Its lower end, by a small hole in its Center, rests on the end of a small Screw, that comes through the Screw-hole, in the Arm *H*, which is fixed on the backside of the Column; the upper end of the Screw is filed less than the Body of the Screw, and goes through the Center of the round Plate without shaking; and to prevent its do-

ing.

By -----
n. 236. p. 4.
Fig. 2.

By Mr. Der-
ham. n. 237. p.
45.
Fig. 3.

By Mr. Steph.
Gray. n. 240. p.
176.
Fig. 4.

ing so, either upwards or downwards, there is added a springing Plate *n*, which keeps the shoulder of the Screw close to the underside of the Plate *K*; over this Plate there goes an Index *o*, and over that an handle *L*, upon the end of the Screw which comes through the Center of the Plate, which I should before have told you, is riveted to the top of the Column *BB*. The Teeth of the Screw must be of that size, as to have just 10 in an inch. The fore-side of the Column must be divided into inches and tenths, beginning about the height of the Socket *H*, where the lower end of the Screw rests, and so continue to the top of the Column. The Limb of the round Plate must be divided into an 100 parts. In the Focus of the Eye Glass of the Microscope is fixed an Hair, or very fine silver Wire, in a Horizontal Position.

When you use this Instrument, take hold of the Handle, and looking through the Microscope, turn the Screw till you have brought the Hair to touch, as it were, the surface of the Mercury *m*; then observe what divisions are cut on the Column, by the upper or under Edge of the Socket, which are tenths of an inch. See likewise to what parts the Index points on the Limb of the round Plate, which are Hundreds of a Tenth, or Thousand Parts of an inch; when you perceive the Mercury varied, raise or depress the Microscope, till the Hair be brought to its surface, as before; then by subtracting the lesser from the greater of the two observed Numbers, you will have the Variation in Inches and thousand Parts.

This Instrument becomes a Micrometer on the same Principles; though I was obliged to alter its structure from that used with the Telescope, which was first invented by Mr. *Gascoign*, improved by Mr. *Townley*, and described by Dr. *Hook*.

Vid. Vol. I.
Chap. IV. §. V.
1. 2.

The Thermometer is also capable of the like Improvement.

VII. 1. *May* 26. 1697. between One and Two in the Afternoon, on the top of *Snowdon Hill* I thrice repeated the *Torricellian* Experiment, and as often found the height of the Mercury 26,1 inches. And being come down to *Llanberris*, at the foot of the Hill, about 6 that Evening, I as often found it 29,4 inches. The next day about 8 in the Evening I found the Mercury by a triple Experiment, to stand at 29,9 inches, very near the surface of the Sea: when at the same time, at *Llanerch* in *Denbysshire* (about 25 Miles East from *Snowdon*, and 6 from the Sea, several foot above the surface of it) by Mr. *Davis*'s standing Barometer it was above 29, 7½. And the Air continued both before and after in the same state. Hence I conclude, that the difference of the Air's Pressure on the Sea, and on the top of *Snowdon*; is rather more than 3 inches 8 tenths. I could have wished for one of Mr. *Hunt*'s portable Barometers; which will certainly be accurate enough for taking the Levels for bringing of Water from distant Places, and certainly much less subject to error; there being a Tenth of an inch for each 30 yards; which may be divided into many parts evidently. *Snowdon* was measured by Mr. *Caswell*, with *Adam*'s Instruments, to be 1240 yards High; which abating the height of the Mercury 3 inches 8 tenths, may serve for a Standard; till a better be obtained on a higher Place.

The height of the Mercury, at the top of *Snowdon Hill*; by Mr. Halley. n. 229. p. 582.

Considered; by
Dr. Wall's. n.
233. p. 653.

At the top of the
Monument; by
Mr. Derham.
n. 236. p. 2.

2. This Observation had been more useful, had it been repeated at several other perpendicular heights in the Ascent. For from such Comparative Observations, we may make a Judgment of the height of the Atmosphere.

VIII. In Sept. 1696. I observed the Variation of the Mercury on the Monument, and found by one of Mr. Quare's best portable Barometers, that it descended $\frac{1}{10}$ of an inch at the height of 80 feet, and $\frac{2}{15}$ at 160 Feet.

But since that, finding my Observations a little different from Mr. Halley's on Snowdon Hill, I tryed it again more nicely, in Nov. 1697. after this manner; I provided a pretty large Glas Tube well cleaned: This I lodged in Wire, and filled it with well strained Mercury; which being cleared of all Air, I then plunged the Bottom of the Tube into a broad Cistern of Mercury, and then fixed both the Tube and Cistern together, in a Wire Case or Frame. On the top I left an Eye in the Wire, to suspend the whole Barometer on a string, that it might hang pendulously, which is absolutely necessary; because if the Cistern be deeper on one side than another, or if the Tube hang more towards one side than the other, it will cause a great and erroneous Variation in the Mercury above, according as the Tube stands perpendicularly, or not.

My Instrument being thus (I think) very nicely prepared, I marked exactly the Height of the Quicksilver, upon two narrow Labels of Paper, pasted on each side the Tube, both at the Bottom, and in my Ascent up the Monument. The differences of the Mercury's height I measured with a Decimal inch Scale of thin Brass. The Quantity of my Ascent, I measured with a Gunter's Chain, because a string would stretch. By the nicest Observation I could make, I found that at the height of 82 Feet, the Mercury fell, $\frac{1}{10}$ of an inch, and at about 164 Feet, $\frac{2}{10}$.

n. 237. p. 46.

By tarrying above somewhat long, I perceived the Pressure of the Atmosphere was somewhat altered, so that the Mercury in my descent, was about 0,01 of an inch different from my Observations in ascending. Upon which, I repeated my Experiment by ascending and descending quicker. At both which times, my Observations agreed exactly with the first Tryal. From whence I conclude, that at every 82 Feet height, or thereabouts, the Mercury will descend $\frac{1}{10}$ of an inch. But I am inclined to think that the Mercury riseth or falleth sometimes more sometimes less at one and the same height. As for instance, if the Mercury sinketh 0,1 of an inch at the height of 82 Feet, when the Mercury standeth at 30 inches in the Barometer, I Quære, whether it will sink so much when the Barometer is at 29 inches.

The heights of
the Mercurial
Cylinder at any
Elevation a-
bove the surface
of the Earth,
by Mr. Halley.
n. 181. p. 104.

IX. It has been shown by undoubted Experiments, that the specifick Gravity of the Air, near the Earth's surface, to that of Water, was once as 1 to 840, again as 1 to 852, and a 3^d time, in a very large Vessel holding ten Gallons, as 1 to 860; all which, considering the difficulty of the Experiment, agree well enough, the Mercury standing at all those times about 29 inches $\frac{3}{4}$; but by reason 'twas Summer weather, and consequently the Air rarified, when all these were tryed, we may without sensible error say in round Numbers, that the Barometer standing at 30 inches, and in a mean state of Heat and Cold, the specifick Gravity of the Air to Water, is as 1 to 800. By the like Tryals the Weight of the Mercury to Water, is as 13 $\frac{1}{2}$ to 1, or very near it; so that
the

the Weight of Mercury to Air is as 10800 to 1, and a Cylinder of Air of 10800 inches, or 900 Feet, is equal to an inch of Mercury, and were the Air of an equal density like Water, the whole Atmosphere would be no more than 5,1 Miles high, and in the ascent of every 900 Feet the Barometer would sink an inch. But the Expansion of the Air encreasing in the same proportion as the incumbent weight of the Atmosphere decreases, that is as the Mercury in the Barometer sinks, the upper parts of the Air are much more rarified than the lower, and each space answering to an inch of Quicksilver grows greater and greater, so that the Atmosphere must be extended to a much greater height.

These Expansions of the Air being reciprocally as the heights of the Mercury, it is evident, that by the help of the Curve of the *Hyperbola* and its *Asymptotes*, the said Expansions may be expounded to any given height of Mercury; for by the 65th Prop. Lib. 2. *Conic. Mydorgii*, the Rectangles *ABCE*, *AKGE*, *ALDE*, &c. are always equal, and consequently the sides *CB*, *KG*, *LD*, &c. are reciprocally as the sides, *AB*, *AK*, *AL*, &c. If then the Lines *AB*, *AK*, *AL*, be supposed equal to the heights of the Mercury, or the pressures of the Atmosphere, the Lines *CB*, *KG*, *LD*, answering thereto, will be as the Expansions of the Air under those pressures, or the bulks that the same quantity of Air will occupy; which expansions being taken infinitely many, and infinitely little, (according to the *Method of Indivisibles*) their Sum will give the spaces of Air between the several heights of the Barometer; that is to say, the Sum of all the Lines between *CB*, and *KG*, or the Area *CBKG*, will be proportioned to the distance or space intercepted between the Levels of two places in the Air; where the Mercury would stand at the heights represented by the Lines *AB*, *AK*; so then the spaces of the Air answering to equal parts of Mercury in the Barometer, are as the Areas *CBKG*, *GKLD*, *DLMF*. &c. These Areas again are, by the demonstration of *Gregory of St. Vincent*, proportionate to the Logarithms of the Numbers expressing the *Ratios* of *AK* to *AB*, of *AL* to *AK*, of *AM* to *AL*, &c. So then by the common Table of Logarithms, the height of any place in the Atmosphere, having any assigned height of the Mercury, may most easily be found: For the Line *CB* in the *Hyperbola*, whereof the Areas design the Tabular Logarithms, being 0,0144765; 'twill be as 0,0144765, to the difference of the Logarithms of 30 and any other lesser Number, so 900 Feet, or the space answering to an inch of Mercury, if the Air were equally prest with 30 inches of Mercury, and every where alike to the height of the Barometer in the Air, where it will stand at that lesser Number of inches: And by the converse of this proportion may the height of the Mercury be found, having the Altitude of the place given. From these Rules I derived the following Tables.

Fig. 5.

Given

<i>Given heights of the Mercury</i>	<i>Altitudes.</i>		<i>Given Alti- tudes.</i>	<i>Heights of the Mercury.</i>
Inches	Miles	Feet	Feet	Inches
30		0	0	30, 00.
29		915	1000	28, 91.
28		1862	2000	27, 86.
27		2844	3000	26, 85.
26		3863	4000	25, 87.
25		4922	5000	24, 93.
20		10947	Miles 1	24, 67.
15		18715	2	20, 29.
10		29662	3	16, 68.
5		48378	4	13, 72.
1		91831	5	11, 28.
0, 5		110547	10	4, 24.
0, 25		129262	15	1, 60.
0, 1	29 or	154000	20	0, 95.
0, 01	41 or	216169	25	0, 23.
0, 001	53 or	278338	30	0, 08.
			40	0, 012.

Upon these Suppositions it appears, that at the height of 41 Miles, the Air is so rarified as to take up 3000 times the space it occupies here, and at 53 Miles high it would be expanded above 30000 times; but 'tis probable, that the utmost power of its spring cannot exert it self to so great an Extension, and that no part of the Atmosphere reaches above 45 Miles from the Surface of the Earth.

This seems confirmed from the Observations of the *Crepusculum*, which is observed commonly to begin and end when the Sun is about 18 Deg. below the *Horizon*; for supposing the Air to reflect light from its most rarified parts, and that as long as the Sun illuminates any of its Atoms, they are visible to an Eye not intercepted by the Curvity of the Earth, it will follow that the proportion of the height of the whole Air, to the semidiameter of the Earth, is much about as 1 to 90, or as the excess of the Secant of about $8\frac{1}{2}$ Deg. to Radius. For if *E* be the Eye of the Observer, *S* a place where the Sun sets at the end of Twilight in *E*, and the Arch *ECS*, or *TCA*, be found 18 Deg. the Excess of the Secant of half thereof *ECH*, would be the height of the Air, viz. *GH*: But the Beam of the Sun *ASH*, and the Visual Ray *EH*, do each of them suffer a Refraction of about 32 or 33 *Min.* whereby being bent inwards from *H*, towards *G*, the height of the Air need not be so great as if they

Fig. 6.

they went streight; and having from the Angle $EC S$, taken the double Refraction of the *Horizontal Ray*, the half of the Remainder will be $8\frac{1}{2}$ *Deg. circiter*, whose Secant being 10111, it follows that as 10000 to 111, so the semidiameter of the Earth supposed 4000 Miles, to 44,4 Miles; which will be the height of the whole Air, if the places E, S , whose visible portions of the Atmosphere $ERZH$, and $SHKB$, just touch one the other, be 18 *Deg.* asunder.

At this height the Air is expanded into above 3000 times the space it occupies here, and we have seen the Experience of condensing it into the 60th part of the same space, so that it should seem, that the Air is a substance capable of being compressed into the 180000th part of the space it would naturally take up, when free from pressure: Now what texture or composition of parts shall be capable of this great expansion and contraction, seems a very hard question; and which, I suppose, is scarce sufficiently accounted for, by the comparing it to Wool, Cotton, and the like springy Bodies.

'Tis true, the weight of the whole Atmosphere is various, being counterpoised sometimes by $28\frac{1}{2}$ inches of Mercury, and at other times by no less than $30\frac{1}{2}$, so that the under parts being pressed by about a 15th part, less weight, the specifick Gravity of the Air upon that score will sometimes be a 15th part lighter than another; besides Heat and Cold does very considerably dilate and contract the Air, and consequently alter its Gravity, to which add the mixture of Effluvia or steams rising from almost all Bodies, which assimilating into the form of Air, are kept suspended therein, as Salts dissolved in Liquors, or Metals in corroding Menstrua, which bodies being all of them very much heavier than Air, their particles by their admixture must needs encrease the weight of that Air they lye incorporated withal, after the same manner as melted Salts do augment the specifick Gravity of Water. 'Tis also true that the Condensations are not possible beyond certain degrees, for being compressed in an 800th part of the space it takes up here, its consistence would be equally dense with that of Water, which yields not to any force whatsoever, as hath been found by several Experiments tried here, and at *Florence* by the *Academia del Cimento*. Nor can the Rarefaction proceed *in infinitum*; for supposing the spring whereby it dilates it self, occasioned by what texture of parts you please, yet must there be a determinate magnitude of the natural state of each Particle, as we see it is in Wool and the like, whose bodies being compressible into a very small space, have yet a determinate bulk which they cannot exceed, when freed from all manner of pressure.

These Objections disturb the Geometrical accuracy of these Conclusions drawn from the specifick Gravity of the Air observed at any time; but the Method here shewn will compute, by a like calculation, the heights of the Quicksilver, and the Rarefactions of the Air from any assigned height of the Barometer at the Earth's surface, and any specifick Gravity given. As to the Condensation and Rarefaction by Heat and Cold, and the various mixture of Aqueous and other vapours, these two Objections seem generally to compensate each other, for when the Air is rarified by heat the Vapours are raised most capiously, so that tho' the Air properly so call'd, be expanded, and consequently lighter, yet the Interstices thereof being crowded full of Vapours of

much heavier Matters, bulk for bulk, the weight of the Compositum may continue much the same; at least a most curious Experiment made by the Ingenious Mr. *John Caswel* of *Oxford*, upon the top of *Snowdon Hill* in *Caernarvanshire*, seems to prove that the first Inches of Mercury have their portions of Air near enough to what I now determine; for the height of the Hill being 1240 Yards, or very near it, he found the Mercury to have subsided to 25,6 Inches, or 4 Inches below the mean Altitude thereof at the level of the Sea, and the space answering to 4 Inches, by my Calculation should be 1288 Yards; and it agrees as well with the Observations in the Appendix to M. *Pascal's* Book, *del' Equilibre des Liquers*, made on the high Hill in *Auvergne*, call'd *le puy de Domme*. So that the Rarefaction and Vapours seem not to have altered considerably the Gravity of the under parts of the Air; and much above the height where these Experiments were made, do few Vapours ascend, and the Cold is such that the Snow lies continually, so that for the more elevated parts of the Sphere of Air there is much less reason to doubt.

*The Reason of
the Ascent of the
Quicksilver; by
Dr. Lister. n.
165. p. 790.*

X. 1. It is observed of the Barometer, that the Quicksilver is not affected with the weather, or very rarely, let that be either Cloudy, Rainy, Windy, or Serene in *St. Helena*; or the *Barbadoes*: and therefore probably not within the *Tropicks*, unless in a violent Storm, or Hurricane. The first is affirmed by Mr. *Halley*, who kept a Glas near two Months in the Island *St. Helena*, and the other of *Barbadoes* stands upon the Credit of our Registers.

2. In *England* in a violent Storm, or when the Quicksilver is at the very lowest, it then visibly breaks and emits small Particles, as I have more than once observed; which disorder I look upon as a kind of fretting; and consequently at all times of its descent, it is more or less upon the Fret.

In this disorder of the Quicksilver I imagine it hath its parts contracted and closer put together; which seems probable, for that, for Example, the Quicksilver then emits, and squeezes out fresh particles of Air into the Tube, which encreasing the bulk of the Air, and consequently its Elasticity, the Quicksilver is necessarily depressed thereby, that is by an external force or power; and also the Quicksilver must of it self come closer together in its own internal parts, that is, descend for both reasons.

And that much Air is mixed with it, appears from the Application of a heated Iron to the Tube, as is practised in the purging of it that way; and also for that polish'd Iron will rust though immerst in it, as some Philosophers have lately observed.

Now when the Quicksilver rises in the Pipe (which it certainly does both in Hot and Frosty weather) it may then be said to be in a natural state, Free, Open, and expanded like it self, which it seems it ever is within the *Tropicks*, and with us only in very Hot, and very Frosty weather. But when it descends, it is then contracted, and as it were convulsed and drawn together, as it mostly is in our Climate of *England*, and more or less, as we guess, in all places on this side the *Tropicks*. Which Contraction plainly appears from the Concave Figure of both Superficies, not only in that of the Quicksilver in the Tube, but also (if well observed) in that which stagnates in the pot or dish it self.

The difficulty seems to lye in the reconciling the same Effect of the Quicksilver's Rising in the Tube, from such seemingly different Causes, as great Heat and intense Frost: and those who shall willingly assent to us in one particular, and grant us warmth as a probable Cause of its Restitution to its Nature, will yet be at a stand how to imagine, that great Frost likewise should bring the Quicksilver nearer its own nature too: I answer, that Salts Liquified will Coagulate or Crystalize, that is, will return to their own proper Natures, both in Cold and in Heat; and therefore though most men practise the setting them in a cool Cellar for that purpose, yet some (as *Zwelfer*) advise, as the best means to have them speedily and fairly Crystallized, to keep them constantly in *Balneo*. Thus also the Lympha of the Blood doth become a Jelly, if you set it in a cool place, and the same is by warmth in like manner inspissated. Again, that it is no new opinion, that Water is naturally Ice, if no disquiet from some external Accident hinder. *Bornichius* the Learned Dane has said something for it: and although some may think that what he hath said, was a meer Complement to his own Frozen Climate; yet I dare venture to add, in Confirmation of that Doctrine, that Salt is naturally Rock, that is naturally Fossile, not Liquid; and yet this is most like Ice of any thing in Nature, not only because of its transparency, but also for its easie Liquefaction, and the sudden Impressions and Changes which Air makes upon it, so that it is scarce to be preserved in its natural state of Crystallization. Also Salts of all sorts seem naturally to propagate themselves in a hard state, and to vegetate in a dry form. The like is to be observed in Quicksilver, of its being a hard Rock, and also from its willingness to embrace upon all occasions a more fixt state, as in its Amalgamizing with almost all sorts of Metals.

It will not be amiss, by way of Corollary, to add a Note or two about Healthful and Sickly Seasons, more particularly as they may refer to this *Phænomemon* of great Cold and Frost. If therefore Quicksilver and Liquids are nearest their own Natures, and have less violence done to them, in very Cold and very Hot seasons; the Humours of our Bodies, as Liquids, in all probability must be in some measure accordingly affected. And that therefore Cold is Healthful, I argue from the vast Number of Old Men and Women to be found upon the Mountains of *England*, comparatively to what are found elsewhere.

Again, the Blood it self, or the Vital Liquor of Animals equivalent to it, is in most kinds of Animals in Nature sensibly Cold; for that the Species of Quadrupeds and Fowls are not to be compared for number to Fishes and Insects: There being in all probability, by what I have observed, above a hundred Species of these latter Creatures, whose Vital Juice is Cold, to one of the former: But because we most converse with those whose Vital Juice is Hot, we are apt to think the same of all.

Again, I have observed, which I offer as an Argument of the little injury intense Cold does to the Nature of Animals, I say, I have seen both Hexapode Worms (which I compare to the tender Embryo's of Sanguineous Animals, because such are in a middle state) and Flies of divers sorts hard Frozen in the Winter, and I have taken them up from the Snow, and if I cast them against the

Glass, they would endanger the breaking of it, and make it ring like so much hard Ice; yet when I put the Insects under the Glass, and set them before the Fire; they would after a short time nimbly creep about, and be gone, if the Glass which I whelmed upon them; had not secured them.

It hath indeed been noted by a very wise Philosopher, in contradiction to our *English Proverb*; which says, that *A green Christmas makes a fat Church-yard*; that the last Plague broke out here at *London* after a long and severe Winter 1665. But I reply, That that was accidentally only, for that disease is never bred amongst us, but comes to us by Trade and Infection. 'Tis properly a disease of *Asia*, where it is Epidemical. And therefore by the Providence of God, we are very secure from any such Calamities as the Natural Effect of our Climate. But we are not to judge or prognosticate of the Salubrity or Sickliness of a Year, from Foreign diseases, but the raging of such as are Natural to the Men of our Climate.

2. To account for the different Heights of the Mercury at several times, 'twill not be unnecessary to enumerate some of the principal Observations made upon the Barometer.

The first is, That in Calm Weather, when the Air is enclined to Rain, the Mercury is commonly Low.

2. That in Serene good Settled Weather the Mercury is generally High.

3. That upon very great Winds, tho' they be not accompanied with Rain, the Mercury sinks Lowest of all, with relation to the point of the Compass the Wind blows upon.

4. That *Cæteris paribus*, the greatest Heights of the Mercury are found upon Easterly and North-easterly Winds.

5. That in Calm Frosty Weather the Mercury generally stands High.

6. That after very great Storms of Wind, when the Quicksilver has been Low, it generally rises again very Fast.

7. That the more Northerly places have greater Alterations of the Baroscope than the more Southerly.

8. That within the *Tropicks*, and near them, those accounts we have had from others, and my own Observations at *St. Helena*, make very little or no variation of the Height of the Mercury in all Weathers.

Hence I conceive, that the principal Cause of the Rise and Fall of the Mercury, is from the Variable Winds, which are found in the *Temperate Zones*, and whose great unconstancy here in *England* is most notorious.

A second Cause is the uncertain Exhalation and Precipitation of the Vapours lodging in the Air, whereby it comes to be at one time much more crouded than at another, and consequently Heavier; but this latter in a great measure depends upon the former. Now from these Principles, I shall endeavour to explicate the several *Phænomena* of the Barometer, taking them in the same order as I laid them down. Thus,

1. The Mercury's being Low enclines it to Rain, because the Air being Light the Vapours are no longer supported thereby, being become specifically Heavier than the Medium wherein they floated; so that they descend towards the Earth, and in their fall, meeting with other Aqueous particles, they incorporate

By Mr. Edm.
Halley. n. 181.
p. 110.

porate together and form little drops of Rain; but the Mercury's being at one time Lower than at another is the effect of two Contrary Winds blowing from the place where the Barometer stands; whereby the Air of that place is carried both ways from it, and consequently the incumbent Cylinder of Air is diminished, and accordingly the Mercury Sinks; as for instance, if in the *German Ocean* it should blow a gale of Westerly Wind, and at the same time an Easterly Wind in the *Irish Sea*; or if in *France* it should blow a Northerly Wind, and in *Scotland* a Southerly; it must be granted me that that part of the Atmosphere impendent over *England*, would thereby be exhausted and attenuated, and the Mercury would subside, and the Vapours which before floated in those parts of the Air of equal Gravity with themselves, would sink to the Earth.

2. The greater Height of the Barometer is occasioned by two Contrary Winds blowing towards the place of Observation, whereby the Air of other places is brought thither and accumulated; so that the incumbent Cylinder of Air being increased both in height and weight, the Mercury pressed thereby must needs rise and stand high, as long as the Winds continue so to blow, and then the Air being specifically heavier, the Vapours are better kept suspended, so that they have no inclination to precipitate and fall down in drops, which is the reason of the Serene good Weather, which attends the greater Heights of the Mercury.

3. The Mercury sinks the Lowest of all by the very rapid Motion of the Air in storms of Wind. For the Tract or Region of the Earth's Surface, wherein these Winds rage, not extending all round the Globe, that stagnant Air which is left behind, as likewise that on the sides, cannot come in so fast as to supply the Evacuation made by so swift a Current, so that the Air must necessarily be attenuated when and where the said Winds continue to blow, and that more or less according to their Violence; add to which, that the *Horizontal* motion of the Air being so quick as it is, may in all probability take off some part of the perpendicular pressure thereof: and the great agitation of its particles is the reason why the Vapours are dissipated, and do not condense into drops so as to form Rain, otherwise the natural consequence of the Air's Rarefaction.

4. The Mercury stands the Highest upon an Easterly or North-easterly Wind, because in the great *Atlantick Ocean*, on this side the 35th Deg. of North Latitude, the Westerly and South-westerly Winds blow almost always Trade, so that whenever here the Wind comes up at East and North East 'tis sure to be checked by a contrary gale, as soon as it reaches the Ocean; wherefore, according to what is made out in our second Remark, the Air must needs be heaped over this *Island*, and consequently the Mercury must stand High, as often as these Winds blow. This holds true in this Country, but is not a general Rule for others where the Winds are under different Circumstances: and I have sometimes seen the Mercury here as Low as 29 inches upon an Easterly Wind, but then it blew exceeding hard, and so comes to be accounted for by what was observed upon the third Remark.

5. In Calm Frosty Weather the Mercury generally stands High, because (as I conceive) it seldom Freezes but when the Winds come out of the Northern and North-eastern Quarters, or at least unless those Winds blow at no great distance off;

off; for the Northern parts of *Germany, Denmark, Sweden, Norway*, and all that Tract from whence North-eastern Winds come, are subject to almost continual Frost all the Winter; and thereby the lower Air is very much condensed, and in that state is brought hitherwards by those Winds, and being accumulated by the Opposition of the Westerly Wind blowing in the *Ocean*, the Mercury must needs be prest to a more than ordinary Height; and as a concurring Cause, the Shrinking of the lower parts of the Air into lesser Room by Cold, must needs cause a descent of the upper parts of the Atmosphere to reduce the Cavity made by this contraction to an *Equilibrium*.

6. After great Storms of Wind, when the Mercury has been very Low, it generally Rises again very Fast; I once observed it to rise $1\frac{1}{2}$ inch in less than 6 Hours after a long continu'd Storm of South-west Wind. The reason is, because the Air being very much rarified, by the great Evacuations which such continued Storms make thereof, the Neighbouring Air runs in the more swiftly to bring it to an *Equilibrium*; as we see Water runs the faster for having a great declivity.

Equilibre des
Liquers.

7. The Variations are greater in the more Northerly places, as at *Stockholm* greater than at *Paris* (compared by *M. Pascal*), because the more Northerly parts have usually greater Storms of Wind than the more Southerly, whereby the Mercury should sink lower in that extream; and then the Northerly Winds bringing the Condensed and Ponderous Air from the Neighbourhood of the *Pole*, and that again being checked by a Southerly Wind at no great distance, and so heaped, must of Necessity make the Mercury in such case stand higher in the other extream.

8. Lastly, This Remark, That there is little or no Variation near the *Equinoctial*, does above all others confirm the *Hypothesis* of the variable Winds being the Cause of these Variations of the Height of the Mercury, for in the places above named there is always an easy gale of Wind blowing nearly upon the same point, *viz. E. N. E. at Barbadoes, and E. S. E. at St. Helena*, so that there being no contrary currents of the Air to exhaust or accumulate it, the Atmosphere continues much in the same state: However upon Hurricanes (the most violent of Storms) the Mercury has been observed very Low, but this is but once in two or three Years, and it soon recovers its settled state of about $29\frac{1}{2}$ Inches.

The Principal Objection against this Doctrine is, that I suppose the Air sometimes to move from those parts where it is already evacuated below the *Equilibrium*, and sometimes again towards those parts where it is condensed and crouded above the mean state, which may be thought contradictory to the Laws of *Statics*, and the Rules of the *Equilibrium* of Fluids. But those that shall consider how when once an *Impetus* is given to a Fluid Body, it is capable of mounting above its Level, and checking others that have a contrary tendency to descend by their own Gravity, will no longer regard this as a material Obstacle; but will rather conclude, That the great Analogy there is, between the Rising and Falling of the Water upon the *Flux* and *Reflux* of the Sea, and this of accumulating and extenuating the Air, is a great Argument for the truth of this *Hypothesis*. For as the Sea, over against the Coast of *Essex*, rises and swells by the meeting of the two contrary Tides of Flood, whereof the one comes from

from the *S. W.* along the *Channel* of *England*, and the other from the North; and on the contrary sinks below its level upon the retreat of the Water both ways, in the Tide of Ebb; so it is very probable, that the Air may Ebb and Flow, after the same manner; but by reason of the diversity of Causes, whereby the Air may be set in moving, the times of these *Fluxes* and *Refluxes* thereof are purely casual, and not reducible to any Rule, as are the Motions of the Sea, depending wholly upon the regular course of the *Moon*.

XI. 1. The Experiment is briefly this; that a Tube being after the *Torricellian* way filled with Mercury, and before Inversion perfectly purged of Air, doth when Inverted remain top full, even to the Height of 75 Inches.

M. *Hugens*, to render a probable Cause of this strange Effect, conceiveth, That, besides the Pressure of the Air which keeps the Mercury suspended at the Height of about 27 Inches, (and of the truth of which we are convinced by a great Number of other Effects that we see) there is yet another Pressure, stronger than that, of a more subtile matter than Air, which without Difficulty penetrates Glass, Water, Quicksilver, and all other Bodies, which we find impenetrable to Air. This Pressure, he saith, being added to that of the Air, is capable to sustain the 75 Inches of Mercury, and possibly more, as long as it works only against the lower surface, or against that of the Mercury, in which stands the open End of the Tube: But as soon as it can work also on the other side, (which happens when striking or hitting against the Tube, or intromitting into it a small Bubble of Air, you give way to this matter to begin to act) the Pressure of it becomes equal on both sides, so that there is no more but the Pressure of the Air which sustains the Mercury at the ordinary Height of 29 Inches.

The Cause of the Suspension of the Mercury at an Unusual Height; by M. Hugens. n. 86. p. 5027.

If you ask, why the Quicksilver in the Tube of this Experiment does not feel the Pressure of this Matter, even whilst that Vessel is yet full; since M. *Hugens* supposeth, that it pierceth without Difficulty the Glass as well as the Mercury, &c? and why the particles of this Matter do not joyn together and begin the Pressure, in regard that they go and come thorow the whole Extent of the Mercury, and that the Glass does not hinder their Communication with those that are without?

To remove this Difficulty, which in M. *Hugens's* own Opinion is very great, he answers, That though the parts of the Matter, by him supposed, do find passage between those that compose the Glass, Quicksilver, &c. yet they there find not sufficiently large ones for many to pass together, nor to move there with that force which is requisite to separate the parts of the Quicksilver, that have some Connexion together. And this very same Connexion, he saith, is the Cause that though on the side of the inner surface of the Glass, which touches the suspended Mercury, many of its parts be pressed by the Particles of this Matter; yet there being also a great Number of them that feel no Pressure, by reason of the Parts of the Glass, behind which they are placed, they retain one another, and they remain all suspended, because there is much less Pressure on the surface of the Quicksilver that is contiguous to the Glass, than upon that below, which is all exposed to the Action of that Matter which makes this second Pressure.

The

The Ingenious and Candid Author of this Solution acknowledges himself, That it doth not so fully satisfie him, as not to leave some Scruple behind; but then he adds, That that keeps him not from being very well assured of that new Pressure, which he hath supposed besides that of the Air, by reason as well of the Experiment already alledged, as of two others; which he subjoyns to this Effect.

First, When two Plates of Metal or Marble, whose Surfaces are perfectly plain, are put one upon another, they do so stick together, that the uppermost being lifted up, the undermost follows without quitting it: And the Cause hereof is justly ascribed to the Pressure of the Air against their two External Surfaces. He taking then two Plates, each of them but about an Inch square, being of that Matter of which anciently they made Looking Glasses, and closing them so exactly together that without putting any thing between the uppermost keeps not only up the other, but sometimes also with it 3 Pounds of Lead fasten'd to the lowermost; and thus they remain together as long as you please. Having thus joyned them, and Charged them with 3 Pounds Weight, he suspended them in the Recipient of his Engin, and Exhausted it of Air so far as that there remained not enough to sustain by its Pressure as much as an Inch height of Water, and yet his Plates disjoined not. He adds, that he made the same Experiment by putting Spirit of Wine between the two Plates; and found that in the Recipient evacuated of Air they sustained, without being severed, the same weight they did when it was full of Air. This he thinks shews clearly enough, that there remains yet in the Recipient a Pressure great enough after that of the Air is thence taken away; and that there is no more Reason to doubt of it, than of the Pressure of the Air it self.

The *Second* Experiment is, That whereas the Effect of a Siphon of unequal Legs, by which you make the Water of a Vessel to run over, is no longer ascribed to a *Fuga Vacui*, but to the Weight of the Air which pressing upon the Water of the Vessel makes it Rise in the Siphon, whilst on the other side it descends by its Weight; M. *Hugens* found a Means to make the Water of the Siphon run after that the Recipient was exhausted of Air, and he saw that with Water purged of Air it did the Effect as well as without the Recipient. The shortest of the Legs of the Siphon was 8 Inches long, and its Aperture, of two Lines. And he will not have us doubt whether the Recipient was well exhausted of Air, for he did assure himself of that, as well by finding that there came out no more Air through the Pump, as by other more certain Marks.

And this he takes for a farther Confirmation of his Supposition of a pressing Matter more subtile than the Air. To which he adds, That if you take the Pains of searching, to what Degree the Force of this Pressure reacheth, (which he saith cannot be better made than by pursuing the Experiment with Tubes full of Mercury yet longer than those employed by Mr. *Boyle*) it will perhaps be found, that this force is great enough to cause the Union of the parts of Glass, and of other sorts of Bodies, which hold too well together as not to be conjoyned but by their Contiguity and Rest, as M. *Des Cartes* would have it.

iii. Cap. 14. Schol. Prop. 13. where I hinted two Reasons (though not perfectly satisfied in either :) The one of my own, concerning the Spring of the Air necessary to put heavy Bodies in Motion, not impelled by any other force: The other, of my L. *Brounker*, That there might be in the Air yet a greater Weight or Pressure than is necessary for the Height of 29 Inches, in Case there be nothing but the bare Weight of Quicksilver to be supported. I find M. *Hugens* to fall in with that of my L. *Brounker*, save that what we comprehend under the Name of Air, he calls a more Subtile Matter: which alters not the Case at all, but only the Name.

But surely there must be somewhat more than this Subtile Matter, to solve the *Phænomenon*, notwithstanding the two Experiments now alledged by M. *Hugens* in favour of it. For, if this Matter be so Subtile as to press through the top of the Glass upon the Quicksilver, (and consequently through the upper upon the neather of the two Marbles,) as is acknowledged (and without which it is no more able to precipitate the Quicksilver while impure, and when it is in part subsided, than when it is pure, and the Tube top full :) I do not see, why it should not Ballance it self (above and below) in the same manner as Common Air would do, if the Tube were pervious to it at both Ends, and the Quicksilver, by the Preponderance of its own Weight fall presently. And the answer, That though Glass be penetrated by it, yet not in so copious a manner as where no Glass is; doth not to me solve the Difficulty: Because the same Obstacle doth just in the same manner remain, when the Tube is in part emptied; and when the Quicksilver is unpurged: the Pores of the Glass not being, by either of those, made more open or more pervious. And if we suppose the Subtile Matter by Percolation to be strained through with some Difficulty, (as Air or Water would be through a Cloth,) this might possibly cause the Quicksilver, when it does sink, to sink gradually; but not (as we see it) suddenly to fall to the height of 29 Inches.

The Connexion or Cohælion of the parts of Quicksilver, either each to other, or to the sides of the Glass, which M. *Hugens* supposeth to require for their Separation a greater Force than is in these percolated Particles till they have Room made for them to Combine; seems to me the less considerable, because it is not so necessary to separate them from each other, since that they may unseparated slide down by the sides of the Glass; to which it is well known, and visible to the Eye, the Quicksilver is not at all apt to stick, but doth rather decline that Contact; in like manner as we find Water not apt to joyn with Oyl or Grease; though Water to Glass, and Quicksilver to Gold, do very readily apply themselves. So that there needs no such Force to disjoyn the Quicksilver from the Glass, whatever there may be for disjoyning its parts one from another.

If therefore we should suppose the Pressure of the grosser Air downwards on *AB* (the Surface of the Stagnant Quicksilver,) and consequently by Means thereof upwards at *C*, sufficient only to bear up that in the Tube to the height of *I*; but the superadded Weight or Pressure of the Purer Air to hold it up as high as *D*, (75 Inches or more) while it is full and the Quicksilver well cleansed, as if so long it could not enter at *D*; but in Case it be not so cleansed;

Fig. 7.

or be already sunk to *H*, this Purer Air would enter at *D*, and thrust it down to *I* Counterballancing the Pressure (at *C*) of the Purer but not of the Groffer Air (which I take to be the Sum of the Cause assign'd by *M. Hugen's*): I am yet to seek, why it may not as well penetrate *D* at first, to begin the Descent, as afterwards to pursue it; and why not as well begin the Descent when the Quicksilver is well cleansed of Air, as when it is not so; and why also, if the Pure Air do freely enter at *D*, it does not presently fall; or, if not freely, why, when it does fall, it falls suddenly and not leisurely from *D* to *I*; especially since so small a Weight as *DH* of pure Air (for the Groffer cannot enter,) is very inconsiderable; if not at all, or not freely, pressed by that Incumbent on *D*; and the Adhæfion not considerably less, by being separated only at the Top, while it yet continues to touch the Sides.

I am apt therefore, as heretofore, to adscribe the Cause of this *Phænomenon* to the Spring that is in Air, and the want thereof in Quicksilver; For, that in Air there is a Spring or Elasticity, is now undoubted; but in Water cleansed of Air, though many Experiments have been attempted to that purpose, it has not yet been found that there is any: And I am apt to think the like of Quicksilver; though I do not know that this has been yet so rigorously examin'd. Now supposing, That Matter being at Rest will so continue till it be put in Motion by some Force; this Force may be either that of Percussion from some Body already in Motion (which is the Case when the Quicksilver falls by shaking, or striking the Tube;) or of Pulsion from a Contiguous Body beginning to move, as by the Expansion of some adjacent Spring, (which is the Case when the Springy parts of the Air, either left in unpurged, or readmitted in the Quicksilver, by expanding themselves put the Quicksilver in Motion;) or some Conatus or Endeavour of its own, such as is that of a Spring, from whatever Cause it be, which I do not here enquire, but has place only in Springy Bodies, and therefore if Water and Quicksilver be not such, they will not on this Account put themselves in Motion.

Gravity or Heaviness is reputed to be such a Conatus or Pronity to move downwards, and so to put it self in Motion: And the Wonder at present is why it does not so here. But if this which we call Gravity should chance to be not a Positive Quality or Conatus originally of it self, but only the Effect of some Pulsion or Percussion from without, (which possibly may be the Case, and principally from the Spring of the Air about us;) then while this Pulsion and Percussion is wanting (however Obviated,) the Bodies accounted heavy, will not of themselves begin to fall: which seems to be the present Case.

And this is the more Considerable, because we cannot (at least not yet) find, what is the utmost Height at which the Quicksilver thus accumulated will remain suspended; there having been (for ought I know) no Height yet attempted, at which, if cleansed, it will not stand; and that of 75 Inches, considering the Weightiness of Quicksilver, is a very great one, being more than Equivalent to 80 Foot of Water.

My Lord *Brounker* doth a little alter the Case, from what I take to be the *Hypothesis* of *M. Hugen's*. For he supposeth this Purer part of the Air to be of like Nature with the Groffer part, (which I think *M. Hugen's* doth not;) and, though

though Finer than the rest, so as to penetrate Glass, which the Groffer will not (there being in all sorts of Grains, some greater than others, and which will not pass so fine a sieve) yet of a Springy nature, as the groffer parts are: Which therefore Acts, not by its Weight only, but by its Spring; and therefore when once entered, though in a small Proportion, acts as effectually at its first Entrance as if the whole incumbent Air had Admission; its Spring being of a like Tensure with that of the outward Air; (as I have heretofore shewed, *Cap. 14. De Motu, Prop. 11, 12, 13.*) but M. *Hugens's* more Subtile Matter than Air, though he must allow it Weight (for else its Entrance would be nothing to the Purpose,) yet whether he allow it a Spring, I cannot tell; nor doth he Inform us. And when he says, this more Subtile Matter than Air doth without Difficulty Penetrate Glass, Water, Quicksilver, and all other Bodies, which we find Impenetrable to Air, I know not whether he mean, without any Difficulty (as the words seem to import,) or (as I conjecture by what follows) without great Difficulty, though with some.

But his *Lordship* (if I mistake not) though he allow his (Springy) Subtile Matter to penetrate Glass, yet not without Difficulty, and till it have some Room made, (as *HD*) wherein it may recollect it self, cannot exert its Spring; and therefore not while top full of cleansed Quicksilver, but so soon as some Room is made for it: Whereas if the Quicksilver be not purged of Air, that little Air remaining doth by its Spring begin the Motion.

He thinks it also not improbable (and if it so prove, it will be a good Confirmation of this *Hypothesis*) that a large but low Tube of Glass (shorter than 29 Inches) may stand top full of Quicksilver, though with a small Hole in the top as at *K*; at least if immersed in Water, in Case Air be too subtile for our Mechanicks.

He might also, suitably enough to his own *Hypothesis*, have so explained himself, as to allow his more subtile parts of common Air to penetrate Quicksilver but not Glass; and therefore, in Case of Room for it at *HD*, it might through the Stagnant Quicksilver, and that at *C*, pass upwards to *HD*, and there exert its Spring.

There is yet another way of explicating the same *Hypothesis*, without allowing this Subtile Matter to pierce the Glass; which is this. Our Common Air being an Aggregate of very Heterogenious parts, we may well suppose some of them to be Springy, and others not to be so. The Springy parts we may conceive to be so many Consistent Bodies, like small Hairs or Springy Threads wrapped up in Different Forms and variously intangled, and so as to form many Vacuities capable of admitting (what the other parts of the Air may be supposed to be) some Fluid Matter, which may insinuate into those Vacuities (as Water in a Bundle of Bushes,) without disturbing the Texture of those Springy parts; and which may press as a Weight, but not as a Spring, (of which Distinction see *Cap. 14. De Motu, Schol. Prop. 11. & Schol. Prop. 13. p. 729, 730, 732, 733.*) Now if in the *Toricellian* Tube there be a Quantity of such Springy Matter, the Spring hereof will be of equal strength with that of External Air, (and therefore able to Counterballance it, though its weight be much less,) because admitted with such a Tensure, (*ibid. Prop. 12, 13.*) But

if only an unspringy Fluid (which presseth but as a Weight not as a Spring) and this defended by the Glass Tube from any other Pressure, save that of its own Weight; it will still be too weak to force its own way, till its single Weight be Equivalent to that which it is to Encounter; which is, not only the Springy part of the Air, but also that Fluid Unsringy part; which though (because Fluid) it would give way to a Springy Body pressing through it; yet not to this Fluid, like it self, and destitute of such a Spring; and is therefore able to keep it up to a much greater Height than it could do if Un-cleansed of Springy Air: So long, at least, as till some Springy Body be admitted, or some Concussion Equivalent to it, put it in Motion; but being once in Motion, it will so continue (as a Bullet impelled by Gun Powder, or an Arrow out of a Bow,) till stopped by some Positive Force Equivalent.

Vid. Inf. §. Penult.

I do not deny, but that this Explication may be subject to some Difficulties and Exceptions; but I think, fewer than that of allowing the Glass penetrable by this Subtile Matter. But the best way to settle this business, is by suitable Experiments.

A Statical Baroscope; by Mr. Boyle. n. 14. p. 231.

XII. I caused to be blown at the Flame of a Lamp some Glass-bubbles, as Large, Thin, and Light, as I could then procure, and choosing amongst them one, that seemed the least unfit for my turn (being of the bigness of a somewhat large Orange, and weighing about 1. Dr. and 10. gr.) I counterpoised it in a pair of Scales, that would loose their *Equilibrium* with about the 30th part of a grain, and were suspended at a Frame. I placed both the Ballance and the Frame by a good Baroscope, from whence I might learn the present weight of the Atmosphere. Then leaving these Instruments together, though the Scales, being no nicer than I have expressed, were not able to shew me all the Variations of the Air's weight that appeared in the Mercurial Baroscope, yet they did what I expected, by shewing me Variations no greater than altered the height of the Quicksilver half a quarter of an inch, and perhaps much smaller than those. I had the pleasure to see the Bubble sometimes in an *Equilibrium* with the counterpoise; sometimes when the Atmosphere was high preponderate so manifestly, that the Scales being gently stirr'd, the Cock would play altogether on that side, at which the Bubble was hung; and at other times (when the Air was heavier) that, which was at the first but the Counterpoise, would preponderate, and upon the Motion of the Ballance make the Cock vibrate altogether on its side. And this would continue sometimes many days together, if the Air so long retained the same measure of Gravity; and then (upon other changes) the Bubble would regain an *Equilibrium*, or a preponderance; so that I had oftentimes the satisfaction by looking first upon the statical Baroscope (as for distinctions sake it may be called) to foretel, whether in the Mercurial Baroscope the Liquor were High or Low.

If the ground, on which I went in framing this Baroscope, be demanded, the answer in short may be; 1. That though the Glass Bubble, and the Brass counterpoise at the time of their first being weighed be in the Air, wherein they both are weighed, exactly of the same weight; yet they are nothing near of the same bulk, the Bubble by reason of its Capacious Cavity (which contains no-
thing

thing but Air, or something that weighs less than Air) being perhaps a hundred or two hundred times bigger than the Metallin counterpoise. 2. That according to the Hydrostatical Laws, if two bodies of equal Gravity but unequal bulk come to be weighed in another Medium, they will be no longer equiponderant; but if the new Medium be heavier, the greater Body, as being lighter in specie, will lose more of its weight, than the lesser and more compact; but if the new Medium be lighter than the first, then the bigger body will out-weigh the lesser: and this disparity, arising from the Change of Mediums, will be so much the greater, by how much the greater inequality of bulk there is between the Bodies formerly equiponderant. 3. That, laying these two together, I considered that 'twould be all one, as to the effect to be produced, whether the Bodies were weighed in Mediums of differing Gravity, or in the same Medium, in case its (specifick) Gravity were considerably alter'd: And consequently, that since it appeared by the Baroscope that the weight of the Air was sometimes heavier and sometimes lighter, the Alterations of it, in point of Gravity, from the weight it was of at first counterpoising of the Bubble of it, would unequally affect so large and hollow a Body as the Bubble, and so small and dense an one as a Metallin weight: And when the Air by an increase of Gravity should become a heavier Medium than before, it would buoy up the Glas more than the Counterpoise; and if it grew lighter than it was at first, would suffer the former to preponderate.

One Morning early being told of a Mist, I sent to see whether it made the Air so heavy as to buoy up the Bubble; but I did not learn, that that Mist had any sensible operation on it.

Though a single Bubble of competent bigness be much preferable, by reason that a far less quantity and weight of Glas is requisite to comprise an equal Capacity, when the Glas is blown into a single Bubble, than when it is divided into two; yet I found that the employing of two instead of one, did not so ill answer my expectations, but that they may for a need serve the turn instead of the other; than which they are more easie to be procured: and if the Ballance be strong enough to bear so much Glas, without being injured, by employing two or a greater number of large Bubbles the effect may be more conspicuous, than if only a single Bubble (though a very good one) were employed.

This Instrument may be much improved by divers accommodations. As,

1. There may be fitted to the Ansa (or Cheek of the Ballance) an Arch of a Circle divided into 15 or 20 Deg. (more or less according to the goodness of the Ballance) that the Cock, resting over against these divisions, may readily and without Calculation shew the Quantity of the Angle, by which when the Scales propend either way the Cock declines from the perpendicular, and the Beam from its *Horizontal* Parallelism.

2. Those that will be so curious, may instead of the ordinary Counterpoise (of Brass) employ one of Gold, or at least of Lead, whereof the latter being of equal weight with Brass is much less in bulk, and the former amounts not to half its bigness.

3. Those parts of the Ballance, that may made be of Copper or Brass, without any prejudice to the exactness, will by being made of one of those Metals be

less subject than Steel, (which yet if well hardned and polished may last good a great while) to rust with long standing.

4. Instead of the Scales, the Bubble may be hung at one end of the Beam, and only a Counterpoise to it at the other, that the Beam may not be burthened with unnecessary weight.

5. The whole Instrument, if placed in a small Frame like a square Lanthorn with Glass windows, and a Hole at the top for the Commerce of the internal and external Air, will be more free from dust, and irregular agitations; to the latter of which it will otherwise be sometimes incident.

6. This Instrument being accommodated with a light Wheel and an Index (such as have been applyed by the excellent Dr. *Chr. Wren* to open Weather Glasses, and by the Ingenious Mr. *Hook* to Baroscopes) may be made to shew much more minute Variations than otherwise.

7. And the length of the Beam and exquisiteness of the Ballance, may easily without any of the foregoing helps (and much more with them) make the Instrument far exacter than any of those I was reduced to employ. And to these Accommodations divers others may be suggested by a farther consideration of the nature of the thing, and a longer practice.

Though in some respects this Statical Baroscope be inferior to the Mercurial; yet in others it has its own advantages and conveniences above it.

And, 1. It confirms *ad Oculum* our former Doctrine, that the Falling and Rising of the Mercury depends upon the varying Weight of the Atmosphere; since in this Baroscope it cannot be pretended, that a *Fuga Vacui*, or a *Funiculus*, is the cause of the Changes we observe. 2. It shews that not only the Air has weight, but a more considerable one, than some Learned Men, who will allow me to have proved it has some Weight, will admit; since even the Variation of Weight in so small a quantity of Air, as is but equal in bulk to an Orange, is manifestly discoverable upon such Ballances as are none of the nicest. 3. This Statical Baroscope will oftentimes be more parable than the other; for many will find it more easie to procure a pair of good Gold Scales and a Bubble or two, than a long Cane seal'd, a quantity of Quicksilver, and all the other requisites of the Mercurial Baroscope; especially if we comprise the trouble and skill that is requisite to free the deserted part of the Tube from Air. 4. And whereas the difficulty of removing the Mercurial Instrument has kept men from so much as attempting to do it even to neighbouring places; the Essential parts of the Scale Baroscope (for the Frame is none of them) may very easily in a little Room be carried whither one will, without the hazard of being spoiled or injured. 5. There is not in Statical Baroscopes, as in the other, a danger of uncertainty, as to the goodness of the Instruments, by reason, that in these the Air is in some more and in some less perfectly excluded; whereas in those, that consideration has no place. (And by the way, I have sometimes upon this account, been able to discover by our new Baroscope, that an esteemed Mercurial one, to which I compared it, was not well freed from Air.) 6. It being very possible to discover Hydrostatically, both the bigness of the Bubble and the Contents of the Cavity, and the weight and dimensions of the Glassy substance (which together with the included Air make up the Bubble) much
may

may be discovered by this Instrument, as to the weight of the Air absolute or respective. For when the Quicksilver in the Mercurial Baroscope is either very High, or very Low, or at a Middle station between its greatest and least Height, bringing the Scale Barometer to an Exact *Equilibrium*, (with very minute divisions of a Grain) you may by watchfully observing when the Mercury is risen or fallen just an Inch, or a fourth, or half an Inch, &c. And putting in the like minute divisions of a Grain to the lighter Scale, till you have again brought the Ballance to an exquisite *Equilibrium*; you may, I say, determine what known weight in the Statical Baroscope answers such determinate Altitudes of the Ascending and Descending Quicksilver in the Mercurial. And if the Ballance be accommodated with a divided Arch, or a Wheel and Index, these Observations will assist you for the future to determine readily, by seeing the Inclination of the Cock, or the degree marked by the Index, what Pollency the Bubble hath, by the Change of the Atmosphere's weight, acquired or Lost. 7. By this Statical Instrument, we may be assisted to compare the Mercurial Baroscopes of several places (though never so distant) and to make some estimates of the Gravities of the Air therein. As if, for Instance, I have found by Observation that the Bubble I employ, weigh'd just a *Drachm*, when the Mercurial Cylinder was at the height of $29\frac{1}{2}$ inches (which in some places I have found a moderate Altitude) and that the Addition of a $\frac{1}{16}$ th part of a *gr.* is requisite to keep the Bubble in an *Equilibrium*, when the Mercury is risen an $\frac{8}{16}$ th, or any determinate part of an inch above the former station: When I come to another place, where there is a Mercurial Barometer, as well freed from Air as mine (for that must be supposed) if taking out my Scale Instrument, it appear to weigh precisely a *Drachm*, and the Mercury in the Baroscope there stand at just $29\frac{1}{2}$ inches, we may conclude the Gravity of the Atmosphere not to be sensibly unequal in both those two places, though very distant. And though there be no Baroscope there, yet if there be an addition of weight, as for Instance the $\frac{1}{16}$ th part of a Grain, requisite to be added to the Bubble to bring the Scales to an *Equilibrium*, it will appear that the Air at this second place is at that time so much heavier than the Air of the former place was when the Mercury stood at $29\frac{1}{2}$ inches.

But in making such Comparisons, we must not forget to consider the situation of the several places, if we mean to make Estimates not only of the weight of the Atmosphere, but of the weight and density of the Air. For though the Scales will shew (as has been said) whether there be a difference of Weight in the Atmosphere at the two places; yet if one of them be in a Vale or Bottom, and the other on the top, or some elevated part of a Hill, it is not to be expected, that the Atmosphere, in this latter place, should gravitate as much as the Atmosphere in the former, on which a longer pillar of Air does lean or weigh.

And the mention I have made of the differing situation of places, puts me in mind of something that may prove another use of our Statical Baroscope; namely, that by exactly poysing the Bubble at the foot of a high Steeple or Hill, and carrying it in its close Frame to the top, one may, by the weight requisite to be added to the Counterpoise there to bring the Beam to its *Horizontal* position,

position, observe the difference of the weight of the Air at the bottom, and at the top; and in case the Hill be high enough, at some intermediate Stations: And perhaps when duly improv'd, it may assist men to Estimate the Absolute, or Comparative Height of Mountains, and other Elevated places of the Earth.

The Use of Barometers; by.....
n. 122. p. 539.

XIII. By Accurate Baroscopes we may regain that Knowledge which still resides in Brutes, and we forfeited by not continuing in the Open Air, as they do for the most part, and by Intemperance corrupting the Crasis of our Senses.

Thermometers and Observations made with them; by Dr. J. Beal. n. 55. p. 1114.

XIV. 1. *Dec. 26. 1669.* in the Morning, the Weather was colder than ever I found it, since I could take it by the Measure of a Thermometer; that is since these 5 or 6 Years. It was very cold, and Freezing quick some days before and after: And yet in this time the Mercury hath some times fallen more than an Inch, without any other change of Weather than some Gusts of Wind, some sprinklings of Snow at several times, in all scarce enough to cover the Ground; and some abatements of Cold, more especially when the Sun was up. To note this Degree of Cold more particularly, I must acquaint you, that in my stanch Thermometer on the said 26. of *December* the Liquor was at $3\frac{1}{2}$ inches: whereas in ordinary brisk Frosts it is at 7 Inches. Yet here I must observe, that sometimes the Frost dissolves, when it is at the 7th Figure, and sometimes I find it at the 8th Figure in a smart Frost. 'Tis warm *May* weather when 'tis at the 10th Figure, and 'tis not much above the 12th Figure in the hottest Weather of *June, July, and August.*

I think it remarkable, that the 7th inch and sometimes the 8th in my Thermometer should abide Freezing, and the Frost increase till the Liquor descend $4\frac{1}{2}$ Inches; and yet, that it should not ascend from the 8th Inch more, than $4\frac{1}{2}$ Inches in our hottest Summer, being hung in the same place within 18 Inches of the Glass Window, facing the Northwest, and in a little Writing Room in the second row of Buildings. But now I am strongly perswaded, that the Degrees of Heat and Cold are not exactly indicated by the inclosed Spirit of Wine: For when the Snow melted, and the Frost was first dissolved without Sun shine, the Liquor was not above the Height of $5\frac{1}{2}$ Inches; possibly it retains some part of the Cold a while after the ambient Air becomes more tepid.

By Dr. J. Wallis. n. 55. p. 1118.

2. My Thermoscope was first made in *Dec. 1664.* The whole height of the small Cylindrick Glass, whose Cavity was about $\frac{1}{8}$ of an Inch Diameter, was about 28 Inches; besides a small Spherical Bowl at the top, of about $\frac{1}{4}$ of an Inch Diameter, and a Bowl at the bottom, which contained the Liquor, (being Spirit of Wine tinged with Cochineal) of about 2 Inches Diameter: the space above the Liquor being at the first composure of it, void of Air, save what it had out of the Liquor, which being warm at the first putting in filled the whole Cavity, while the Glass was Hermetically seal'd. I placed it so, as never to be exposed to the Sun; but in a Room that has a Window only to the North; and therefore it gives an Account only of the Temperature of the Air in General, not of the immediate heat of the Sunshine. It is so nice as that

n. 10. p. 169.

ib. p. 167.

my

my being or not being in my Study I find to vary it's height sometimes almost $\frac{1}{4}$ of an Inch.

The lowest mark to which the Liquor did subside in *Jan.* and *Feb.* 1664⁴ was at $12\frac{1}{4}$ Inches: at $14\frac{1}{2}$ it was Frost certain, and sometimes at 15, and at $15\frac{1}{2}$ (yet this I often observed, that the Air by the Thermoscope has appeared considerably colder, and the Liquor Lower, at some times when there is no Frost, than at some other times when the Frost hath been considerably hard:) The greatest height in the Summer following was at 25, 26, $26\frac{1}{2}$.

n. 55. p. 1118.

n. 10. p. 169.

n. 55. p. 1118.

In *Dec.* *Jan.* and *Feb.* 1665. we had at $14\frac{1}{2}$ Frost certain; sometimes at 15 or higher; and the lowest, to which it did that Winter descend, was $12\frac{3}{4}$. The height in the following Summer, 1666, was usually about 19, 20, 21; the highest of all at 25.

In *Dec.* and *Jan.* 1666. it was Frost certain at about $13\frac{1}{2}$ (an Inch lower than the Years before, the Liquor (it should seem) becoming less Spirituous) sometimes at 14 or $14\frac{1}{2}$, it was hard Frosty Weather at 12, 11, and once at $10\frac{1}{2}$ the Weather being very cold. The usual height in the Summer following, 1667. was about 19, 20, 21, and the highest at $24\frac{1}{2}$.

The Winter following, 1667. it was scarce certain Frost at 13; but yet sometimes at 14, or a little higher: the lowest, to which it did descend that Winter, (being very mild after *Christmas.*) was at 12. And the following Summer, 1668. usually about 18, 19, 20; the highest of all (the heat of that Summer being but very moderate,) at 22.

The next Winter it was Frost certain, about $12\frac{1}{2}$; but sometimes, at 13, or higher: The lowest of all at $10\frac{1}{4}$. And in the Summer following, 1669. the highest of all (being but a cool Summer) not much above 20.

At *Christmas*, 1669. though I found it to be Frost certain about $12\frac{1}{4}$, and sometimes higher than 13; yet hath it come sometimes lower than 8; and particularly *Dec.* 26. in the Morning to $7\frac{3}{4}$, and did not all that day come so high as 8 Inches. Which being so much lower, than ever it had been in any of the precedent Years of my Observation, though it may in part be attributed to the Dis-spiriting of the Liquor, yet principally to the extremity of the Cold. *Jan.* 1. when the Frost seem'd to relent, it was somewhat higher than 9; and *Jan.* 7. about $13\frac{1}{2}$.

3. The greatest height, the Spirit did rise to in the Thermometer, was two Divisions below extreme Hot, when we were near the *Aequinoctial.*

A Thermometer Observed at Sea; by Mr. Ja. Cunningham. n. 264. p. 577.

XV. Since the same degree of Heat does not proportionally expand all Fluids; some swelling with a gentle Warmth, and others not till they be considerably Hot; some boiling with a Moderate Heat, and others not at all; some capable of great Expansion, others increasing very little; it may well be concluded, that no one of them does Increase and Diminish in the same proportion with the Heat, and consequently that the Thermometers graduated by equal parts of the Expansion of any Fluid, are not sufficient Standards of Heat or Cold.

The Expansion of several Fluids, in order to ascertain the Divisions of the Thermometer; by Mr. Edm. Halley. n. 197. p. 650.

This will be more evident from the Experiments which I made (in the Months of *Feb.* and *Mar.* about 4 Years since, the Weather being reasonably

Cold and not Freezing) with Water, Mercury, and Spirit of Wine, wherein the following particulars were very remarkable.

1. I took a large Bolt-Head, holding about $3\frac{1}{2}$ *lb.* of Water, with a narrow Neck to make the Augment thereof more sensible; and having filled it with Water, and some few Inches up the Neck, I noted exactly to what Mark the Water came; then I immersed it into a Skillet of Warm water, and let it stand so long, till I concluded the Warm water had communicated it's temper to the Water included in the Bolt-Head, and I found that tho' the Water were Warm, much beyond the degree of the Summer's Heat, and notwithstanding it was Winter; yet that gentle Heat had scarce any effect in dilating the Water, so that it scarce appeared to have ascended in the neck of the Bolt-Head. Then I took the Skillet and set it over the Fire, when it was observable, that the Water as it grew Hot did slowly ascend in the Neck, especially at first; but after it began to boil in the Skillet, the Expansion thereof became more visible, and it ascended apace till such time as it stopped again, the utmost Effort of Boiling Water being able to raise it no higher. Then having made a Mark at the utmost height whereto it had arisen, I took it out, and had the satisfaction to observe, that though it was not raised so high without a very strong boiling, yet it subsided very slowly, as retaining some time the space it had acquired from the Heat, even after the Heat was pass'd, and the Glass was so cool as to be touched without burning the Fingers. However the next Morning I found it reduced to the first Mark, where it stood when at first put in, having lost nothing sensible by Evaporation during the Experiment, which I attribute to the length of the Neck wherein the Vapours were condensed into Drops before they reached the top. Then I examined how much Water would raise that in the Neck to the Mark whereto it had been encreased by boiling, and found it was a *26th* part of the bulk of the first Water, which upon repeated Experiment I found to be true; but it was obvious that Water, encreasing so very little with all the Degrees of Heat the Air receives from the Sun, was a very improper Fluid to make a Thermometer withal; and besides any freezing Liquor is useless for this purpose in these Northern Climates.

2. I took a smaller Bolt-Head with a proportional Cane or Neck, and filled it after the same manner with Mercury, and having boiled it as above, I observed that 125 Ounces of Mercury had increased the space of 810 Grains, or a *74th* part of its bulk when Cold. But it was very remarkable, that whereas a Gentle Heat had scarce any effect on Water, here on the contrary, the Mercury did sensibly ascend at first, and had almost attained its greatest Expansion before the Water boiled in the Skillet. And after it boiled, though I let it stand very long over the Fire, I could not discern that the most vehement boiling had any effect on it, above what appeared when it first began to boil. The Mercury being taken out, as it cooled subsided, and in a few hours returned to the Mark whereto it stood before it was put into the Water. This Fluid being so sensible of a gentle warmth, and withal not subject to evaporate without a good degree of Fire, might most properly be applied to the Construction of Thermometers, were it's Expansion more considerable.

However, small as it is, it is sufficient to disturb the precise nicety of the Mercurial Barometers, shewing the Counterpoise of the Pressure of the Atmosphere by a Cylinder of Mercury; for if Mercury be more expanded, and consequently lighter in Warm weather than in Cold, it will necessarily follow, that the same weight of Atmosphere will require a taller Cylinder in Summer, and a shorter in Winter to Counterpoise it. And if the Extremity of Weather do but occasion an 150th part of difference, as 'tis probable it doth, the Effect thereof on a Barometer will be a tenth of an inch above and below the Mean, or a Fifth in all.

3. I fill'd the smaller Bolt-Head with Spirit of Wine, and having set it in the Skillet of Water over the Fire, I found that it ascended gradually as the Heat increased, but slower at first, and faster after it was well warm. At length being arrived at a certain degree of Heat, it would fall a boiling with great Violence, emitting Bubbles, which coming into the Neck of the Bolt-Head, would Lift all the Incumbent Spirit, till they had made their way through. And these succeeding one another very fast, would often raise the Spirit to the top of the Neck, and spill it; so that I found I could go no further with this Liquor, than to that Degree of Heat which occasioned this boiling, and which wanted very much of that of boiling Water, being almost tolerable to the Touch. It was however very remarkable how exactly this degree of Heat was determined by the Expansion of the Spirit, for in the instant it reached a certain Mark on the Neck, it began to emit its Bubbles: and having been taken out a little to cool and subside, it would certainly and constantly fall a Bubbling again, when upon a second immersion, it was arrived at the foresaid Mark. During this Experiment, it appeared both by the dew on the Neck, and by the scent in the Room, that though the Neck were about 30 inches long, yet the Spirit did evaporate very fast for the smallness of the Surface of the Liquor: And I have often noted the like Evaporations, condensed in Dew, within the Head of the ordinary seal'd Thermometers, in very Hot weather.

This Degree of Heat which made Spirit of Wine begin to boil being determined so nicely as I have said, made me conclude that this might very properly be taken for the Limit of the Scale of Heat in a Thermometer; and the effect thereof in the Expansion of any other Fluid being accurately noted, might be easily transferred to any sort of Thermometer whatsoever. Only it must be observed, that the Spirit of Wine used to this purpose be highly Rectified or Dephlegmed, for otherwise the differing goodness of the Spirit will occasion it to boil sooner or later, and thereby pervert the designed Exactness. And by the Way give me leave to hint, that the sooner or later boiling of Spirit or Spirituous Liquors may possibly be as good a Test of their strength and Perfection as their specific Gravity, or any other yet used.

The Spirit of Wine I made use of was possibly none of the best, but I observed that at the point of boiling it had encreased a 12th part in bulk: Which great Dilatation makes it a Liquor sufficiently adapted to our purpose, were it not for the Evaporation thereof; and for the difference in goodness of the Spirit, and for that in length of time it becomes as it were Effete, and loses gradually a part of its Expansive Power.

Hist. of Cold.
Tit. 18. §. 8. p.
 475.

4. This Expansive Power is in no Fluid comparably so conspicuous as in that rare Elastick Fluid the Air; for by several Experiments that I have made, I find that the Heat of Summer does expand the Ordinary Air about a 30th part; and that late Honourable Patron of Experimental Philosophy, Mr. Boyle, alleges his own Tryals, proving that the Force of the strongest Cold in *England* does not contract the Air above $\frac{1}{20}$ part. So that the same Air which in extream Cold occupiess 12 parts of space, in very Hot Summer Weather will require thirteen such Spaces; which is as great an Expansion as that of Spirit of Wine when it begins to boil: For which reason, and for its being so very sensible of Warmth or Cold, and continuing to exert the same Elastick Power after never so long being included, in my Opinion it is much the most proper Fluid for the purpose of *Thermometers*.

Now the Thermometers hitherto in use are of two sorts; the one shewing the differing temper of Heat and Cold by the Expansion of Spirit of Wine, the other by the Air: But I cannot learn that any of them of either sort were ever made or adjusted, so as it might be concluded, what the Degrees or Divisions of the said Instruments did mean; neither were they ever otherwise graduated, but by Standards kept by each particular Workman, without any agreement or reference to one another: So that whatsoever Observations any curious Person may make by his Thermometer, to signify the Degree of Heat in the Air or other things, (which is of constant use in Philosophical Matters) cannot be understood, unless by those who have by them Thermometers of the same Make and Adjustment. Much less has the way been shewn how to make this Instrument without a Standard, or to make two of them to agree artificially, without comparing them together.

I shall only add, that whereas the Usual Thermometers with Spirit of Wine, do some of them begin their degrees from a Point, which is that whereat the Spirit stands when it is so Cold as to Freeze Oil of Anniseeds; and others from the Point of beginning to Freeze Water: I conceive these Points are not so justly determinable, but with a considerable Latitude: And that the just beginning of the Scales of Heat and Cold should not be from such a Point as Freezes any thing, but rather from Temperature, such as is in places deep under ground, where the Heat of the Summer, or Cold in Winter, have (by the certain Experiment of the curious M. Mariotte in the *Grottoes* under the *Observatory* at *Paris*) been found to have no manner of effect.

Hygrosopes; by
 n. 127. p.
 650.

Fig. 8.

XVI. 1. The *Hygroscope* I make use of, I thus contrived. I took two pieces of Deal-board (Poplar would have been better) each about two foot long, and a Foot or more in breadth, *A B*. These I got well plained and shotten, that their edges might meet even together. Of these two, set edge by edge, I fastned each end between two ledges of Oak *CC*, of two inches broad, and long enough to reach athwart both boards, (but one ledge, if it be thick enough, might be made to serve each end, by making hollow furrows or gutters in it to receive the ends of the boards) and so I fixed both boards in, as pannels are set in Wainscot. This done, supposing $\frac{1}{4}$ of an inch to be the utmost distance that

that these two boards would shrink asunder in driest weather, (for it mattered not much, though it should be somewhat more or less) I took a thin piece of Brass *D*, of two or three inches long and $\frac{1}{4}$ inch broad, and upon one edge, towards the end, I measured $\frac{1}{4}$ of an inch: (which was the utmost distance I supposed the two boards would gape asunder:) which space *dd*, I divided into five equal parts, and with a small File made them into so many fine teeth, like those of a Watch wheel. This piece of Brass I placed flat, across the juncture of the two boards, nailing its one end by means of two small holes *bb*, to the board *A* only, and leaving the other end, which is the toothed one, free and reaching to a competent distance over the board *B*, to which it had no coherence. Next I made a pinion, (consisting of as many teeth as the Brass had) *e*, upon the end of a piece of thick Iron wire: This Axle *F*, with its pinion *e*, I so fastened to the other board *B*, by means of the Brachiolum *E*, and so adapted to the teeth of the Brass-plate, that when the boards do shrink asunder, the Brass being drawn a little away, must needs turn this Axle (by means of its toothed pinion) more or less; and so if ever it happens, that the boards gape but a quarter of an inch asunder, this Axle will have made one intire revolution: Wherefore I put a long Index *GG*, upon the extremity of this Axle, and made a Circle round it with the usual graduations, numbred from what point I pleased, and the Motion of the Index back or forward, shews me the degrees of the drought or moisture of the Air. Now this Axle may be made to come through a round plate of Wood or Mettle that hides the contrivance, all but the Hand and Figure, as in a Clock or Watch. 'Tis to be noted moreover, that the boards must be fastned to the ledges, only at the outer edges, as at *aaaa*; that they may have the more liberty of swelling and shrinking asunder. Though the *Hygroscope* which I make use of be none of the best workmanship, nor exactly made after the description I have here given you, (the boards having not liberty of gaping above $\frac{2}{10}$ of an inch) yet I have oftentimes the pleasure of seeing the Index turn 10 or 20 degrees in an Hour or two, and when the Air is changed, will return as swiftly, by the shrinking and swelling of the boards.

2. *AAAA*, Is a Frame of Wood for two Pannels of Deal to play loose in at top and bottom, to which at the two ends they are fastned. *BB*, The two Pannels of slit Deal, three foot deep and three foot broad apiece, with a distance left in the middle for the scope of the Motion. *C*, The Hand, placed or fastned by the Axletree to the plate, and also with Nail holes which are to fasten it to the middle of the Pannel within half an inch of the scope for motion; at the lower or shorter end of which Axletree there is, by a wire like, an *S*, fastned a small Silver Chain within a straw's breadth of the Axletree; which Chain is to be carried and placed cross the distance between the two pannels and fastned to the pannel opposite by a Brass noose, through which it is to slip, so as that it may be taken up or let down at pleasure. *D*, The Roller with a weight annexed, which by a string is fastned to the lowest end of the hand *C*; so that as the Relax gives way, the Weight will adjust the motion of the hand to the Index *E*. *E*, the Index of Paper, pasted upon the opposite pannel to the hand, and so as it is in this Figure, placed near the top, for the better advantage of

By Mr. Coni-
ers. n. 129. p.
715.
Fig. 9.

of the Hand's motion; and this Index, being but a quarter of a Circle, is divided into inches more or fewer according to the Scope which the Pannels hand requires for their motion, but when the Relax shall require more room for the hand, then the Chain is to be taken up one Link more, and so you will be ready for more play upwards and downwards: Which taking up may yet be again repeated, when there is occasion, or the time of year requires it.

Now if the Chain be placed near the Axletree, the motion will be the nicer and larger; if farther off, then it will be less: For Example, the motion of two more than that of three, and 3 than that of 4, &c. as you may perceive by the Figures 2, 3, 4, 5, 6; which are placed in this Figure by the lower end of the hand near below the Axletree thereof.

From this contrivance it was, that I have for this 5 or 6 years past made these following Observations.

1. That these Pannels of Deal-wood will move by shrinking most in Summer, and swelling most in Winter seasons; but will vary from this, according to the Change to the then more or less Heat or Cold, moisture or drought, that the temper or season of the year, such as Spring and Fall do produce; it being then more apt to swell or shrink on the sudden, but not attaining then to the highest shrinking or swelling, as in Summer and Winter it doth.

2. That for the most part, especially in the Spring and Summer time this motion happens only in the day time; for then generally all night it rests and moves very seldom.

3. That one kind or manner of this motion happens in dry fair Weather, but sometimes in the forepart of the forenoon, and sometimes not until the latter part of the forenoon, and then at that time it relaxes or swells the Deal for about two or three hours; more, seldom; less, often; and then all the afternoon after shrinks; nay, some times even when a small rain hath newly fallen, or is then falling; and this not so often, but more seldom in Winter, or Cold moist Weather.

4. This Shrinking is gradual very often, or for the most part a little after a moist time (*viz.*) the first day after Moisture it shrinks a little, the second day more, and so yet more according to the then time of year, and as it is then inclined to moisture or drought, and alteration of the Wind and the then Heat or Cold.

5. The Winds being in the North, North East, and East, Winter and Summer, for the most part at that time the Deal shrinks in the Night also as well as in the Day; but not so much: Which is a sign of drying Weather, and sometimes of Frost or Cold in Winter; Heat or Scorching in Summer, in a clear Day. But on the contrary, the South Winds blowing, or the West and Southwest, the Deal then always relaxes that Day, or at least is at a Stay, provided this happen in the Day time; for then, if in the Night, not so much; and so this will do some considerable time before Rain.

6. By a constant Observation of this Experiment of the Deal's Motion and Rest,

Rest, you may be able to know or guess at the Winds Situation without a Weather-cock; provided you have by you a common and a seal'd Thermometer.

7. Also you may know the time of the year; for in the Spring it moves quicker and more than in Winter; in Summer it is more shrunk than in the Spring; in Autumn less in motion than in the Summer.

I shall only add, that to find whether the Moisture was rarified out of the small Cylinder-like Ends of the Wood only, or out of the Sides also; I took two pieces of season'd Deal; the Ends of the one piece I clos'd up with Diachylon Plaister, but the Sides of this Deal I did not so close up; but left these sides with the other piece without Diachylon. Both being expos'd to the open Air, they were found the next day both of them alike to have increased in proportion of Weight, which seems to prove that the Sides also do take in and let out Moisture.

In a second Contrivance, *AAAA*, is the Frame of Wood, for the Pannels of Deal to play loose in, at the top and bottom. *BBBB*, the Crosses of Deal or Iron fastned to the Frame on each side; to which is annexed the Circular Index divided into 12; in the Center of which the Axletree *b*, for the hands, is placed. *CC*, the two Pannels of slit Deal, 3 foot deep, and 3 foot broad apiece, fastned at each end of the Frame, with a distance left in the middle for the scope of the Motion. Fig. 10.

The inward work is thus contrived. *AA*, the two Hands. *BB*, the two Brass Pullies or Rollers, the one bigger the other less; to the bigger a flat Leaden weight is fastned with a Cat-gut string; to the smaller is fastned a small Silver Chain, which is by the Noose or Loop of the Brass *C*, to be fastned to the Pannel under the middle of the Cross, near the Gap or Scope for the motion; and in that noose the Chain to have a fastning to be taken up or let down at pleasure. *D*, the Roller or Pully to be placed on the other Pannel opposite to the Noose, and near the Gap or Scope, betwixt the two Pannels; over which Roller the small Chain, upon its return to the Axletree, is to be placed. *E*, the Axletree, upon which the two Rollers or Pullies *Bb*, are to be fastned, and the two hands *AA*, for the Index. *F*, the Weight annexed to the biggest Roller or Pully *B*, and the string or Cat-gut to be moved, is to have the contrary posture for motion to the small Roller or Pully upon which the Silver Chain is fastned: so that as the Shrinking of the Pannel moves the Axletree one way, the Relaxing may give way to the moving the hands or Axletree the other way by the Power of the weights drawing; which contrary postures, will give the nicest account of this Motion. Fig. 11.

The Circumference of the smallest Pully or Roller *b*, is to be no bigger than just so much scope or distance as the two Pannels make by the extremity of their utmost swelling or shrinking; and so one full Revolution of the hand upon the Index may answer the fullest shrinking and swelling in the Year, and the distance between the two Rollers or Pullies, fixt upon the Axletree, must be the thickness of your Pannels; so that the Weight is to play or move on the one side of the Pannel, and the Chain on the other, without disturbance

bance or rubbing against the sides of the Pannel or the Cross, between which, out of sight, in the middle they are to be placed.

This way was so contrived 1675, some years after the former; and so with Chain and Pullies to avoid the shaking that would happen by applying the Work of Pinion and Teeth to move the Hands; which was then also propounded to Mr. *Tompion* the Watchmaker, but by him rejected, though I think that way may be used also with a Weight added to regulate the Motion.

The Deal-board should be of the finest straightest grain'd *Dram-deal*, laid a drying in your house two or three Years.

By Mr. Molyneux. n. 172. P. 1032.

Fig. 12.

3. *AB*, is a Whipcord about four foot long, tyed fast to the end of the Hook *A*. At the end of this Whipcord there hangs the Weight *C*, about a pound or something more; this weight is so fitted at the end as to receive and carry the Index *D*. Under these there is placed a Graduated Circle on the Board *EF*, Fixt by a Bragget against the Wall.

All things being thus adapted, the Moisture of the Air twists the Rope, and gives a motion to the Index over the Divisions in the Graduated Circle; and again, as the Air grows more Dry, the Cord untwists and brings back the Index by a contrary Motion. The Reason of this is plain; for the little particles of the Moisture insinuating and soaking into the Cord are like so many Wedges, which must needs shorten the Rope, as a Bladder is shortned by being blown up and will lift a great weight, but the easiest way for the Rope *AB*, to shorten and lift up the weight *C*, is to do it by way of a Screw; for it self is a Screw, the strands thereof being twisted (and each particular thread in it) Screw-wise, and consequently must give a Circular Motion to the Index.

To make an Experiment of this, I wetted a Cord and hung it up with the weight at the end of it, and I perceived as it dryed it untwisted, and that too very quick, so as to be perceived by the Eye; after the Cord had so far untwisted, as I thought it had come to that degree of dryness, that the present constitution of the Air would permit, I took a Bason of warm Water, that sent out a Steam and Fume, and placed it under the Cord; immediately the Cord began again to twist very quick, and so continued till the Water ceased Fuming, or was removed, and then immediately it began to return its twists. I then tryed to breath upon it gently with my breath, and found according to my expectation, that 8 or 10 breathings would twist it 5 degrees of a Circle. I then permitted it to the Air only, and I find it to obey the Alterations thereof most nicely; there falls not the least shower, at which it does not presently twist; and when by Rising Clouds a fair day becomes overshadowed, the Cord is inmediately sensible thereof, and again as sensible of their vanishing and Alteration to fair Sun-shine. So that I repute it to be the nicest *Hygrometer* that has ever yet been used, and I am sure is as cheap and plain as any.

One of the grand defects of most (indeed I think of all) *Hygrometers* hitherto invented, is that they grow weak with age, and do not so nicely obey the Alterations of the Air, when long kept as when first made; but whether our present invention be subject to the same fault I leave to time to determine.

The

The Alterations also of the Air may give this kind of *Hygrosopes* more than one Turn; now this being inconvenient, and the Duplication of the Turn hard to be registred as Mr. *Hook* proposes, in his *Micrography*, concerning the Beard of a Wild-Oat; I have thought of a way for remedying this, for it being in our Power to increase the Diameter of our graduated Circle as large as we please, what need have we of more than one Turn, from the greatest degree of Moisture to the greatest degree of Drought? Now suppose I find this *Hygroscope* to have two compleat Revolutions (this is to be found by Observation throughout a whole Year,) I say then the way of rectifying it is thus. The Index *D*, has two compleat Turns, the point *A*, as being fixt, has no Turn or motion, therefore the middle point *G*, has but one Turn, and consequently if I hang it up at the point *G*, or no longer than *GD*, half the former length, the Index *D*, will have but one Turn. What is here said of two Turns and the middle point *G*, may be accommodated to any other Number of Turns and parts, and points in the Rope.

If a Candle, or Heated Iron, be applyed nigh the Rope, it makes it Twist very quick, contrary to Mr. *Hook's* Oat-beard.

We may in this Experiment perceive something that may help us in the consideration of the strength and motion of the Muscles of Animals; for take a Cord able to sustain an hundred pound weight, by the Weak Fume or Steam of Warm water this weight shall be lifted up; for if this Steam turn the weight (as most certainly it will do, if the Rope be of any moderate length, the weight is as certainly lifted up thereby as by a Screw, as is evident to any one that considers it. If therefore such mighty performances can be produced by the Application of such mean agents, as we all know and are conversant with, what shall we think is too great for those parts which God has contrived and framed in the Bodies of Animals.

4. It is Observed, that when *Oyl* of *Vitriol* is satiated in the Moistest Weather, it afterwards retains or loses its acquired Weight as the Air proves more or less Moist. Thus one Grain after its full Encrease often vary'd its *Equilibrium* so sensibly, that the Tongue of the Ballance of $1\frac{1}{2}$ inch long described an Arch of Variation to $\frac{1}{3}$ of an inch compass, (which Arch would have been $2\frac{2}{3}$ inches, had the Tongue been but one Foot in Length) even with that little Quantity of Liquor; so that if more Liquor expanded under a large Surface be used, the minutest Alteration of Weather must needs very much more affect it, and a bare pair of Scales will afford an *Hygroscope* as nice perhaps as any yet known.

This Ballance may be contrived two Ways, either such whose Pin should be in the middle of the Beam, with a very slender tapering Tongue, of a Foot or one Foot and an half long, pointing to the Divisions on a broad Arched Plate, fixt above in the Handle; or else the Scale with the Liquor may be hung to a point of the Beam very near the Pin, and the other extream made so long as to mark a large Arch on a board plac'd conveniently for that purpose. The Scale in either may be a Concave Glass of 4 or 5 inches Diameter. Lastly on the Division of the Arches should be inscrib'd the different Temperature of the Air shewn by the Liquor.

By Mr. Will.
Gould. n. 156.
p. 504.

Vid. inf.
Cap. III.

Fig. 13.

Fig. 14.

I have Reason to think that Oyl of Sulphur per Campanam, as also Oyl of Tartar per Deliquium, and the Liquor of Fixt Nitre, &c. may succeed as well.

Another; by
Mr. W. Gould.
ib. p. 505.
Fig. 15.

5. Another Hygroscope may be made of a Viol-string running upon Pullies, and suspending a Bullet fixt to the shorter End of an Index, whose other Extremity is so long as to describe a long Arch by the Falling and Rising of the Bullet upon the Stretching and Shrinking of the String, which would be more Nice were the Index fastned to the Center of the last Pully.

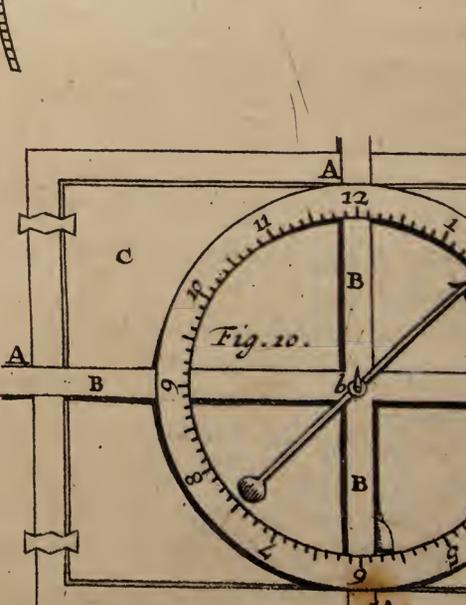
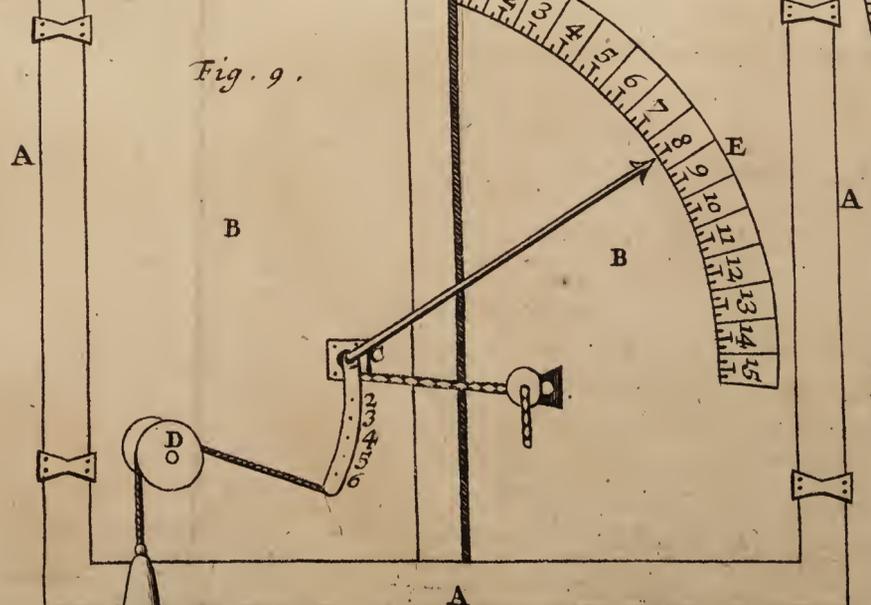
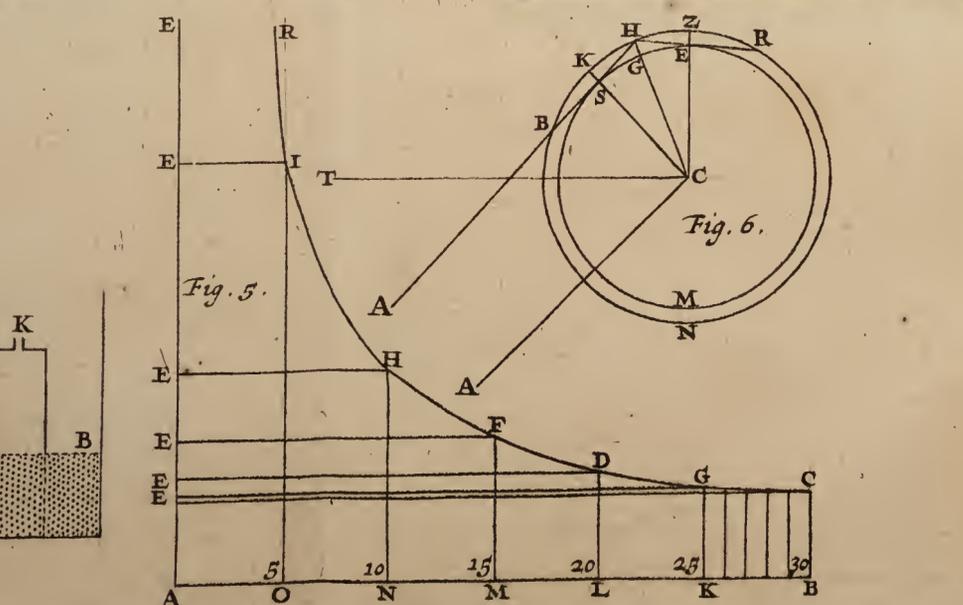
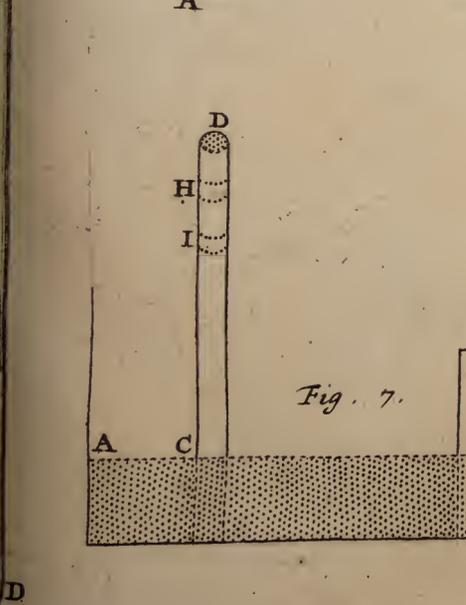
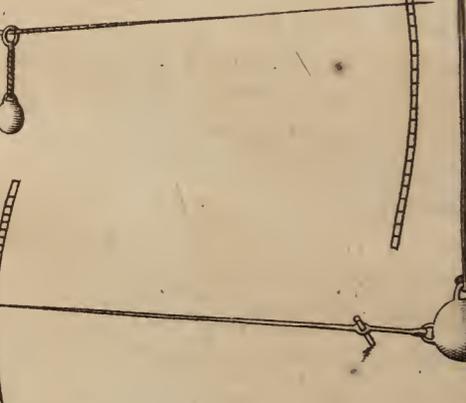
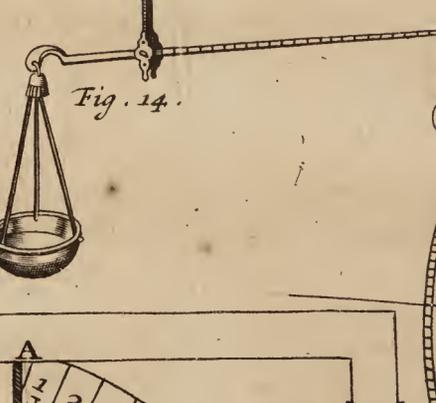
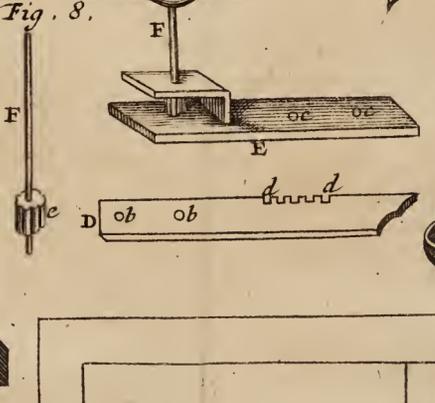
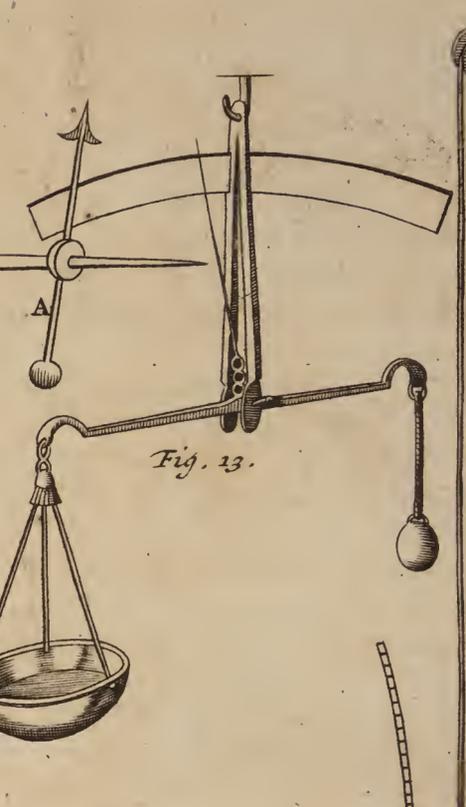
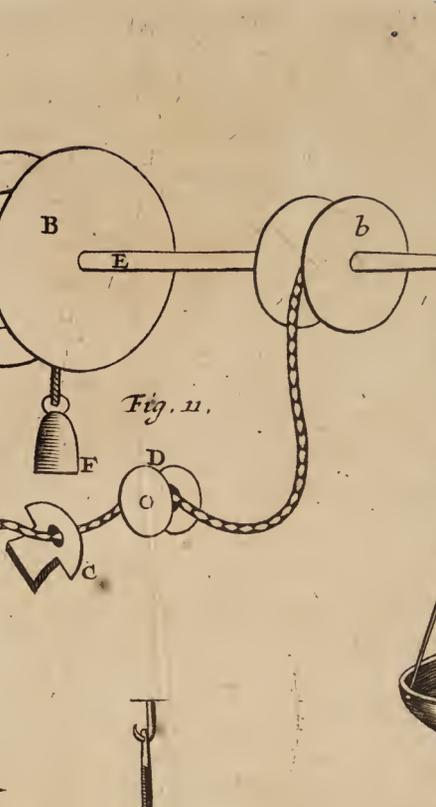
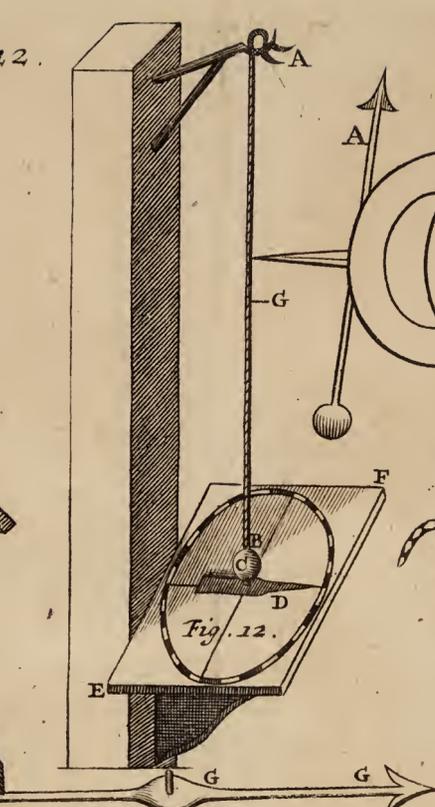
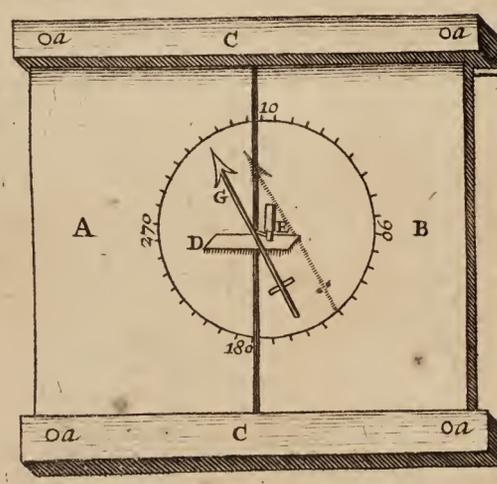
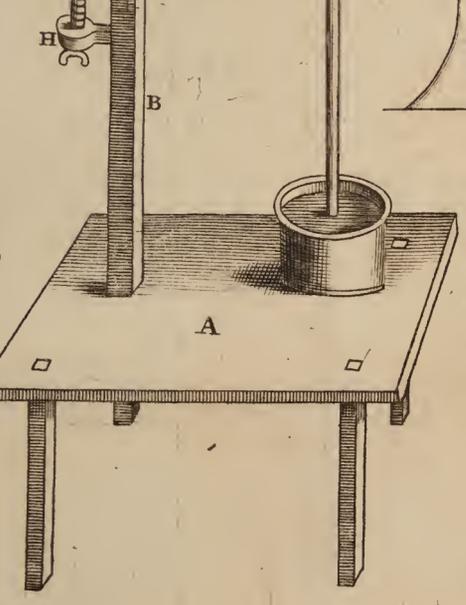
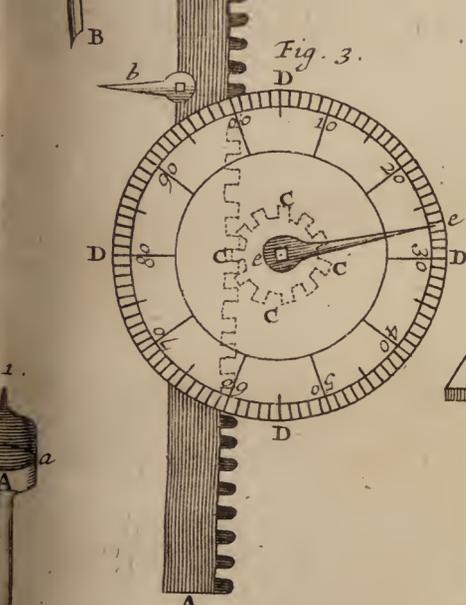
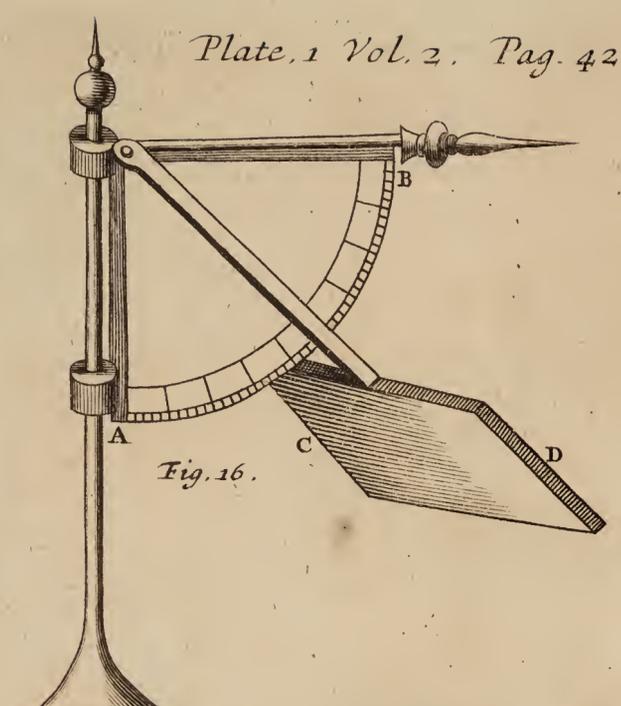
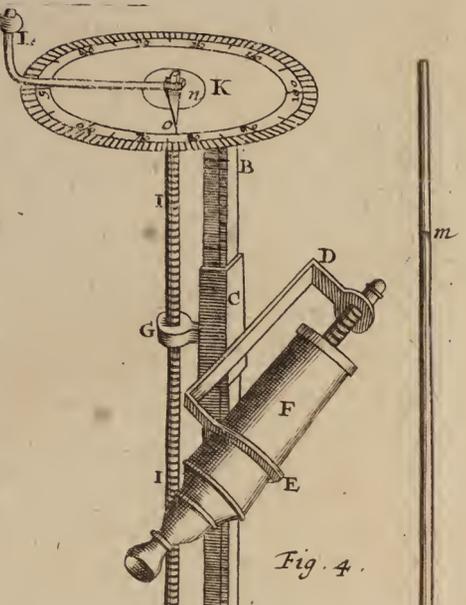
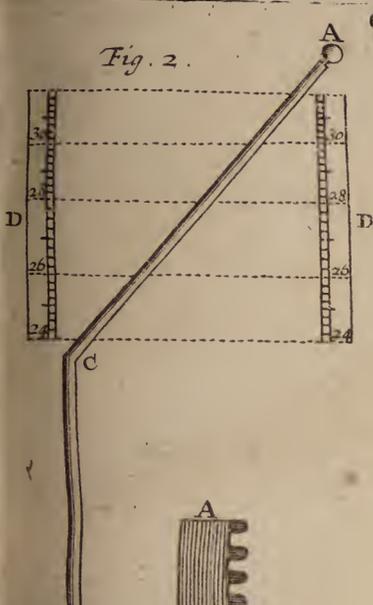
To Observe the
Strength of
Winds;
by..... n. 24.
p. 444.
Fig. 16.

XVII. Expose the Instrument *ABCD*, to the Wind, so as the flat side *CD*, may be right against it; the Number of Degrees upon the Limb *AB*, to which the Wind blows up or raises that flat side, shews the Force or Strength of the Wind, in proportion to the Resistance of the flat side of the Instrument.

Remarks con-
cerning the Gra-
dual Alteration
of the Tempera-
ture of the Air
in America and
in Ireland;
by
n. 127. p. 648.

XVIII. That in *America* (at least as far as the *English* Plantations are extended) there is an extraordinary alteration, as to Temperature, since the *Europeans* began to Plant there first, is the joynt assertion of them all. This change of Temperature, is, and not without some reason, generally attributed to the cutting down of vast Woods, together with the clearing and Cultivating of the Country. But that *Ireland* should also considerably Alter, without any such manifest Cause, doth very much invalidate that reason. For if it be true, as some Compute, that this Kingdom was better inhabited and husbanded before the late bloody War, than at present, it should, according to the reasons alledged for the Change of Temperature in *America*, be rather grown more Intemperate, viz for want of Cultivation: But the contrary is observable here, and every one almost begins to take notice, that this Country becomes every year more and more Temperate. Now whether there were more Inhabitants in *Ireland* before the late War than at present, I shall not here insist upon, neither do I think it an easy matter to determine; yet sure I am, that there hath been no such increase of People here, within these 16 or 20 Years, nor such improvements, as to be accountable for the great change of Temperature that is of late observed. Within less than the time newly mentioned, 'twas not unusual to have Frost and deep Snows of a fortnight and three Weeks continuance; and that twice or thrice, sometimes oftener in a Winter; nay we have had great Rivers and Lakes Frozen all over; whereas of late, especially these two or three Years last past, we have had scarce any Frost or Snow at all. Neither can I impute this extraordinary Alteration to any fortuitous Concourse of ordinary Circumstances, requisite to the Production of Fair Weather; because it is manifest, that it hath proceeded gradually, every year becoming more Temperate than the Year preceeding. And I Observed particularly that all the Winter 167 $\frac{1}{2}$ was very mild, and warmer than could be well expected from such a Season, and but very little Rain. Having in the whole Month of *February* not Rained above twice or thrice (at least in that part of the Country where I was then,) in so much that many took upon them to predict, that such unseasonable Weather would certainly be the Cause of some Dearth or Pestilence the ensuing Summer, or Autumn; but their Predictions proved as false as the following Harvest was extraordinary both for Health and Plenty.

This



This Winter 167 $\frac{1}{2}$. now newly ended, I have kept an exact Account of Wind and Weather, being well provided with a *Barometer*, Sealed *Thermometers*, *Hygrosopes*, &c. To transcribe my Journal here would be too tedious; Let it suffice therefore to tell you, that it hath been a very Fair and Warm, or rather no Winter at all; that we have not had above 5 or 6 Frosty Mornings this Winter, and none that lasted longer than till Noon; that we had Snow but thrice, the first before *Christmas*, the second upon the 11 th , and the third upon the 17 th , of *January*: This last, which was the longest Snow we had this Winter, continued not 48 Hours, but Thawed. All this Winter we never had 2 days of Rain together, nor above 2 or 3 that could be well called Rainy days. *Mar.* 14. we had a shower of Rain and Hail together; the Wind being South-west and calm. The Mercury in my *Barometer* (which is very slender, but carefully fill'd, and conveniently placed) is for the most part about 29 $\frac{4}{10}$ Inches high, above the Surface of the Stagnant Quicksilver; but yet doth very sensibly and frequently vary its height, according to the difference of the Atmosphere's Gravity: *Jan.* 17. (which was the day it last Snowed here) the Mercury was subsided to 28 $\frac{2}{10}$ Inches. The next Day it was 28 $\frac{6}{10}$; being towards Night somewhat blustering, and the Snow Thawed. *Jan.* 19. being Fair but very Foggy, the Mercury was at 28 $\frac{1}{2}$, which is the lowest Station it was ever at yet with me; the Wind was Westerly and Calm. The next Day it was up again to 29, and afterwards higher. *Feb.* 15. in the Morning, being Cloudy, the Wind Westerly and blustering, the Mercury was at 29 $\frac{8}{10}$; and about 11 that Night, being Fair, Clear, and Calm, it was risen to 30 $\frac{2}{10}$ inches. The next day being still Fair and Calm, it was at 30 $\frac{3}{10}$ inches; which is the utmost Height I have yet seen it at. Next Day it fell a little beneath 30, and kept, as before, for the most part about 29 $\frac{3}{10}$ or $\frac{4}{10}$, to this present; only on the 11 th of *March* it was at 30 again. Though it be observed, that Frosty and Snowy Winters make early Springs, and for as little as we have had of either this Winter, yet there hath not within the memory of any now living happened a forwarder Spring in *Ireland*; since this place could produce some store of Ripe *Cherries* in the midst of *April*. The wind keeps for the most part here between the North-west and the South, seldom at East, and yet seldomer at North or North-east, in so much that many here don't scruple to affirm, that for at least $\frac{1}{4}$ of the Year the Wind is Westerly; and we have sometimes known Passengers wait at *Chester* and *Holy-head* no less than 3 Months for a fair Wind, to come hither.

Observations of the Weather; in Ireland. 1675. ib. p. 649.

XIX. I fixed a Round Tunnel of 12 inches Diameter to a Leaden Pipe, which could admit of no water, but what came through the Tunnel, by reason of a part solder'd to the Tunnel it self, which went over the Pipe, and served also to fix it to it, as well as to keep out any wet that in stormy weather might beat against the under part of the Tunnel, which was so placed that there was no building near it that would give occasion to suspect that it did not receive its due proportion of Rain that fell through the Pipe some nine Yards perpendicularly, and then was bent into a window near my chamber,

To Measure the Quantity of falling Rain; by Mr. Townley. n. 208. p. 51.

under which convenient Vessels were placed to receive what fell into the Tunnel; which I measured by a Cylindrical Glass, at a certain mark containing just a Pound or 12 Ounces *Troy*, and had marks for smaller parts also. By the Help of this Cylindrical Glass I thus kept my account of what Rain fell, and generally twice or thrice a Day; when I took several other Observations, both of the *Thermometer*, *Barometer*, *Winds*, &c. What Rain I found in the Receivers, if not more than made what was left in the Cylindrical Glass a full Pound, I again left in it; but if there was more than that quantity, I filled it just to the Pound-Mark, which I threw away, and did the like with the remaining water, as often as it would allow, still keeping an account chiefly of the Pounds thrown away, and noting also the parts of a Pound remaining in the Glass; by the help of which latter, and the parts remaining at any time before, by numbring the Pounds and subtracting the parts at the end, (for example, of one Month,) from the Pounds thrown away, and the parts remaining at the end of another, I find the Quantity of Rain fallen betwixt these two times, and that so as to assure me that I erred no more in the quantity of Rain of another Year, than by the mistake in the differences of the parts of a Pound in the first and last Observation: Whereas should I still write down the Rain that falls between two Observations, I might be subject to make as great a mistake in every one of them, and consequently be much more uncertain of the Quantity of Rain fallen in many of those added together: Besides, this Addition is longer in performing, and giving the Quantity sought, than the Method I make use of. I have added these particulars to shew you how little trouble there is in this Task.

Observations of
the Rain, fall-
ing Monthly for
35 Years; by
Mr. Townley.
ib. p. 53.

	1677	78	79	80	81	82	83	84	85	86	Sum.
<i>Jan.</i>	472	371	43	512	53	986	238	32	110	472	3289
<i>Feb.</i>	270	371	161	492	363	135	245	483	42	20	2582
<i>March.</i>	245	250	202	413	235	237	305	87	185	572	2731
<i>April.</i>	325	170	92	222	57	308	402	370	380	305	2631
<i>May.</i>	313	581	105	188	69	315	353	97	201	437	2659
<i>June.</i>	516	257	298	342	397	517	468	192	410	473	3870
<i>July.</i>	351	335	350	302	292	482	412	313	497	188	3526
<i>Aug.</i>	485	145	835	502	425	385	582	338	398	870	4955
<i>Septem.</i>	223	527	553	146	607	293	152	199	163	572	3435
<i>October.</i>	333	644	616	570	170	427	330	425	325	293	4133
<i>Novem.</i>	432	555	127	479	235	525	192	579	522	709	4355
<i>Decemb.</i>	400	57	439	269	423	456	37	299	548	132	3051
<i>Sum.</i>	4365	4267	3821	4428	3326	5066	3716	3414	3781	5043	41227

	1689	90	91	92	93	Sum.
Jan.	333	707	197	54	218	1509
Feb.	393	171	112	168	78	922
March.	875	145	476	342	298	2136
April.	468	78	386	498	539	1969
May.	182	244	300	330	93	1149
June.	302	179	412	416	181	1490
July.	120	218	285	448	112	1183
Aug.	222	402	193	198	668	1683
Septem.	442	403	215	665	641	2306
October.	740	765	165	273	514	2457
Novem.	415	717	230	148	627	2137
Decemb.	368	262	169	892	261	1952
Sum.	4860	4291	3140	4372	4230	20893

All I have yet learnt from these Observations, as to the main point, is, that here we have almost just twice the quantity of Rain that falls at *Paris*. This County, (of *Lancaster*) and particularly that part of it (about *Townley*) where I live, being generally esteemed to have much more Rain than other Parts, and in a greater proportion then I thought reasonable to be allowed; however it be, yet by what I have sent you 'twould be unjust, without farther Observations of the like nature in other parts, that all *England* should be esteemed to abound as much in Rain as these parts do; where, by reason of the very high grounds in *Yorkshire*, and the Eastern parts of *Lancashire*, the Clouds driven hither by the *S.* and *S. W.* the general winds in this part of the World, are oftener stopt and broken and fall upon us, than such as come by an *E.* or *S. E.* wind, which broken by the Hills, are generally spent there, and then little affect us; and this is the Reason that *Lancashire* has often considerably more Rain than *Yorkshire*.

In the Table I have sent you the Pounds and parts are doubled, and these I have rather sent you than those of the whole Pounds; since the same gives both the quantity of Half Pounds, and the Height in inches, according to the general way of estimating the quantity of Rain, only with this difference, that for the Half Pounds, only the last Figure is a Decimal Fraction, and the other the number of the Half Pounds; and for the Height, the two last Figures denote the Decimal Fraction of an inch, and the remainder the height in inches, so near the truth, that they only fall short of it one inch in 200, which defect is easily supplied. To this I need only add, that the Numbers on the right hand are the Sums of all those in the same line, that is in the first part, of several Numbers for 10 Years; so that the last of them shews the Sum both of the Half Pounds that have fallen during that space of time, and the Height the Water would have been raised in that time also. To this I shall only

only add one Example: The Sum of all the Rain in the 10 first Years is 41227, and therefore according to what hath been said, 4122,7 is the number of Half Pounds that fell in the compass of the Tunnel during those 10 Years; and 412,27 the Height it would have raised the Water during that time. But if you desire to be more critical, if you add 2,06, its 200th part, you will have 414,33 for the true Height, and 41,433 for the mean Height, by those ten Years Observations; and 412,27 for the mean quantity of Half Pounds. By the same Method you will have the Means for the other five, viz. of Height 41,78, and 417,8 for the mean number of Half Pounds, which means do strangely agree, and both considered do give for the Mean by all the 15 Years 41,516 inches in Height, which is about $\frac{1}{4}$ of an inch more than double to that raised by the water at Paris, which as set down in the *Memoirs for the Ingenious*, for February last, is stated about $19\frac{1}{2}$ French inches, which make 21 English.

My way of gauging by weight is grounded upon 22,7368 Cubical inches of Rain-water being equal in weight to one Pound, or 12 Ounces Troy; so that dividing any Superficies in inches of a Vessel, for receiving the Rain-water, by the before mentioned Number, it will give you the Pounds and parts that will raise the Water upon that Superficies, with upright Sides, just an inch: And thus I found that 4,974 Pounds would fill a Cylinder equal at the bottom to my Tunnel and one inch High, which you see is very near 5 Pound, which you will also find will only raise the Cylinder higher by $\frac{1}{233}$ th part.

*A History of the
Weather at Ox-
ford, 1684; by
Dr. Plot. n.
169. p. 930.
Fig. 17.*

XX. I here give you the Observations of a full Year, made by order of the *Philosophical Society* at Oxford, not only of the Rise, and Fall of the Quick-silver, (markt by the wandring prickt Line, after Dr. Lister's Method) and the Weather; but also how the Wind stood each day. If the same Observations were made in many Forreign and Remote parts at the same time, we should be enabled with some grounds to examine, not only the Coastings, Breadth, and Bounds of the Winds themselves, but of the Weather they bring with them; and probably in time thereby learn to be forewarned certainly, of divers Emergencies (such as Heats, Colds, Dearth, Plague, and other Epidemical Distempers,) which are now unaccountable to us; and by their Causes be instructed for Prevention, or Remedies. Thence too in time we may hope to be informed how far the Positions of the Planets, in relation to one another and to the Fixt Stars, are concerned in the alterations of the Weather, and in bringing and preventing Diseases, or other Calamities; for by this means it is, doubtless, that the Learned Dr. Goad of London has arriv'd to that pitch of knowledge, he already has, in predicting Weather. This no Question was the Opinion of the Industrious Walter Merle, Fellow of Merton College, who thus observed the Weather here at Oxford every day of the Month 7 years together, viz. from Jan. 1337. to Jan. 1344; the MS. Copy of which Observations are yet remaining in the Bodleyan Library. And doubtless it was some such Consideration as this, that moved Erasmus Bartholin to make Observations of the Weather every day through the whole Year 1671. which are printed *inter Acta Medica Tho. Bartholini.*

D.	Weather. Jan. 168 $\frac{3}{4}$.	D.	Wind.	Weather. Feb. 168 $\frac{3}{4}$.
1	Hard Frost, and Fair.	1	N. E.	Frost, and Fair.
2	Frosty, but Yielding a little towards night.	2	N. E.	Frost, a little Thaw at night.
3	Rimy Frost.	3	Due E.	Frost, and Fair.
4	Hard Frost, and Fair.	4	Due S.	Close weather, and a little Thaw and Snow at night.
5	Hard Frost, and Fair.	5	S. W.	Thawing weather, Wind and Rain at night.
6	Hard Frost, and Fair.	6	Due W.	Fair Clear weather.
7	Hard Frost, but a little Yielding at night.	7	Due W.	Close Thawing Rainy weather.
8	Rimy Frost, morn. Fair all day, Windy night.	8	N. b. W.	Close weather.
9	Frost, but Snow at night.	9	Due S.	Fair in the morning, Rain and Snow at night.
10	Cold Raw weather toward noon, Rain toward night.	10	Due S.	Close Wet weather.
11	Moist Thawing weather.	11	Due S.	Fair morning, Wet at night and Windy.
12	Close Thawing weather.	12	S. S. W.	Close morning, Fair at night.
13	Moist, Close weather, a small Frost at night.	13	N. b. W.	Close morn. Fair at night.
14	Close Frosty weather.	14	W. & N.	Rainy morn. Fair at night.
15	Close Frosty weather.	15	N. W.	Fair weather.
16	Close Frosty weather, at night Windy.	16	Due S.	Rainy morning, Close at night.
17	Frost, at night Snow.	17	S. W.	Close Moist weather.
18	Snow, and Wind.	18	S. W.	Rainy and Wind.
19	Close Sharp weather.	19	Due W.	Moist morning, Fair afternoon.
20	Close <i>ut supra</i> , but a little Yielding at night.	20	W. S. W.	Open Fair weather.
21	Mild Frost, and Fair.	21	S. W.	Close weather, windy.
22	Hard Frost, Snow at night a little.	22	W. S. W.	Close Rainy weather.
23	Hard Frost.	23	Due W.	Wet morn. Fair afternoon.
24	Hard Frost, and Fair.	24	W. b. S.	Fair morning, Close evening.
25	Hard Frost, and Snow.	25	S. W.	Fair morning, Close evening.
26	Frost, a little Snow.	26	S. W.	Wet morning, Close evening.
27	Frost, a little Thaw about noon.	27	S. E.	Wet morn. Fair evening.
28	Frost, and Fair.	28	N. E.	Close Frosty weather.
29	Frost, a small Thaw all the afternoon.	29	E. b. S.	Frosty Clear weather.
30	Hard Frost, and Fair.			
31	Frost, and Fair.			

D.	Wind.	Weather. March 168 ³ / ₇ .	D.	Wind.	Weather. April 1684.
1	S. E.	Clofe Frosty Cold weather.	1	N. & W.	Fair Sun-shine weather.
2	N. E.	Clofe Cold weather.	2	W. b. N.	Rain in the morning, Fair evening.
3	N. b. W.	Clofe Frosty weather.	3	S. b. W.	Fair morning, Wind and Rain at night.
4	N. b. W.	Clofe Cold weather.	4	S. b. W.	Clofe moist weather.
5	Due N.	Clofe morning, Snow evening.	5	S. W.	Rainy weather.
6	N. E.	Clofe Cold weather.	6	Due W.	Fair morning, Wet at night.
7	N. N. E.	Frost, Fair and Windy.	7	Due W.	Fair weather.
8	N. N. E.	Frost, Clofe and Windy.	8	S. W.	Clofe weather.
9	E. b. N.	Frost, and high Winds.	9	N. W. & N.	Clofe weather, but Fair.
10	E. N. E.	Clofe Frosty cold weather.	10	N. E.	Clofe fair weather.
11	N. b. W.	Frost and fair, Clofe at night.	11	Due E.	Rain and Wind moderate.
12	Due N.	Frosty, Snowy, Windy weather.	12	N. & W.	Clofe cold weather.
13	N. b. E.	Frost morning, Fair night.	13	N. b. E.	Fair Sun-shine weather.
14	N. b. E.	Frost, Snow, and Wind.	14	E. N. E.	Fair morning, Clofe evening.
15	N. N. E.	Snow and Wind.	15	N. E. b. E.	Clofe cold weather.
16	N. N. E.	Snow and Rain.	16	E. b. N.	Clofe cold weather.
17	N. b. E.	Clofe Moist weather.	17	E. b. N.	Clofe cold weather.
18	W. b. N.	Clofe morning, Fair nights.	18	S. & W.	Variable dry weather.
19	N. E.	Cold changeable weather.	19	Due S.	Moist morning, Wet night.
20	N. N. W.	Snow, and cold high Winds.	20	S. E. & S. W.	Clofe warm weather.
21	N. E.	Clofe, but Fair weather.	21	S. E.	Fair Sun-shine weather.
22	N. E.	Fair weather, but Cold.	22	S. & N. & E.	Fair morning, inclineable to Rain at night.
23	E. b. N.	Cold fair weather.	23	S. W.	Rainy morning, Fair evening.
24	E. b. N.	Cold fair weather.	24	S. W.	Fair Sun-shine weather.
25	E. b. N.	Cold fair weather.	25	S. W.	Fair Sun-shine weather.
26	Due E.	Cold fair weather.	26	Due S.	Clofe dry weather.
27	Due E.	Cold clofe weather.	27	S. W.	Fair Sun-shine weather.
28	S. b. W.	Warm Moist weather.	28	S. W.	Clofe dry weather.
29	S. b. W.	Wind and Rain.	29	S. W.	Clofe dry weather.
30	S. b. W.	Clofe fair weather.	30	Due S.	Rain morning, Fair evening.
31	Due S.	Fair calm weather.			

D.	Wind.	Weather. May 1684.	D.	Wind.	Weather. June 1684.
1	S. S. W.	Variable weather.	1	S. W.	Clofe morning, Fair evening.
2	Due W.	Fair weather.	2	Due W.	Clofe morning, Rainy evening.
3	S. S. W.	Clofe Fair weather.	3	Due W.	Fair morning, Rainy evening.
4	W. S. W.	Clofe Fair weather.	4	Due W.	Clofe Fair weather.
5	W. S. W.	Moist morning, Fair evening.	5	Due W.	Clofe Fair weather.
6	W. S. W.	Clofe Fair weather.	6	Due W.	Clofe Fair weather.
7	W. S. W.	Clofe morning, Rain at night.	7	W. & N.	Clofe Fair weather.
8	S.S.E.&S.W.	Fair Warm weather.	8	Due N.	Fair Sun-shine weather.
9	N. W.	Clofe Fair weather.	9	Due N.	Clofe Fair weather.
10	Due W.	Clofe Fair weather.	10	N. E.	Fair Sun-shine weather.
11	Due W.	Clofe Fair weather.	11	Due E.	Fair Sun-shine weather.
12	Due W.	Misty morning, Fair evening.	12	Due E.	Fair Sun-shine weather.
13	S. & W.	Wet morning, Fair evening.	13	E. S. E.	Fair Sun-shine weather.
14	S. W.	Clofe weather, some Rain.	14	E. S. E.	Fair Sun-shine weather.
15	Due N.	Clofe Fair weather, some Wind.	15	E. S. E.	Fair Sun-shine Dry weather.
16	N. N. E.	Windy morning, Clofe evening.	16	E. S. E.	Fair Sun-shine Hot weather.
17	N. E.	Clofe Dry weather.	17	E. S. E.	Fair Sun-shine Hot weather.
18	N. E.	Clofe Fair weather.	18	E. b. N.	Sun-shine morning, Cloudy evening.
19	N. E.	Fair Sun-shine, weather.	19	E.b.N:S.S.W.	Sun-shine Hot weather.
20	E. b. N.	Clofe Fair weather, some Wind.	20	S. b. W.	A little Rain, Cloudy.
21	N. E.	Warm morning, Clofe evening.	21	S. E: E. S. E.	Lowring, some Rain.
22	N. E.	Clofe, Fair, and Windy.	22	N. E.	Fair Hot weather.
23	N. E.	Clofe, Fair, and Windy.	23	N. E.	Hot, a Muddy Sky.
24	N. E.	Clofe morning, Fair Sun-shine evening.	24	N. E.	Sun-shine Clear.
25	N. E.	Clofe Fair weather.	25	N. E.	Sun-shine Fair weather.
26	S. E.	Fair Sun-shine weather.	26	N. E.	Sun-shine Dry weather.
27	N. E.	Clofe Fair weather.	27	N. E: E.	Very Dry.
28	E. b. N.	Fair Sun-shine weather.	28	E: S. E.	Hot Lowring evening.
29	S. W.	Wind and Rain.	29	S: S. W.	Sun-shine Clear.
30	Due W.	Clofe Fair weather.	30	S. W.	Cloudy, Cool.
31	S. W.	Clofe weather, a little Rain at night.			

D.	Wind.	Weather. July 1684.	D.	Wind.	Wbeather. August 1684.
1	S.W:W.N.W.	Somewhat Cloudy.	1	N.	Warm Sun-shine weather.
2	W.	A little Rain, Fair.	2	W.	Cool Fair weather.
3	S. W.	Fair, but Cloudy.	3	S. W.	Warm Fair weather.
4	S. W : W.	Clofe, some Rain.	4	Due S.	Hot Sun-shine weather.
5	S. W.	Sun-shine morning, Gloom- my evening.	5	S. W. b. S.	Hot Sun-shine weather.
6	S. W.	Clofe.	6	S. W. b. S.	Warm Sun-shine wea- ther.
7	W. S. W.	Cool, Clofe.	7	Due S.	Rainy morning, Fair e- vening.
8	S. W.	Hazy, some Rain.	8	Due S.	Clofe Fair weather.
9	W: N. W.	Some Rain, Clear.	9	Due W.	Fair Sun-shine weather.
10	N. W.	Clear Sun-shine.	10	Due N.	Fair Sun-shine weather.
11	S. W.	Rain.	11	S. W.	Fair morning, inclinable to Rain at night.
12	W.	Some Rain, Fair evening.	12	Due W.	Rainy morning. The same in the evening.
13	W.	A shower or two.	13	Due W.	Fair Sun-shine weather.
14	W : S. W.	Cool Clofe weather.	14	Due W.	Fair Sun-shine weather.
15	W. S. W.	Rain.	15	W.	Fair Sun-shine weather.
16	W.	Cool Clofe weather.	16	W : N.	A Shower, Sun-shine wea- ther.
17	W.	Cool Clofe weather.	17	N. W.	Sun-shine morning, Clou- dy evening.
18	N: W.	Fair Sun-shine weather.	18	N.N. W: N.	A Muddy Sky in the morning, Sun-shine e- vening.
19	W. S. W.	Lowring Cool weather.	19	N: S. W.	Fair Sun-shine weather.
20	W : N. W.	Fair Sun-shine weather.	20	S. S. W.	Hot Sun-shine weather.
21	W.	Fair Sun-shine weather.	21	S. S. W.	Hot Sun-shine weather.
22	W.	Hot Sun-shine weather.	22	S. W.	Fair Sun-shine weather.
23	W: S.	Hot Sun-shine weather.	23	S. W.	Hot Sun-shine weather.
24	S: E.	Hot Sun-shine weather.	24	S. W.	Hot Sun-shine weather.
25	E. b. S.	Hot Sun-shine weather.	25	N.	Rain all day.
26	E. b. S.	Hot, a little Rain towards night.	26	S. W.	Rain at night.
27	W: N.	Hot Sun-shine weather.	27	N. W.	Clofe, some Rain.
28	W.	Hot, Thunder, Rain.	28	S. W.	Clofe weather.
29	N. N. E.	Cloudy, some Rain.	29	S. S. W.	Clofe, Rain at night.
30	N. N. E.	Fair Sun-shine weather.	30	Due S.	Variable weather.
31	N. E.	Hot Sun-shine weather.	31	S. b. E.	Clofe, some Rain.

D.	Wind.	Weather. September 1684.	D.	Wind.	Weather. October 1684.
1	S. b. E.	Cloſe, ſome Rain.	1	N. W.	Moift weather, ſome Rain.
2	Due S.	Cloſe, ſome Rain.	2	W. b. S.	Cloſe weather, but Fair.
3	S. E: W.	Cloſe, Rain, Thunder.	3	S. W.	Cloſe morning, Fair evening.
4	S. E: S. W.	Cloſe, ſome Rain.	4	S. b. W.	Cloſe all day, Rain at night.
5	Due E.	Cloſe morning, Rain afternoon.	5	W: N. W.	Rainy morning, Fair evening.
6	S. S. E.	Cloſe, ſome Rain.	6	Due W.	Rainy Windy weather.
7	N. W.	Fair Sun-ſhine weather, Rain at night.	7	S. b. W.	Rain all day.
8	N. W.	Fair Cloſe Dry weather.	8	N. N. W.	Rain morning, Fair evening.
9	N. W.	Sun-ſhine morning, Cloſe evening.	9	N: N. N. W.	Cloſe Fair weather.
10	N. W: N. E.	Sun-ſhine morning, ſome Rain.	10	N. W.	Fair weather.
11	W. b. N.	Fair morning, Cloſe evening.	11	S. W.	Windy Rainy morning, Fair evening.
12	N. W: N.	Fair morning, ſome Rain at night.	12	S. S. W.	Cloſe, and ſome Wind.
13	N. N. W.	Rainy weather.	13	S. S. W.	Cloſe, ſome Rain.
14	Due N.	Fair Sun-ſhine weather.	14	S. S. W.	Rain, and Wind.
15	N. b. E.	Fair Sun-ſhine weather.	15	S. b. E.	Wind and Rain.
16	Due N.	Cloſe Fair weather.	16	S. S. W.	Fair Sun-ſhine weather.
17	N. W.	Cloſe, and Windy.	17	S. W.	Fair Sun-ſhine weather.
18	Due N.	Fair morning, ſome Rain, Fair again.	18	W. b. N.	Fair weather.
19	Due N.	Fair morning, Cloſe evening.	19	N. W.	Cloſe morning, Fair Sun-ſhine evening.
20	Due S.	Fair Sunſhine-weather.	20	N. W.	Fair weather.
21	S. b. E.	Fair Sun-ſhine weather.	21	Due W.	Fair Sun-ſhine weather.
22	Due S.	Fair Sun-ſhine weather.	22	Due W.	Cloſe Fair weather.
23	S. b. W.	Fair morning, Cloſe evening.	23	Due W.	Fair morning, Wind and Rain at night.
24	Due W.	Fair-Sunſhine weather.	24	N. W.	Wind, Snow, and Rain.
25	S. b. W.	Changeable weather.	25	N. W.	Cloſe, Cold, and Windy.
26	Due S.	Changeable weather.	26	N. W.	Fair Froſty weather.
27	Due S.	Rainy weather.	27	N. E.	Froſt, and Snow.
28	Due S.	Cloſe Moift weather.	28	S: W: N.	Froſt, and Snow.
29	S. W.	Cloſe Moift weather.	29	N: W.	Froſty Cold weather.
30	N. W.	Cloſe morning, Sun-ſhine evening.	30	N: W.	Snow, and Wind.
			31	Due N.	Cold Thaw in the morn. Clear Froſty evening.

D.	Wind.	Weather. Nov. 1684.	D.	Wind.	Weather. Dec. 1684.
1	S. b. W: N.	Thaw, Snow, Frost.	1	N. N. E.	Frost, Sun-shine.
2	N. W: W.	Frosty morning, Thaw afternoon.	2	N.	Frost, Sun-shine.
3	S. b. W: W.	Thawing weather all day.	3	W. S. W.	Snow, much small Rain.
4	N. W.	Close, and Windy.	4	S.	Cloudy, some Rain.
5	N. W.	Close, and Windy; little Frost.	5	S.	Warm Sun-shine weather.
6	Due W.	Fair weather, little Frost.	6	S. E: E. N. E.	Misty, Thick Moist Air.
7	N: S.	Fair morning, Rain evening.	7	E. N. E.	Frost, Sun-shine weather.
8	E. b. S.	Small Rain all day.	8	E. N. E.	Moist Cloudy Air.
9	S. E.	Misty Moist weather.	9	E. N. E.	Moist Cloudy Air.
10	Due W.	Rainy Misty weather.	10	E. N. E.	Thick, Moist Air.
11	N. W.	Cloudy Moist weather.	11	E. N. E.	Fair but Cloudy.
12	S. W.	Cloudy Moist weather.	12	E. N. E.	Close.
13	S. W.	Cloudy, some Sun-shine.	13	E. N. E.	A Moist Close Air.
14	S. W.	Close, a Mist at night.	14	E. S. E.	Frost, Clear Sun-shine.
15	N. W.	Frosty morning, Close evening.	15	E: W. S. W.	Frost, Cloudy.
16	N. W.	Close morning, Clear Frosty evening.	16	N. W: N.	Frost, Cloudy.
17	N. W: N.	Hard Frost and Clear.	17	W.	Frost Cloudy, a little Snow.
18	N.	Hard Frost, Sun-shine.	18	N.	Frost, Sun-shine.
19	S.	Close, Snow, Rain.	19	W.	Thaw, Cloudy.
20	S.	Much Rain.	20	N. N. W.	Rain, Hail, Snow.
21	W.	Warm Sun-shine weather.	21	W.	Frost, Sun-shine.
22	S.	Frost, Rain.	22	N.	Frost, Sun-shine.
23	S. W.	Fair, somewhat Warm.	23	E.	Hard Frost, Windy.
24	W. S. W.	Some Rain.	24	N. E.	Frost, Sun-Shine.
25	W. N. W.	Close, Fair.	25	N.	Frost, Cloudy, much Snow.
26	W.	Fair, Warm, Close.	26	N.	Hard Frost, Sun-shine.
27	N. W.	Some Rain.	27	W.	Frost, Sun-shine.
28	N.	Cold, Cloudy, Rain.	28	N. W.	Rain all day.
29	N. E.	Fair, but Cloudy.	29	N. W.	Frost, Rain at night.
30	N.	Fair.	30	W. N. W.	Some Rain, Fair evening.
			31	E.	Fair, Cloudy.

XXI. At *Cape Corse* in the Latitude of $4^{\circ} 49'$ N. A. 1686. Nov. 24 and 25. Clear and Hot. 26. About 2. a. m. a Storm of Rain with Thunder for $\frac{1}{2}$ hour. 27. At the same hour, Rain which lasted somewhat longer. 28. About 5. a. m. some Rain, afterward Misty, and about 10 extream Hot. 29. About 2. a. m. a great Storm of Rain, flacking often, but renewing again, it lasted about an Hour; the Day after Clear.

The Weather at Cape Corse. 1686. and 1687. by Mr. J. Hillier. n. 232. p. 693.

Thence to Dec. 7. Clear; then Cloudy in the Morning; between 12 and 1. p. m. a Shower lasting about $\frac{1}{2}$ hour. Thence Clear and Hot. 10. A little Mist in the Morning, otherwise very Clear and Hot; so till 15.

15. And some Days after, somewhat Thick, especially in the Morning. 19. and 20. We had a Dry North and North Easterly Wind, call'd an *Hermitan*, and it overcame the *Sea Brize*; found very ill for the Eyes, and most Men complained of a Feverish Temper; it was Parching, but rather Colder than ordinary. 21. It ceased; a Clear Air and very Hot.

23. We had the *Hermitan* again; but the morrow it ceased; Then and 25. Some Clouds, but no Rain. Thence to 29. Clear and Hot; 29. The *Hermitan* returned, but did not continue. Thence Clouds sometimes, but no Rain till Jan. 2.

This Month we had three Funerals, one being Sick of the Flux laid violent Hands upon Himself, through Impatience of the Pain, the 3d Day. The Second upon the 25th died Convulsively, not having been Sick above one Day. The Third, Dec. 27. Died of a Dropsy, which had succeeded a Tedious Flux.

A. 1687. Jan 2. About 5. a. m. Rain for $\frac{1}{2}$ hour, between 7 and 9; an Hour; from $\frac{1}{2}$ hour past 9. to 1. p. m. the rest Cloudy. 5. At 2. a. m. about $\frac{1}{2}$ hour. 8. At 1. in the Morning about an Hour, the Days between somewhat Cloudy. Thence to 12 extream Hot.

12. and 14. Somewhat Cloudy, otherwise the Heat continued. 17. At 7. p. m. a *Tornada* for above $\frac{1}{2}$ hour, and about 12 at Night another; but the Heat very little abated.

22. Between 5 and 6. p. m. began a *Tornada*, which lasted above an Hour very violent, with great Claps of Thunder and Lightning. Tank fill'd 1. Foot. 23. In the Morning a great Mist, after 8 Clear and extream Hot.

The latter End of *January*, and the Beginning of *February* commonly Misty in the Morning; after, extream Hot.

Feb. 10. Somewhat Cloudy and Cool, till then we were troubled with Coughs, for the most part; about this time they ceased. So the 11th toward Night, Thunder afar off, and Expectation of a *Tornada*; but it fail'd. 12. Extream Hot. 13. A stronger Wind than ordinary from Sea-ward. 14. Something like an *Hermitan*, but not from its usual Quarter. Clear and Hot till about 2. p. m. then Cloudy, but no Rain. Thence to 22. extream Hot and Clear. From 22 to Mar. 1. some flying Clouds without Rain; Sultry Hot and unwholesome.

24. Some shew of a *Tornada*, but it past away.

This Month we had two Funerals.

The Beginning of *March* as the latter end of *Feb.* 5. From 6. *a. m.* for an Hour and $\frac{1}{2}$ a Violent *Tornado*; the Day after Cloudy. 6. Clear. 7. At Night Lightning and Clouds afar off; but nothing followed. Thence to the 11. Clear and Hot.

11. About 5. *a. m.* a violent Rain for almost $\frac{1}{2}$ hour. 12, and 13. Cloudy. 14. About 4. *a. m.* a gentle shower, but lasted not long. 15. Between 6 and 7. *a. m.* a few Drops, and likelihood of more, but nothing followed; both Days Cloudy. 16. Extream Hot. 17. Somewhat Cloudy. Thence to 20. Extream Hot.

20. Cloudy; about 10. *a. m.* some few Drops. 21. Very Hot. 22. In the Morning Hot; about 12 a violent Rain for a Quarter of an Hour. 23. Clear. 24. About 2. *a. m.* Rain for about $\frac{1}{2}$ hour; the Day after Clear. Thence to *April* 3. Clear and extream Hot.

No Funeral.

Apr. 3. At 3. *p. m.* a violent *Tornado*, but only some few Drops of Rain; at 5. *p. m.* a little more Rain. 4. Cloudy by fits, otherwise very Hot. 5. Hot and Clear. 6. In the Morning Hot, about 2. *p. m.* Cloudy; about 3. some Drops of Rain, in the Evening the Clouds dispersed. 7. Clear and Hot. 8. Between 12 and 1. in the Morning, a violent Rain for near an hour; after 2, one somewhat longer; the Day after there appeared to have been much Rain; Tank fill'd 2 Foot and somewhat more. 9. About 7 *a. m.* Some Drops, Cloudy all Day.

10. Cloudy, about 11. *a. m.* a small Mist. 11. Presently after Midnight it began to Rain, and lasted till 6. *a. m.* a great part of the time very violently, it began with a strong *Tornado*; Tank above 3 Feet. The Day after some Clouds; otherwise extream Hot. So also 12, and 13. 14. About 5. *a. m.* a Shower for $\frac{1}{2}$ Hour, between 6. and 7. *p. m.* another of the same Continuance, the Day between extream Hot. So 15. 16. A Shower for $\frac{1}{2}$ hour; it began with a violent *Tornado*, the Rain not much, afterwards Cloudy. 17, and 18. Clear. 19. Clear also, about 7. *p. m.* a considerable Wind, and some Drops of Rain.

20. Clear but Windy. 21. Between 12 and 2. moderate Rain for near an hour. 22. About 2. *a. m.* moderate Rain almost an hour; at 11. *p. m.* a short Shower, and gentle; the Day between extream Hot. 23. Cloudy, about 10. *a. m.* some Drops. 24. Extream Hot. 25. About 1. *a. m.* Rain for near an hour; the Morning after Hot; Afternoon Cloudy; most part of the Night, Thunder and Lightning, but no Rain. 26. At 7. *a. m.* strong Rain for $\frac{1}{2}$ Hour, after that a little Mist; Afternoon from 12 to 3. it rained unequally, but the most part moderate. 27. Extream Hot. 28. About 12 somewhat Cloudy, at 3. *p. m.* it began to Rain, and lasted about an hour and $\frac{1}{2}$; after, Cloudy and some Drops, in the Night a Shower or two. 29. Cloudy. Thence to *May* 6. sometimes Cloudy; but for the most part violent Hot.

This Month we had 3. Funerals; one the 3^d of a Fever, another on the 19th of I know not what Pains in the Guts; another on the 24th, of the Flux.

The 15. and some Days following, there settled upon the Castle Walls, certain swarms of Winged Ants, a little bigger than Bees; they would bite very severely, and were blown up with Powder.

May. 6. In the Morning Cloudy, a little after Noon some Wind, followed by gentle Rain, which lasted till 3. *p. m.* after, Cloudy. 7. Hot. 8. Cloudy, about 10. *a. m.* a gentle Shower for $\frac{3}{4}$ hour; about 8. *p. m.* a very violent Storm of Wind and Rain, but it quickly grew moderate, and lasted in all not above $\frac{1}{2}$ hour. 9. Clear. 10. About Noon a violent Shower for $\frac{1}{4}$ Hour; after 8. *p. m.* another as long, but not so violent; past 9. another shorter.

11. Clear. 12. Clear; past 9. *p. m.* a very violent *Tornada* with Rain, which lasted somewhat more than 2 Hours. 13. Between 12 and 1. in the Night, a short Shower; about 9. *a. m.* some Drops; so also in the Afternoon, but nothing considerable; cloudy all Day. 14. Cloudy; at 9. *a. m.* a violent Rain for $\frac{1}{4}$; after, gentle for above an hour; about 3. *p. m.* some Drops. 15. About 3. *a. m.* Rain for $\frac{1}{2}$ hour; between 4 and 5, another; after, Foggy and Cloudy, with some few Drops; about 7. *p. m.* a violent *Tornada* with Rain for near an hour. 16. About 4. *a. m.* Rain for an hour; after 8. for $\frac{1}{4}$ hour; after 6. *p. m.* Rain and Wind, but both moderate, for $\frac{1}{2}$ an hour; past 8. about as much. 17. About 4. *a. m.* a short Shower; after, Clear. 18. Clear. 19. Cloudy; about 10. *a. m.* some Drops.

20. Cloudy; between 8 and 10. *a. m.* a Shower; first violent, after more moderate, till it ended in a kind of Mist; it lasted in all about $1\frac{1}{2}$ hour; the Day after Clear. 21 and 22. Clear. 23. In the Afternoon Cloudy; about 6. *p. m.* some Drops; the Night after, a Shower not considerable. 24. Hot, about 10. *p. m.* a little Shower. 25. Clear. 26. In the Night some little Rain. 27. Held up. 28. at 9. *p. m.* a short Shower. 29. At 5. *a. m.* Rain till near 7; a little past 7 till 9. after Cloudy. 30. Cloudy; the Night after, some Rain. 31. About 8. *a. m.* Rain for $\frac{1}{2}$ hour; from 9 till 12. it Rained for the most part very violently; before 1. another Shower for $\frac{1}{2}$ hour; from a little after 2 till 5. with very great Thunder.

One Funeral on the 25th, after but 3 Days Sickness.

The Beginning of this Month, we had an extraordinary Number of Toads, which after sometime were not to be seen. The 14. We had winged Ants as before.

24. Was the First Corn, the Seed-time having been the middle of March.

Jun. 1. About 4. *a. m.* Rain for an Hour; past 1. *p. m.* for $\frac{1}{2}$ hour; the rest Cloudy and Misty. 2. From 2. *a. m.* till 5. continual Rain, 'tis said there was some before; from 9. *a. m.* till $\frac{1}{2}$ hour past 6. *p. m.* continual Rain, sometimes very fierce; from $\frac{1}{2}$ hour past 9. at Night, Rain till past 10. 3. From 6. to a little past 7. *a. m.* a very gentle Rain, from thence till 1. *p. m.* most commonly very fierce; thence for a little while more moderate, but it rained hard again till 6. *p. m.* then it droped but slowly, and so continued till about 7. In the Night some little Rain. 4. About 8. *a. m.* some Drops, thence
Clear

Clear. 6 and 7. Clear, except some few flying Clouds. 8. After 3. *a. m.* gentle Rain for near an hour; then Cloudy and some Drops, after 10. *p. m.* a Shower. 9. At 5. *a. m.* a gentle Shower, lasted till past 7; thence a very violent Rain till almost 9; some Drops after that; about 3. *p. m.* it began and rained till past 10, somewhat moderately. 10. Clear and Hot.

11. Cloudy; about 8. *p. m.* a few Drops. 12. From about 2. *a. m.* till near 5, Rain, but not violent; a little before 6. a furious Storm of Rain, but little Wind; it lasted till $\frac{1}{2}$ hour past 7. About 3. *p. m.* a moderate Rain, till a little past 4. And from thence to 6. somewhat more than a Mist; the Night after it Rained a little. 13. Cloudy; in the Afternoon it drop'd a little. 14. About 8. *a. m.* a few Drops. 15. Somewhat Cloudy. 16. Extream Hot; toward Night Cloudy; about 5. *p. m.* a violent Shower for $\frac{1}{2}$ hour; from a little before 8. till past 10. it rained continually. 17. From 4. *a. m.* till almost 6. gentle Rain; so from a little past 6 till past 7. thence till past 3. *p. m.* Cloudy, and now and then some Drops; then a violent Shower for $\frac{1}{8}$ of an hour; half an hour after 4 it rained again, and continued till past 10. for the most part very furiously; with some little intermission it rained all Night. 18. At 3. *a. m.* It rained very fiercely; about $\frac{1}{2}$ hour after 6. it held up, but Cloudy still; from 8. *a. m.* till past 3. *p. m.* it rained, but moderately; then it held up a little, but Rained after till past 6. all Day Cloudy, and at Night a great Fog. 19. About 9. *a. m.* some Drops; from 1. till past 3. *p. m.* very gentle Rain.

Thence to the first of *July*, Foggy, Morning and Evening, sometimes Hot, but for the most Cloudy, and more Temperate than could be expected from the Climate

Two Funerals, one the 9th of an Asthma; The other the 21st of a Fever.

We saw some sorts of Insects not usual here, whether Monstrous or not I cannot tell. The most notable, a kind of Spider about the Bigness of a Beetle, the Form nearest of a Crab Fish, with an odd kind of Orifice Visible in the Belly, whence the Web proceeded.

Jul. 1. Extream Hot. 2. Foggy in the Morning; about 9. *a. m.* a few Drops; after, Clear. 3. In the Morning a great Fog; about 9. *a. m.* it rained small Rain for near an Hour; Toward Night more Foggy than ever before; about 6. *p. m.* small Rain for a litte time; from 8 till past 9. somewhat more brisk Rain, after that it cleared up. 4. From 9. *a. m.* to 3. *p. m.* small Rain, the rest Foggy; between 10 and 11. *p. m.* some Rain. 5. From 2. *a. m.* till past 8. constant Rain, sometimes very fierce, sometimes moderate; about 10. *a. m.* some Rain; between 2 and 3. *p. m.* it began to Rain, but continued not long; from 8. *p. m.* to 10. Rain. 6. From about 2. *a. m.* to 6, Rain; after, fair. 7. Foggy and Cloudy; between 7 and 8. *a. m.* some Drops. 8. Foggy in the Morning, otherwise clear and Hot. 9. About 1. *a. m.* a smart Shower, between 3 and 5, some more Rain. The Day after Foggy.

Foggy. 10. Very Dull and Cloudy; from 3. *p. m.* till Night, a very great Mist.

11. Tolerably Clear, and very Hot, yet somewhat Foggy Morning and Evening. 12. Cloudy; thence to 15. in the Morning and Evening Foggy; else very Hot. 15. Cloudy; about 10. *a. m.* some Drops; from $\frac{1}{2}$ hour past 2 till 4, moderate Rain; about 7, some Drops. 16. Cloudy, several times it dropped a little, but nothing considerable. 17. A little before Day, a short Shower; after, Cloudy; thence to 20. Foggy Morning and Evening, and the most part Cloudy.

20. Very clear all Day, and extream Hot. 21. Not Foggy at all; yet somewhat Cloudy, but about Midday it cleared up. 22, and 23. Very clear and extream Hot. 24. Cloudy in the Morning; after, as the Two last. 25. Cloudy, but not Misty nor Foggy; Sultry Hot. 26. In the Morning Cloudy; after, extream Hot. 27. Hot and clear. 28. Thin clouds, through which the Sun shone very Hot. 29, and 30. Cloudy. 31. About 3. *a. m.* Two short Storms of Rain, the Day after Clear and Hot.

Two Funerals; one the 17. Drowned; the other 21. of a Feaver.

Aug. 1. to 5. Clear, for the most part in the Mornings Cloudy; but without Fogs; sometimes very Hot. 5. About 5. *a. m.* a Shower near an hour long, about 7 another for $\frac{1}{2}$ hour; till 10, some small Rain; thence Cloudy till 1. about 7. *p. m.* a few Drops. 6. Cloudy all Day, sometimes it dropp'd a little. 7. About 2. *a. m.* Violent Rain with Wind for above $\frac{1}{2}$ hour. The Day after, Cloudy. 8, and 9. Cloudy and Foggy. 10. More Foggy than ordinary; about 10. *a. m.* a great Mist, or small Rain for most part of the Day after.

11. Foggy as the former and Misty; between 8 and 9. *a. m.* a Shower of small Rain; Afternoon, Clear. 12. Small Rain in the Morning; after, as 11. 13. Clear and Hot, the *Land Brize* very strong. 14. Cloudy all Day, the *Land Brize* turn'd to a kind of *Hermitan*, but not troublesome, nor continued beyond this Day. 15. Cloudy, several times very Misty, and some small Rain. 16. Cloudy, but no Mist; Afternoon, Clear. Thence to 22. Clear and Hot, but the Nights Colder than at other times.

22. At 6. *p. m.* Cloudy, a Wind *Tornada* but moderate, with some Drops of Rain very large. 23. Clear and Hot. 24. Cloudy and Misty at first; about 10. *a. m.* Clear and Hot. 25. Clear and Hot. 26. Very Foggy, Morning and Evening; for the rest, Hot. 27. From 5. to 10. *a. m.* it Rained smartly; thence Cloudy; about 2. *p. m.* it cleared up for a while; about 9. *p. m.* a sharp Rain for $\frac{1}{2}$ hour. 28. Between 12. and 3. *a. m.* it Rained about two Hours; about 7 some few Drops; after, Cloudy; in the middle of the Day it Cleared a little, but quickly Overcast again. 29. In the Night some Rain; at 7. *a. m.* Rain for $\frac{1}{2}$ hour; till past 12 a very thick Mist; about 3. *p. m.* Clear; at Night a very thick Mist. To the End Cloudy and Misty.

Three Funerals; 6. one of a Feaver; 7. another of a Consumption; 29. a third of a Feaver.

Sept. 1, and 2. as the last. 3. Some few Drops. Thence to 8. Cloudy also and Misty. 8. About 6. *p. m.* some small Rain; between 8, and 10 *p. m.*

for an hour pretty brisk Rain. 9. In the Morning Cloudy and Misty. 10. About 10. *p. m.* a little Rain.

11. Extream Hot and Clear; in the Night considerable Rain for several Hours. 12. About 10. *a. m.* some small Rain, the Morning very Foggy, Afternoon Clear. 13. Clear and Hot. 14, and 15. In the Morning Extream Cloudy, and some Drops of Rain. 16. Clear and extream Hot. 17. Moderate, about 7. *p. m.* some Drops; at Night also some Rain, not considerable. 18. Cloudy; in the Morning about 12, some Drops; all this Week, Morning and Evening Foggy and Thick. 19, 20, 21. Extream Hot; the Fogs ceased.

22. About 1. *a. m.* some Rain, the Day after Cloudy. 23, 24, 25. In the Morning Cloudy; after, very Hot. 26. At Night also somewhat Misty, with many Flashes of Lightning, but no Thunder. The like Flashes most Nights to the End of the Month; also often Cloudy; at other times extream Hot.

Two Funerals; One 19. of a Fever; the Other 26. whose disease I do not know.

Octob. 1. About 3. *a. m.* a very fierce Rain for near an Hour, milder towards the End; the Day after some Flying Clouds. 2. About 4. *a. m.* a little Rain, the Day after as before; from 8. *p. m.* till 10. moderate Rain. 3. Cloudy; about 10. *a. m.* Rain for somewhat more than an hour. 4. Cloudy between 8. and 10. *p. m.* a very smart Rain for above an Hour. 5. About 9. *a. m.* a little Shower. 6. About 5. *a. m.* a little Shower; another past 6. The Day after, and 7. extream Hot. 8. Hot in the Morning; after Noon a Shew of a *Tornada*, with Thunder, and a considerable Wind, but no Rain.

Thence to 16. some flying Clouds, but generally Hot. 16. About 4. *p. m.* a little Rain, the Sun shining then, and the whole Day very Hot; about 8. *p. m.* a very strong *Tornada*, Wind and Rain for about $\frac{1}{2}$ hour, afterward the Rain continued, but more moderate, for near two hours. 17. Clear and Hot. 18. So too, except that about 3. *p. m.* there was a very short Shower. 19. and 20. somewhat Cloudy.

21. About 7. *a. m.* a few Drops; after, Clear and extream Hot, but quickly Cloudy again; at 11. *a. m.* a violent *Tornada*, with very strong Rain and Thunder for near an hour; thence all the time till Night, thick and Misty; till 2. *p. m.* Rain. 22. Cloudy. 23. Clear and Hot. 24. Somewhat Cloudy; at 7. *p. m.* a little Rain. 25. Cloudy; about 11. *a. m.* Expectation of a *Tornada*, with some Thunder, but it ended in a few Drops of Rain about 1. *p. m.* 26. About 2. *a. m.* a very violent *Tornada*; and after the Wind, Rain not very fierce, which lasted till 8. *a. m.* the Day after Cloudy. 27. About 10. *p. m.* a violent Wind with Rain, but it lasted not long. 28. About 3. *a. m.* a strong Rain for near an hour; the Day after, extream Hot. 29, and 30. Hot yet with some Clouds. 30. Half an Hour after 11. *p. m.* began a very furious *Tornada*, the Wind was quickly over, but the Rain lasted with extream Violence about 2. hours. 31. In the Morning very Hot; about 2. *p. m.* a violent *Tornada*, with Rain and Thunder very near; it ceased

ceased sometimes, but beginning again, lasted till near 4. *p. m.* afterward Cloudy.

Three Funerals, all upon the 6. Day; Two of Feavers, the Other I know not.

Nov. Clear and extream Hot till the 6th. 6. About $\frac{1}{2}$ hour past 1. in the Morning, a very violent Rain for more than an hour.

Thence to 14. except that the 11th at Night there were some few Drops, very Hot.

14. Extream Hot, about 9 *p. m.* a little Shower; the same Night about 1. a smart Rain for an Hour and Half. 15. Hot; toward Night Cloudy and Foggy. Thence to 19. very Hot. 19. Some likelihood of a *Tornada*; but nothing followed.

20. About 1. *p. m.* a short Shower, about a quarter past 2. another not much longer; till Night Cloudy. Thence to 26, no Rain, but Cloudy and somewhat Cooler; yet some days extream Hot. 26. About 10. *p. m.* a short Shower. 27. About 2. another; the rest Clear. 30. About 2. *a. m.* fierce Rain for about $\frac{1}{2}$ hour.

This last Year has been the Wetteft and most Cloudy of any that can be here Remember'd, yet the Air has been Clearer than it uses to be in *England* one Day with another.

ib. p. 691.

A *Tornada* is a Violent Storm of Wind, followed commonly by Rain, but not always; the Wind ceases not presently upon the Rain; but after, sometimes it does: In this Place it comes (as does an *Hermitan*) most frequently from the North, taking in the next Points, whether to the East or West, but chiefly the East, though I have seen both that and an *Hermitan* from other Points; so the Account is not without Exception. There are in it short uncertain Blasts from all Quarters, which I believe reach not many Yards, but the General Wind (for ought that I see) is not so unconstant; Vessels that go to Windward are helped by them, when they are not over strong, for they are Opposite to the *Sea Brize*, and they can Steer by them a Regular Course; which sure they could not do, if they were very Irregular. They never fail to give Warning beforehand, though sometimes after that Warning they do not follow; there is a very black Cloud appears afar, in which if there be a kind of white Spot, the Wind will be most, if not the Rain; this the Sailors say. Sometimes there is that Mark, sometimes not, though I doubt the Prediction from it is not very certain; as neither are any perhaps of that kind.

ib. p. 692.

XXII.

The Rain at
Gresham Col.
London. 1695,
and 1696. n.
223. p. 357.

M.	D.	lb	ʒ	gr.	M.	D.	lb	ʒ	gr.	M.	D.	lb	ʒ	gr.
Aug.	19	2	6	216	Jan.	6	4	10	105	May	4	4	10	45
	26	4	6	246		13	0	1	12		11	7	6	0
						20	1	10	450		18	5	2	105
Sept.	2	0	4	96		27	1	5	82		25	1	7	60
	9	3	10	397	Feb.	3	6	11	372	Jun.	1	0	0	99
	16	0	1	204		10	4	9	242		8	5	6	150
	23	0	6	336		17	0	6	291		15	0	2	120
	30	4	1	444		24	0	2	180		22	7	5	285
Oct.	7	2	3	96							29	1	5	84
	14	0	2	60	Mar.	2	0	9	12	Jul.	6	0	1	120
	21	0	1	234		9	0	2	459		13	16	1	0
	28	0	0	458		16	0	0	396		20	1	7	240
Nov.	4	0	0	207		23	4	4	263		27	5	1	256
	11	1	11	65		30	1	5	285	Aug.	3	1	10	120
	18	1	1	309	Apr.	6	2	4	375		10	1	11	90
	25	0	9	285		13	1	0	294		12	0	0	0
Decem.	2	0	8	126		20	2	2	000					
	9	3	7	324		27	0	7	390					
	16	1	3	435										
	23	0	1	60										
	30	5	8	93										

This Account of the Quantities of Rain fallen in one Year in Gresham College, Lond. per Month, begun Aug. 12. 1695 and the Rain was weigh'd every Monday morning till Aug. 12. 1696. by Pounds, Ounces, and Grains, Troy Weight: The Diameter of the Vessel which receives the Rain being 11.4 Inches, whose Area is a little more than 102,1 Inches.

lb ʒ gr.

The Sum amounted to 131. 7. 113. which is equal to 29,11 Inches in a Cylinder of the aforesaid Diameter, viz. 11,4 Inches.

Fig. 18.

ABCD, is a Frame to support the Glasses. E, is a large bolt Head, with a Neck of 20 Inches long, and capable of holding above two Gallons. F, is a Funnel, whose Diameter is 11 Inches, and $\frac{4}{10}$, from G, to H. I, K, Are two Stays, or Pack Threads, which are strained by two Pins, L, M, to hold the Tunnel steady against the High Winds. N, The Pipe of the Tunnel, at N being no wider than $\frac{1}{2}$ of an Inch, through which the Evaporation can be but little.

JANUARY. 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	8	Frost	W. S. W.	30 07	
	12			30 07	
	9	Fair		30 04	
2.	8			30 05	
	12	Misling	S.	30 06	
	9			30 05	
3.	8	Fog	S. b. W.	30 07	
	12	Cloudy	S.	30 11	
	9			30 15	
4.	8			30 18 0	50
	12	Misling	S.	30 18	
	9			30 18	
5.	8	Calm	W. b. S.	30 22	
	12	and	S. W.	30 23	
	9	Cloudy		30 26	
6.	8	Fog		30 22	
	12	Warm	W.	30 00 0	30
	9	Misling		30 14	
7.	8		W. b. N.	30 05	
	12	Cloudy	N. W.	30 05	
	9				
8.	8		N. W.	29 94	
	12	Cloudy	N. W.	29 90	
	9			29 82	
9.	8	Sun-shine		29 51	
	12	Rain	S.	29 38	
	9	Snow		29 10 1	20
10.	8	Frost	S. W.	29 02	
	12	Thaw	S.	29 00	
	9	Rain	S. b. E.	28 95 0	70
11.	8	Cloudy		29 46	
	12	Fair	N.	29 00	
	9			29 77	
12.	8		N.	29 83	
	12	Sleet			
	9				
13.	8				
	12	Cloudy			
	9			29 91	
14.	8		N. E.	29 96	
	12	Snow	N. E.	29 96 0	20
	9		E. N. E.	29 98	
15.	8	Frost	E. N. E.	29 94	
	12	Cloudy	E.	29 92	
	9			29 90	
16.	8	Frost	E. N. E.	29 90	
	12	Cloudy	N. E. b. N.	29 91	
	9			29 94	

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	8	Frost	N.	30 02	
	12	Cloudy	N.N.W.	30 02	
	9	Calm		30 04	
18.	8	Frost	W.	30 09	
	12	Fair	S. W.	30 10	
	9			30 10	
19.	8				
	12				
	9				
20.	8	Fair			
	12	Frost			
	9	Cloudy	S.W. b. W.	30 20	
21.	8				
	12				
	9				
22.	8	Cloudy	W.	29 95	
	12	Thaw	W. b. N.	29 90 0	08
	9	Rain		29 95	
23.	8	Frost	N.W.	29 90	
	12	Snow	N.W.	29 80 0	30
	9	Fair	N.N.W.	29 68	
24.	8	Snow	N.W. b. W.	29 64	
	12	Storm	N. E.	29 67 0	20
	9	Snow.	N. b. E.	29 95	
25.	8	Frost	E.	29 95	
	12	Fair	E. b. N.	29 97	
	9		N. E.	29 98	
26.	8	Sharp	N. E.	29 96	
	12	Frost	N. b. E.	29 96	
	9		N. N. E.	29 86	
27.	8			29 77	
	12	Frost	N. E.	29 77	
	9			29 77	
28.	8	Cloudy	S.	29 69	
	12	Frost	N. E.		
	9			29 60	
29.	8	Snow		29 47	
	12	Thaw	S. W.	29 31 0	08
	9			29 29	
30.	8	Frost	S. W.	29 41	
	12	Fair	W.	29 50	
	9		W. b. S.	29 54	
31.	8	Frost	W.	29 77 0	05
	12	Fair	N.N.W.	29 86	
	9		N. b. W.	29 95	
				Total	3 61

XXIII.

The weather
1697 at Up-
minster, in
Essex; by
Mr. Will.
Derham. n.
237. p. 47.

F E B R U A R Y. 1697.

D.	b.	Weather.	Winds.	Barom.	Rain.
1.	7 12 9	Frost		30 06	
2.	7 12 9	Cloudy Frost	N. E.	30 05 29 95	
3.	7 12 9	Cloudy Frost Calm	N.E.b.E. E. S.	29 75 29 66 29 50	
4.	7 12 9	Cloudy Thaw Sleet	E. b. S.	29 30 29 26 29 20	0 02
5.	7 12 9	Snow Fair Frost	E.	29 20 29 20 29 19	0 03
6.	7 12 9	Frost Cloudy Snow	N. b. E. N.	29 05 29 02 28 90	0 03
7.	7 12 9	Snow Cloudy	N. W. b. S. S. b. W.	28 86 28 83 28 83	0 01
8.	7 12 9	Fairer Sleet	S. W.	28 82 28 84 28 97	0 01
9.	7 12 9	Thaw Frost	S. W.	29 10 29 18 29 25	
10.	7 12 9	Frost Fair	S. W. S.W.b.W.	29 43 29 52 29 61	
11.	7 12 9	Snow Rain Fair	S. b. E. S. E. E.	29 65 29 76 29 94	0 27
12.	7 12 9	Cloudy Frost	E. b. S.	30 08 30 08	
13.	7 12 9	Thaw Warm Cloudy	S.	30 00 30 00 29 95	
14.	7 12 9	Calm Rain	S. S. b. W. S.	29 88 29 87 29 80	0 40
15.	7 12 9	Mist Warm Rain	N. N. W. E.	29 85 29 86 29 80	0 30
16.	7 12 9	Cloudy Fair	S. b. E. W. S. W.	29 54 29 62 29 60	0 28

D.	b.	Weather.	Winds.	Barom.	Rain.
17.	7 12 9	Rain Fair Rain	S.	29 50 29 52 29 52	0 20
18.	7 12 9	Cloudy Blustering Fair	S. b. E. S.	29 30 29 26 29 42	
19.	7 12 9	Rain Fair	E. b. S. S.	29 30 29 33 29 39	0 05
20.	7 12 9	Frost	S. E. E. b. S. E.	29 46 29 46 29 40	
21.	7 12 9	Fair	E.	29 36 29 37 29 45	
22.	7 12 9	Rain Fair	E.	29 47 29 48 29 52	0 03
23.	7 12 9	Hoar-Frost Fair Rain	E. S. S.	29 52 29 54 29 60	
24.	7 12 9	Fair Rain	S. b. W.	29 68 29 75 29 81	0 04
25.	7 12 9	Cloudy Bluster. Fair	S.	29 84 29 85 29 88	
26.	7 12 9	Fair Cloudy Rain	S. S. W.	29 88 29 92	0 10
27.	7 12 9	Misting Fair Calm	S. S. b. W. S. S. W.	29 93 29 97 29 98	
28.	7 12 9	Cloudy Fair Cloudy	S. W.	30 01 30 01 30 40	0 03
				Total	1 80

M A R C H. 1697.

D.	b.	Weather.	Winds.	Barom.	Rain.
1.	7	Cloudy		30 12	
	12		S. W.		
	9	Fair		30 20	
2.	7	Cloudy	W.S.W.	30 18	
	12	Warm	S.W.	30 19	
	9	Spring		30 14	
3.	7	Fog	S.	30 02	
	12		W.	29 95	
	9	Fair	W. b. S.	29 88	
4.	7	Mist		29 75	
	12	Rain	S. W.	29 69	13
	9	Fair		29 65	
5.	7	Fair	S. W.	29 71	
	12	Colder		29 70	
	9		S.	29 46	
6.	7	Rain	S. W.	29 20	
	12	Bluster.	W.	29 12	85
	9	Fair		29 21	
7.	7	Fair	W.	29 48	
	12	Colder	W. b. N.	29 57	
	9	Bluster.	W.	29 60	
8.	7	Frost	N. W.	30 01	
	12		N.	30 11	
	9	Fair	N. b. E.	30 15	
9.	7	Frost	E.	30 15	
	12		W.	30 14	
	9	Fair	S. W.	30 08	
10.	7	Mist	S. W.	29 95	
	12		S.W.b.S.	29 90	
	9	Fair	S. b. W.	29 76	
11.	7	Mist	S.	29 65	
	12	Frost	W. b. S.	29 64	
	9	Cloudy		29 60	
12.	7	Rain	N. W.	29 47	
	12	Fair	W.S.W.	29 35	
	9	Rain	W. b. N.	29 21	
13.	7		N. b. W.	29 18	
	12	Rain	N.	29 25	32
	9		N.	29 35	
14.	7	Frost	N.	29 59	
	12	Fair	W.	29 60	02
	9	Cloudy	W.	29 48	
15.	7	Fair		29 40	
	12	Bluster.	W.	29 48	
	9	Storms		29 28	
16.	7	Fair		29 04	
	12	Hail	W.	29 04	82
	9	Snow		28 93	

D.	b.	Weather.	Winds.	Barom.	Rain.
	7	Frost		29 16	
17.	12		N. W.	29 30	
	9	Fair		29 32	
	7	Frost	S.	29 10	
18.	12	Snow	N. W.	29 10	
	9		W.	29 16	
	7	Frost	W. b. S.	29 27	
19.	12	Fair	N. W.	29 41	
	9		S.W.b.S.	29 43	
	7	Frost	S.	29 42	
20.	12	Snow	S. S. E.	29 37	52
	9	Fair	S. E.	29 25	
	6	Bluft.	E. b. N.	29 07	
21.	12	Cloudy	E. b. N.	29 10	
	9	Hazy	N. N. E.	29 24	
	6				
22.	12				
	9				
	6				
23.	12				
	9	Frost	N. E.	29 40	
	6	Frost	N.	29 46	
24.	12		N.N.W.	29 54	
	9	Fair	N. b. E.	29 70	
	6	Frost	N.b.E.I.	29 78	
25.	12		S. I.	30 02	
	9	Fair	S. o.	30 11	
	6	The	E. o.	30 11	
26.	12	same	S.E.b.E.I.	30 10	
	9			30 04	
	6			29 97	
27.	12	Same	E. o.	29 98	
	9			30 07	
	6	Same	E. o.	30 13	
28.	12	Hazy	E. o.	30 15	
	9		E. I.	30 20	
	6	Cloudy	N.E.b.N.o.	30 14	
29.	12	Cold	N. N. E. I.	30 12	
	9			30 12	
	6	Cloudy	N. I.	30 12	
30.	12	Warmer	N. N. E.	30 12	
	9			30 05	
	6	Cloudy	N. I.	29 96	02
31.	12				
	9	Rain	N. by E.	29 88	
				Total	2 68

A P R I L 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6	Cloudy		29 83		17.	6		N.b.W.1.	29 96	
	12	Warm	N. E. o.	29 83			12	Fair		29 96	
	9	Fair		29 84			9		N. I.	29 94	
2.	6		N. I.	29 88		18.	6	Fair	N. o.	29 91	
	12	Fair	N. E. 2.	29 88			12	Hot	E. N. E.	29 93	
	9			29 87			9	Day		29 95	
3.	6	Fair	N.E.b.E.1.	29 83		19.	6			29 93	
	12	Want of	E. 1.	29 82			12	The	E. I.		
	9	Rain.		29 82			9	same		29 80	
4.	6	Misling	N. o.	29 75		20.	6		E. o.	29 69	
	12	Cl udy					12	The	S. I.	29 60	
	9	Fair.		29 68			9	same	S. o.	29 52	
5.	6	Cold		29 68		21.	6	Cloudy	E. b. S. o.	29 35	
	12	Fair	N. b. E.	29 68			12	Fair	E. b. S. 1.	29 21 0	43
	9	Misling		29 74			9	Rain	S. b. E. 1.	29 10	
6.	6	Frost		29 73		22.	6	Cloudy	E. I.	29 08	
	12		E.	29 71			12	Rain	S. I.	29 05 0	30
	9	Fair		29 68			9	Fair	S. E. o.	29 15 0	62
7.	6	Frost		29 66		23.	6	Fair	E. o.	29 20	
	12	Dry Sea-	E.	29 67			12	Rain	S. b. E. 1.	29 22 0	06
	9	son		29 70			9	Fair	S. E.	29 27	
8.	6	Frost		29 71		24.	6	Rain	S. E. 1.	29 31	
	12		E.	29 70			12		N.N.W.	29 32 1	24
	9	Warmer		29 71			9	Thunder	E.	29 34	
9.	6	Fog	W.	29 66		25.	6	Showers	E. b. N.	29 28	
	12	Fair	W.	29 64			12		E.	29 27 0	75
	9	Cloudy		29 64			9	Fair	E. o.	29 18	
10.	6	Warm	E. o.	29 61		26.	6	Cloudy	S.	29 14 0	65
	12	and	E. b. S. 1.	29 61			12				
	9	Fair		29 60			9				
11.	6	Fair	E. o.	29 60		27.	6				
	12	Warm	E. 1.	29 63			12				
	9	Cloudy	N.b. E. 2.	29 64			9				
12.	6	Fair	N.N.E.2.	29 65		28.	6				
	12	Cloudy	N. b. E.	29 67			12				
	9	Rain		29 70			9				
13.	6	Cloudy		29 72		29.	6				
	12	Rain	N. E.		2 38		12				
	9			29 78	0 30		9				
14.	6		N.N.E.o.	29 75		30.	6				
	12	Fair	E.b.N.o.	29 76			12				
	9			29 76			9				
15.	6	Fair		29 77							0 80
	12	Warm	E. 1.	29 77							
	9	Spr. Day		29 73							
16.	6	Fair	E. o.	29 73							
	12			29 75							
	9	Cloudy	N. o.	29 86							
										Total	7 53

M A Y. 1697.

				D.	h.	Weather.	Winds.	Barom.	Rain	
				17.	6	Cloudy				
					12	Misling		29 65	3 0	
					9	Blustr.	S. W. 2.	29 55		
				18.	6	Rain	W. 2.	29 57		
					12	Fair	W. b. N. 1.	29 65	0 19	
					9			29 74		
				19.	6		W. b. S. 1.	29 79		
					12	Fair	E. 1.	29 85		
					9			29 92		
				20.	6	Fair	E. b. N. o.	29 99		
					12		N. 2.	30 02		
					9	Cool	N. b. E. o.	30 07		
				21.	6	Cloudy	N. o.	30 08		
					12	Cold	N. b. E. 1.	30 08		
					9	Fair	N. b. E. o.	30 11		
				22.	6	The	N. b. E. o.	30 07		
					12	same	N. b. E. o.	30 07		
					9		E. o.	30 02		
				23.	6	Cloudy	E.	29 98		
					12	Lefs Cold	E. b. N. o.	29 93		
					9	Fair	E. b. N. o.	29 88		
				24.	6	The	N. b. E. o.	29 85		
					12	same				
					9		E. o.	29 88		
				25.	6	Mist		29 88		
					12	Hot and	E. o.			
					9	Dry		29 85		
				26.	6	The	E. o.	29 83		
					12	same	E. 1.	29 80		
					9		E. o.	29 73		
				27.	6	Fair	N. o.	29 65		
					12	Little	N. 1.	29 65	0 01	
					9	Rain		29 75		
				28.	6	Fair	N. o.	29 82		
					12	Warm				
					9		S. o.	29 74		
				29.	6	Fair	S. o.	29 79		
					12	Hot	E. o.	29 75		
					9		E. 1.	29 73		
				30.	6	The	E.	29 73		
					12	same		29 76		
					9		S. o.	29 80		
				31.	6	The		29 80		
					12	same	S. o.			
					9			29 75		
								Total	3	20

J U N E. 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6	Fair		29 66	
	12	Hot	S. o		
	9	Rain		29 56	
2.	6	Rain	S. o	29 42	
	12	Shine	S. I	29 29	0 44
	9	Rain	S. I	29 10	
3.	6	Fair	S.b.W.o.	29 08	0 79
	12		S. I.	29 04	
	9	Showers	S. I.	29 02	0 27
4.	6		S. W. 2.	29 18	
	12	Cloudy		29 38	
	9		S. I.	29 58	
5.	6	Cloudy		29 72	
	12	Sultry	S.b.W.1.	29 83	
	9	Hot		29 85	
6.	6	Thunder	E. b. S.	29 85	
	12	Rain	E. o.	29 82	1 13
	9	Thunder		29 74	
7.	6	Fog	S. b. W.	29 70	0 02
	12	Fair	S. W. I.	29 71	
	9	Hot	S.W.b.W.	29 72	
8.	6	Fair	S.W.b.W.	29 70	
	12				
	9	Cloudy	S. o.	29 56	
9.	6		S. b. E. o.	29 50	
	12	Fair	S. I.	29 48	
	9	Rain	S. o.	29 51	
10.	6		S. b. E. o.	29 60	
	12	Fair	S.b.W.1.	29 68	0 01
	9		S. o.	29 75	
11.	6		S.	29 75	
	12	Fair	S.		
	9		E. o.	29 65	
12.	6	Cloudy	N. W. 1.	29 60	
	12	Fair	N.W.b.W.	29 55	
	9		N. W. o.	29 49	
13.	6		W. o.	29 40	
	12	Fair	S. W. o.	29 34	
	9		S. W. o.	29 28	
14.	6	Fair			0 20
	12				
	9	Rain	E. o.	29 38	
15.	6	Misty	E. o.	29 45	
	12	Fair			
	9	Hot	N.b.W.4.	29 64	
16.	6			29 78	
	12	Cloudy	N. I.		0 01
	9			29 90	

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	6	Cloudy	N.	29 90	
	12	Fair	W. I.	29 92	
	9	Sultry	W. o.	29 94	
18.	6	Very	W.b.S.o.	29 98	
	12	Droughty	W.b.S.I.	30 00	
	9		S. W. o.	30 00	
19.	6	Hot	SW.b.W.2.	29 93	
	12		N.b.E.1.	29 91	0 22
	9	Rain	N. E. o.	29 93	
20.	6	Cloudy	N.b.E.o.	29 92	
	12			29 92	
	9	Cooler	N. I.	29 96	
21.	6	Cloudy	N. o.	30 00	
	12	Much			
	9	Cooler	N. E. I.	30 02	
22.	6		N. o.	30 01	
	12	Fair	E. I.		
	9		N.E.b.N.o.	29 90	
23.	6	Cloudy	N. o.	29 80	
	12	Rain	E. I.	29 79	
	9	Fair		29 79	
24.	6	Great	N.E.b.E.1.	29 77	
	12	Drought	E. I.	29 78	0 10
	9			29 78	
25.	6	Cloudy	N.E.b.E.o	29 74	
	12	Dry	N. E. I.	29 73	
	9		E. I.	29 71	
26.	6	Sultry		29 71	
	12		E. o.	29 71	0 05
	9	Dry		29 73	
27.	6	Mist	E. o.	29 74	
	12	Rain	E. b. S.	29 73	0 29
	9	Thunder	S. o.	29 74	
28.	6	Mist		29 81	
	12	Hot and	S. I.	29 83	
	9	Dry		29 86	
29.	6	Dry	E. o.	29 85	
	12	Burning	E. I.	29 85	
	9	Day	S. o.	29 87	
30.	6	Fair	S. W. o.	29 88	0 97
	12			29 88	
	9	Rain	S. I.	29 80	0 21
				Total	4 91

JULY. 1697.

D.	b.	Weather.	Winds.	Barom.	Rain.
1.	6	Rain	S. S. W.	29 75	
	12		S. W. I.	29 72	
	9	Fair	S. W. o.	29 70	o 24
2.	6		S. W. o.	29 67	
	12	Same			
	9		S. W. I.	29 59	o 22
3.	6		W.b.N.I.	29 64	
	13	Fair		29 75	
	9		W. o.	29 84	
4.	6	Cloudy	S. o.	29 85	
	12	Fair	S. W. I.	29 85	
	9	Hot	S. W.	29 85	
5.	6	Fair	W. o.	29 87	
	12	Cool			
	9	Breezes	W. I.	29 99	
6.	6	Hot	W. o.	29 95	
	12	Dry	W.b.S.I.	29 94	
	9	Day		29 90	
7.	6	Fair	W.b.N.o.	29 86	
	12	Hot			
	9	Rain	W.b.S.o.	29 79	o 12
8.	6	Mifling	S. W. I.	29 68	
	12	Rain	S. W. 2.	29 60	
	9	Cloudy	S.S.W. I.	29 44	o 32
9.	6	Rain	S. W. I.	29 42	o 75
	12	Cool	S. W. I.	29 43	
	9	Fairer	W.N.W.o.	29 47	o 77
10.	6	Fair and	W.b.N.o.	29 58	
	12	Cool	W. I.	29 71	
	9		N.W.b. W.	29 83	
11.	6	Rain		29 85	
	12	Warmer	S. W. I.	29 85	
	9			29 93	o 50
12.	6		S.W.b.W	30 00	
	12				
	9				
13.	6	Fair			
	12	and			
	9	Hot	S. o.	29 98	
14.	6	Fair	S. o.	29 90	
	12		S.b.W. I.	29 88	
	9	Cloudy	S. W. I.	29 84	
15.	6	Rain	N.b.W.I.	29 84	
	12	Cloudy	W. I.	29 85	o 48
	9	Fair	N. W. o.	29 90	
16.	6	Cooler	W. I.	29 95	
	12	Rain	N.W.b.W.	29 94	
	9	Thunder		29 92	o 42

D.	b.	Weather.	Winds.	Barom.	Rain.
17.	6	Fair	W.b.N.o.	29 91	
	12	and	N. o.	29 93	
	9	Cool	N.N.W.o.	29 93	
18.	6	Fair	N. W. I.	29 95	
	12	Cloudy			
	9	Rain	N. I.	29 98	
19.	6	Mifling	N.	29 98	
	12		W.N.W.I.	30 00	o 62
	9	Cloudy			
20.	6				
	12	Showry			
	9		W.b.S. I.	29 88	
21.	6	Rain	W.S.W.I.	29 75	
	12	Fair	W. b. N. I.	29 71	
	9	Mifling	W. I.	29 60	
22.	6	Mitty	S.W.b.W.	29 48	
	12	Rain			
	9	Fair	S.W.b.S.o.	29 50	o 43
23.	6	Fair	S.b.W.o.	29 50	
	12	Cool	S. I.	29 48	
	9	day	S. o.	29 48	
24.	6	Fair Thun.	S. I.	29 50	
	12	great Sh.	W.&N.&	29 56	
	9	with Hail.	S.	29 60	I 02
25.	6	Fairplea-	W. o.	29 65	
	12	lant day	N. W. I.	29 72	
	9		W.S.W.o.	29 77	
26.	6	Fair		29 76	
	12	Cloudy	W.b.S.o.	29 76	
	9	Mifling		29 69	
27.	6	Cloudy	S.b.W.o.	29 63	
	12	and	S.E:S.b.W.	29 60	
	9	Cool	E.b.N.I.	29 60	
28.	6		N.N.E.2.	29 58	
	12	The same	E.b.N.2.	29 62	
	9			29 69	
29.	6	Fair	N. I.	29 70	
	12	Cool	N. 2.	29 76	
	9	day		29 90	
30.	6		N.b. W. o.	29 77	
	12	The same	W.b. N. I.	30 00	
	9			30 00	
31.	6	Cloudy	S. b. E. I.	29 90	o 20
	12	Warmer	S. S. E. I.	29 86	
	9	Rain	S. I.	29 79	

Total 6 09

AUGUST. 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
	6		S.b.E. 1.	29 73			6		S. o.	29 48	
1.	12	Cloudy	S.b.E. 2.	29 72		17.	12				
	9	Rain	S.b.E. 2.	29 65			9				
	6	Fair	S.b.E. o.	29 63	o 51		6				
2.	12	Showers	W.b.S. 1.	29 65		18.	12				
	9	Fair		29 68	o 40		9				
	6	Rain	S.b.E. 2.	29 69			6				
3.	12	Cloudy	W. 3.	29 71		19.	12				
	9	Fair		29 78	o 05		9				
	6	Rain	S.W.b.S. 1.	29 69			6	Fair	S.b.W. 2.		
4.	12		S.b.W. 2.	29 65		20.	12	gr. Storm			
	9	Fairer	W. 1.	29 60	1 00		9	Thunder		29 60	1 88
	6	Rain					6	Cloudy		29 60	
5.	12		S. W. 2.	29 50		21.	12	Rain	S. 1.	29 60	
	9	Fairer	S. W. 1.	29 49	o 79		9	Cloudy		29 61	o 13
	6	The	S.b.W. o.	29 47			6	Cloudy	W.b.S. o.	29 74	
6.	12	fame	S. 1.	29 48		22.	12	Misting	W. 1.	29 84	
	9			29 49	o 22		9	Fair	W.	29 90	
	6	Cloudy	S.b.E. o.	29 51			6	Fair	W.b.S. o.	29 92	
7.	12	Rain	E.b.N. 1.	29 55		23.	12		W.b.S. 2.	29 88	
	9	Fairer	E.N.E. 1.	29 58	o 07		9	Cloudy	S. W. 2.	29 84	
	6		N. 2.	29 50			6	Fair		29 82	
8.	12	Rain	N. 1.	29 48	4 00	24.	12		S. W. 1.		
	9	both	N. 2.	29 35	o 91		9	Sultry		29 78	
	6		W. 2.	29 37			6	Cloudy	S.W.b.S. 1.	29 70	
9.	12	Days	W.b.S. 1.	29 42	o 50	25.	12		S.W.b.S. 2.	29 67	
	9			29 48	2 20		9	Fair	S.b.W. 2.	29 54	
	6	Cloudy	W. 1.	29 60	o 39		6	Rain	S. 3.	29 29	
10.	12	Rain	N. W. 2.	29 66		26.	12		W.b.S. 3.	29 31	
	9	Fairer	W. 1.	29 75	o 07		9	Fair		29 54	o 53
	6	Fair	W. o.	29 77			6		S. W. 1.	29 81	
11.	12	Pleasant	W. 1.	29 80		27.	12	Fair	W.b.S. 2.	29 93	
	9	Day	W.N.W. 1.	29 82			9			29 98	
	6	Cloudy	W.b.N. o.	29 82			6		S.S.W. o.	29 94	
12.	12		W.b.N. o.	29 82		28.	12	Fair	S.S.W. 2.	29 94	
	9	Fair	N. o.	29 85			9			29 90	
	6	Mitt	N. o.	29 88			6	Cloudy	S. W. o.	29 95	
13.	12	Cloudy	W.b.S. 1.	29 89		29.	12	Sultry	E. o.	29 99	
	9	Rain	S.b.W. 1.	29 83	o 33		9	Very Cl.		30 03	
	6	Cloudy	S. W. 2.	29 78			6		N. E. o.	30 03	
14.	12		W. 2.	29 83		30.	12	Fair			
	9	Fair	W. 2.	29 88			9				
	6	Cloudy	S. W. 1.	29 84			6	Fair			
15.	12	Little	W.b.S. 2.	29 81		31.	12	and			
	9	Rain	S.W.b.W. 1.	29 75			9	Sharp Air		30 01	
	6	Cloudy		29 70						Total	13 98
16.	12	Fair	S. 1.	29 62							
	9	Cloudy		29 53							

SEPTEMBER. 1897.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6	Fair	E.b.N. 1.	29 98		17.	6	Fair	W. 1.	29 45	
	12		N. E. 2.	30 00			12	Cool			
	9	Cool		29 98			9		.o.	29 75	
2.	6		N.E.b.N. 1.	29 93		18.	6		E. b. S. o.	29 55	
	12	The same	N. E. 2.	29 92			12	Rain	S.S.W. 2.	29 34	3 10
	9			29 90			9		S. W. 2.	29 10	1 60
3.	6	Hot Sun	E. b. N. o.	29 88		19.	6	Fair	W. b. N. o.	29 38	
	12	but	E. 1.	29 89			12	Cloudy	S. W. 1.	29 50	
	9	Cool Air	E.	29 89			9	Rain	S. 1.	29 32	0 56
4.	6	Fair	E. o.	29 84		20.	6	Rain	S. W. 3.	29 05	
	12	Warmer	E. 2.	29 84			12		W. S. W. 3.	29 02	
	9	Air		29 80			9	Fair	3.	29 21	0 14
5.	6	Fair	E. 1.	29 78		21.	6	Cloudy	W. S. W. 3.	29 35	
	12		E. o.	29 80			12	Rain	S. 1.	29 31	
	9	Hot		29 83			9	Cold	S. W. 1.	28 98	
6.	6	Mist	E. o.	29 83		22.	6	Fair	S. W. 2.	29 24	
	12	Fair	S. b. E. o.	29 86			12	Shower.			
	9	Hot		29 87			9			29 38	0 09
7.	6		S. o.	29 85		23.	6	Fair	S. W. 1.	29 51	
	12	The same	E. 2.	29 83			12				
	9		E. o.	29 80			9	Rain	W. N. W.	29 74	
8.	6		E. o.	29 73		24.	6		S. W. o.	29 87	
	12	The same					12	Fair	N.		
	9			29 70			9	Rain		29 87	
9.	6	Fair	E. b. N. 1.	29 68		25.	6		E. o.	29 66	0 08
	12	Cooler	E. b. N. 2.	29 66			12	Cloudy	S. E. 2.		
	9			29 56			9	Misting		29 38	0 30
10.	6	Cloudy	E. 1.	29 43		26.	6	Fair	N. E. o.	29 38	
	12		S. 2.	29 39			12	Rain	E. 1.	29 40	
	9	Rain		29 40	0 10		9	Cold		29 30	0 24
11.	6		S. b. E. o.	29 38		27.	6	Fair	E. o.	29 27	
	12	Showers	W. S. W. 1.	29 40			12	Cloudy	E. b. N. 1.	29 25	
	9			29 60	1 59		9	Rain		29 30	0 84
12.	6	Fair	S. o.	29 76	0 07	28.	6	Fair	N. E. 1.	29 38	
	12		S. b. W. 2.	29 77			12	Cold	N. b. E. 3.		
	9	Cloudy		29 70			9	Day		29 56	
13.	6	Rain	S. 2.	29 49		29.	6	Hoar-	N. b. W. 1.	29 65	
	12		S. 3.	29 38			12	Frost	N. b. W. 1.	29 70	
	9	Fair		29 63	1 54		9	Fair		29 78	
14.	6		S. o.	29 67		30.	6	Ice	N. b. W. o.	29 80	
	12	Rain	S. 2.	29 50			12	Fair		29 82	
	9		S. 4.	29 32			9	Cloudy		29 83	0 22
15.	6	Fair	S. W. 1.	29 46							
	12			29 30							
	9	Rain	3.	29 30							
16.	6	Fair	S. W. 4.	29 28							
	12	Cool	W. b. S. 6.	29 32							
	9	Cloudy	2.	29 34							
										Total.	10 47

OCTOBER. 1697.

D.	b.	Weather.	Winds.	Barom.	Rain.
1.	7	Cloudy	N. W. o.	29 79	
	12	Misty	S. 1.		
	9	Warm	S. o.	29 78	
2.	7	Rain.	S. o.	29 77	10
	12	Cloudy	S. b. E. o.	29 75	
	9	Warm		29 70	
3.	7	Cloudy	S. b. E. o.	29 51	
	12		S. 1.	29 40	
	9	Rain		29 31	72
4.	7	Fair	S.W.b.W. 1	29 50	
	12	Cold	S. W. 2.	29 52	
	9	Rain.		29 28	
5.	7		S. 4.	29 00	12
	12	Rain	S. b. W. 2.	28 98	
	9			29 13	57
6.	7	Rain	S. 1.	29 16	
	12	Stormy	E. & W.	28 97	
	9	Fairer	S. & 6.	29 28	36
7.	7	Rain	S. b. E. 1.	29 08	
	12		N. 1.	29 13	
	9	Fair	W. 1.	29 58	52
8.	7	Rain	S. 2.	29 66	
	12	Cloudy	S. W. 4.	29 64	10
	9	Stormy	5.	29 44	
9.	7	Stormy	S. W. 8.	29 39	
	12	Cloudy	W.S.W. 4	29 51	
	9	Fairer	2.	29 66	
10.	7	Fair	S.W.b.W. o	29 88	
	12	and	W. b. S. o.	30 00	
	9	Pleasant		30 15	
11.	7	Frost	W. b. S. o.	30 20	
	12	and		30 21	
	9	Misty	S. W. o.	30 18	
12.	7	Frost	S.W.b.W. o	30 17	
	9	Fair			
13.	7				
	9	Fair	W. 1.	30 20	
14.	7	Fair	W. b. S. o.	30 18	
	12	and	W. N. W. o.	30 18	
	9	Warm		30 16	
15.	7	Cloudy	W. b. S. o.	30 12	
	12	Warm	N. W. o.	30 12	
	9	Misting		30 10	
16.	7	Cloudy	W. o.	30 06	
	12	Fair	N. N. W. 2.	30 08	14
	9	Cold	N. b. W.	30 20	

D.	b.	Weather.	Winds.	Barom.	Rain.
17.	7		N. b. W. o.	30 27	
	12	Same	N. b. E. 1.	30 30	
	9			30 34	
18.	7	Cloudy	N. b. E. o.	30 32	
	12	Fair		30 33	
	9	Colder	E. b. S. o.	30 27	
19.	7	Hoar Fr.	S. W. o.	30 22	
	12	Mist	N. b. E. o.	30 28	
	9	Fair		30 30	
20.	7	Fog. Frost	N. W.	30 28	
	12	Cold	S. W.	30 26	
	9			30 23	
21.	7	Cloudy	W. S. W. 1	30 15	
	12		W. b. S. 1.	30 16	
	9	Fair		30 20	
22.	7		W. b. S. o.	30 25	
	12	Fog.	S. W. o.	30 25	
	9			30 25	
23.	7	Cloudy	S. S. W.	30 22	
	12	Fair			
	9	Cloudy		30 15	
24.	7	Cloudy	S. W. o.	30 06	
	12	and			
	9	Warm		29 94	
25.	7		S. W. 2.	29 80	
	12	Same	W. S. W. 2	29 78	
	9			29 74	
26.	7	Cloudy	S. W. 2.	29 60	
	12	Warm	S. W. 6.	29 52	
	9	Rain	6.	29 27	
27.	7	Fair	S. W. 2.	29 37	52
	12	Rain	S. W. b. W. 5	29 34	
	9	Stormy	o.	29 88	21
28.	7	Frost	S. W. o.	30 08	
	12	Fair			
	9	Rain		29 89	
29.	7	Warm	S. W. 4.	29 78	
	12	Small			02
	9	Showers	3.	29 74	
30.	7	Cloudy	W. b. S. 5.	29 48	
	12		W. 6.	29 54	
	9	Fair		29 72	
31.	7	Fair	N. o.	30 04	01
	12	and	N. E. 2.	30 17	
	9	Cool		30 26	
				Total	8 39

DECEMBER. 1697.

D.	b.	Weather.	Winds.	Barom.	Rain.	D.	b.	Weather.	Winds.	Barom.	Rain.
1.	8	Hard	W.b.N.0	29 86		17.	8	Frost		29 57	
	12	Frost and	W.b.N.2	29 87			12	Cloudy	E. 0.	29 56	
	9	Fair		29 89			9	Fairer		29 62	
2.	8		N. 1.	29 90		18.	8			29 64	
	12	Same	N. 0.	29 94			12	Mist	E. 0.	29 72	
	9			29 99			9			29 72	
3.	8		N. 0.	30 05		19.	8	Cloudy		29 70	
	12	Same	N.N.E.0	30 08			12	Warm	E. 1.	29 68	
	9			30 06			9	Day		29 63	
4.	8	Cloudy	N.W. 1.	29 98		20.	8	Fog	E. 2.	29 50	
	12	Snow	W.N.W.1	29 89			12	Cloudy			
	9	Half Inch		29 96			9	Colder		29 44	
5.	8	Cloudy	N.b.E.2.	30 00		21.	8	Rain		29 45	0 23
	12	Fair	N.N.E.1	30 06			12	Cloudy	E. 1.	29 51	
	9			30 09			9	Cold		29 62	0 17
6.	8	Snow	N.W.b.N.3	29 98		22.	8	Rain		29 75	0 02
	12	Fair	N.W.b.N.1	29 99			12	Cloudy	E. 1.		
	9	Sn. 1 Inch		30 00			9	Fair		29 90	
7.	8	Snow 6	N.W. 0.	29 93		23.	8		S.b.E. 1.	29 83	
	12	Snow 8	S. 0.	29 71			12	Cloudy	S. 1.	29 76	
	9	sn 1 Inch		29 68			9			29 64	
8.	8			29 84		24.	8		S.b.W. 2.	29 52	0 46
	12	Fair	E. 0.	29 87			12	Rain	S. 2.	29 46	
	9			29 85			9	Stormy	6.	29 34	0 56
9.	8	Snow		29 64		25.	8	Fair	W. 3.	29 25	
	12	Sleet	S.b.E. 1.	29 55			12	and	S.W. 2.	29 40	
	9	Thaw		29 42			9	Warm		29 61	0 03
10.	8	Frost	E.N.E.0.	29 55		26.	8	Cloudy	W.S.W.2	29 62	
	12	Thaw	E. 0.	29 57	3 62		12	Fair	W.b.S.2.	29 70	
	9	Snow	2.	29 46			9	Warm	3.	29 87	
11.	8	Rain	E.S.E. 2.	29 09	2 76	27.	8	Cloudy	W.S.W.2	29 90	
	12	Warm	S.b.W.1	29 10			12				
	9	Thaw		29 24	0 90		9	Misling		29 82	
12.	8	Thaw	S.b.E. 2.	29 14		28.	8	Cloudy	S.b.W.0.	29 66	
	12		S. 2.	29 04			12	Rain	W.b.S.3.	29 56	
	9	Rain		29 11	0 42		9	Fair		29 75	0 08
13.	8	Fair	S.W. 3.	29 33		29.	8	Fair	W. 2.	29 90	
	12	Warm	W.S.W.3	29 50			12	Cloudy	W.b.N.2	29 97	
	9	Pleasant	S.W. 1.	29 61			9	Rain	0.	29 97	
14.	8	Cloudy	S.W. 1.	29 68		30.	8	Fair	N.E. 1.	30 10	0 05
	12	Warm	W.S.W.1	29 67			12	Cloudy	N.E. 1.	30 15	
	9	Day	W.S.W.0	29 65			9	Fair		30 20	
15.	8	Misty	E. 1.	29 64		31.	8	Frost	E. 0.	30 18	0 01
	12	Warm	E.b.N.0.	29 64			12	Cloudy	E.b.S.0.	30 15	
	9	Day		29 65			9	Fair		30 08	
16.	8	Frost				Total					9 31
	12		E.b.N.1.	29 58							
	9	Fair		29 59							

In this Table, the Quantity of Rain, which fell through a Tunnel of 12 Inches Diameter, is set down in Pounds and Centesimals: and I measured it with a Cylindrical Glass, after Mr. *Townley's* Method.

Where only one sort of Weather is noted upon one Day, that was the Weather of all the Day; especially if the Barometer be noted 3 times. The same Observe also in the Column of Winds.

In the Column of Winds, 0, signifies a Calm; 1, 2, 3, &c. denotes the strength of the Wind; wherefore, 5, or 6, is a little Storm; 7, or 8, a great Storm.

I have noted in the Column of Weather, the Depth of the Snow upon the Ground.

The whole Quantity of Rain that fell through my Funnel last year, was 77,60 *l.* which is less than fell from the Beginning of *March* (at which time I began my Rain Observations) till the End of *December*, 1696. In which 10 Months there fell here, at *Upminster* almost 115. *l.* and at *Townley* in *Lancashire* (according to Mr. *Townley's* Observations) above 172. *l.* and in the whole year at *Townley* 203,76. *l.*

XXIV. The Quantity of Rain which fell through my Tunnel this Year 1698. was 122,32 Pounds. I find Foggy Weather makes the Mercury rise, as well as the North Wind; as may be Observed in the following Table, in the Month of *December*, at which time the Mercury was very high, although the Wind was in the Southerly Points. I submit it, whether the Cause be not the Increase of the Weight of the Atmosphere, by an Addition of those Vapours of which the Fog consists, which are manifestly as heavy as the Air, because they swim in it without Ascending? These filling up many of the Vacuities of the Air, without extruding much the parts of Air (as I judge Clouds do) do add considerably to the Weight of the Atmosphere, and so cause the Mercury to Ascend.

The Weather
1698. at *Upminster*.
by Mr.
Wil. Derham.
249. p. 45.

The greatest Range I have ever Observed the Mercury to have, is no more than 2,12 Inches; it being here never higher than 30,40 nor lower than 28,28 Inches. The lowest it ever was, within my Observations, was *Jan.* 24. about 2 of the Clock in the Afternoon; about which Hour Mr. *Townley* Observed his Barometer to fall to 27,80 Inches, which, he says, was remarkably low.

JANUARY. 1698.

D.	b.	Weather.	Winds.	Barom.	Rain.
1.	8	Frost	S. E. o.	29 95	
	12	Fair	S.b.E.1.	29 90	
	9	Hard Fr.	o.	29 82	
2.	8	Cloudy	S.b.E.1.	29 63	
	12	Frost	S.b.E.2.	29 48	
	9	Snow	o.	29 26	
3.	8	Snow	W.b.S.o.	29 15	
	12	1 Inch			
	9	Rain		28 94	o 55
4.	8	Rain	E. o.	28 80	o 99
	12	Sleet	E. o.	28 88	
	9	Snow 4. Cloudy		29 18	2 98
5.	8	Frost	W. o.	29 44	o 20
	12	Fair	W.S.W.1	29 53	
	9	Cloudy		29 64	o 33
6.	8	Rain	E. 1.	29 49	o 20
	12	Fair	E.b.N.1.	29 50	
	9	Cloudy		29 78	o 23
7.	8	Frost	N.b.W.1	29 98	
	12	Fair	N. 1.	30 04	
	9	Snow re.		30 14	
8.	8	Frost	N.b.E.1.	30 18	
	12	Showers	N.N.E.2	30 18	
	9	of Snow		30 16	
9.	8	Cloudy	N. E. 2.	30 07	
	12	Cold	N.E.b.N.2.	30 04	
	9	Day		30 00	
10.	8	Frost	N. E. 1.	29 90	
	12	Cloudy		29 89	
	9	Day			
11.	8	Same	N. E. o.		
	12	but less		29 79	
	9	Cold		29 73	
12.	8	Cloudy	N. E. o.	29 61	
	12	Fairer	S.o: W.1	29 53	
	9	Fair		29 36	
13.	8	Frost	S. o.	29 21	
	12	Fair		29 18	
	9	Snow	W. o.	29 16	
14.	8	Snow. 3.	N.N.W.1.	29 23	
	12	Cloudy	N.N.W.1.	29 29	
	9	Fair	N. 1.	29 40	
15.	8	Hard	N.b.W.1	29 52	
	12	Frost	N. 1.	29 65	
	9	Fair	N. o.	29 79	
16.	8	Same	N.b.W.o	29 77	
	12	Same			
	9		N. o.	29 74	

D.	b.	Weather.	Winds.	Barom.	Rain.
17.	8	Snow	N.W.o.	29 57	
	12	with the former, 5	E.1:N.E.2.	29 60	
	9	Inches	N.b.E.1.	29 65	
18.	8	Little	N. 1.	29 68	
	12	Snow very	N. 2.	29 69	
	9	Cold	N.b.E.2.	29 71	
19.	8	Snow 3	E. o.	29 62	
	12	Inch.more	E.b.S.2.	29 59	
	9	Cloudy all Day	2.	29 59	
20.	8	Cloudy	E.b.N.3.	29 65	
	12	very	E.b.N.3.	29 70	
	9	Cold Day	2.	29 84	
21.	8	Hard Fr.	E.b.N.2.	29 92	
	12	& Cloudy	E.b.N. 2.	29 95	
	9	as before	1.	29 95	
22.	8	Fairer	E.b.S. o.	29 82	
	12	very	E. 1.	29 68	
	9	Cold	E. 3.	29 30	
23.	8	Snow 5	E.b.N. o.	29 00	
	12	Inches	N. E. 1.	29 00	
	9	Cloudy Snowy Day		29 07	
24.	8	Snow 3	E.b. S. 1.	28 73	
	12	Inches	S. E. 2.	28 38	
	9	Sleet Thaw	S. W. 1.	28 28	
25.	8	Thaw	S. 2.	28 38	o 30
	12	Showers	S. 1.	28 40	
	9	of Rain		28 56	o 32
26.	8	Rain	S. o.	28 72	o 28
	12	Thaw with			
	9	Showers		28 94	o 06
27.	8	Fairer	S.b.w.o.	29 03	o 08
	12		S. b.E.1.	29 00	
	9	Rain		28 88	o 39
28.	8	Frost &	S.W.b.S.o.	28 98	o 14
	12	Fair	S.S. W.1.	28 88	
	9	Rain	S.E.b.S.1	28 68	o 28
29.	8	Same with	S. W. 2.	28 90	
	12	Bluftring	S.S.E.4.	28 67	
	9	Snow	4.	28 53	o 76
30.	8	Frost	W.b.S.1.	28 92	o 48
	12	Fair Plea-	W. 2.	29 06	
	9	sant Day		29 51	
31.	8	Fair	N.W.o.	29 70	o 30
	12	Wet After-	S. W. 1.	29 71	
	9	noon		29 58	
				Total	10 94

F E B R U A R Y. 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	7 12 9	Missing Warm	S. W. 2.	29 48	
2.	7 12 9	Fair Missing		4. 29 11	
3.	7 13 9	Fair Cloudy Fair	W.b.S. 3. W.S.W. 4. I	28 97 29 06 29 26	0 34
4.	7 12 9	Frost Fair and Pleasant	S. W. 0. W. 1.	29 36 29 42 29 63	
5.	7 12 9	Same	N. 1. N. E. 1.	29 86 30 06	
6.	7 12 9	Frost and Cloudy	E.b.N. 1. E. 1.	30 08 30 08	
7.	7 12 9	Frost Fair and Warm	E.b.N. 0. W. 1.	30 01 30 01 29 96	
8.	7 12 9	Frost Fair Colder	E.b.N. 0. E. 0. 0.	29 88 29 89 29 89	
9.	7 12 9	Same	E.b.N. 0. E.N.E. 1.	29 83 29 84 29 91	
10.	7 12 9	Cloudy Cold Fair	N. E. 1. N. E. 2.	29 99 30 02 30 07	
11.	7 12 9	Frost and Fair	N. E. 1. E.b.N. 2. N. E. 1.	30 08 08 30 11	
12.	7 12 9	Fair Clo. with Frost	E.N.E. 1. N. E. 2. 2.	29 90 29 87 29 85	
13.	7 12 9	Frost Cl. and very Cold	E.N.E. 3. N. E. 4. N. E. 3	29 84 29 86 29 94	
14.	7 12 9	Snow	N.b.W. 0. N.W.bN. 2. 4.	29 83 29 86 29 86	
15.	7 12 9	Snow half Inch very cold	N. E. 3. N.E.bN. 4. 2.	29 86 29 81 29 72	
16.	7 12 9	Sn. 1 Inch very Cold	N.E.b.E. 2. E.N.E. 3.	29 63 29 56 29 53	

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	7 12 9	Cloudy Sleet, less Cold	E.b.N. 2. E.b.N. 1.	29 42 29 38 29 43	
18.	7 12 9	Fairer Cloudy Thaw Rain	E. 0. E.b.N. 1.	29 46 29 50 29 52	0 14 0 16
19.	7 12 9	Cloudy Rain Cloudy	E 2 E.b.N. 2.	29 51 29 55 29 67	0 15 0 28
20.	7 12 9	Fairer Colder Freezing	E.b.N. 2. E.b.N. 3.	29 68 29 71 29 75	
21.	7 12 9	Frost Fair and Pleasant	E.b.N. 1. E.b.N. 2.	29 81 29 84 29 84	
22.	7 12 9	Same	N. E. 0. E.b.N. 1.	29 85 29 88 29 90	
23.	7 12 9	Frost and Fair Cl. Warm	E.b.N. 0. E. 1.	29 94 29 97 30 00	
24.	7 12 9	Cloudy Fr. Cold Fair	E. 0 E. 1	29 96 29 97 29 97	
25.	7 12 9	Mist Fr. Fair and Warmer	E.b.N. 0. E. 0.	29 95 29 95 29 93	
26.	7 12 9	Frost Cloudy	E. 0. E. 1.	29 88 29 88 29 88	
27.	7 12 9	Frost and Fair Warmer Cloudy	E. 0. E. 1. S. W.	29 79 29 78 29 70	
28.	7 12 9	Rain Fair, and Thaw	S.W., b.S. 1.	29 60	0 24
				Total	1 31

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D.	b.	Weather.	Winds.	Barom.	Rain.	D.	b.	Weather.	Winds.	Barom.	Rain.	
1.	6 12 9	Fair Warm & Pleasant		29 60		17.	6 12 9	Same Rain	S. 1. S. W. 2. S.b.W. 3.	29 80 29 68 29 43		
2.	6 12 9	Fair Warm Rain	S.S. E. 0. S.b.W. 1. N.W. 2 W. 1	29 39 29 38 29 60	0 32	18.	6 12 9	Fairer Hail, and Cooler	W.b.S. 4. W.b.S. 7. 1.	29 24 29 36 29 50	0 23 0 09	
3.	6 12 9	Cloudy	N. W. 1. N. 2.	29 74 30 00		19.	6 12 9	Hoar Fr. Fair Rain	S. W. 0. W. 2. 0	29 60 29 74 29 78		
4.	6 12 9	Cloudy Colder Day	N. 1. N.b.E. 2.	30 05 30 10 30 19		20.	6 12 9	Cloudy Warmer	S.W.b.W. 2. S. W. 3.	29 76 29 78 29 78	0 01	
5.	6 12 9	Cloudy Cold Winds	N. E. 1. E.b.N. 2.	30 16 30 10 30 05		21.	6 12 9	Same	S.S.W. 2. S. W. 3.	29 68 29 58		
6.	6 12 9	Frost Fair	N. E. 0. N. E. 1.	29 92 29 90 29 83		22.	6 12 9	Cloudy Fair	S.S.W. 1. W. 1. N. W. 0.	29 59 29 73 29 98		
7.	6 12 9	Frost Cloudy Cold	N. E. 2. N.E.b.E. 3	29 72 29 74 29 74		23.	6 12 9	Frost Fair and Pleasant	N.b.W. 0 S. 1. S. W. 0.	30 11 30 14 30 14		
8.	6 12 9	Frost Cloudy Warmer	N. E. 0. N.E.b.E 1	29 70 29 71 29 80		24.	6 12 9	Same	S. b. E. 0 E. b. S. 1	30 09 30 08 30 00		
9.	6 12 9	Fr. and Fair and Sharp Snow Rain	S.E.b. E. 0. S. 1.	29 81 29 76 29 68		25.	6 12 9	Frost Fair Rain	E.b. N. 0 E. 1.	29 90 29 88 29 83		
10.	6 12 9	Cloudy Showers Fair	S. 0. W. 2.	29 51 29 54 29 71	1 49 0 10	26.	6 12 9	Fair, very Warm Lightning	E. 0. E.b. S. 1.	29 77 29 77 29 71	0 38	
11.	6 12 9	Showers Fairer	S. 1. S.S.W. 2. S. W. 2.	29 63 29 42 29 61	0 70	27.	6 12 9	Misty Fair Cloudy	S. W. 0. S. 1. 29 66	29 73 29 75		
12.	6 12 9	Rain Warm Showers	S.S.W. 3 S. W. 5. S. W. 3.	29 42 29 35 29 39	0 26 0 98	28.	6 12 9	Rain Cloudy Cooler	S. 2. S.b.W. 4	29 42 29 34 29 46	0 28 0 05	
13.	6 12 9	Fair	S.W.b.W. 2 S.W.b.W. 2 W.S.W. 2	29 63 29 69 29 78		29.	6 12 9	Fair Showers	w.S.w. 1. W.b.S. 2.	29 63 29 70 29 79	0 06	
14.	6 12 9	Warm Cloudy Day	S.w.b.W. 2 S.W.b.W. 4	29 74 29 74 29 84		30.	6 12 9	Hoar Frost, Rain	S. 0. S. W. 3.	29 70 29 59 29 46	0 34	
15.	6 12 9	Same	S. W. 2. S. W. 3. W.b.S. 2.	29 87 29 89 29 95		31.	6 12 9	Rain Rain Fairer	E.b.N. 0. N. 2.	29 36 29 49 29 72	2 52 1 52 9 33	
16.	6 12 9	Same	W.S.W. 2	30 02 30 03							Total	9 33

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D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6		S. b. E. o.	29 68	
	12	Rain	S.S.W.1.	29 48	
	9			29 26	1 47
2.	6	Cloudy	W.S.W.2	29 27	0 11
	12		W.N.W.3	29 40	
	9	Fair		29 57	
3.	6	Hoar Fr.	S. W. o.	29 62	
	12	Fair	W. 1.	29 71	
	9	Rain		29 83	0 26
4.	6		E.b.N.o.	29 90	0 03
	12	Fair	N. E. 1.	29 95	
	9			30 00	
5.	6		N.N.E.1.	29 97	
	12	Same			
	9				
6.	6				
	12	Cloudy		29 88	
	9				
7.	6	Fair	N.N.E.o.	29 94	
	12		E. 2.	29 91	
	9	Cloudy		29 79	
8.	6		S.b.W.2.	29 65	
	12	Showers	N. W. 2.	29 71	
	9			29 83	0 22
9.	6	Hoar Fr.	S. W. o.	29 83	
	12	Cloudy	S. W. 2.	29 82	
	9	Fair	S. o.	29 82	
10.	6		S.b.W.2.	29 75	
	12	Cloudy	S.S.W.2.	29 67	
	9			29 64	
11.	6	Fair with	S. W. 1.	29 66	
	12	Showers			
	9		W.b.S.2.	29 56	0 11
12.	6	Fair	W.b.S.1.	29 60	
	12	and		29 68	
	9	Cool	S. o.	29 70	
13.	6	Cloudy	S. 1.	29 68	
	12	Warm	S.S.W.1.	29 66	
	9	Rain	W.b.S.o.	29 62	
14.	6		W.b.N.1	29 68	0 14
	12	Fair			
	9	shower		29 80	0 06
15.	6	Cloudy	W.b.S.2.	29 50	
	12		W.N.W.4	29 50	
	9	Showers	N.N.W.3	29 73	
16.	6	Snow	N. W. 3.	29 76	
	12		N. 5.	29 85	
	9	Cloudy	N. 2.	29 89	1 00

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	6	Fair	N.b.W.2	29 87	
	12	and	N. 2.	29 88	
	9	Cold	N.b.E.1.	29 92	
18.	6		N.b.W.1	29 90	
	12				
	9				
19.	6	Cloudy			
	12	Warmer	N. 1.	29 88	
	9	Rain		29 90	
20.	6	Cloudy	W. 1.	29 80	0 44
	12	Rain	W.S.W.2	29 68	
	9			29 42	
21.	6	Fair and	W. 2.	29 28	0 37
	12	Cold	W.b.N.2.	29 30	
	9	Cloudy		29 26	
22.	6	Rain	N. 3.	29 34	0 19
	12	Snow	N.N.W.3	29 43	
	9	Fair		29 44	0 03
23.	6	Ice very	E.S.E.1	29 32	
	12	Cold	S. E. 2.	29 29	
	9	Rain		29 28	0 58
24.	6	Misting	E.b. S. o.	29 31	
	12	Warmer	E. 1.	29 46	
	9	Fair		29 68	
25.	6	Showers	S. W. 1.	29 70	
	12		W. 2.		
	9	Fair		29 83	0 42
26.	6	Fair	W. 2.	29 83	
	12	Hail	W. 3.	29 80	
	9	Showers		29 63	
27.	6	Snow	W.b.S.2.	29 56	0 89
	12	Sleet	W. 3.	29 56	
	9	Fairer		29 62	0 48
28.	6	Showers	N.W. 1.	29 67	0 20
	12	of Hail	N.b.W.2	29 71	
	9	and Rain		29 83	0 31
29.	6	Cold	N.w.b.N.1	29 84	
	12	Showers	N. W. 2.	29 86	
	9			29 81	0 43
30.	6		N.N.W. 1.	29 78	0 09
	12	Rain	N.N.E.2.	29 78	
	9			29 80	0 25
				Total	8 08

M. A. Y. 1698.

D.	h.	Weather.	Winds.	Barom.	Rain
1.	6 12 9	Rain	S. 1. N. W. 1.	29 74 29 73 29 75	0 58 0 73
2.	6 12 9	Fair	N. 2. W.N.W. 1.	29 72 29 75 29 72	0 46
3.	6 12 9	Fair Snow Ice	N. o.	29 75	
4.	6 12 9	Fair Cold Cloudy	N.b.E.2.	29 71	0 22
5.	6 12 9	Cold and Fair	W. o. S. W. 1. S.b.W.2.	29 72 29 71 29 70	
6.	6 12 9	Rain Warm Fair	S. W. 1. S. b. E. 1	29 66 29 78	0 76
7.	6 12 9	Cloudy Fair	S.b.E.1. S.b.E.1. S.S.E.o.	29 78 29 80 29 80	0 13
8.	6 12 9	Fair Warm Day	N.b.W.1. N.N.W.2. N. o.	29 89 29 94 30 10	
9.	6 12 9	Same	N.b.W.1 W.b.S.1.	30 11 30 11 30 00	
10.	6 12 9	Small Showers	W.b.N.1 N. W. 2. N.b.W.3	29 87 29 80 29 81	0 08
11.	6 12 9	Cloudy Cooler Rain	N.N.W.3. N.N.W.2. N.N.E.o.	29 82 29 85 29 82	0 03
12.	6 12 9	Showers	N. E. 2. N.N.W.2.	29 69 29 68	0 51 0 10
13.	6 12 9	Cloudy Fair	N.W.b.N.2 N. 3. N. o.	29 70 29 70 29 74	
14.	6 12 9	Fair	N. o. E. 2.	29 75 29 82 29 87	
15.	6 12 9	Fair	N. E. 1. N.b.E.1. E.b.S.o.	29 92 29 95 29 94	
16.	6 12 9	Fair and Warm	E. o. E. o.	29 87 29 73	

D.	h.	Weather.	Winds.	Barom.	Rain
17.	6 12 9	Rain	E. o.	29 66 29 63	0 54
18.	6 12 9	Rain Warm Fair	N.E.b.E.o. S. E. 1. S.S.E.o.	29 59 29 56 29 53	0 43 0 05
19.	6 12 9	Cloudy Hot Fair	E. 1. E.b.E.2. S. o.	29 48 29 46 29 49	
20.	6 12 9	Cloudy Cooler Fair	S.E.b.E.1 S. 4. S.b.W.2.	29 49 29 50 29 62	
21.	6 12 9	Showers Fair	S.S.W.3. S.W.b.W.5	29 68 29 73 29 81	0 32
22.	6 12 9	Showers and Cooler	S.b.E.1. E.S.E.1. S.W.b.S.3.	29 72 29 70 29 66	0 02 0 95
23.	6 12 9	Rain Cloudy Fair	S.b.E.1. S.b.W.2. S.b.W.o.	29 48 29 47 29 46	0 79
24.	6 12 9	Showers	S. 2. S.W. o.	29 43 29 46	0 49
25.	6 12 9	Fair			
26.	6 12 9	Rain Cool	N.N.E.2.	29 53	2 73
27.	6 12 9	Cloudy Warmer Fair	E.b.S.1. S. 1. E. o.	29 67 29 71 29 78	0 23
28.	6 12 9	Fair Shower Rain	N. 1. E.b.N.1. E. 1.	29 78 29 77 29 76	0 02
29.	6 12 9	Missing	N.b.E.1. E.b.S.o. S. 1.	29 69 29 74 29 76	1 60 0 22
30.	6 12 9	Fair	S.b.W.1. N.b.W.1	29 76 29 70	
31.	6 12 9	Fair	N.W.b.N.1 W.N.W.1. W.S.W.o	29 68 29 65 29 62	0 04
				Total	12 03

J U N E 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6	Fair	W. 2.	29 60	
	12	and		29 60	
	9	Hot	S. 0	29 60	
2.	6	Fair	S.W.b.S.2	29 57	
	12		W. 3.	29 52	
	9	Rain	S. 1.	29 50	0 23
3.	6	Cloudy	S. 1.	29 51	
	12	Thunder	N. W. 2.	29 55	
	9		N.b.W.0	29 72	0 46
4.	6	Misling	N b, W. 2	29 81	
	12	Fair and	N. 3.	29 90	
	9	Cool	E.S.E.0.	29 99	0 02
5.	6	Fair	E.b.S.0.	30 01	
	12	Cloudy	W. 2.	30 02	
	9	Fair	S. W. 0.	30 04	
6.	6	Fair	S: W. 0	30 06	
	12	and	S.S.W.1.	30 07	
	9	Hotter	0.	30 08	
7.	6	Fair	W.b.S. 1.	30 09	
	12	and	S.b. E. 0.	30 09	
	9	Hot		30 10	
8.	6	Fair	E.b.N.0.	30 08	
	12	Hot	E.b.N.2.	30 08	
	9	Cloudy	N.E.b.N.3.	30 05	0 08
9.	6	Cloudy	N.N.E.2.	30 02	
	12	Fair	N.N.E.3.	30 01	
	9	Cloudy	N. E. 2.	29 95	
10.	6	Cloudy	N. E. 2.	29 86	
	12	Cooler		29 81	
	9	Rain	E. 1.	29 74	2 25
11.	6	Cloudy	N.b.E.0.	29 68	0 17
	12	Clofe.	N.b.E.1.	29 66	
	9	Day		29 62	
12.	6	Much	N.N.W.1.	29 57	
	12	Rain	N.N.W.1.	29 52	
	9		N.N.W.1.	29 47	3 92
13.	6	Misling	N. 0.	29 42	0 91
	12		W.b.S. 1.	29 52	0 38
	9				
14.	6		W.b.S.2.	29 62	0 10
	12	Cloudy	S. W. 3.	29 67	
	9		S. W. 2.	29 70	
15.	6		S. W. 1.	29	
	12				
	9				
16.	6				
	12				
	9				

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	6	Fair			
	12				
	9	Cloudy	N. W. 0.	30 05	
18.	6		N. W. 0.	30 04	
	12	Fair	N.N.W. 1.	30 05	
	9		E. 1.	30 08	
19.	6		E. 0.	30 08	
	12	Fair	E. b. S. 1.	30 08	
	9		E. 0.	30 05	
20.	6	Fair	E. b. S. 0.	30 03	
	12		E. b. S. 0.	30 00	
	9	Hot		29 92	
21.	6	Fair	E. b. S. 0.	29 87	
	12		S. W. 2.	29 86	
	9	Cloudy	W. 0.	29 86	
22.	6	Misling	W. b. S. 0.	29 86	
	12		N. b. W. 1	29 89	
	9	Cloudy	E. 1.	29 90	
23.	6	Fair	E. 0.	29 83	
	12	and			
	9	Hot	S. b. W. 1.	29 73	
24.	6	Rain	S. b. W. 2.	29 65	
	12	and	S. 3.	29 61	
	9	Cooler	S. 2.	29 58	0 08
25.	6	Fair	S. W. b. W. 3	29 62	0 19
	12	Rain	S. b. W. 3.	29 64	
	9	Fairer	S. 0.	29 68	0 06
26.	6	Fair	W. S. W. 1.	29 76	
	12		W. b. S. 1.	29 78	
	9	Cloudy	W. b. S. 0	29 80	
27.	6		S. W. 1.	29 78	
	12	Cloudy	W. S. W. 3.	29 75	
	9		W. b. S. 2	29 69	
28.	6			29 69	
	12	Rain			
	9				
29.	6				
	12	Fair	W. 1.	29 73	
	9				
30.	6	Cloudy	W. b. S. 2.	29 71	
	12	Misling	W. S. W. 1	29 74	
	9	Cloudy		29 78	
				Total	8 77

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D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6		W.N.W.1.	29 78	
	12	Cloudy	W.b.S.1.	29 78	
	9		W.S.W.0.	29 75	
2.	6	Cool	N. 1.	29 77	
	12	Rain	N.N.E.2	29 83	
	9	Warmer	N. 0.	29 88	0 23
3.	6	Fair	N. 0.	29 88	
	12	and	S. W. 2	29 86	
	9	Hot		29 82	
4.	6	Cloudy	S.W.b.S.3.	29 74	
	12	Missing	S. W. 3.	29 67	
	9	Rain	S. W. 3.	9 61	
5.	6		S.b.W.2.	29 52	1 87
	12	Fairer	W.S.W.4.	29 50	
	9	Rain	S. W. 3.	29 56	0 05
6.	6	Cloudy	W.S.W.1.	29 66	0 05
	12	Hot	S.W.b.W.3	29 70	
	9	Fair	W.b.S.0.	29 75	
7.	6	Fair	S.W.b.S.1.	29 77	
	12	Rain		29 76	
	9	Fair	S. W. 0.	29 73	
8.	6	Misty	S. W. 0.	29 73	
	12	very	W.S.W.1.	29 75	
	9	Hot	S.b.E.0.	29 78	
9.	6	Cloudy	E.b.S.1.	29 79	
	12	Hot and	E. 1.	29 78	
	9	Sultry	E. 0.	29 76	
10.	6		E. 0.	29 73	
	12	Same	E.b.S.1.	29 72	
	9		E. 0.	29 67	
11.	6	Thunder &	E.S.E.1.	29 59	2 83
	12	Rain	S.S.W.1.		
	9	Rain Fairer	S.b.W.0.	29 50	0 84
12.	6	Cloudy	N.N.W.1	29 48	
	12		W. 2.	29 47	
	9	Rain	N. W. 3.	29 47	4 98
13.	6	Cloudy	N.N.W.1	29 54	0 01
	12		N.W.b.W.2	29 61	
	9	Fair	N.W.b.w.0	29 62	
14.	6	Cloudy with	S.W.b.W.2	29 63	
	12	some	S.W.b.W.1	29 63	
	9	Fair	S.b.W.2.	29 58	
15.	6	Cloudy	S.b.W.3.	29 48	
	12	Rain	S. 4.	29 43	
	9	Cloudy	S. 2.	29 38	0 36
16.	6	Fair	S. W. 3.	29 43	
	12	Cool	W.S.W.4	29 53	
	9	Rain		29 64	0 47

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	6	Fair	S. W. 1.	29 74	0 06
	12	Fair Cloudy	S. 3.	29 77	
	9	Rain	S.b.W.2.	29 73	
18.	6	Missing.	S.W.b.W.3	29 51	0 94
	12	Rain	S. W. 3.	29 56	
	9	Fairer		29 75	1 12
19.	6		W.S.W.1	29 83	
	12	Fair	W.b.N.2.	29 87	
	9			29 87	
20.	6		W.S.W.0	29 84	
	12	Hot			
	9				
21.	6				
	12				
	9				
22.	6				
	12				
	9				
23.	6				
	12				
	9				
24.	6				
	12				
	9				
25.	6	Thun and			
	12	Rain but			
	9	Fair at Tun- bridge Wells			
26.	6				
	12				
	9	Missing	S. W. 2.	29 50	4 10
27.	6	Fair	W.b.S.1.	29 67	
	12	and	W. 2.	29 78	
	9	Cooler	W.S.W.0.	29 83	
28.	6	Fair	S.W.b.S.0.	29 86	
	12	Cool and	S.b.W.3.	29 81	
	9	Cloudy	S. 2.	29 80	
29.	6	Rain	S.b.W.3.	29 68	0 02
	12				
	9	Fair	W.S.W.0	29 76	
30.	6	Fair	S. W. 0.	29 75	
	12				
	9	Missing		7.29 41	
31.	6	Fair	W.b.S.5.	29 41	10
	12	Cooler	W. 4.	29 52	
	9	Cloudy		29 57	
				Total	17 03

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D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6	Fair	S. W. 2.	29 51	
	12		W.b.N.3.	29 49	
	9	Showers		29 46	0 13
2.	6		S.W.b.W.1	29 43	
	12	Showry			
	9		N.b.E.1.	29 55	0 39
3.	6		W.b.S. 0.	29 60	
	12	Fair	N. W. 2.	29 62	
	9			29 67	
4.	6	Misling	S.W.b.W.1	29 64	
	12	Fairer	W.N.W.2.	29 65	
	9	Rain		29 71	
5.	6	Fair	W.b.N.0.	29 75	0 14
	12		W.N.W.2.	29 81	
	9	Showers		29 87	0 40
6.	6	Cloudy	W.b.S.1.	29 88	
	12	Showers	W.b.S.3.	29 87	
	9	Fair Cool	N. W. 2.	29 87	0 05
7.	6	Fair	N.W.b.W.1.	29 84	
	12	Rain	N.N.W.2.	29 81	
	9	Fairer	N.N.W.0.	29 80	0 26
8.	6	Misty	W.b.S.1.	29 72	
	12	Cool	N.N.E.1.	29 72	
	9	Rain	N.N.E.0.	29 72	1 57
9.	6	Cloudy	S.W.b.W.1	29 63	0 01
	12	Dull	S. W. 2.	29 61	
	9	Day		29 58	
10.	6		N.W.b.N.1	29 58	
	12	Rain	N. 1.	29 61	
	9		N. E. 0.	29 63	1 40
11.	6	Cloudy	N. 1.	29 63	
	12	Cool	N.b.W.2.	29 65	
	9	Day	N. 0.	29 67	
12.	6		N.b.W.1	29 69	
	12	Misling	N. 3.	29 70	
	9			29 76	0 02
13.	6	Fair and	N.b.W.1	29 79	
	12	Cool	N. 2.	29 84	
	9	Cold	E.b.N.0.	29 90	
14.	6		N.b.E. 0.	29 98	
	12	Fair	E. 2.	30 01	
	9			30 00	
15.	6	Fair	S.E.b.E.0.	29 95	
	12	and	N. E. 2.	29 96	
	9	Warm		29 98	
16.	6		E. 0.	30 00	
	12	Same	E.N.E.2.	30 04	
	9			30 09	

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	6	Fair	N. 0.	30 10	
	12		N.E.1.	30 09	
	9	Cloudy		30 05	
18.	6		E. 0.	29 95	
	12	Cloudy	E. 2.	29 94	
	9		S. 1.	29 85	
19.	6	Fairer	S.S.W.0.	29 82	
	12	Warm	W.S.W.2	29 82	
	9	Cloudy		29 80	
20.	6	Cloudy	S. W. 0.	29 76	
	12		S. W. 3.	29 73	
	9	Fair		29 67	
21.	6	Fair	S.W.b.S.1	29 59	
	12		S.S.W.2.	29 58	
	9	Cloudy		29 55	
22.	6	Cloudy	S.S.E.1.	29 44	
	12		S. 3.		
	9	Rain		29 37	0 10
23.	6	Rain	S. 0.	29 48	0 48
	12		S.E.b.E.2	29 51	
	9	Thunder		29 47	1 58
24.	6	Showers	S.b. E. 1.	29 42	
	12		S. 3.	29 42	
	9	Fair		29 42	0 01
25.	6	Cloudy	S. W. 1.	29 42	
	12		W.b.N.1.	29 42	
	9	Fair		29 42	
26.	6		E.S.E.0.	29 42	
	12	Fair	N. W. 2.	29 41	
	9		N. 1.	29 44	
27.	6	Fair and	S. W. 0.	29 50	
	12	goodHar.	N.W.2.	29 58	
	9	Weather		29 67	
28.	6		S. W. 1.	29 75	
	12	Fair	S. W. 3.	29 79	
	9	Rain		29 76	
29.	6		W. 1.	29 73	
	12	Fair	W.S.W.3	29 76	
	9	Rain		29 73	0 11
30.	6	SomeFair	S.W.0.	29 71	
	12	and some	S.S.W.3.	29 75	
	9	Rain		29 80	0 35
31.	6	Cool	N. W. 0.	29 83	0 02
	12	Fair with	N.W.b.N.2	29 85	
	9	Rain		29 84	
				Total	7 02

SEPTEMBER. 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6	Cloudy	N. N. W. 0	29 80	
	12	Cold	W. 1.	29 72	
	9	Day		29 64	
2.	6		S. W. 1.	29 52	
	12	Showers	S. W. 3.	29 54	
	9			29 56	0 14
3.	6		S. S. W. 1	29 48	
	12	Rain	S. W. 5.	29 45	
	9			29 41	1 55
4.	6	Fair	S. W. 0.	29 40	
	12		S. b. W. 2.	29 37	
	9	Rain		29 16	0 20
5.	6	Fair	W. S. W. 2.	29 13	1 10
	12	Rain			
	9	Fair	S. W. 3.	29 48	0 03
6.	6	Rain	S. W. b. W. 2.	29 50	
	12		S. W. 4.	29 46	
	9	Cloudy		29 47	0 09
7.	6		S. b. W. 4.	29 41	
	12				
	9				
8.	6	Rain			
	12				
	9	Fair		29 76	0 77
9.	6		S. 0.	29 81	
	12	Cloudy	S. b. W. 2.	29 80	
	9		S. b. W. 0.	29 80	
10.	6	Fog	S. W. 0.	29 86	
	12	Fair	S. b. W. 1.	29 89	
	9	Cloudy	W. b. S. 0.	29 89	
11.	6		S. b. E. 1.	29 81	
	12	Rain	S. b. E. 2.	29 70	
	9		E. b. S. 0.	29 61	1 34
12.	6	Fair	N. 1.	29 86	0 01
	12	Warm	E. 2.	29 92	
	9	Day		29 87	
13.	6		E. b. S. 0.	29 70	
	12	Cloudy	E. b. S. 1.	29 61	
	9			29 55	
14.	6		E. 0.	29 57	
	12	Fairer	N. E. 2.	29 62	
	9			29 63	
15.	6	Fair and	E. N. E. 2.	29 60	
	12	Warm			
	9	Cloudy		29 51	
16.	6	Rain	N. E. b. E. 0.	29 41	
	12	Warm	S. b. E. 2.	29 44	
	9	Fair		29 46	0 61

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	6	Rain	E. b. N. 0.	29 39	
	12		E. b. S. 0.	29 36	
	9	Fairer		29 34	1 46
18.	6	Rain	E. b. S. 0.	29 31	
	12		S. E. 1.	29 34	
	9	Fairer		29 36	1 43
19.	6		E. N. E. 1.	29 25	
	12	Showers	S. W. 3.	29 25	
	9			29 31	0 65
20.	6	Rain	S. W. 1.		0 15
	12	Cloudy	S. W. b. W. 2.	29 38	
	9	Rain		29 42	
21.	6	Foggy	S. W. 0.	29 46	0 55
	12	Shower.	W. S. W. 1.	29 49	
	9	Fair		29 52	0 01
22.	6	Hoar Frost	S. W. b. W. 0.	29 47	
	12	Fair	S. 2.	29 41	
	9	Rain		29 37	0 20
23.	6	Fair	S. W. 1.	29 42	
	12	Warm	W. S. W. 3	29 42	
	9	Colder		29 44	
24.	6	Fair	S. S. W. 0.	29 44	
	12	Cooler	S. E. b. E. 1	29 43	
	9	Cloudy		29 31	
25.	6	Rain	S. S. E. 2.	29 20	0 42
	12				
	9				
26.	6				
	12	Fair		29 45	0 01
	9				
27.	6	Fair and	S. S. E. 1.	29 42	
	12	Pleasant	S. 3.	29 42	
	9	Rain		29 41	0 11
28.	6	Fair	S. 0.	29 40	0 03
	12	Showers	S. 3.	29 36	
	9	Fair		29 26	0 01
29.	6	Rain	E. b. S. 1.	29 05	0 04
	12	Rain	S. b. E. 3.	29 06	
	9			29 06	0 76
30.	6	Rain	S. b. E. 2.	29 04	
	12	Warm	S. S. W. 4.	29 07	
	9	Fair		29 36	0 40
				Total.	12 07

OCTOBER. 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	7	Misting	S. 3.	29 37	
	12	Warm	S.W.b.S.4.	29 45	
	9	Fair		29 66	
2.	7	Cloudy	S. 2.	29 69	0 20
	12	Warm and	S. 3.	29 71	
	9	Fair		29 77	
3.	7	Rainy	S. 2.	29 83	
	12	Warm	S.S.E. 2.	29 83	
	9	Day		29 63	2 87
4.	7	Fair	S.W.b.W.1	29 50	1 17
	12	Fair		29 50	
	9	Rain	w.N.w.7.	29 50	0 36
5.	7	Cloudy	w.N.w.2.	29 82	
	12	Fair	N.b.W.3	29 88	
	9	Cooler		29 95	
6.	7		S.w.b.w.1.	30 00	
	12	Cloudy	W.b.N.2	30 03	
	9		W.b.N.0	30 07	
7.	7	Cloudy	W. 1.	30 07	
	12	Fair	W.b.N.1	30 07	
	9	Cloudy	W. 0.	30 07	
8.	7	Fair and	N. W. 0	30 10	
	12	some what	N.b.W.1	30 10	
	9	Cooler	N. W. 0.	30 11	
9.	7	Cloudy	N. W. 0.	30 07	
	12	and	w.S.w.1	30 03	
	9	Cooler	S. W. 3.	29 88	
10.	7	Rain	W.b.N.3	29 62	1 55
	12	Fair	w.N.w.3.	29 76	
	9	Rain	S.W. 3.	29 61	
11.	7	Cloudy	W.b.N.3	29 35	0 63
	12	Fair	W.b.N.3	29 36	
	9	Cloudy	W.b.N.3	29 37	
12.	7	Cloudy	W. 2.	29 30	
	12	and some	W. 3.	29 30	
	9	Rain		29 27	0 23
13.	7	Fair	W.b.S. 0.	29 14	0 02
	12	Warm	N. 2.	29 09	
	9	Cold		29 08	
14.	7	Fair	W.b.N.0	29 20	
	12	Rain	N.b.E.2.	29 30	
	9	Cloudy		29 42	0 07
15.	7	Hoar Fr.	N.W.b.N.0.	29 47	
	12	Fair and	N.W.b.N.1.	29 47	
	9	Cold		29 47	
16.	7	Icy Frost	N.N.W.1.	29 50	
	12	Fair and	N.b.W.1	29 53	
	9	Cold		29 61	

D.	h.	Weather.	Winds.	Barom.	Rain.
17.	7	Ice and	N.N.W.1.	29 62	
	12	Fair			
	9	Rain		29 57	0 34
18.	7	Ice	S. 1.	29 44	
	12	Cloudy	S. W. 2.	29 33	
	9	Fair		29 15	
19.	7	Cold	E.S.E.2.	28 98	
	12		S. b. E. 2.	28 84	
	9	Rain		28 83	1 20
20.	7	Cold	S. W. 2.	29 01	0 41
	12	and	W.b.S.2.	29 12	
	9	Cloudy		29 24	
21.	7	Frost and	N. 0.	29 23	
	12	Fair	N. W. 2.	29 24	
	9	Cloudy		29 46	
22.	7	Showers	N.N.E.0	29 50	
	12	Hail	S. 2.	29 51	
	9	Showers		29 57	1 41
23.	7	Hard Frost	S.E.b.E.0.	29 65	
	12	and	E. S. E. 1	29 68	
	9	Fair		29 70	
24.	7	Fair	E. 0.	29 62	0 04
	12	Warm			
	9	Rain		29 58	0 10
25.	7	Rain	S. 3.	29 40	0 11
	12	Mild	S. b. E. 3.	29 24	
	9	weather		29 42	
26.	7	Cloudy	S. S. E. 2.	29 48	
	12	Fair and	S.E.b.S.3.	29 47	
	9	Warm		29 43	
27.	7	Fair	S.b.W.0.	29 52	
	12	Cloudy		29 52	
	9	Rain		29 42	0 80
28.	7	Mist	W.0.	29 41	
	12	Fairer	N.N.E.2	29 24	
	9	Rain		29 46	0 05
29.	7	Cloudy	N.b.E.2.	29 41	
	12	Colder	N.b.E.1.	29 41	
	9	Rain		29 41	
30.	7	Snow	N.b.E.4.	29 22	1 23
	12	Sleet	N. 3.	29 23	
	9	Fairer		29 42	0 29
31.	7	Hard Fr.		29 62	
	12	Cloudy			
	9			26 76	
				Total	13 08

NOVEMBER. 1698.

D.	b.	Weather.	Winds.	Barom.	Rain.
1.	8	Frost	S.W.b.S.2.	29 63	
	12	Sleet	S.W. 2.	29 62	
	9	Cloudy		29 65	0 12
2.	8	Fair	S.S.W.0	29 67	0 06
	12	Warmer	S.S.W.1.	29 68	
	9	Showers		29 64	0 03
3.	8	Fair	S. 1.	29 55	
	12				
	9	Cloudy	S.b.W.3.	29 49	
4.	8	Showers	S. 3.	29 40	
	12	Warm and	S. 3.	29 30	
	9	Cloudy	S. 4.	29 15	0 11
5.	8	Rain	W.S.W.5	28 98	0 19
	12	Fair and	S.W.b.W.6	29 14	
	9	Pleasant	S.w.b.W.0	29 37	
6.	8	Frost	S.W.b.W.0	29 45	
	12	Fair and	S.b.W.0.	29 45	
	9	Cold	S.b.W.0.	29 43	
7.	8	Rain	S.W.b.W.3	29 22	0 26
	12	Fair and	W.b.S.4	29 28	
	9	Warmer	S.W.b.S.1	29 42	
8.	8	Rain	S. 1.	29 24	
	12		W.b.S.2.	29 12	
	9	Fairer	W.S.W.2.	2 27	2 30
9.	8	Fair	S.W. 3.	29 33	0 23
	12	Cloudy	W.S.W.2.	29 2	
	9	Snow	S.S.E.1.	29 27	
10.	8	Cloudy	W.S.W.0	29 42	0 36
	12	Misty	S.W.b.S.1.	29 48	
	9	Day		29 47	
11.	8	Snow and	N.b.E.1.	29 48	
	12	Sleet all	N.b.E.1.	29 47	
	9	Day Snow		29 43	2 66
12.	8	Snow, 3	N.b.W.2	29 46	2 56
	12	Inches,	N.b.W.1	29 54	
	9	Cloudy		29 65	0 65
13.	8	Hard Fr.	W.b.S.0.	29 60	
	12	and	W.S.W.1	29 58	
	9	Fair		29 62	
14.	8	Fair, Snow	W.S.W.1	29 63	
	12	and Hard	W.b.S.2.	29 61	
	9			29 70	
15.	8	Frost	N.N.W.1.	29 90	
	12	Misty &	W.b.N.0	29 98	
	9	less Cold		30 01	
16.	8	Cloudy	S. 1.	29 92	
	12	Fair	S.S.E.2.	29 92	
	9	Thaw		29 81	

D.	b.	Weather.	Winds.	Barom.	Rain.
17.	8	Frost	S. 0.	29 67	18
	12	and			
	9	Fair		29 37	
18.	8	Rain	S. E. b. S.2	29 07	
	12	Fair and	S.W.b.W.2	29 16	
	9	Cold		29 31	0 04
19.	8	Rain and	S.b.E.2.	29 28	
	12	Cold thaw	S.W.b.S.3.	29 14	
	9	Fair		29 20	0 10
20.	8	Rain	S. W. 2.	29 20	0 44
	12	Fair and	S. W. 4.	29 27	
	9	Warm		29 31	
21.	8	Rain	S. W. 4.	29 14	2 81
	12	Fair and	S. W. 3.	29 20	
	9	Warm		29 48	
22.	8	Frost and	W.b.S.1.	29 77	
	12	Fair		29 83	
	9	Cloudy		29 75	
23.	8	Rain and			
	12	Warm			
	9				
24.	8				
	12	Rain			
	9	Stormy		29 75	1 15
25.	8	Some	S.W.b.S.8.	29 15	0 61
	12	Fair	S.W.b.W.8	29 30	
	9	Some Rain	3.	29 52	0 15
26.	8		S.W.4.	29 41	
	12	Rain	S.W.b.W.5	29 33	
	9			29 30	0 07
27.	8	Small Fr.	W.S.W.3.	29 25	
	12	and	W.S.W.3.	29 27	
	9	Fair		29 53	
28.	8		W.b.S.1.	29 41	
	12	Same	W.b.N.1	29 44	
	9			29 37	
29.	8	Snow	E.b.N.1.	29 13	
	12		E.b.N.2.	29 09	
	9	Sleet		29 17	0 74
30.	8	Frost &	N.b.W. 4	29 56	
	12	Fair	N.N.W.2.	29 66	
	9	Rain		29 86	0 01
				Total	16 83

D E C E M B E R. 1698.

D.	b.	Weather.	Winds.	Barom.	Rain.	D.	b.	Weather.	Winds.	Barom.	Rain.
1.	8	Hard Fr.	N.b.W.0	29 85		17.	8	Rain	S.b.W.6.	29 09	
	12	Fair	E.b.S.0	29 80			12	Warm	S.b.W.6.	29 10	
	9	Snow 3.		29 78			9	Rain		29 22	0 42
2.	8		W.N.W.0	29 93		18.	8	Cloudy	S.W.b.S.3.	29 32	0 40
	12	Foggy	W. b.N.	30 01			12	and	S.W.b.S.2.	29 30	
	9			30 11			9	Warm		29 34	
3.	8	Cloudy	W.b.S.0.			19.	8	Fair	S.b.W.0.	29 72	
	12	with gentle	W.b.S.0.	30 15			12	Cooler	S.b.E.1.	29 67	
	9	Thaw	W.b.S.0.	30 16	1 32		9	Rain		29 35	
4.	8		W.b.S.0.	30 09		20.	8		S. 3.	29 23	0 56
	12	Foggy	S. W. 0.	30 08			12	Rain	S.b.E.5.	28 98	
	9		S.W.b.S.0	30 06			9			28 68	0 24
5.	8	Fog and	S.W.b.S.0	30 02		21.	8	Fair	W. 4.	29 36	
	12	Misting	S.b.W.0.	30 03			12	and	W. 3.	29 52	
	9		S.b.E.0.	30 00	0 41		9	Rain		29 52	
6.	8	Fog	E.S.E. 1.	29 97		22.	8		W.b.S.4.	29 49	0 17
	12	Warm	E. 2.	29 94			12	Fair	W.S.W.3.	29 55	
	9	Clearer	S.E.b.E.1	29 92			9			29 66	
7.	8	Misty	S. E. 0.	29 92		23.	8			29 81	
	12	Clearer	S. E. 0.	29 91			12	Cloudy		6 29 65	
	9	Misty	E.b.S.0.	29 88		24.	8	Cloudy	S. W. 7.	29 34	
8.	8	Mist	E.b.S.0.	29 83	0 04		12	Warm	W.b.N.8	29 56	
	12	Fair	E.b.S.1.	29 86			9	Fair	2. 29 82		
	9	Fog	S.W.b.S.0	29 94	0 12	25.	8		W.b.S.2.	29 94	
9.	8	Rain	S.b.W.2	29 99	0 03		12	Fair	W.S.W.2.	29 95	
	12	Cloudy	S.b.W.3.	29 98			9			30 00	
	9	and Warm	S.S.W.4.	29 91		26.	8	Cloudy	W.b.S.3.	29 93	
10.	8	Cloudy	S. 6.	29 66			12	and	W.b.S.4.	29 90	
	12	Rain	W.b.S.6.	29 64			9	Warm		29 77	
	9	Fair	W.b.S.2.	29 96	0 49	27.	8	Rain	W.b.S.4.	29 50	
11.	8	Fair and	W.S.W.4	30 10			12	Colder	S.W.b.W.4	29 43	
	12	Cooler	S. W. 3.	30 14			9	Fairer		0 21	
	9	Cloudy		30 00		28.	8	Frost and	S. W. 3.	29 49	
12.	8	Rain	W.N.W.3.	29 79	0 72		12	Fair		29 40	
	12	Fair		30 11			9	Frost			
13.	8	Frost	S.E.b.S.0.	30 10		29.	8	Warmer	S. W. 7.	28 88	
	12	Fair	S.S.E.1.	30 06	0		12	Rain	S. W. 8.	28 79	
	9	Cloudy		29 96			9	Colder		28 69	
14.	8					30.	8	Snow	W.b.S.3.	28 79	0 69
	12						12	Frost and	W.b.S.3.	28 89	
	9	Rain					9	Fair			
15.	8					31.	8	Frost	W. 0.	29 23	
	12						12	and	W.N.W.2.	29 36	
	9						9	Fair		29 67	
16.	8	Cloudy	S.b.W.2	29 60	0 01					Total	5 83
	12	Rain	S. 3.	29 50							
	9	Warm	7. 29 44								

XXV.
The Rain 1697.
and 1698. at
Townley; by
Mr. Townley.
n. 249. p. 47.

	1697		1698			1697		1698	
<i>Jan.</i>	10	26	12	94	<i>Jul.</i>	27	00	20	74
<i>Feb.</i>	14	34	11	76	<i>Aug.</i>	80	50	43	00
<i>Mar.</i>	9	86	40	32	<i>Sept.</i>	93	80	43	58
<i>Apr.</i>	8	24	41	90	<i>Oct.</i>	55	20	44	52
<i>Ma.</i>	23	76	17	90	<i>Nov.</i>	21	44	49	44
<i>Jun.</i>	17	84	12	90	<i>Dec.</i>	49	00	40	84
					<i>Sum.</i>	411,	24	379,	84

As far as I have learned, the Mercury rises and falls much after the same Measure in most parts of our Island, and of this you may better Judge by some Observations I have here transcribed and sent you, of the very low Stations, *Decemb.* 28. about 3 of the Clock Mercury 28,17; on the 29. about 2 *h.* $\frac{1}{2}$ 28,18; and *Jan.* 2. about the same Hour 28,05. and, this time it hardly rise before I went to Bed; and on the 6th still about 3. *h.* 28,19; but this time before 9 at Night it was got to 29,28. What I note is, that though once I saw it lower many Years ago, yet never since I kept my Observations, did the Quicksilver Descend so often to those Pitches; or when it was found very low, did it ever continue so for any considerable time, as it hath done this Year, during which it hath never been very high, and as I remember, generally much lower than other Years. This hath proved very unseasonable here, and so backward, that I thought I had never known the like; but examining my Observations, I find that of 1673 much what as late, though the Consequence proved not so fatal to these parts of all Europe, as this.

The Weather
1698. and 1699.
at Emuy in
China; by Mr.
Ja. Cunning-
ham. n. 256. p.
323.

XXVI. At *Emuy* in *China* in the Latitude of $24^{\circ} 20'$ N. *An.* 1698. *Octob.* From 1. to 8. the Weather was Fair and Clear; the Mercury's Alt. $29\frac{14}{20}$ Digit. From the 8th to the 11th. Close and Cloudy Weather; the Mercury falling to $29\frac{13}{20}$ Dig.

11. Close Weather, somewhat Cloudy. 12. Close Weather blowing fresh at N. E. 13, and 14. Close and Cloudy Weather with much Rain, and fresh winds from N. E. to N. W.

The Tide, (which commonly flows 3 Fathoms) did flow above half a Foot higher 3 Days after the Full Moon, than it did on the Full Moon at the \AE -quinox.

15. Fair and Clear Weather, with small Gales at N. E. From the 15 to the 24 fine Moderate fair Weather, with small Gales at N. E. and to the 31st Winds and Weather variable.

Nov. 1. to the 15. variable, Close and Cloudy Weather, with some Rain, and variable Gales round the Compass.

15. Fair and Clear Weather, with small Gales at N. E. in the Morning the Mercury's Alt. $29\frac{15}{20}$ at Noon $29\frac{14}{20}$; and at 10 of the Night being Cold, rising

ing to $29\frac{16}{20}$ 16. At Sun Rising very Cold, the *Mercury's* Alt. $29\frac{18}{20}$. At Noon Fair and pleasant Weather, the *Mercury* falling to $29\frac{17}{20}$. At Night Cold, rising to $29\frac{18}{20}$. The Wind at N. E. 17. This Morning Cold, the *Mercury* at $29\frac{18}{20}$, Fair and Clear Weather all Day, and at Night blowing somewhat Fresh at N. E. the *Mercury* at $29\frac{17}{20}$. 18. This Morning Cold, the *Mercury* at $29\frac{17}{20}$. All Day Fair and pleasant Weather, the *Mercury* falling to $29\frac{14}{20}$, and by Noon to $29\frac{12}{20}$. The Weather Fair, somewhat Close and Cloudy; the Afternoon Sun shining and Warm, and at Night temperate, the *Mercury* continuing at $29\frac{12}{20}$. Small Winds at N. E. and almost Calm.

20. A Pleasant Sun-shining Morning, the *Mercury* at $29\frac{12}{20}$. At Noon overcast, and Cloudy, with little Wind at N. E. the *Mercury* falling to $29\frac{10}{20}$. In the Afternoon some Drops of Rain, with Close Weather, and at Night the *Mercury* continuing at $29\frac{10}{20}$ with small Westerly Winds. Some Rain in the Night. 21. Close and Cloudy Weather, with small Gales, at N. E. the *Mercury* at $29\frac{10}{20}$ in the Morning, and continued so all Day, with some Drops of Rain in the Afternoon, the Gale freshning, and a Shower of Rain at 8. of the Night, the *Mercury* rising to $29\frac{12}{20}$. 22. Gray and Cloudy Weather all Day, with Fresh Gales between E. and N. E. The *Mercury* at $29\frac{12}{20}$, and at Night Rising to $29\frac{17}{20}$. Fair Weather somewhat Cloudy. 23. A very cold Morning, Fair and Clear, with fresh Gales from N. E. to N; the *Mercury* at 30 Dig. Fair and clear all day, with a moderate Gale about N. E. Clear and very cold all Night, the *Mercury* continuing at 30 Dig. 24. A Fair Clear, and Cold Morning, the wind at N. E. a Moderate Gale, the *Mercury* continuing at 30. Dig. A Clear Sun-shining Day, Cold and Clear all Night, the *Mercury* as before. 25. A Sharp Cold Morning, Fair and Clear, with a moderate Gale at N. W. the *Mercury* fallen to 29. All Day fair and pleasant, very warm and no Wind, the *Mercury* falling at Noon to $29\frac{15}{20}$, and at Night being somewhat Hazy and Calm withal, to $29\frac{14}{20}$. 26. Temperate Weather all Night, and this Morning somewhat Close and Hazy, and no Wind, the *Mercury* at $29\frac{14}{20}$, and and towards Noon growing Clearer, and Warmer, rising to $29\frac{16}{20}$. Small Brizes at N. E. at Night falling to $29\frac{14}{20}$. Temperate Weather. 27. Fine Pleasant Weather all Day with small variable Brizes from the N. to W. and about to S, the *Mercury* in the Morning at $29\frac{14}{20}$, and at Noon falling to $29\frac{12}{20}$, and at Night rising to $29\frac{14}{20}$. Fair Weather and Calm. 28. Fine Moderate Weather, with a Gale at N. E. the *Mercury* at $29\frac{14}{20}$. In the Afternoon the Gale freshned, the Weather somewhat Cloudy, and at Night the *Mercury* was at $29\frac{15}{20}$. Blowing fresh. 29. Fair and Clear Weather, somewhat Cold this Morning, with a Fresh Gale at N. E; the *Mercury* at $29\frac{18}{20}$. Fine pleasant Weather all Day, with small Gales at N. E. at Noon the *Mercury* falling to $29\frac{15}{20}$, and at Night being Clear and somewhat Cold, rising to $29\frac{17}{20}$. 30. Fair and Pleasant weather, with small Gales at N. E. The *Mercury* at $29\frac{17}{20}$. At Noon a fresh Gale, the *Mercury* falling to $29\frac{14}{20}$. At Night Temperate Weather, and little Wind, the *Mercury* rising to $29\frac{16}{20}$.

Dec. 1. Fine Temperate Weather, with small Gales at N. E. the *Mercury* at $29\frac{16}{20}$ in the Morning. Fair Weather all Day, and small Brizes at N. E. The *Mercury* at Noon falling to $29\frac{14}{20}$, and in the Evening to $29\frac{12}{20}$, and at Night rising to $29\frac{12}{20}$, being fine Clear Weather. 2. Fair and Temperate Weather,

Weather, somewhat Cloudy, and overcast with small Gales at N. E. The *Mercury* at $29\frac{14}{20}$ and at Night rising to $29\frac{15}{20}$. 3. A Clear and Cold Morning, with a fine Sharp Gale at N. b. E. The *Mercury* at $29\frac{17}{20}$. A Cold Air all Day, the *Mercury* at Noon falling to $29\frac{15}{20}$, and at Night, the Gale freshning made it Colder, the *Mercury* rising to $29\frac{18}{20}$. 4. A Sharp Morning with a Fresh Gale at N. b. E. The *Mercury* at $29\frac{19}{20}$. Fair and Clear all Day, with a small Northerly Gale, the *Mercury* by Noon falling to $29\frac{15}{20}$. A Serene Temperate Night, and almost Calm, the *Mercury* as before. 5. A Fine Clear Morning with a moderate Gale at S. W. somewhat Cold, the *Mercury* at $29\frac{15}{20}$. At Noon a small Brize, at E. b. S. Pleasant Weather, the *Mercury* at $29\frac{12}{20}$. At Night a small Gale at S. b. E. Fair and Temperate Weather, somewhat Hazy, the *Mercury* at $29\frac{13}{20}$.

6. This Morning somewhat Close and Cloudy, with a few Drops of Rain, the Weather Temperate, with small Southerly Brizes, the *Mercury* at $29\frac{13}{20}$. The Afternoon Calm, and somewhat Hazy, the *Mercury* falling to $29\frac{10}{20}$. At Night overcast and Cloudy, with some Rain, blowing fresh at N. the *Mercury* rising to $29\frac{14}{20}$. 7. A Gray Morning, Clearing up with a fresh Gale at N. E. the *Mercury* at $29\frac{17}{20}$. In the Afternoon the Horizon a little Hazy, the *Mercury* falling to $29\frac{15}{20}$. At Night Clearer, with a Fresher Gale, the *Mercury* rising to $29\frac{18}{20}$. A very Cold Night. 8. A Sharp Clear Morning, with a fine Gale at N. E. the *Mercury* at 30. At Noon falling to $29\frac{18}{20}$, a fine Sun-shining Day. At Night Cold and Clear, a small Gale at N. E. the *Mercury* rising to 30. 9. This Morning as the last, all Day and Night the same, and the *Mercury* also.

10. A Cold Morning, somewhat Foggy, with a fine Gale at N. E. the *Mercury* at 30. All Day fair, Clear and Sun-shining. At Night Cold, the *Mercury* at $29\frac{19}{20}$. 11. A Cold Morning with a Moderate Gale at N. W. the *Mercury* at $29\frac{19}{20}$. All Day Fair and Clear, the *Mercury* falling to $29\frac{16}{20}$. At Night a fresh Gale at N. E. the *Mercury* at $29\frac{19}{20}$. 12. A Gray Cold Morning, somewhat Cloudy, with a Hazy Horizon, a fresh Gale at N. E. the *Mercury* at $29\frac{19}{20}$; towards Noon falling to $29\frac{17}{20}$ with little Wind, and fair Weather; at Night Calm and somewhat Cold, the *Mercury* rising to $29\frac{18}{20}$. 13. A Fine Pleasant Morning, with a small Brize at N. W. the *Mercury* at $29\frac{18}{20}$. At Noon a small Gale at N. E. and in the afternoon Calm, the *Mercury* falling to $29\frac{14}{20}$. All Day serene; at Night Calm; with a Clear Sky, somewhat Cold, the *Mercury* rising to $29\frac{15}{20}$. 14. A fine Temperate Morning, with some small Rain like Dew, and a moderate Gale at S. W. the *Mercury* at $29\frac{15}{20}$. The afternoon a little overcast and the Horizon somewhat Hazy, a small Gale at S. E. the *Mercury* falling to $29\frac{12}{20}$. At Night Temperate and Calm, the *Mercury* rising to $29\frac{14}{20}$. 15. A fine Temperate Calm Morning, the *Mercury* at $29\frac{15}{20}$. At Noon Fair, Pleasant, Calm Weather, the *Mercury* fallen to $29\frac{12}{20}$. All the Afternoon, and at Night a fresh Gale at N. E. Fair Weather, the *Mercury* rising to $29\frac{15}{20}$. 16. A Gray Cloudy Morning, somewhat Hazy, with a fresh Gale at N. E. the *Mercury* at $29\frac{17}{20}$. At Noon Fair and Clear, the Gale moderate, and the *Mercury* falling almost to $29\frac{14}{20}$. The Afternoon somewhat Cloudy with a fine Gale at N. E. At Night a little Wind, Serene and Sharp, the *Mercury* rising to $29\frac{18}{20}$. 17. A Gray Morning somewhat Cold, with a fine Gale at N. E. the *Mercury*

Mercury at $29\frac{17}{20}$ and at Noon falling to $29\frac{15}{20}$. At Night little Wind, the *Mercury* rising to $29\frac{16}{20}$. 18. A Fair Temperate Calm Morning, somewhat Foggy, the *Mercury*, at $29\frac{17}{20}$. All Day Fair Weather, somewhat Cloudy with small Winds at N. E. the *Mercury* falling to $29\frac{15}{20}$. At Night blowing fresh, the *Mercury* rising to $29\frac{18}{20}$. 19. A Gray Cloudy Morning with a fresh Gale at N. E. the *Mercury* at $29\frac{13}{20}$. Close Thick Weather, with continual Rain all Day and Night, and a moderate Gale at N. E. at Night the *Mercury* rising to $29\frac{19}{20}$. 20. Close Thick Rainy Weather, in the Morning, with a moderate Gale at N. E. the *Mercury* falling below $29\frac{18}{20}$. And by Noon to $29\frac{16}{20}$, continual Thick Rainy Weather all Day and Night, the *Mercury* at $29\frac{16}{20}$, and the Gale as before.

21. A Gray Cloudy Morning, but fair and beginning to clear up and Calm withal, the *Mercury* at $29\frac{14}{20}$, at Noon Fair Weather, and somewhat Clear, with a small Gale at S. W. the *Mercury* falling to $29\frac{12}{20}$. At Night Calm and somewhat Cloudy, the *Mercury* at $29\frac{14}{20}$. 22. A Gray Cloudy Morning continuing so all Day, with a small Gale at N. E. the *Mercury* at $29\frac{14}{20}$, at Night rising to $29\frac{15}{20}$.

23. A Gray Cloudy Morning continuing so all Day, with small Gales at N. E. the *Mercury* at $29\frac{14}{20}$, at Night more Serene the *Mercury* rising to $29\frac{15}{20}$. 24. A Gray Morning and Calm Weather, the *Mercury* at $29\frac{15}{20}$, Close and Cloudy Weather all Day and no Wind, the *Mercury* falling to $29\frac{14}{20}$. At Night rising almost to $29\frac{15}{20}$.

25. A Gray Cloudy Morning (some Rain before Day-light) with small Southerly Brizes, the *Mercury* at $29\frac{14}{20}$. Towards Noon Sun shining and pleasant; little Wind variable, the *Mercury* falling to $29\frac{12}{20}$. The Afternoon and at Night overcast and Cloudy, the Wind at S. b. E. and the *Mercury* rising to $29\frac{13}{20}$.

27. A Fine Pleasant Morning, with a Hazy Horizon, and altogether Calm, the *Mercury* at $29\frac{13}{20}$, and by Noon at $29\frac{11}{20}$. All Day Pleasant Weather, and at Night small Gales at North East, the *Mercury* rising to $29\frac{12}{20}$.

28. A Fine Pleasant Morning with a small Brize at E. N. E. the Horizon somewhat Hazy, and the *Mercury* at $29\frac{11}{20}$. at Noon falling to $29\frac{10}{20}$. All Day Fair and Pleasant Weather with the foresaid Brize. At Night Calm, the *Mercury* falling almost to $29\frac{9}{20}$.

29. A Gray Morning, with a Close Horizon and a small Brize about E. N. E. the *Mercury* at $29\frac{9}{20}$. Calm all the Forenoon, in the Afternoon Pleasant Weather, with a small Gale at S. E. the *Mercury* at $29\frac{6}{20}$. At Night Calm, the *Mercury* at $29\frac{7}{20}$.

30. A Gray Cloudy Morning, and Close Weather, with a fresh Gale at S. E. the *Mercury* at $29\frac{10}{20}$. All Day Cloudy and Dark, the Gale freshning and Veering to E. N. E. the *Mercury* rising to $29\frac{12}{20}$. 31. Gray Cloudy Weather all Day, with a fresh Gale at N. E. in the Evening some Rain, blowing fresh all Night.

Jan. 1. 1699 Variable Weather with small Gales at N. E. 2. Rainy Thick Weather all Day and Night with little Wind at N. E. 3. Continual Thick Rainy Weather all Day and Night, the Wind at N. E. 4. Fair Weather somewhat Close, and Calm all Day and Night. 5. Close Weather with some Rain and Calm this Forenoon; and in the Afternoon a small Brize at W. N. W.

M A R C H 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.	D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
1.	6	Fair						17.	6	Fair	S. 2.	S. b. W.	29 84	108	
	9	Sleet	N. b. E. 2		29 26	86	0 12		9	Hail			30 12	92	0 05
2.	6	Snow	N. b. w. 3		29 40	82		18.	6	Small Fr.	S. W. 0.		30 19	78	
	9	Fair			29 64	80	0 04		9	Fair and Pleasant.	W. 2.		30 22	112	
3.	6	Hard F.	N. W. 1. N. 0.		29 72	68		19.	6	Cloudy	S. W. 4.		29 88	98	
	9	Cloudy	w. b. S. 1. N. W.		29 77	96			9	Rain	S. W. 4.		29 77	115	
4.	6	Cloudy	N. b. w. 2	N. N. E.	29 82	93		20.	6	Cloudy	s. w. b. w. 3		29 47	101	0 05
	9	Rain	N. 2.		29 91	98			9	Fair	w. b. S. 4.	w. S. w.	29 54	118	
5.	6	Frost	N. W. 0.	N. 1.	30 11	79		21.	6	Fair	S. W. 3.	W. b. S.	29 38	99	
	9	Fairer	N. b. W. 0.		30 19	77			9	Rain			29 49	96	0 25
6.	6	Hard Fr.	N. N. w. 0		30 11	65		22.	6	Hoar Fr.	w. S. w. 1		29 50	82	
	9	Cloudy	S. b. E. 0.		29 95	87			9	Cloudy	S. W. 2.	W.	29 53	113	
7.	6	Fair	S. E. 1.	S. b. E.	29 82	82		23.	6	Rain	S. b. E. 3.	S. b. W.	29 40	101	
	9	Cloudy	S. E. b. S. 2	S. E.	29 88	89			9		S. 3.		29 32	118	
8.	6	Fair	E. S. E. 0	N. E. b. E.	29 97	82		24.	6	Cloudy	S. b. W. 2	S. S. W.	29 07	100	0 57
	9	Fair	E. b. N. 2		30 05				9	Thunder	S. 4.		29 06	119	
9.	6	Frost	N. E. 0.		30 12	80		25.	6	Rain	S. W. 3	W.	29 19	99	0 59
	9	Cloudy	E. N. E. 2.		30 14	87			9	Fair	W. 2.		29 31	117	
10.	6	Cloudy	N. b. E. 0	E.	30 10	85		26.	6	Hoar Fr.	S. W. 0.		29 39	82	
	9	Cloudy	N. b. E. 1		30 08	91			9	Rain	S. b. w. 2		29 41	117	
11.	6	Small Rain	E. b. N. 0	S.	30 00	86		27.	6	Fair	S. 0.	w. S. w.	29 48	86	
	9	Cloudy	S. b. w. 2		29 93	92	0 41		9	Hail	S. 0.		29 50	121	
12.	6	Cloudy	S. 1.		29 84	93	0 18	28.	6	Rain	S. S. E. 0.		29 63	92	
	9	Cloudy	S. b. w. 1		29 84	106			9		N. N. W. 1		29 71		
13.	6	Rain	S. b. w. 1		29 63	93	0 01	29.	6	Fair					
	9	Fairer	S. b. E. 1		29 58	102			9	Fair			29 33	96	0 10
14.	6	Frost	W. 0.		29 80	81		30.	6	Cloudy	w. b. S. 1	W.	29 30	93	
	9	Cloudy			29 84	108			9	Fair	w. S. w. 3		29 23	112	
15.	6	Cloudy	S. w. b. S. 2	W. b. S.	29 87	107		31.	6	Cloudy	w. N. w. 4.		29 20	99	0 24
	9	Cloudy			30 02	116			9	Rain	N. N. W. 6		29 29	102	
16.	6	Cloudy	S. W. 1.	W. S. W.	30 04	112					N. W. 2.		22 43	96	
	9	Cloudy	S. W. 2.		29 99	110							Total		5 63

A P R I L. 1699.

D.	h.	Weather.	Winds.	Clouds	Barom.	Ther.	Rain.
1.	6	Rain	w.b.N.1.	N. W.	29 37	93	
	12	and	N. 4.		29 39	102	
	9	Hail			29 52	98	0 27
2.	6		N.N.W.3		29 50	92	
	12	Same	N. 2.		29 53	102	
	9		N.b.E.2	N. E.	29 61	95	0 14
3.	6		N. 2.	N.E.b.N.	29 63	88	
	12	Cloudy	N.E.b.N.3		29 67	108	
	9		N.b.E.3	N.E.b.N.	29 79	93	
4.	6	Fairer	N.b.E.3	N. E.	29 85	90	
	12	Day	N.E. 4.		29 90	107	
	9		N.b.E.2		29 91	86	
5.	6	Frost and	N.b.E.2		29 83	82	
	12	Fair	N.E. 2.		29 75	109	
	9	Cloudy			29 69	95	
6.	6		E.b.N.0	N.	29 55	92	
	12	Cloudy	E.S.E.1	S.	29 46	112	
	9				29 43	95	
7.	6	Cloudy	S.E.b.E.1	S. E.	29 37	85	
	12	Cold	E. 2.		29 36		
	9	Fair			29 28	98	
8.	6	Cloudy	N. 2.		29 17	98	
	12	with some	N.b.w.1		29 21	103	
	9	Drops			29 17	98	
9.	6	Cloudy	S. o.	N. W.	29 13	97	
	12		S. 1.	S. W.	29 15	115	
	9	Rain			29 16	97	0 52
10.	6	Fair	S.b.w.0	S. W.	29 23	93	
	12		S. 1.		29 31	124	
	9	Cloudy			29 43	104	
11.	6		N. 1.		29 46	99	
	12	Rain	N. 3.	N.N.E.	29 48		
	9				29 52	101	0 07
12.	6		N.E. 3.		29 59	103	0 35
	12	Cloudy	N.E. 4.		29 70	113	
	9				29 83	99	
13.	6	Cloudy			29 90		
	12	Fair	N. E.				
	9	Cloudy			29 86	97	
14.	6	Cloudy	N.E.b.E.3		29 82	104	
	12	Fair	E.N.E.3	E.	29 83	121	
	9	Rain			29 76	108	0 12
15.	6	Cloudy	N.E.b.N.1	E.	29 64	105	0 05
	12	Rain	S.W.1.	S. W.	29 61	118	
	9	Fairer			29 61	101	0 97
16.	6	Cloudy	S. b.w.1.		29 58	101	
	12		S. 1.		29 50	129	
	9	Fair			29 36	103	

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	6	Rain	w.s.w.2		29 21	103	
17.	12						
	9	Fair			29 25	99	0 21
18.	6	HoarFr.	S.W.1.		29 34	85	
	12	Fair					
	9	Rain	S. 1.		29 34	100	
19.	6	Fairer	E. 2.		29 28	103	0 02
	12		w.b.N.1		29 42	125	
	9	Cloudy			29 65	110	
20.	6	HoarFr.	W. o.		29 72	89	
	12	Fair					
	9				29 84	115	
21.	6	Cloudy	S.S.w.1	S. W.	29 87	110	
	12	Warm &	S.W.2.		29 94	131	
	9	Fair			29 98	115	
22.	6	Cloudy	w.s.w.0	W.	29 99	97	
	12		w.b.S.2		30 00	130	
	9	Fairer			29 97	110	
23.	6	Fair	s.w.b.w.2		29 96	104	
	12	and	w.s.w.3	N. W.	29 97	131	
	9	Pleasant			29 88	113	
24.	6		S.S.w.3	W.S.w.	29 74	109	
	12	Fair					
	9				29 60	110	
25.	6	Fair	s.w.b.w.3	W.	29 64	102	
	12						
	9	Rain			29 37	105	
26.	6	Fair	s.w.b.w.4	W.	29 12	109	0 71
	12		W. 4.		29 15	123	
	9	Cloudy			29 14	100	
27.	6	Fair	S.W.1.		29 23	91	
	12	Rain	w.b.S.1		29 31	124	
	9	Cloudy			29 41	105	0 01
28.	6	Fair	w.b.N.1	N.b.W.	29 52	89	
	12	drops of	N. 2.		29 64	122	
	9	Rain	E. 1.	E. b. N.	29 77	101	
29.	6	HoarFr.	N. E. o.		29 81	92	
	12	Fair	E. 1.	N. b. E.	29 81	129	
	9	Cloudy	E. o.		29 79	104	
30.	6	Cloudy	E. o.	N. b. W.	29 78	106	
	12	Fair	S. b. w. 1	N. w. b. w.	29 79	135	
	9	Cloudy	N.E.b.N.0		29 81	117	
					Total	3 44	

M A Y. 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
1.	6	Fair	w.b.S.1.	N.W.	29 84	112	
	9		N.W.1.			138	
2.	6	Fair					
	9	Dry					
3.	6	Cloudy	s.w.b.w.2.		29 47	120	34
	9	Showers	w. S.w.3.		29 38	133	
4.	6	Fair	S.W.1.		29 34	105	
	9	Rain			29 11	99	88
5.	6	Fair	w.b.S.2.		29 17	90	
	9	Thunder	S.W.1.		29 31	118	
6.	6	Hoar Fr.	S.S.w.1.		29 51	92	08
	9	Showers	S.W.3.		29 58	121	
7.	6	Fair	S.b.w.o.		29 79	98	
	9	Fair	S.b.E.2.		29 81	137	
8.	6	Fair	S. 1.		29 90	102	
	9	Fair	S. 2.		29 93	143	
9.	6	Fair					
	9	Warm	E. 1.		29 93	115	
10.	6	Same	N.E.1.		29 90	92	
	9	Same	N.b.E.1.		29 88	147	
11.	6	Same	N.b.E.3.		30 00	117	
	9	Same	N. 2.		30 10	150	
12.	6	Fair	N.b.W.2.		30 17	105	
	9	Dry	N. 4.		30 14	132	
13.	6	Same	N.b.E.3.		30 10	110	
	9	Same	N.N.E.4.		30 08	137	
14.	6	Cloudy	N.N.E.2.		30 05	110	
	9	Fair	E. 1.	N.N.E	30 01	112	
15.	6	Same	E.N.E.1.	N. E.	29 99	110	
	9	Same			29 92	100	
16.	6	Cloudy	N.E.b.E.2.	E.N.E.	29 88	108	
	9	Cloudy	E.N.E.3.		29 87	131	

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
17.	6	Cloudy	E.N.E.3.		29 76	113	
	9	Cloudy	N.E.b.E.3.		29 72	137	
18.	6	Fair and	N.E.b.N.2.		29 69	115	
	9	Hot Day			29 77	124	
19.	6	Fair	N. 2.	N.b.E.	29 80	113	
	9	Fair	N.E.b.E.3.		29 83	146	
20.	6	Same	N.E.2.		29 86	110	
	9	Same	E.b.S.2.		29 86	143	
21.	6	Cloudy	N.N.E.1.		29 80	112	
	9	Hot and	E.b.N.2.		29 76	148	
22.	6	Fair	N.E.2.		29 72	112	
	9	Hot and			29 66	115	
23.	6	Cloudy	N.E.b.N.1.	N.b.E.	29 66	109	
	9	Fair	E. 1.	N.	29 59	134	
24.	6	Rain	N.N.E.3.	N.b.E.	29 43	117	
	9	Fair			29 50	106	08
25.	6	Fair	N.N.W.2.	N.b.W.	29 53	102	
	9	Hail	N.b.w.3.		29 55	120	
26.	6	Fair	E.b.S.1.	N.b.W.	29 55	104	
	9	Rain	S.W.2.	W.b.S.	29 57	132	
27.	6	Fair	S.W.1.		29 65	109	
	9	Cloudy	S.W.1.	S.	29 67	140	
28.	6	Fair	E. 1.	S. E.	29 61	122	
	9	Sultry	E. 2.	S.	29 57	150	
29.	6	Same	E. o.	E.S.E.	29 58	131	
	9	Same		N. W.	29 63	124	09
30.	6						
	9						
31.	6	Hot and					
	9	Dry	W.b.S.2.		30 08	140	
Total							2 67

J U N E. 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
1.	12	6 very Dry Hot Day	S.W.2.	W.b.S.	30 08	132	
	9				30 00	138	
2.	12	6 Fair	s.w.b.s.o	S.w.b.S.	29 91	132	
	9	9 Rain			29 85	134	0 01
3.	12	6	W. 2.		29 90	123	
	9						
4.	12	6					
	9						
5.	12	6					0 01
	9						
6.	12	6 Fair and Dry	W.b.S.2		29 72	120	
	9						
7.	12	6	W.b.S.3.	W.b.N	29 78	121	
	9		W. 2.		29 82	142	
8.	12	6					
	9						
9.	12	6 great Drought					
	9						
10.	12	6 Cloudy	W.b.N.2	N. W. W.b.N.	29 67	146	0 53
	9	9 Fair	W. o.		29 73	125	
11.	12	6 Fair Hot	W.b.S.1.		29 79	126	
	9	9 Cloudy	E. o.		29 87	128	
12.	12	6 Hot and very Dry	E. 1.	W.b.S.	29 86	138	
	9		E.b.S.o.		29 81	136	
13.	12	6 Fair	E. 1.		29 76	131	
	9	9 Rain	E.b.S.1. S. 1.	S.E.b.S. S.b.E.	29 71 29 70	158 138	0 04
14.	12	6	S.S.W.3.		29 86	126	
	9		S.b.W.4.	S.W.b.S.	29 92	154	
15.	12	6					
	9						
16.	12	6					
	9						

D.	h.	Weather.	Wind.	Clouds.	Barom.	Ther.	Rain.
	6						
17.	12						
	9						
	6						
18.	12						
	9						
	6						
19.	12						
	9						
	6	Some Cloudy	w.N.W.1		29 88	148	3 61
20.	12	9 some F.	w.N.W.o	N.w.b.N	29 92	128	
	9						
	6		W. c.	N.N.w.	29 95	130	
21.	12		S. 1.	N. W.	29 98	163	
	9						
	6						
22.	12						
	9						
	6	Fair Hot Day	S. E. 1.		29 93	165	
23.	12	9			29 93	141	
	9						
	6	Fair Sultry	S. E. 1. N.b.w.1	W.	29 94	140	
24.	12	9 Rain	E. 1.		29 94	165	
	9				29 93	140	0 20
	6	Fair Hot Day	E. o.	W.b.N.	29 89	140	
25.	12	9	w.b.S.1.		29 87	166	
	9		s.w.b.w.2		29 82	144	
	6		W. 2.	W.b.N.	29 76	142	
26.	12	9 Fair	N.W.2.		29 84	134	
	9						
	6		N.W.2.	N.w.b.N.	29 98	130	
27.	12	9 Same	S. 2.	W.	30 01	158	
	9				29 96	135	
	6		W.S.W.2	W.	29 90	133	
28.	12	9 Same	W.N.w.2	W.	29 91	161	
	9				29 92	125	
	6		W.N.w.2		29 96	118	
29.	12	9 Same	W.b.S.1		29 99	143	
	9				29 99	135	
	6		N.W.b.W.1	N. W.	29 99	135	
30.	12	9 Same.	N.W.b.W.3.		29 97	162	
	9		E. 1.	N.	29 97	130	
Total							4 4

JULY. 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.	D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
1.	6	Misting	N.E.E.1		30 00	134		17.	6	Same	E.b.N.0		29 91	130	
	12	Hot and	E.S.E.2	N.	30 00	150			12	Same	E.b.N.2		29 93	167	
	9	Fair			29 97	122			9				29 99	131	
2.	6	Fair	E.S.E.1		29 96	125		18.	6	Cloudy	N.b.E.3		30 03	130	
	12	and	N.E.2.		29 92	150			12	Cool	N. 2.		30 06	142	
	9	Hot			29 87	124			9	Day			30 06	127	
3.	6	Same	E. 1.		29 83	131		19.	6	Same	N. 2.		30 01	126	
	12		E. 2.		29 82	157			12	Rain	N. 1.		29 98	138	
	9				29 78	129			9				29 92	123	
4.	6	Fair	E.b.N.1		29 74	120		20.	6	Cloudy	N.N.w.2		29 86	115	
	12	Cloudy							12	and	N.N.w.2.		29 86	139	
	9	Fair	N.E.b.N.1		29 80	135			9	Cool			29 86	126	0 06
5.	6	Fair	N. 2.		29 85	123		21.	6	Cloudy	N.N.W.1		29 87	126	
	12		N. 2.	N.N.E.	29 87	150			12	Fair	N.N.W.1	N.N.E.	29 87	155	
	6	Cloudy			29 90	125			9		S. 1.		29 83	134	
6.	6	Cloudy	N.b.E.1		29 90	120		22.	6	Fair	w.b.S.1.		29 81	122	
	12		N.N.E.2.		29 90	143			12	Cloudy	N.W.1		29 80	159	
	9				29 86	115			9		S. E. o.		29 78	135	
7.	6	Fair	N.E.b.N.0	E.b.N.	29 84	120		23.	6	Fair	S. E. 1.		29 78	131	
	12		E. 1.		29 81	147			12	Some	S. 2.		29 74	172	
	9				29 78	125			9	Drops			29 73	139	
8.	6	Fair	E.b.S.1.		29 79	116		24.	6	Fair	S.W. 1.		29 71	128	
	12	and	W.N.W.1	w.b.N.	29 82	165			12	Rain	S. W.2.	W.	29 67	160	
	9	Hot	N.W.b.N.0		29 90	143			9	Fair			29 58	129	0 01
9.	6	Same	N.b.W.1		30 01	132		25.	6	Rain	S.S.E. 1.	S.	29 37	129	
	12		N.W.b.W.1	N. W.	30 03	153			12		S. 1.		29 21		
	9				30 04	131			9				29 17	129	1 89
10.	6	Same			30 01	119		26.	6	Fairer	S. 1.	S. W.	29 21	118	
	12								12	Rain		S. S.W.	29 24	156	
	9		W.		29 88	147			9	Fair	S. 2.		29 25	129	0 23
11.	6	Hot &	w.b.S.2.		29 89	140		27.	6	Same	S.b.W.2	S.W.b.S.	29 11	128	
	12	Dry	w.b.N.2.	N. W.	29 89	162			12		S. 4.	S. S.W.		153	
	9				29 92	143			9				29 18	128	0 21
12.	6	Sultry	E.b.N.0		29 97	140		28.	6	Fair	S. 1.		29 24	125	
	12	Hot	E.N.E.1		29 97	178			12		S. W.4.	S. S. W.	29 27	147	
	9	Cloudy			29 97	143			9	Rain			29 28	129	0 34
13.	6	Very	E.b.S.0.		29 96	133		29.	6	Fair	S.b.w.3.		29 30	129	
	12	Hot &	E.S.E.1	S. b. E.	29 97	173			12	Rain	S.w.b.S.4	S. W.	29 29	148	
	9	Dry			29 90	142			9	Thunder			29 35	124	2 21
14.	6	Sultry	E. 1.		29 87	136		30.	6	Fairer	S.w.b.S.3	S. W.	29 38	122	
	12	Rain and	E.b.S.2	E. b. N.	29 88	164			12		S. W.4.		29 42	149	
	9	Thunder			29 91	139	0 64		9				29 46	128	
15.	6	Cloudy	N.E.b.N.2.		29 93	136		31.	6	Rain	S.S.E. 1.	S. b.W.	29 36	126	1 04
	12	Fair	N. E. 3.		29 90	164			12		S. 4.		29 34	144	
	9	& Dry			29 87	136			9	Fair			29 36	127	
16.	6	Fair	N.E. 2.		29 87	140									
	12	Hot &	E. 2.	N. E.	29 88	172									
	9	Dry			29 89	134									
														Total	6 63

SEPTEMBER. 1699.

D. h. Weather. Winds. Clouds. Barom. Ther. Rain.						D. h. Weather. Winds. Clouds. Barom. Ther. Rain.					
6	Mist	S. W. o.		29 84	98	6		E. o.		29 59	112
1. 12		S.w.b.S.2.	S.	29 85	145	17. 12	Rain	S. W. 1.		29 50	141
9	Fair	S. o.		29 80	122	9				29 60	116 2 36
6		S. E. o.	S. b. E.	29 77	112	6		W.b.S.2.	N. W.	29 82	102
2. 12	Cloudy			29 77	130	18. 12	Fair	w.N.W.2.		29 88	
9				29 77	130	9				29 91	106
6		S.S.E.o.	S.	29 67	122	6	Rain	S.S.w.2.	W.	29 80	115
3. 12	Same	N.W.2.	N.w.b.N.	29 65	144	19. 12				29 65	130 0 01
9				29 72	120	9	Cloudy			29 65	130 0 01
6		N.E.b.N.1.	S. S.E.	29 90	108	6	Rain	S.b.w.3.		29 41	127
4. 12	Fair	N. 2.	N.b.w.	29 18	138	20. 12		S.w.b.S.4.	S.b. W.	29 42	125
9				30 12	115	9	Cloudy			29 36	115 0 34
6	Mist	N. o.	E.	30 17	96	6	Fair	W.S.W.3.		29 44	106
5. 12		E. 1.		30 18	39	21. 12	Cloudy	S.b.w.4.	W:	29 46	132
2	Fairer			30 15	112	9	Rain			29 38	116 0 16
6	Mist	E. o.		30 07	92	6	Fairer	S.W. 3.		29 14	112 2 57
6. 12		E.S.E.1.	E.	30 03	142	22. 12	Rain	S.W.b.W. 4.		29 21	128
9	Fair			30 01	115	9	Stormy			29 21	116 1 01
6	Mist	E. o.		30 03	97	6	Fair	S. W. 3.		29 05	103 0 27
7. 12	Fair	N.E. 2.	N.N.E.	30 06	147	23. 12	Cloudy	S.w.b.S.5.		29 07	122
9	Cloudy			30 15	131	9	Rain			28 95	102
6	Misting	N.b.E.2.		30 21	123	6	Fairer	w.b.S.2.	N.N.w.	29 08	100 0 77
8. 12	Fair	E.N.E.3.	N. E.	30 22	137	24. 12		w.b.S.3.	W.b.N.	29 26	121
9	Cloudy			30 22	121	9	Rain			29 51	100 1 07
6		N. 1.	N.E.b.N.	30 18	116	6		w.b.S.1.		29 75	88
9. 12	Fair			30 12	115	9				30 00	101
6		E. o.		30 10	97	6	Misting	S.W. 1.		30 04	102 0 06
10. 12	Fair	E. 2.		30 08	142	26. 12		W.N.w.1.	N.b.W.	30 10	130
9				30 05	121	9	Cloudy	N.b.w.o.		30 18	121
6	Mist	E. o.		29 95	110	6		E.S.E.o.	E.N. E.	30 21	112
11. 12		E. 1.		29 94	150	27. 12	Fair	E.b.S.2.		30 23	123
9	Fair			29 91	121	9				30 23	101
6		E. o.		29 89	102	6	Fair	N.b.W.1.		30 16	100
12. 12	Same	E. 1.		29 90	152	28. 12	Small	N.b.E.2.		30 12	130
9				29 90	127	9	Rain			30 08	117
6	Misty	E. o.		29 91	114	6		E. o.	E.N.E.	30 12	117
13. 12	somewh.	E.b.N.1.	E.	29 93	143	29. 12	Fair	E.b.N.2.		30 12	135
9	Cloudy			29 93	129	9		E.N.E.2.		30 11	122 0 29
6	Misty	E. o.		29 89	126	6		E.b.N.3.		30 08	122
14. 12	less			29 89	127	30. 12	Cloudy	E. 3.	E.b. N.	30 10	127
9	Cloudy			29 89	127	9		E.b.N.3.		30 08	123
6		S.W. 1.	S.W.b.w.	29 91	122						
15. 12	Same			29 93	134						Total 8 06
9	very Dry			29 93	134						
6	Rain	S.w.b.S.o.		29 92	128						
16. 12		S.S. W. 1.		29 92	140						
9	Cloudy			29 81	122 0 15						

OCTOBER. 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
1.	6	Fairer	E.b.N.1.	E.	29 97	122	
	12		E. 2.		29 93	132	
	9	Cloudy			29 93	123	
2.	6	Rain	E.b.N.2.		29 87	118	
	12	Fairer	E.b.N.1.		29 80	131	
	9	Rain			29 73	111	1 45
3.	6	Fairer	E.b.S. 1.	S. S. W.	29 66	115	1 92
	12	Cloudy	S. W. 2.		29 67	128	
	9				29 73	118	
4.	6		S. W. o.		29 79	108	
	12						
	9						
5.	6	Cloudy					
	12						
	9	Fair			29 98	96	
6.	6	HoarFr.	N.N.W.1.		30 12	87	
	12	and	N. 1.		30 17	112	
	9	Fair			30 22	89	
7.	6		N. W. o.		30 18	99	
	12	Cloudy	w.b.N.1.		30 19		
	9	Rain			30 20	96	
8.	6		N.E.b.N.1		30 21	105	0 07
	12	Cloudy	E.b.N.1		30 20	119	
	9				30 16	110	
9.	6		E. o.		30 07	106	
	12	Same	E.b.N.2		30 06	119	
	9				30 01	99	
10.	6	Mist	E.b.N.o		29 92	92	
	12						
	9	Fair			29 85	104	
11.	6	Mist	E. 1.		29 80	99	
	12	Cloudy					
	9	Misting			29 80	120	
12.	6	Mist	S.E.b.E.o		29 75	109	0 42
	12	Warm	S. 2.		29 77	140	
	9	Fair			29 79	115	
13.	6	Cloudy	S. o.	S. b. W.	29 77	106	
	12	and	S.w.b.S.3		29 79	136	
	9	Warm			29 87	119	
14.	6		S.b. E. 2		29 87	119	
	12	Same	S. 2.		29 81	133	
	9				29 65	122	
15.	6	Cloudy	S. 3.	S. S. W.	29 57	129	
	12	Misting	S. 2.		29 57	136	
	9	Rain			29 54	127	
16.	6		E.S.E.2	S.E.b.S.	29 52	122	
	12	Rain	S. E. 1	S. b. E.	29 48	130	
	9				29 50	122	0 64

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	6		E. 1.	S. E.	29 50	117	
17.	12	Fair	E. 1.	S.E.b.E.	29 56	130	
	9				29 61	111	
	6		N. E. 2		29 65	118	
18.	12	Cloudy	E.b.N.1		29 65		
	9				29 66	119	
	6		N.E. 2		29 68	116	
19.	12	Same	E.b.N.3		29 71	123	
	9				29 74	114	
	6	Cloudy	E. 3.		29 75	111	
20.	12	and	E.b.N.3		29 80	111	
	9	Cool			29 85	93	
	6		E. 1.		29 89	79	
21.	12	First Ice	E. 3.		29 92	102	
	9				29 93	83	
	6	Frost	E. o.		29 91	73	
22.	12	and	E.b.S. 1		29 91	98	
	9	Fair			29 87	79	
	6		E. o.		29 77	70	
23.	12	Same	E.b.S. 2.	E.	29 77	101	
	9				29 70	82	
	6	Cloudy	E. 1.	S. W.	29 51	85	
24.	12		S. E. 3.	S.w.b.S.	29 32	111	
	9	Rain			29 07	109	1 95
	6	Fair	S. W. 3		29 18	94	1 04
25.	12	Cloudy					
	9	Rain			29 16	96	
	6		W. 1.	N.w.b.N.	29 18	92	0 90
26.	12	Fair	N.b.w.3	N. W.	29 32	110	
	9		w.N.w.o		29 51	88	
	6	Frost	w.S.w.o		29 51	82	
27.	12		S. 3.		29 42	107	
	9	Cloudy	S. W. 1.		29 43	111	
	6	Cloudy	S. W. o.		29 51	100	
28.	12		S.w.b.S.1		29 51	114	
	9	Rain	E.S.E. 2		29 28	110	1 24
	6		S. 3.		29 08	117	0 31
29.	12	Rain	S.S.E. 2	S.	29 03	122	
	9		w.N.w.3.		29 16	96	0 43
	6		S.w.b.w.2		29 48	89	
30.	12	Fair					
	9				29 48	109	
	6	Cloudy	S. 4.	S. W.	29 36	115	3 12
31.	12						
	9	Rain			29 14	113	
					Total		13 49

NOVEMBER. 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.	D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
1.	8		W. 3.	W.S.W.	29 29	95		8			N.W. 3	W.	29 86	103	
	12	Fair	W.b.N.4.		29 42	103		17.	12	Fair	W. 1.		29 93	105	
	9	Rain			29 67	99		9					29 91	85	
2.	8		S.W.S.W. 0.	W.b.S.	29 80	106	0 28	8		Frost	W.S.W. 3		29 81	92	
	12	Fair	S.b.W. 2	S. W.	29 85	116		18.	12		W.S.W. 3		29 87	107	
	9	Cloudy			29 84	109		9		Fair			29 94	94	
3.	8	Fairer	S. 3.		29 53	105		8		Frost	S.b.W. 0	N. W.	29 94	79	
	12		S. 6.	S.b.W.	29 52	119		19.	12	and	S. 1.		29 94	97	
	9	Rain			29 60	102	0 36	9		Fair			29 91	92	
4.	8		S.W. 3.	W.S.W.	29 85	96		8			S. 1.	S. W.	29 85	88	
	12	Fairer			29 92	112		20.	12	Same	W.b.S. 2.		29 85	106	
	9				29 96	111		9					29 86	109	
5.	8	Fair	S.W. 3.	N.N.W.	29 98	107		8		Cloudy	S.W. 1. 2.	W.S.W	29 84	112	0 05
	12	Cloudy	S.W. 2.	W.	30 01	120		21.	12	Mild	S.W.b.S. 3.	W.b.S.	29 82	122	
	9	Fair			30 03	112		9		Fair			29 78	112	
6.	8		S.S.E. 0.		30 02	100		8		Rain	W. 0.	N.W.b.W.	29 75	103	0 45
	12	Fair	S.S.E. 1.	S.	30 02	115		22.	12	Fair	N. 1.		29 83		
	9				29 97	97		9					29 89	85	
7.	8	Misty	S.S.W. 2		30 02	110		8		Frost	N W 0.	N.b.E.	29 89	80	
	12							23.	12	and	N.W. 0.		29 90	91	
	9	Fair			30 22	94		9		Fair			29 92	75	
8.	8		W. 0.		30 27	84		8		Frost	N.W. 0		29 86	71	
	12	Mist	W. 1.		30 27	98		24.	12	and	N.W. 1		29 85	90	
	9				30 30	101		9		Cloudy	S.W. 1.		29 83	95	
9.	8		S.b.E. 1.		30 29	100		8		Cloudy	S.W. 0.		29 76	89	
	12	Cloudy	S. E. 1.		30 28	107		25.	12						
	9				30 22	87		9							
10.	8	Frost	E. 1.		30 16	80		8							
	12	and	E. 1.		30 18	103		26.	12	Rain					
	9	Fair			30 27	92		9							
11.	8		N. 0.		30 31	87		8		Frost					
	12	Foggy	N.b.E. 0		30 30	101		27.	12	and					
	9				30 33	96		9		Fair					
12.	8	Mist	N.N.E. 0.	S.W.b.S.	30 30	94		8							
	12		E.b.N. 0	S.w.b.w.	30 30	104		28.	12	Hard Fr.					
	9	Cloudy			30 23	103		9							
13.	8	Cloudy	S.W. 1.	W.b.N.	30 09	103		8							
	12	Fair	S.W. 3.		30 03	110		29.	12	Snow					
	9	Cloudy			29 85	109		9							
14.	8	Fair	W.S.W. 1		29 76	103	0 20	8		Snow					
	12		W.S.W. 4	N. W.	29 70	110		30.	12						
	9	Stormy	W.S.W. 8		29 36	114		9		Fairer	N.b.E. 2		29 60	60	0 59
15.	8	Cloudy	W. 6.	N. W.	29 53	109									
	12		W.b.N. 5	N. W.	29 63	115									
	9	Fair			29 84	94									
16.	8		W.b.S. 1.	W.N.W.	29 87	89									
	12	Fair	W.S.W. 2	W.	29 88	105									
	9				29 80	113									
													Total.		1 93

DECEMBER. 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.	D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
1.	8	Cloudy	N.N.W.0		29 71	73		17.	8	Frost &	N. 0.		30 25	73	
	12	Hard F.	N.W.0.		29 71	76			12	Fair	S.W.1.		30 20	88	
	9	Fairer			29 58	60			9	Rain			30 33	90	0 29
2.	8	Frost	E.b.S.3.		29 30	78			8	Frost	N.W.1.		30 44	82	
	12	Cloudy	E. 4.		29 12	82		18.	12	Hazy					
	9	Snow			28 91	83			9	Fair			30 35	76	
3.	8		E. 3.		28 61	91	0 56		8	Cloudy	W. 1.	N. W.	30 21	81	
	12	Rain	E.b.S.3.		28 52	94		19.	12	with	N.W.1.		30 20	93	
	9				28 41	100			9	Thaw			30 23	91	
4.	8	Cloudy	E.S.E.3.	S. S. E.	28 60	98	0 18		8	Cloudy	N.W.0.	N.	30 26	86	
	12	Fair						20.	12		N.W.1.		30 27	102	
	9	Rain			28 74	99			9	Fair	W.N.W.0		30 31	94	
5.	8		S.b.E.0.	S.b. W.	29 01	99	0 13		8	Missing	N.b.W.0.		30 36	90	
	12	Fair	S. 2.	S.S.W.	29 14	110		31.	12		N.b.E.1		30 40	99	
	9	Rain			29 28	103			9	Fairer			30 47	94	0 03
6.	8	Fair	S. 2.		29 26	107	0 74		8	Missing	N. 0.	N. E.	30 50	89	
	12	Rain &	S.b.E.3.	S.b. W.	29 32	115		22.	12		N. 1.		30 49	92	
	9	Warm			29 39	108			9	Cloudy			30 46	85	0 07
7.	8	Cloudy	S. 1.		29 50	106	0 36		8	Frost	N.b.W.0.		30 40	74	
	12	and			29 48	112		23.	12	Fog	N. 0.		30 38	88	
	9	Warm			29 48	105			9	Cloudy	S. b. E.		30 35	86	
8.	8	Cloudy	S.S.E.1.	S.b.E.	39 37	109			8		S. W. 0.		30 21	86	
	12	Missing	S.S.E.3.		29 32	116		24.	12	Cloudy	S.w.b.S.2		30 19	94	
	9	Warm			29 36	114			9		S.S.W.1		30 15	91	
9.	8		S. E. 3.		29 19	113			8	Fairer	S.S.W.1		30 14	98	
	12	Rain	S.S.E. 3.		29 19	117		25.	12		S.W.b.W.1		30 12	102	
	9				29 29	112	0 38		9	Rain	S.b.W.1		29 98	102	
10.	8		S.b.E.1.		29 41	103			8	Cloudy	W. 0.	N.W.b.W.	29 96	107	0 68
	12	Fair	S.b.E.2.		29 46	112		26.	12		W. 1.	N. W.	30 06	105	
	9				29 57	98			9	Fair			30 10	94	
11.	8	Fair	S. W.0.		29 88	92	0 06		8		W.b.S.2.	N:N. W.	29 95	86	
	12	Cloudy						27.	12	Fair	N.W.2.		29 94	98	
	9	Rain			29 95	108			9		W.b.N.0.	N.b.W.	29 94	91	
12.	8	Cloudy	S.b.E.2.	S. b. W.	29 84	109	0 36		8	Fog	W.b.N.0.		29 90	94	
	12	& some	S. 1.	S. W.	29 78	115		28.	12	Missing	W.b.S.0	N.W.b.W.	29 86	108	
	9	Rain			29 73	108			9	Rain			29 80	106	0 27
13.	8	Cloudy	S. W. 3		29 54	110	0 61		8		W.b.N.2.		29 72	96	0 58
	12		S.W.b.W.0.		29 57	112		29.	12	Fair	N.W.4.		29 83	100	
	9	Fair			29 63	104			9				30 03	82	
14.	8		S. W. 1.	W. b. S.	29 51	102	0 21		8	Frost	S.W. 2.		30 01	89	
	12	Rain	W.b.S.1		29 43	108		30.	12	Cloudy	S.W. 3.	W. b. S.	29 96	104	
	9				29 48	98			9	Rain			29 94	105	0 24
15.	8	Fair	W.b.N.2.	N.N.W	29 64	100			8	Fairer	S. W. 3.		29 93	110	0 02
	12		N.N.W.1		29 69	103		31.	12		S. W. 3.		29 92	112	
	9	Cloudy			29 91	99			9	Cloudy			29 95	108	
16.	8	Missing	N.N.w.1		30 07	95									
	12		N. 1.		30 14	101									
	9	Fair			30 27	87									
														Total	5 77

n. 249. p. 46.

In these Tables, I have never set down the *Flying of the Clouds*, but when they varied from the Winds; which oftentimes happens, especially before the Wind shifteth its Course. Mountains, &c. may cause some Variation, but as little at *Upminster* as almost any where. This last Column will be necessary, among other Uses, to shew the Reason why the *Mercury* varies sometimes: As suppose the Wind was in the Southerly Points, and the Clouds flew from the Northerly; the Rising of the *Mercury* would be readily accounted for.

n. 262. p. 527.

My *Thermometer* is Graduated by Inches and Decimal parts. The Point of Freezing is about 80, or at most 82 Degrees, and consequently 'tis Cold at about 90, and Temperate at about 100 Degrees. I need not say, that the Degrees above 100 are warm or Hot; and those below 80 are Harder Frosts. The Degrees of my *Thermometer* reach to 240, although I could never make the Spirits descend with Artificial Freezing, much lower than 50, neither when exposed to the Heat of a pretty strong Sun, did they ascend above 225. It is placed in the open Air, and always defended from the Beams of the Sun. So that it sheweth only the true present Temperature of the Air.

The Winter has been so Mild (as appears by the *Thermometer*) that many of the Days of *Nov.* and *Dec.* were not much Colder than many of the Mornings and Evenings of the Warmer Months. These two last Months have been also much dryer than usual, so that had it not been for the Rains of *Oct.* perhaps a Drought had been a General Calamity.

I have had frequent Confirmations of what I Observed last Year, concerning the *Mercury* Rising in Foggy Weather. The like it doth also in Misty Weather; as may be seen in divers places of this Table. Particular *Dec. 22.* The Weather being Misty, and Wind Northerly, it Ascended to 30,50 Inches, the Highest I ever saw it at *Upminster*.

Hurricanes and Storms by Mr. J. Templer. n. 71. p. 2156.

XXVIII. 1. *Octob. 30. 1669.* Between 5 and 6 of the Clock in the Evening, the Wind Westerly, at *Ashley* in *Northamptonshire* happened a formidable *Hurricane*, scarce bearing 60 Yards in its breadth, and spending it self in about 7 minutes of time. Its first discerned assault was upon a Milk-maid, taking her Pale and Hat from off her Head, and carrying her Pale many scores of yards from her, where it lay undiscovered some days. Next it storm'd the yard of one *Sprigge*, dwelling in *Westthorp*, where it blew a Waggon-body off of the Axletrees, breaking the Wheels and Axletrees in pieces, and blowing three of the Wheels so shattered over a Wall. This Waggon stood somewhat cross to the passage of the Wind. Another Waggon of *Mr. Salisburies* marched with great speed upon its Wheels against the side of his House to the astonishment of the Inhabitants. A branch of an Ash-tree, of that bigness that two lusty Men could scarce lift it, blew over *Mr. Salisburies* House without hurting it, and yet this branch was torn from a Tree an hundred Yards distant from that House. A Slate was forced upon a Window of the House of *Samuel Templer Esq;* which very much bent an Iron bar in it; and yet 'tis certain, that the nearest place, the Slate was first forced from, was near

near 200 Yards. At Mr. *Maidwell's* Senior, it forced open a door, breaking the Latch, and thence marching through the Entry, and forcing open the Dairy-door, it overturned the Milk Vessels, and blew out three Panes or Lights in the Window; next it mounted the Chambers, and blew out 9 Lights more. From thence it proceeded to the Parsonage, whose Roof it more than Decimated; thence crosseth the narrow Street, and forcibly drives a Man head-long into the doors of *Thomas Briggs*. Then it passed with a cursory salute at *Thomas Marston's*, down to Mr. *George Wignil's*, at least a furlong's distance from *Marston's*, and two furlongs from *Sprigg's*, where it plaid notorious Exploits, blowing a large Hovel of Pease from its supporters, and setting it cleverly upon the ground, without any considerable damage to the Thatch. Here it blew a Gate post, fixed two foot and an half in the ground, out of the Earth, and carried it into the Fields many yards from its first abode.

About $\frac{1}{2}$ a Mile distant from the Town is a small Wood on the Top of an Hill, and partly descending into a Vale encompassed by Northerly and Southerly Hills; so that the Wind may seem confined to the Vale as a Channel, before it assaulted the Town, and thereby enforced to spend it self only in that Glad. But I am unapt to think, that some *Flatus* from the descending Wood-ground might contribute to this accident, because the Wind continued, so far as Men could Judge, as high in the Field afterwards; and the scite of the Town did expose (by reason of those Valleys) a far greater part of the Town to this damage than was troubled, the Vally being above, 4 or 5 times the breadth of that part of the Town concerned in it.

2. Oct. 13. 1670. At *Braybrook* in *Northamptonshire*, about 11 a Clock, the Wind in a strange form assaulted a Pease Reek in the Field, uncovering the Thatch of it, and leaving another within 20 Yards unconcerned. Thence it proceeded to the Parsonage, where it carried not 12, scarce 8 Yards in Breadth, blowing up the end of a Barley-Reek, and therewith some Stakes in it of near 5 foot long: In the mean while it left a Wheat-hovel, within 6 Yards of the Barley-reek, and being without all Shelter untouched, no part of the Thatch of the Hovel being so much as furred. Nevertheless it beat down a Jack-daw from the Reek with that violence as forced the Guts out of the Body, and made it bleed plentifully at the Mouth. This I saw and took up in some Company the Daw very warm - Thence it went in a right Line to the Parsonage-house, took off the Cover of all the House in its compass. From hence it passed over the Town without any damage, the rest of the Town being low in Situation, and went on to a place call'd *Fortbill*, where it uncloathed so much of a Mault-house as lay within its Line and Breadth, so as to expose the Mault upon the Floor to the open Air.

By Mr. J. Temple.
ib. p. 2157.

Braybrook stands in a Valley environed by Hills on 3 sides at three quarter of a Miles distance from it. But (what I could chiefly observe) there is an Hill, call'd by the Name of *Clackbill*, within a Mile of it, and exactly in that point of the Compass in which the Wind then stood; no Hill in its way till the Wind had passed over all the places it endamaged: And, which is remarkable, there have been two Earthquakes in this Town within these 10

Years,

Years, when the then gentle Air (or Wind shall I call it) only vibrated upon that point of the Compass.

By Sir George Mackenzy, n. 114. p. 307.

3. Dec. 21. 1674. the Wind here (at *Tarbut*) was extraordinary: It broke a Standard-Stone, that stood as an *Obelisk* near an old Church; which Stone was about 12 Foot high, 5 Foot broad, and near 2 Foot thick. Whole Woods were overturned, and torn up from the Root, though in a low Situation. It blew from the Northwest, and of a long time the Wind had continued Westerly.

By Mr. Scarborough, n. 231. p. 659.

4. Oct. 19. 1693. There happen'd a most violent Storm in *Virginia*, which stopped the course of the Antient Channels, and made some where never were any: So that betwixt the Bounds of *Virginia*, and *Newcastle* (in *Pensylvania*) on the Sea-board-side, are many Navigable Rivers for Sloops and small Vessels.

By n. 212. p. 192.

5. Aug. 1. 1694. There happened here (at *Warrington* in *Northamptonshire*) between 1 and 2 a Clock a very terrible Whirlwind amongst the Shocks of Corn, in that part of *Acrement Close*, which is in the possession of Mr. *Holt*, and took up into the Air about 80 or 100 Shocks, carried a great deal out of sight; the rest is scattered about the Field, or on the tops of Houses or Trees thereabouts. I have seen of the Corn, which was carried a Mile distant from the Field; and it is reported by Persons of good Credit, that some was carried 4 or 5 Miles distant. The Whirlwind continued in *Acrement Close* full half an Hour; I my self, and several other Persons, saw at least 3 or 4 Waggon Loads of Corn all at once whirled about in the Air.

A Spout, at Topsham near Exeter, by Mr. Zach. Maine, n. 215. p. 28.

XXIX. These Appearances are frequent abroad, but very seldom or never seen before with us; though some pretend to have seen of them in the *Downs*. The *French* call them *Trombs*, I suppose from the Figure and the Noise that they make; that Word signifying a sort of a Humming Top. They are certain Elevations of Water during Storms and Tempests, reaching from the Superficies of the Sea to the Clouds. They happen several ways, sometimes the Water is seen to boyl, and raise it self for a considerable space round about a Foot from the Surface, above which appears, as it were, a thick and black Smoak, in the midst of which is Observed a sort of Stream or Pipe resembling a Tunnel, which ariseth as high as the Clouds: At other times these Pipes or Tunnels are observ'd to come from the Clouds, and suck up the Water with great Noise and Violence. They move from the Place where they were first gathered according to the Motion of the Wind, and discharge themselves sometimes into the Sea, to the unavoidable Destruction of such Ships as are in their Way, if they be small Vessels, and to their great Damage be they never so big: Sometimes on the Shear, beating down all they meet with, and raising the Sand and Stones to a prodigious height. 'Tis said that Vessels, that have any Force, usually fire their Guns at them loaden with a Bar of Iron, and if they be so happy as to strike them, the Water is presently seen to run out of them with a mighty Noise, but no further Mischief.

One of these *Spouts* happen'd here at *Topsham*, Aug. 7. 1694. between 9 and 10 of the Clock in the Forenoon; 'twas then very near, if not quite

Low.

Low-Water, which is lookt on as a special Providence, since had it been High-Water, 'tis concluded its strength would have been much greater, and its consequences more sad. The Water that was near it seemed to fly hither and thither, as though it would fain make its escape from it: Yet I cannot find upon Enquiry that the Channel was at all wholly Dry. There was also some Wind, though not so violent as it had been before; and when the *Spout* or *Tromb* began to move, it went with the wind (which was then at *W. N. W.*) like a dark Smoak.

The Marks + ÷ ÷ Shew the River; O, the *Spout*; S, Mr. *Seaward's* House, which it gently toucht with little Damage, blowing only off a few Tiles; G, Widow *Goldsworthy's* House, which it in part uncovered, and took off almost all the Thatch of her Garden Wall. It took off also an Apple-Tree, which was no way decayed, and between 15 and 16 Inches about, within 2 or 3 inches from the Ground, almost as exactly as any Saw could have done it, and carried it (as I Judge) between 20 and 30 Foot from the Place where it grew, and that not forward in the Path that it took, but almost directly backward, which makes me conclude that it had a double Motion; the one External from the Wind strait forward, the other Internal and Circular, like the Fly of a Jack, which a Man may carry in his Hand, that will Strike any thing either forward or backward as it meets with it. H, Mr. *Green's* House, which was for the most part unill'd. There were two Houses more, *W, L*, very much damaged in their Coverings, yet Mr. *Moxam's M*, tho' it stood between them, and was much higher than either, had only two or three Quarries of Glas broken. EEEEE, shews the March of the Spout. X, Planks that were blown some upright, some several Yards out of their place. D, a Ship newly lanch'd, of about one Hundred Tuns, which was much shaken, but not hurt. K, a Mast of near a Tun weight, thrown out of its Place. C, an Anchor that was torn out of the Ground, and carried 7 or 8 Foot with a Boat that was fasten'd to it, and blown up into the Air; that Boat was rent from the Head to the Keel. B, another new Boat blown about 6 Foot High, and turned upside down. F, A Fisher Boat with one Man in it, which was near the place where the *Spout* was at first perceived, but through Mercy escaped. P, a Lane that goes from the River in which some Houses suffered Damage, which shews that the Spout was divided in its March. 'Tis no small Mercy that no Man, Woman, or Child received the least injury in their Persons.

Fig. 19.

XXX. 1. *John Gill* Affirms, that he hath Observed on several Occasions that being in a Calm, that way which the Sea began to Loom or move, the next Day the Wind was sure to Blow.

Prognosticks of the Wind; by J. Gill. n. 26. p. 481.

2. It hath been the Custom of our *English* and *French* Inhabitants of the *Caribee Islands* to send in, about the Month of *June*, to the Native *Caribees* of *Dominico* and *St. Vincent*, to know whether there would be any *Hurricanes* that Year; and about 10 or 12 Days before the *Hurricane* came they did constantly send them word, and it very rarely or seldom failed. From one of these *Indians*, (whom in 1657 I ingaged by Civilities to remain with me several Years,) I had the following *Prognosticks*.

Prognosticks of Hurricanes; by Capt. Langford. n. 246. p. 407.

1. All *Hurricanes* come either on the Day of the Full, Change, or Quarters, of the Moon.

2. If he will come on the Full Moon, you being in the Change, then observe these signs;

That Day you will see the Skies very Turbulent, the Sun more Red than at other times, a great Calm, and the Hills clear of Clouds or Fogs over them, which in the Highlands are seldom so. Likewise in Hollows, or Concaves of the Earth, or Wells, there will be a great Noise as if you were in a great Storm, and at Night the Stars looking very bigg with Burs about them, and the North-West Sky very Black and Fowl, the Sea smelling stronger than at other times, as usually it doth in great Storms; and sometime that Day, for an Hour or two, the Wind blows very hard Westerly, out of his usual Course.

On the Full of the Moon you have the same Signs, but a great Bur about the Moon, and many times about the Sun.

The like Signs must be taken Notice of on the Quarter Days of the Moon, in the Months of *July*, *August*, and *September*; for the *Hurricanes* come in those Months; the soonest that I ever heard of was the 25th of *July*, and the latest was the 8th of *September*, but the usual Month they come in is *August*.

The Benefit I have had of Foretelling these *Hurricanes* is, that whereas heretofore they were so Dreadful, that all Ships were afraid to go to Sea, and did rather chuse to stay in the Roads at Anchor, than to run the Hazard of the Merciless Sea, although never Ship escaped at Anchor, but was cast a Shoar; many times by the Violence of the Storm, some Vessels have been cast so far on the Shoar, that when the Storm was over, they have been from 20 or 30 Yards Dry from the Wash of the Shore, and the Vessels set whole; and by this Means the Lives of those that were in those Vessels were saved. But I finding that if a Man keeps his Ship Sailable, with good store of Ballast, his Ports well Barr'd and Calked, his Topmasts down, and his Tops too if he have time, his Yards a-Port laced, or long Ships, keeping secure his Doors and Windows of his Ship, and she will lye as well as in other Storms; and they may, having their Ships in a readiness, stay in the Road till the Storm begins, which is always first at North, so to the North-West, till he comes round to the South-East, and then his Fury is over. So with the North Wind they may run away to the South, to get themselves Sea-room for drift of the South-West Wind, where he blows very fiercely; by these Means, I have, by God's Blessing, preserved my self in two *Hurricanes* at Sea, and in three at Shoar, in the Years 1657, 1658, 1660, 1665, and 1667. In those at Sea I lost not a Sail, Yard, or Mast; they being two great *Hurricanes*. And in the Year 1667, I being a Shore at *Nevis*, there was a *Hurricane* on the 19 Day of *August*, and fourteen Days before I did take notice of the Foregoing Signs on a Full Moon; and I acquainted Sir *John Berry*, who was Commander of his Majesty's Ship *Coronation*, and several other Commanders there, who did make their Ships ready for the Sea; and in the Morning about 4 of the Clock, the Wind coming

coming hard Northerly, they put to Sea ; and by God's Blessing came all back, in 4 or 5 Days time, safe to the Road again. On the Shore, being Confident of the *Hurricane's* coming, I took such care before-hand to secure my Sugars and Goods in the Store House, that when the *Hurricane* had carried away the Roof of the House, all except one Hogshead of Sugar remained safe.

The Reasons and Causes of these *Violent Storms*, according to my Judgment, may be these.

1. It is not unknown to all Men of Experience, that to the Southward of the *Tropick* there is constantly a *Trade-Wind*, or Easterly Wind, which goes from the North to the South East all the Year about; except where there are Reversions of *Breezes*, and Inletts near the Land; so that when this *Hurricane*, or rather *Whirl-Wind*, comes in Opposition to the Constant *Trade-Wind*, then he pours down with that force and Violence, that it exceeds all Storms of Wind in the World; for he takes Trees away by the Roots, and those that are extraordinarily strong Rooted, he twists off in the Middle: In the *Hurricane* in 1667 at *Nevis*, I saw the High Mountain that was all Green with Trees, left in most places Bare, and the Wood lying in such a Condition, with half Trees, or Stumps, or Quarters, that one would think it almost incredible.

2. It is remarkable by all Men that have been in those parts where the Sun comes to a *Zenith*, that at his approach towards the *Zenith* there is always Fair Weather; but at his Return to the Southwards, it occasions off the North parts of the *Aequinoctial* generally much Rains and Storms, as *Tornadoes*, and the like, which makes the Wind in the *Tornadoes* to come on several Points. But before it comes, it Calms the constant Easterly Winds; and when they are past, the Easterly Wind gathers Force again, and then the Weather clears up Fair.

3. The Wind being generally betwixt the *Tropicks* Easterly, unless at such times as before declared, meeting with the Opposition of these *Hurricanes*, which comes in a contrary Course to that *Trade-Wind*, doth cause this Violent *Whirl-Wind*, on the Sun's leaving the *Zenith* of *Barbadoes*, and those adjacent Islands; by which the Easterly Wind doth much decay of his Strength: and then the West-Wind, which is kept back by the Power of the Sun, doth with the greater Violence and force pour down on those parts where he encroaches. And it is usual in our Sailing from *Barbadoes*, or those Islands, to the North for a Westerly Wind, when we begin to lose our Easterly Wind to have it Calm, as it is before *Hurricanes*: And then the wind springing up, causeth it, till it comes well settled, to be Various, but after the settled Westerly Wind comes fresh, we have been constantly without those Shufflings from Point to Point.

Here is to be observed, that all *Hurricanes* begin from the North to the Westward, and on those Points that the Easterly Wind doth most violently Blow, doth the *Hurricane* Blow most fiercely against it; For from the *N. N. E.* to the *E. S. E.* the Easterly Wind bloweth freshest; so doth the *W. N. W.* to the *S. S. W.* in the *Hurricane* blow most violent; and when

he comes back to the S. E. which is the common Course of the *Trade-Wind*, then he ceaseth of his violence, and so breaks up. So, with Submission to better Judgments, I take the cause of *Hurricanes* to be the Sun's leaving the *Zenith* of those parts towards the South. And Secondly, the Reverse or Rebounding back of the Wind, which is occasioned by the Calming of the *Trade-Wind*.

But it will be Objected, Why should not this Storm be all over those parts of the *West-Indies*, as well as *Barbadoes* and the *Leeward-Islands*? To which I answer, That it hath, in about 25 Years of my Experience, taken its course from *Bermudoes*, or *Summer Islands*, to the *Caribee Islands*; but seldom or never doth he carry such a Breadth, as from the Latitude of 16 to 32 Degrees, which is the Latitudes of the one and the other places; but it hath been observed, that when *Hurricanes* have been in *Martinico*, which is within two Degrees of Latitude, and two Degrees of Longitude, according to the Miles of that Circle, yet no *Hurricane* hath been in *Barbadoes*; nor could I ever call any of the former Storms at *Barbadoes Hurricanes*, till that in 1675. Again, it hath been noted, that *Hurricanes* have done the like to the Northwards: For when the *Hurricane* hath been in *Antegoa* and *St. Christopher's*, those Ships that were but in the Latitude of 20 Degrees had no *Hurricane*, but constant Westerly Winds reasonable Fair, and then there were no *Hurricanes* in *Bermudoes*; and when the *Hurricanes* were at *Bermudoes*, the *Leeward* or *Caribee Islands* had no *Hurricane*; nor had those Islands the *Hurricane* when *Barbadoes* had it.

It will be further Objected, Why the *Hurricane* was never known to go farther to the Westward than *Porto Rico*, which lies in or near the Latitude of those Islands of *St. Christopher's*? To this I Answer, That from *Porto Rico* downwards, both that Island as well as *Hispaniola*, and other Islands there adjacent, are of vast Greatness and very High Lands, that of themselves doth most commonly give Reversal or Westerly Winds at Night, through the Year: For there, for the Reasons aforesaid, the Easterly Wind, towards Night doth Calm, and those Lands afford a *Land Wind*, which the other Islands cannot do, by Reason of the smallness of those *Caribee Islands*, but very near the Shore, the *Trade-Wind* having his full Power till this General *Whirl-Wind* comes, for the Reasons aforesaid.

I do imagine so likewise to the Southwards of *Barbadoes*, where the *Tornadoes* come frequently, there is no *Hurricanes*; neither was there at *Barbadoes*, when these *Tornadoes* did commonly come there, which made some small Reversal, though it was but for 2 or 3 Hours: Yet the Easterly Wind, giving some Way by the Sun's Declining from that *Zenith*, doth prevent this Furious Reverse, where it hath no Vent, till by the Violence of the two Winds it is forced.

of a Pan of Coals, we brought the Water to the same Degree of Heat which is observed to be that of the Air in our Hottest Summers; the *Thermometer* nicely shewing it. This done, we affixed the Pan of Water, with the *Thermometer* in it, to one end of the beam of the Scales, and exactly counterpoised it with Weights in the other Scale; and by the application or removal of the Pan of Coals, we found it very easy to maintain the Water in the same degree of Heat precisely. Doing thus, we found the Weight of the Water sensibly to Decrease; and at the end of two Hours, we observed that there wanted half an Ounce *Troy*, all but 7 Grains, or 233 Grains of Water, which in that time had gone off in Vapour; tho' one could hardly perceive it smok, and the Water were not sensibly Warm. This quantity in so short a time seemed very considerable, being little less than 6 Ounces in 24 Hours, from so small a Surface as a Circle of 8 Inches Diameter. To reduce this Experiment to an exact *Calculus*, and determine the thickness of the Skin of Water that had so Evaporated, I assume the Experiment alledged by Dr. *Edw. Bernard* to have been made in the *Oxford Society*, viz. that the Cube Foot *English* of Water weighs exactly 76 Pounds *Troy*; this divided by 1728, the Number of Inches in a Foot, will give $253\frac{1}{3}$ Grains, or half Ounce $13\frac{1}{3}$ Grains for the Weight of a Cube Inch of Water; wherefore the Weight of 233 Grains is $\frac{233}{253\frac{1}{3}}$ or 35 parts of 38 of a Cube Inch of Water. Now the Area of the Circle, whose Diameter is $7\frac{9}{16}$ inches, is 49 Square Inches; by which dividing the quantity of Water Evaporated, viz. $\frac{35}{38}$ of an Inch, the Quote, $\frac{35}{1862}$ or $\frac{1}{53}$, shews that the Thickness of the Water Evaporated was the 53^d part of an Inch: But we will suppose it only the 60th part, for the facility of Calculation. If therefore Water as Warm as the Air in Summer, Exhales the thickness of a 60th part of an Inch in two hours from its whole Surface, in 12 hours it will exhale the $\frac{1}{10}$ of an Inch; which quantity will be found abundantly sufficient to serve for all the Rains, Springs, and Dews, and account for the *Caspian Sea's* being always at a Stand, neither Wasting nor Overflowing; as likewise for the Current said to set always in, at the *Streights of Gibraltar*, tho' those *Mediterranean Seas* receive so many and so considerable Rivers.

To estimate the Quantity of Water arising in Vapour out of the Sea, I think I ought to consider it only for the time the Sun is up, for that the Dews return in the Night, as much if not more Vapours than are then Emitted; and in Summer the Days being longer than 12 Hours, this excess is ballanced by the weaker Action of the Sun, especially when Rising before the Water be warmed: So that if I allow $\frac{1}{10}$ of an Inch of the Surface of the Sea to be Raised *per diem* in Vapours, it may not be an improbable Conjecture.

Upon this Supposition, every 10 Square Inches of the Surface of the Water yields in Vapour *per diem* a Cube Inch of Water; and each Square Foot half a Wine Pint; every space of 4 Foot Square, a Gallon; a Mile Square, 69 14 Tons; a Square Degree, suppose of 69 *English* Miles, will Evaporate 33 Millions of Tons: and if the *Mediterranean* be estimated at 40 Degrees long and 4 broad, allowances being made for the places where it is broader by those where it is

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narrower, (and I am sure I guess at the least) there will be 160 Square Degrees of Sea; and consequently the whole *Mediterranean* must lose in Vapour, in a Summer's Day, at least 5280 Millions of Tons. And this quantity of Vapour, though very great, is as little as can be concluded from the Experiment produced: And yet there remains another Cause, which cannot be reduced to the Rule, I mean the Winds, whereby the Surface of the Water is lick'd up, sometimes faster than it Exhales by the Heat of the Sun, as is well known to those that have considered those Drying Winds which Blow sometimes.

The *Mediterranean* receives these considerable Rivers; the *Iberus*, the *Rhone*, the *Tiber*, the *Po*, the *Danube*, the *Neister*, the *Borysthenes*, the *Tanaïs*, and the *Nile*, all the rest being of no great Note, and their quantity of Water inconsiderable. We will suppose each of these nine Rivers to bring down Ten times as much Water as the River *Thames*, not that any of them is so great in reality, but to comprehend with them all the small Rivulets that fall into the Sea, which otherwise I know not how to allow for.

To Calculate the Water of the *Thames*, I assume that at *Kingston Bridge*, where the Flood never reaches, and the Water always runs down, the Breadth of the Channel is 100 Yards, and its Depth 3, it being reduced to an equality, (in both which Suppositions I am sure I take with the most). Hence the Profile of the Water in this place is 300 Square Yards: this Multiplied by 48 Miles, (which I allow the Water to run in 24 Hours, at 2 Miles in an Hour) or 84480 Yards, gives 25344000 Cubick Yards of Water to be Evacuated every Day, that is, 20300000 Tons *per diem*; and I doubt not but in the excess of my measures of the Channel of the River, I have made more than sufficient allowance for the Waters of the *Brent*, the *Wandel*, the *Lea*, and *Darwent*, which are all worth notice, that fall into the *Thames* below *Kingston*.

Now if each of the aforesaid 9 Rivers yield Ten times as much Water as the *Thames* doth, 'twill follow that each of them yields but 203 Millions of Tons *per diem*, and the whole 9 but 1827 Millions of Tons in a Day; which is but little more than $\frac{1}{3}$ of what is proved to be raised in Vapour out of the *Mediterranean* in 12 hours time.

The Evaporation of Water in a Close Room at Gresham Coll. 1693. by Mr. Edm. Halley. n. 212. p. 183.

XXXII. In Order to explain the Circulation of Vapour Experimentally, I caused an Experiment of the Quantity of Vapour arising simply from the Warmth of the Water, without being exposed either to Sun or Wind, to be made in *Gresham Colledge*, which was performed with great care and Accuracy by Mr. *Hunt*, Operator to the *Royal Society*. Having added up into one Sum the Evaporations of the whole Year, I find, that from a surface as near as could be measured of 8 Square Inches, there did Evaporate during the Year, 16292 Grains of Water, which is 64 Cube Inches of Water, and that divided by 8 Inches, the Area of the Water's Surface, shews that the depth of Water Evaporated in one Year amounts to 8 Inches. But this is much too little to answer to the

the Experiments of the *French*, who found that it Rained 19 Inches Water in a Year at *Paris*; Or those of Mr. *Townley*, who by a long continued series of Observations, has sufficiently proved, that in *Lancashire*, at the Foot of the Hills, there falls above 40 Inches of Water in the Year's time. Whence it is very obvious, that the Sun and Wind are much more the causes of Evaporation, than any internal Heat or agitation of the Water.

The same Observations do likewise shew an odd quality in the Vapours of Water, which is that of adhering to the Surface that Exhaled them, which they cloath as it were with a Fleece of Vaporous Air, which once investing it, the Vapour rises afterwards in much less Quantity: which was shewed by the small quantity of Water that was lost in 24 hours time, when the Air was very still from Wind, in proportion to what went away when there blew a strong gale, although the Experiment were made in a place as close from the Wind as could well be contrived. For which reason I do not at all doubt, that had the Experiment been made where the Wind had come freely, it would have carried away at least three times as much as we found, without the assistance of the Sun, which might perhaps have doubled it.

By the same Experiment it likewise appears, that the Evaporations in *May*, *June*, *July*, and *August*, (which are nearly equal) are about three times as much as what Evaporated in the four Months of *November*, *December*, *January*, and *February*, which are likewise nearly equal; *March* and *April* answering nearly to *September* and *October*.

This Fleece of Vapour in still Weather hanging on the surface of the Water, is the occasion of very strange Appearances, by the Refraction of the said Vapours differing from that of the Common Air, whereby every thing appears raised; as Houses like Steeples, Ships as on Land above the Water, and the Land raised, and as it were lifted from the Sea, and many times seeming to overhang. And this may give a tolerable account of what I have heard of seeing the Cattle, at High water time, in the *Isle* of *Dogs* from *Greenwich*, when none are to be seen at Low-water, (which some have endeavoured to explain, by supposing the *Isle* of *Dogs* to have been lifted by the Tide coming under it). But the evaporous Effluvia of Water, having a greater degree of Refraction than the Common Air, may suffice to bring those Beams down to the Eye, which when the Water is retired, and the Vapours subsided with it, pass above, and consequently the Objects seen at the one time may be conceived to disappear at the other.

JANUARY 1693.

FEBRUARY 1693.

JANUARY 1693.				FEBRUARY 1693.			
D.	Grains.	Ther.	Barometer. Weather.	D.	Grains.	Ther.	Barometer. Weather.
1	31 $\frac{1}{2}$	5	29, 7 Frost.	1	36	29	30, 0
2	21	14	29, 7 Some Rain.	2	27	26	30, 2
3	21	12	29, 7	3	33	25	30, 2
4	23 $\frac{1}{2}$	8	29, 7	4	48	16	29, 9
5	23 $\frac{1}{2}$	8	30, 1	5	30 $\frac{1}{2}$	20	29, 9 Some Rain.
6	26 $\frac{1}{2}$	1	30, 5 Frost.	6	26	16	29, 9 Small Rain.
7	31	—3	30, 5 Frost.	7	26	17	29, 8
8	25	—5	30, 4 Frost.	8	28	11	29, 9 A Fogg.
9	23	—3	30, 4 Frost.	9	23	16	30, 0
10	18	0	30, 4	10	26	20	30, 0
11	18	0	30, 4	11	39	8	30, 0
12	18	0	30, 4	12	40	5	29, 8
13	22	—6	30, 3 Frost.	13	52	—1	29, 4 High Wind.
14	20 $\frac{1}{2}$	—7	30, 3 Frost.	14	35	6	29, 2
15	21 $\frac{1}{4}$	—10	30, 3 Frost.	15	35	11	29, 4 Some Rain.
16	24	—15	30, 4 Frost.	16	24	20	29, 2 Rain.
17	18	—13	30, 3 $\frac{1}{2}$ Frost.	17	39	20	29, 5 Rain.
18	18	—11	30, 2 Frost.	18	39	19	29, 8
19	14	—10	30, 1 Frost.	19	35 $\frac{1}{2}$	17	29, 7
20	14	—3	29, 6	20	35 $\frac{1}{2}$	16	29, 3
21	21	0	29, 9	21	35	17	29, 0 Rain
22	18	2	29, 9	22	29	10	29, 2
23	18 $\frac{1}{2}$	0	30, 0 Frost.	23	35	5	29, 3
24	18 $\frac{1}{2}$	—3	30, 0 Frost.	24	37	1	29, 2
25	14 $\frac{1}{2}$	9	29, 9	25	35	—5	29, 4
26	14 $\frac{1}{2}$	14	29, 7	26	23 $\frac{1}{2}$	—8	29, 0 Snow.
27	20	17	29, 2	27	21	—11	29, 4 Frost.
28	36	10	29, 7	28	24	—14	29, 3 Frost.
29	27 $\frac{1}{2}$	15	29, 5 Some Rain.				
30	27 $\frac{1}{2}$	15	29, 7				
31	27	27	29, 6				
	675 Grains.				690 $\frac{1}{2}$ Grains.		

MARCH. 1693.

APRIL. 1693.

D.	Grains.	Ther.	Barometer.	Weather.	D.	Grains.	Ter.	Barometer.	Weather.
1	25	-12	29, 2	Frost.	1	32	15	29, 4	
2	31 $\frac{1}{2}$	-12	29, 1	Snow	2	39	15	29, 5	
3	28	-13	29, 3	Snow Frost	3	37 $\frac{1}{2}$	14	29, 7	
4	28	-12	29, 6	Frost	4	37	23	29, 6 $\frac{1}{2}$	
5	28	-8	29, 3	Frost	5	38	29	29, 2	
6	20	-1	29, 1		6	29	32	29, 2	
7	35 $\frac{1}{2}$	5	29, 3	Rain	7	32	33	29, 3	
8	39	9	29, 7		8	32	35	29, 4	
9	42 $\frac{1}{2}$	8	30, 0		9	28 $\frac{1}{2}$	40	29, 2	
10	39	14	30, 0		10	35	33	29, 4	
11	33	21	30, 0		11	37	33	29, 4	
12	42	21	29, 8		12	34	37	28, 9	
13	42	22	29, 6 $\frac{1}{2}$		13	39	32	29, 4	
14	46	23	29, 4		14	39	33	29, 5	
15	62 $\frac{1}{2}$	14	29, 6		15	39	29	29, 7	
16	41	19	29, 5		16	35	30	29, 8	
17	42 $\frac{1}{2}$	12	29, 4		17	37	31	29, 6 $\frac{1}{2}$	
18	50	10	28, 9		18	36 $\frac{1}{2}$	36	29, 4	
19	51 $\frac{1}{2}$	7	29, 2		19	33 $\frac{1}{2}$	36	29, 3 $\frac{1}{2}$	
20	45	8	29, 2		20	36	32	29, 3	
21	41	7	29, 0		21	39	37	29, 2	
22	50	8	29, 4		22	46	35	29, 4	
23	37	10	29, 5		23	42 $\frac{1}{2}$	35	29, 5	
24	33 $\frac{1}{2}$	6	29, 4		24	52	35	29, 2	
25	27 $\frac{1}{2}$	7	29, 3		25	50	35	29, 3 $\frac{1}{2}$	
26	30	11	29, 4		26	56	36	29, 7	
27	57	9	29, 6		27	38	44	29, 5	
28	38	4	29, 6		28	43	46	29, 7 $\frac{1}{2}$	
29	30	17	29, 5		29	40	49	29, 6	
30	30	20	29, 4 $\frac{1}{2}$		30	52	42	29, 9	
31	20	24	29, 3						
1166 Grains					1203 Grains				

M A Y. 1693.

J U N E. 1693.

M A Y. 1693.					J U N E. 1693.				
D.	Grains.	Ther.	Barometer.	Weather.	D.	Grains.	Ther.	Barometer.	Weather.
1	56	35	30, 1		1	78	65	29, 9	
2	61	26	30, 0		2	85	62	30, 0	
3	66	21	30, 1		3	95	54	30, 2	
4	61	19	30, 1		4	77	52	30, 1 $\frac{1}{2}$	
5	52	31	30, 1		5	63	50	29, 9	
6	48	45	29, 8		6	49	60	29, 7 $\frac{1}{2}$	
7	59 $\frac{1}{2}$	35	29, 8		7	46	67	29, 7	
8	51	34	29, 7		8	63	63	29, 7	
9	51	31	29, 6		9	63	69	29, 8	
10	43	35	29, 5		10	63	71	29, 8	
11	49	30	29, 5		11	55	70	29, 8 $\frac{1}{2}$	
12	54	32	29, 6		12	58	87	29, 8	
13	59	26	29, 7		13	59	75	29, 9	
14	59	32	29, 7 $\frac{1}{2}$		14	86	72	29, 7	
15	46 $\frac{1}{2}$	35	29, 7		15	63	79	29, 8	
16	46 $\frac{1}{2}$	34	29, 8 $\frac{1}{2}$		16	58	78	29, 9	
17	56	36	30, 1		17	86	79	30, 0	
18	70 $\frac{1}{2}$	36	30, 3		18	81	66	30, 0	
19	58 $\frac{1}{2}$	47	30, 1		19	92	57	30, 1	
20	76	50	30, 0		20	81	60	30, 0	
21	62	52	30, 1		21	80	71	29, 9	
22	73	64	30, 1		22	76	67	29, 8	
23	78 $\frac{1}{2}$	64	30, 1		23	63	69	29, 7	
24	90	62	29, 9 $\frac{1}{2}$		24	63	62	29, 6	
25	61	74	29, 9		25	57	65	29, 8	
26	67 $\frac{1}{2}$	68	29, 9 $\frac{1}{2}$		26	46	70	30, 0	
27	64	75	29, 9 $\frac{1}{2}$		27	49 $\frac{1}{2}$	68	30, 0	
28	71	67	30, 1		28	52	74	30, 0	
29	80	69	30, 2		29	59	68	30, 2	
30	89 $\frac{1}{2}$	70	30, 2		30	62	69	30, 2	
31	106	68	29, 9						
1968 Grains.					2008 $\frac{1}{2}$ Grains.				

JULY. 1693.

AUGUST. 1693.

D.	Grains.	Ther.	Barometer.	Weather.
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D.	Grains.	Ther.	Barometer.	Weather.
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1	75	67	30, 0	
2	75	67	30, 0	
3	63	62	30, 0	
4	62	61	30, 1	
5	60	63	30, 1	
6	74	65	30, 0	
7	61	65	30, 0	
8	51	65	30, 0	
9	45	74	29, 9	
10	52	77	29, 9	

1	80	71	29, 5	
2	77	73	29, 6	
3	77	63	29, 8	
4	78	64	29, 9	
5	79	73	29, 9	
6	81	70	29, 9	
7	94	83	29, 6	
8	79	86	29, 6	
9	68	82	29, 7	
10	70	83	29, 8	

11	72	74	29, 8	
12	74	82	29, 4	
13	88	75	29, 7	
14	83	62	29, 9	
15	84	65	30, 1	
16	84	68	29, 8	
17	71	58	30, 1	
18	77	65	30, 2	
19	66	78	30, 1 $\frac{1}{2}$	
20	71	78	30, 1	

11	92	85	29, 8 $\frac{1}{2}$	
12	70	80	30, 0	
13	81	73	29, 9	
14	68	75	29, 7	
15	69	74	29, 9	
16	77	72	29, 8	
17	77	77	29, 7	
18	84	77	29, 7	
19	86	64	29, 5	
20	78	68	30, 0	

21	72	82	30, 0	
22	90	74	30, 0	
23	99	68	30, 0	
24	85	71	30, 0	
25	85	81	29, 9	
26	94	75	29, 9 $\frac{1}{2}$	
27	97	70	29, 8	
28	81	78	29, 7	
29	87	67	29, 9	
30	78	64	29, 9	

21	68	67	29, 7	
22	71	65	29, 7	
23	75	55	29, 9	
24	64	54	29, 5	
25	63	57	29, 5	
26	58	59	29, 4	
27	60	55	29, 5	
28	53	55	29, 9	
29	53	58	29, 7	
30	53	56	29, 7	

31	78	79	29, 3 $\frac{1}{2}$	
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31	63	48	29, 7	
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2335 Grains.

2246 Grains.

SEPTEMBER. 1693.

OCTOBER. 1693.

D.	Grains.	Ther.	Barometer.	Weather.	D.	Grains.	Ther.	Barometer.	Weather.
1	53	53	29, 7		1	40	35	29, 9	
2	55	50	29, 6		2	37	41	29, 6	
3	61	50	29, 7		3	41	35	29, 7	
4	61	48	29, 7		4	27	49	29, 6	
5	63	44	29, 8		5	29	40	30, 0	
6	74	40	29, 7		6	31	49	30, 2	
7	62	39	29, 6		7	29	58	30, 0	
8	59	49	29, 5		8	37	60	30, 0	
9	40	52	29, 5		9	39	59	30, 2	
10	50	48	29, 6½		10	37	55	30, 1	
11	46	41	29, 7		11	34	55	29, 9	
12	48	43	29, 8		12	38	55	29, 8	
13	46	53	29, 7		13	39	42	30, 0	
14	43	57	29, 5		14	49	38	29, 8	
15	46	70	29, 2		15	44	28	29, 7	
16	49	54	29, 3		16	44	19	29, 7	
17	45	52	29, 1		17	35	23	29, 1	
18	52	45	29, 0		18	34	24	29, 2	
19	48	45	29, 3		19	34	20	29, 2	
20	50	44	29, 6		20	35	21	29, 5	
21	43	42	29, 9		21	35	17	29, 9	
22	41	51	29, 5		22	24	28	29, 7	
23	46	45	29, 9		23	28	25	29, 7	
24	44	52	29, 7		24	39	20	30, 0	
25	41	47	29, 8		25	41	13	30, 0	
26	43	47	29, 6		26	34	16	29, 9	
27	46	45	29, 7		27	33	13	30, 0	
28	47	40	29, 9		28	32	18	29, 8	
29	50	44	29, 8		29	33	10	29, 8	
30	40	42	29, 5		30	35	5	29, 7	
					31	28	7	29, 4	
	1495 Grains.					1095 Grains.			

The Changes of
Weather from
the Alterations
of the Gravity
of the Atmo-
sphere; by Dr.
Garden. n. 171.
p. 991.

XXXIII. I. The Air agrees with all other Fluids in this, that it *Gravitates*; and it has this peculiar Property (which is not so much observed of other Fluids,) that its *Specific Gravity* is not always the same. Now you know according to the certain Rules of the ballancing of Fluids amongst themselves, every Fluid *Specifically Lighter* than another will Ascend and Emerge above it, and every Fluid *Specifically Heavier* than another will Descend and Subside below. Now there is some certain proportion between the *Specific Gravities* of the Fluid of Air, and of that which Ascends in Vapours and Falls down again into Rain; and if this proportion were still the same, 'tis like we would have no commixture of those Fluids but the Vapours would either always float above or always stay below. But this proportion of their *Specific Gravity* is frequently changed; for it is known that water when Warm and Tepid is Lighter than when it is Cold, and the daily Observations of the different Heights of the *Mercury* in the *Baroscope* do make appear, that the *Atmosphere's* Gravity is not always the same. And now from these known properties may be easily deduced a Statical account of the Rising of Vapours, their being carried in the Air in Clouds, and their falling down again into Rain. For if we may be allowed to suppose that when the *Atmosphere* is Heaviest, there is some such proportion between its *Specific Gravity*, and that of the Fluid of Vapours, as there is between Water and Oyl; the Vapours according to the known Laws of Fluids must needs Ascend, and so long as this proportion continues they must needs Float above in the Air: But when the *Atmosphere's* Gravity is changed, the Vapours must Fall down again.

I do not know any determinate Instrument that will indicate the Ascent of Vapours, as certainly as the *Baroscope* does the Change of the Air's Weight (for our common *Hygrosopes* are not very exact, and besides I suppose their Change by moisture shews rather the Falling than the Rising of Vapours) yet there are two or three Observations which seem certain Indications of their Ascent: as first, if the *Horizon* and the remote Hills seem Smoaky and inconspicuous, so that nothing can be seen at any distance, and that tho' the Heavens be not Cloudy but Clear, and tho' there be no Fog nor yet any Cap of Clouds upon the Hills (which do rather indicate the falling of Vapours). Again, if when you look to any distant part of the Country, round about you, it appear all in an Undulating Motion, this seems to be a Sign of the plentiful Rising of Vapours, for this is only occasioned by looking through an unequal Waving Medium, which makes frequent Inflections of the Beams of Light, as you see any Object seems to have a Tremulating Motion in all its parts when you look upon it through Smoak. Another Indication of the Ascent of Vapours seems to be the copious Rising of Steams above Waters, Marsh grounds, and Fens, which is frequently seen in Frosts, and in Cool nights in Summer. To these I may add the Redness of the Sun (so as to be easily look'd upon) and Moon, a considerable time before their Setting, or after their Rising. Now since I have had occasion to make Observations of the *Baroscope*; I have always taken notice of all these when the *Mercury* was Rising, and consequently in the Increase of the *Atmosphere's* Gravity: But on the contrary, when the *Mercury* has been Low in the *Baroscope*, and so the *Atmosphere's* Gravity less, I have observed none of these Effects, but the Remote Hills were Clear and Distinct (unless

(unless sometimes a Cloud had fall'n down upon them,) and no Waving to be observed in the Air, nor Steams from the Waters. I know not whether I may add here a conjecture about the great Light, and the *Capræ Saltantes*, which are some Nights to be seen in the North. I have taken notice of them usually when the *Mercury* has been High in the *Baroscope*, and then they appearing in that quarter of the Heavens where the Sun is at that time below the *Horizon*; this has given me occasion to think, that perhaps the Steams of Vapours may have Ascended so far in the *Atmosphere* as to be beyond the Earth's Shadow, in that part of the *Horizon*, and so by Refracting the Beams of Light toward us to occasion that Light, and those *Capræ Saltantes*. It may be considered also whether the Red Skies in the Evening, which betoken Fair Weather, do not proceed from the Height of the Clouds occasioned at that time by the Increase of the *Specific Gravity* of the *Atmosphere*.

Now as to the Falling down of the Vapours again; it is visible by their gathering into thick and dark Clouds, by the Falling down of Clouds and Mists on the Tops of Hills, and thick Fogs in the Air, and by their Dropping down into Rain, Snow, &c. and that these do usually fall out only when the *Mercury* subsides a little, and consequently when the *Atmosphere's* Gravity is less, is the constant Observation of those who have had occasion to take notice of the Changes of the *Baroscope*.

Against this it may be Objected, that it is observable many times that even when the *Mercury* in the *Baroscope* is Rising there will be Rain, and particularly sometimes in North-East Winds. To this I answer, that if the Clouds have been carried for some while towards one Quarter of the Heavens by the Winds, and then if the Winds do suddenly Change into another Quarter, these Vapours, which were formerly scattered into small particles, and so did easily float, are suddenly driven together into little Drops, and so must needs Fall down into Rain: and therefore the Falling of Rain while the *Mercury* is Rising is observable only upon the sudden Change of contrary Winds.

But let us consider in the next place, whether those frequent commotions in the Air, which we call Winds, may not be accounted for upon the same Principles. That known Definition of *Archimedes* is universally acknowledged, *Quod earum partium minus pressæ expellantur à magis pressis*; so that if there be any portion of a Fluid of a far less Pressure and Resistance than the rest, the whole Fluid runs in a Current thither, till all be reduced to an *Æquilibrium*. Now it is evident, that the Pressure of the Air is not always the same: And 'tis very probable (which Experience will determine, by making joint Observations of the *Baroscope* in several places of the Earth at the same time) that the Air's Gravity is not alike chang'd throughout the whole *Atmosphere* in an Instant. So that when the Air becomes *Specifically Lighter* in one place, or its Pressure lessened, the Neighbouring parts of the *Atmosphere*, whose Weight is not thus lessened, run thither in a Current, till the *Atmosphere* thereabouts be reduced to an *Æquilibrium* again; and according to the portion of Air thus changed, and the lessened or acquir'd degrees of the Weight and Spring, the Currents or Winds are Strong or Weak, of a long or short continuance. Now Observation and Experience do agree with this, the *Mercury* being found to
Subside.

Subside for the most part in the *Baroscope* at the Rising of Winds; at least it is observed to be in Motion, and either Rising or Falling, and consequently there is a Change in the *Atmosphere's* Pressure at that time.

But the great difficulty remains still, how to account for the different Changes of the *Specific Gravity* of the *Atmosphere*. Of this there can hardly be expected a satisfactory account, till we come to know the cause of Gravity in general, and of the Air's Weight in particular; and therefore I shall only here offer 2 or 3 Hints, which perhaps may incite others to consider it more narrowly. And *first*, it is now almost generally acknowledged, that there must needs be a Fluid much more Subtile than common Air, and of a far greater Pressure than Air, which is the cause of the Continuity and Cohesion of all Terrestrial Bodies; and in which the Air seems as it were to Float and to have the same relation to it, as the Vapours do in- and have to the Air, and therefore if we could reach its Nature and Properties, it might be considered what Influence this may have upon the Change of the Air's Gravity. Or *Secondly*, seeing the Infusion of one Liquor into another, in Chymical Preparations, will alter its *Specific Gravity*, so that the bodies which were formerly born up in it, will fall down and be Precipitated (as the particles of Gold floating through *Aqua Regis* will be Precipitated by the infusion of another Chymical Liquor,) it may be considered, whether plenty of Nitrous Steams, or some such mixture, may not alter the Air's *Specific Gravity*. Or *3dly*, we may possibly come to a nearer resolution of this, by considering the Influence which the Heat and Cold have upon the Air's Spring. The Air you know has this peculiar Property, which is not so much observed of other Fluids, that it is endued with *Elasticity* as well as Gravity, and therefore we are to consider what Influence the change of its *Spring* may have upon the change of its Weight; and it seems evident, that the increase of its Spring doth diminish its Weight, and the lessening of its Spring will increase it: for upon the increase of the Air's Spring, the Air is Rarified, and so a lesser portion of it Presses upon the subjacent Fluid: but when it is lessened the Air is Condensed, and so a greater Portion of it Presses upon the subjacent body. For example, let us suppose the Springy particles of Air, to be like the Springy hairs of Wool, or the Spring of a Watch; and that many Millions of Rows of them go to make up the Cylinder of Air, which from the top of the *Atmosphere* Presses upon the *Mercury* in the *Baroscope*, and keeps it suspended to the Height of 30 Inches; let us suppose this Air Rarified, so that all its Springy particles expand themselves, and therefore shut off of this Cylinder some Thousands of those Rows; this Cylinder, being now made up of a far lesser number of those Rows of particles, must needs have a lesser Pressure upon the *Mercury*, so that it will Subside, perhaps to 29. And thus it continues till the Air's Spring be weakened, and so the particles crowded again into narrower room. Now if this be found to hold in the *Theory*, Experience seems very well to answer it: for I have hitherto observed, that in Cold Weather, and Sharp Frosts, the *Mercury* Rises highest in the *Baroscope*, and if the Foreign Measures agree with ours, it is usually Higher here than in *France* or *Italy*.

I shall

I shall here after all subjoin two or three Observations, which may serve to confirm what has been said. The first is of the Course of the Weather under or near the *Line*. I have read in the 2d and 4th parts of *Purchas his Pilgrims*, (and I doubt not but later Travellers attest the same truth,) That, in *Brazil* and *Guiana* in *America*; in *Guinea*, *Congo* and *Aethiopia* in *Africa*; in the *East Indies* and the *Maldive Islands*; they have almost continual Floods of Rain from about the beginning of *May* to the end of *August*, which they call their Winter, and the rest of the Months of the year Fair and Clear Weather, which they call their Summer: So that when the Sun is nearest to them, they have constant Rains, and when remotest, Fair Weather. And this I impute, amongst other causes, to the extraordinary Rarefaction of the Air, and lessening of its *Specific Gravity* there at that time, so that the Vapours in the Neighbouring parts of the Air do all flow thither, and Descend as it were in Floods of Rain. And as this is reckoned to be the Cause of the *Inundation* of the *Nile*, and some other Rivers, so perhaps this may be the reason also, why those Countries which are Neighbouring to them, and somewhat remoter from the *Line*, such as *Egypt* and the like, have seldom or never any Rain.

My Second Observation is of the *Baroscope*, viz. that when the Wind is North, North-East, or North-West, the *Mercury* ever Rises, and so the Air is Heavier; but when the Wind comes from the South, South-East, or South-West, it falls and so the Air's Gravity is less: by which we may see what Influence the Cold and Heat have upon the Air's Weight; and you know a Cold Wind is said to drive the Sails of a Ship much more forcibly than a Warm.

My third Observation is of an Experiment of the Honourable Mr. *Boyle*; I n. 63. p. 2048. made, *saieth he*, by Distillation a Blood-Red Liquor, which chiefly consisted of such Saline Spirituous particles as may be obtained from the Mass of Blood in Humane bodies; this Liquor is of such a Nature, that if a Glass Viol about half filled with it, be kept well stop't, the red Liquor will rest as quietly as any ordinary one, without sending up any smook: But if the Viol be unstop't, so that the External Air be permitted to come in, within a quarter of a Minute or less, there will be elevated a copious white Smook, which will not only fill the upper part of the Glass, but plentifully pass out into the open Air, till the Viol be again stopp'd. *And a little after he adds*, If the unstop't Viol were placed in our *Vacuum*, it would not Emit any visible Steams at all, nor so much as appear in the upper part of the Glass it self that held the Liquor; whereas when the Air was by degrees restor'd at the stop-cock, the returning Air would presently Raise the Fumes first into the vacant part of the Viol, whence they would Ascend into the Capacity of the Receiver; and likewise when the Air that was requisite to support them was Pumped out, they also accompanied it, as their unpleasent smell evinced, and the Red Spirit, tho' it remain'd unstopp'd, Emitted no more Fumes till the new Air was let in again. *So far He.* n. 171. p. 1092. Such you see was the proportion between the Gravity of the Vapours of this Red Liquor and the Air, that the Air being in its ordinary degree of Gravity these Vapours did Ascend: but the Air's Gravity being much lessened in the Receiver, by the Pumping out a great deal of it, and so expanding the Spring of the rest, it was not able to Elevate those Vapours.

By Dr. Wallis.
ib. p. 1002.

2. That there is in our Air a Body more subtile than are the Fumes and Vapours mingled with it in our Lower Region, and which with it do make up that Heterogeneous mixture which we commonly call Air, I think to be very certain: But whether that subtile body, be (as Dr. *Garden* seems to suppose,) much Heavier, than our common Air, I much doubt; and do rather think it is not, not having hitherto observed any Cogent Experiment, either to prove it Heavy or Elastick: But it may, for ought I know, be void as well of Weight as Spring; and, what we find of either, in our common Air, may be attributed to the other mixtures with it. For the Air being of a different Gravity, in different times and places, (arising I suppose from the different kinds and quantities of the Fumes and Vapours and other particles which are ingredients in it, and the different force of the Sun's Heat acting thereupon, increasing or allaying the Spring thereof, and otherwise) we are therefore to consider of the Air as a Fluid whose parts are in some places Heavier, and others Lighter. And therefore much of a like nature as if they were different Fluids, of different *Specifick* or Intensive Gravity, one from the other.

Now when several Fluids, or several parts of a Fluid, are thus of different Weights, they will (from the general nature of Heavy Fluids,) when undisturbed, change places with one another, till the Heavier becomes Lowest, and the Lighter Highest.

And this, not only as to the Minuter parts; as is observed in Chymical Precipitations, or the sinking of Sand in Water, or its smaller Earthy particles which subside in a muddy sediment, and the like of other Liquors when at rest, and the Atoms (as they were wont to be called) flying in the Air when disturbed, but subsiding in the form of dust when at rest, all which according as they be smaller do (*cæteris paribus,*) subside more slowly: But much more as to larger parcels; as when Oyl, Wine, Water, Beer, or other the like Liquors, are put together in the same Vessel, as will be observable to the Eye, especially when their Colours are considerably different.

And the same will happen, if some parts of the same Liquor, do accidentally acquire (by expansion or otherwise,) a greater degree of Lightness than the other parts; those Lightened parts ascending, the heavier subside; as when Water, Beer, or other thin Fluids, be gradually heated by a Fire underneath, the lower parts, being first warmed, Ascending to the top, while the Colder and heavier Subside; whence we find in such cases that Bubbles do arise, and that at the top is warmer than that at the bottom: But in case what is warmed be of a thicker consistence, so as that the parts cannot readily shift places, that at the bottom will be hotter; and in case it be heated by Fire over it, there will (I suppose) be no such Bubbling, (or not so much of it,) that at the top being first heated.

From such considerations as this, Dr. *Garden* doth well observe, that some parts of the Air being thus (by Rarefaction, or increasing the Spring thereof, or otherwise,) become Lighter than others; these Heavier parts, rushing into the places of those Lighter, may cause a Wind as from such parts; (in like manner as, on a like occasion, a Tyde or Current would arise in Water;) and other Accidents of a like nature. And contrarywise, on a contrary occasion.

And

And this I take to be very true, (though such accidents happening very variously and uncertainly, will cause such confusion of Motions, and disturbance of each other, that it will be hard to reduce them to a regular Adjustment.)

But I add thereunto, that the Earth's Diurnal Motion, compounded with its Annual, (if we admit that *Hypothesis*, as most do now a-days) the one in some parts Accelerating, in others Retarding the other; and its difference in different times of the year, (by reason of the Obliquity of the *Zodiack* to the *Æquinoctial*) and in different times of the Month (because of the Moon's different Position, which is an Appendage to the Earth's Motion, and doth thereby differently affect it,) and according to the different place of the Earth and Moon, as to the *Aphelion* or *Perihelion* of the one, and the *Apogæum* or *Perigæum* of the other; seem to me to be of much greater consideration, not only as to the *Ebbing* and *Flowing* of the Sea, but as to the Winds also: Especially the *Breezes* and *Trade-Winds*, which at certain times of the day, or of the Year, or of the Month, are observed to Blow constantly (or most frequently,) from such or such a Coast.

And I am not sure, that the Body of Earth and Water (or Terraqueous Globe,) is exactly Spherical (allowing only for the small inequalities of Hills and Dales, which in a Body of that greatness, are inconsiderable,) but may have somewhat of an *Oblong Spheroid*, having a longer Axis from *Pole* to *Pole*, than at the *Equator*. And though this cannot be much; because of the Earth's Shadow in the Moon's Eclipse appearing Circular; and the Descent of Heavy Bodies being always (as to sense) in a Perpendicular to the *Horizon*: yet if it be but little, this (with the Compound Motions before mentioned,) will give the Air a considerable disturbance.

To which I may add also, that we are not sure, that the Seas and Continents (which are of very different comparative Weights, Earth being heavier than Water,) are so adequately adjusted the one to the other, as that its Center of Gravity (by which a Plain passing divides it into parts *Æquiponderant*,) is the same with its Center of Magnitude (by which it is divided into parts equally Great,) which if it happen to be otherwise will (with the rest,) make the Confusions of the Air's Motions yet greater.

From the Comparative Weight or Lightness of the Air at different times he deduceth also the Rising or Falling of Vapours in it. As if, when such Fumes or Vapours; or other the like matters, are Lighter than the Air, they ought (according to the exact rules of *Hydrostaticks*,) to Ascend therein; but when Heavier than so, to Fall down. And this certainly (*cæteris paribus*) is to be admitted also. Only I add thereto; that these *Statick Principles* do chiefly take place, when things are otherwise at Rest and Quiet: But when they are in Commotion, it is many times much otherwise. And, in such cases, we must, beside the Respective Gravity, take into consideration, the Force, Impulse, or Impetus, that is superadded to the Respective Gravity of the parts or matter. Thus, if a Bottle be shaken, the Sediment at the bottom (though Heavier, and for which cause it did before Subside) will be mingled with the supernatant (finer and lighter,) Liquor. And, if a room be swept, it will (as we use to speak,) make a dust, that is, the small Earthy particles of dust, will Rise and

mingle with the Air: not because they be Lighter than it, (for we see that at leasure they will Subside again,) but because by a Force upon them they be put into Motion. And this I take to be the Cause of Fumes, Vapours and other like matters (most of them) which Ascend in the Air, not because Lighter than it, but because Impelled upward out of the Bowels of the Earth, or from the superficial parts of it, either by some Subterranean Heats or other Ferments, that put them into Motion, and Force them upward where they remain suspended in the Air, so long as that Force continues, or the Force of others sent after them on the like Errand (which rather Impels them farther, then gives them leave to Fall,) till either such Force abate, or the great Weight of so many things suspended doth overpower, not only the Air's Weight, but the Strength of that that Impelled them. And that there are such Fumes, and other like matter, Projected upwards from the Bowels of the Earth, and some of them with great violence, is undeniable, not only from Earth-quakes and other Eruptions (with great noises,) as well of Vapours, as of Burning Mountains; but even Poisonous Steams (and others,) in Mines and Bubbling Springs (where Bubbles of Air are seen to make their passage through the Water,) and other perspirations of Air or Vapour through Crannies or small passages of the Earth, discoverable by Steams (whereof some will take Fire at the light of a Candle,) or by the moving of Leaves and other light things laid on the Mouths of such private passages, and by many other means. And to such causes I do principally attribute the *Origine* of *Winds*, and the Ascent of most other things, which from this Lower World, mount into the Air: And, without this, the Comparative Gravity of the Air and them, would give us but a lame account of them.

There is yet another Notion suggested, which is also very considerable as to this affair, which is the Weakening or Strengthening the Spring of the Air. That water hath (of it self,) nothing of Spring or Elasticity (otherwise than by reason of some Airy parts, or other Elastick bodies, which may be included within it,) is generally held; at least none considerable, such as by any Experiments hitherto made can be clearly evinced so to be. But, that the Air (such Air at least as is the common Air which we are conversant with,) is Elastick, is I think out of doubt: the Experiments which prove its Spring being so many and evident, beyond Exception. And that this Spring of the Air is sometimes Stronger, and sometimes Weaker, I think, is undoubted also; And that the Spring of the Air is Strengthened both by Compression, and by Heat, but in a different manner. If the same Quantity of Air be Compressed into a lesser room, the Spring is certainly Stronger: as is undoubtedly seen in the Wind Gun, and other Compressive Engines. And the same quantity of Included Air in a close Vessel (so as not to communicate with the external Air,) will by application of Heat to it have its Spring Strengthened, and drive its counterprize farther off, or (if need be,) Compress it: as is to be seen in *Thermoscopes* of all sorts.

If the Spring be Strengthened by Compression; it is manifest that the Intensive Gravity must be thereby increased; because the same Quantity of Air, and consequently of Weight, extensively taken, is now contracted into a lesser
room,

room, which therefore must be Intensively Heavier, (as being the same Weight in a lesser Bulk.) Now this may possibly, as a greater Pressure or Stronger Spring, force up the Vapours under it with a greater Impetus (according to the Notion I mentioned before) and so make them fly higher: (unless we should suppose it may be relieved, by shortning the Height of the *Atmosphere*:) but not so as to make them Lighter; but rather the contrary, as pressing them closer: much less to make them (as the Phrase is,) *Specifically Lighter* than is the Air it self (though thus Compressed,) and it leaves less room to receive them between the particles of the Compressed Air, as being now thrust closer together.

If the Spring be Strengthened the other way; so as by Heat it useth to be: this doth rather diminish its Intensive Gravity, by thrusting its parts further asunder, and so possessing a Larger room. Now in case this Air be, by a close Vessel, confined so as not to Expand upward; it will certainly press the harder on the stagnant *Quicksilver* under, and make that in the *Tube* Rise higher. But in case it be unconfined, as in the Open Air, it may as well relieve it self upward, by making the *Atmosphere* in this part so much the higher.

Nor is there any necessity, as to the subjacent parts, that the *Atmosphere* should be every where of the same Height. But the Laws of *Statics*, as to the subjacent parts, be equally preserved without it, the greater Altitude compensating for the Levity of the parts, as when a portion of the Sea is covered with a Fleet of Ships; the under parts are equally Pressed, partly by Water, and partly by Ships, though the tops of the Ships over some parts be higher than the Surface of the Water over others. Only, in such case, the upper part of the *Atmosphere*, being Fluid, may Flow collaterally over the other parts on either side if lower. And so, at leisure, (if thus remaining otherwise undisturbed,) reduce it self to an equal Height in all parts. Like as the Sea would do, in a perfect Calm, though otherwise its Waves and Billows are far from being in all places perfectly plain and even.

But however, though the Spring fortified by Heat, may thus relieve it self upward, (yet because it presseth every way,) it must endeavour the like downward also, and thereby press harder what is under it; and because it will require time to work upward gradually before the effect reach the top of the *Atmosphere*; and because by such Dilatation of its parts, more room is left in the Intervals to receive what is forced: 'tis reasonable to believe that in such cases, the pressed Vapours (*cæteris paribus*) may Rise more copiously, than when the Spring of the Air, (for want of Heat,) is less Strong. The rather because the same Heat which thus fortifies the Spring of the Air, doth also Rarify the Vapours and make them Lighter: and may also fortify the Subterranean Heat (or what ever else it is,) that Drives them up. Notwithstanding all which, we have more Rains in Winter; which should argue, that more Vapours do then arise to supply them.

But I suspect that in this whole business (of Strengthening the Spring) there may be a fallacy put upon us: and what we think to be done upon the Open
Air,

Air, is indeed done upon the *Quick-Silver*; or rather upon the Air latent therein. My meaning is this; We find that in very Hot Weather, and also in Frosty Weather, the *Quick-silver* in the Tube commonly stands very High; from whence we are apt to conclude, that therefore the outward Air presses very hard on the Stagnant *Quick-Silver*, without the Tube: Wherein I am not satisfied; For we are to consider, that, in filling the Tube with *Quick-Silver*, before it be inverted, if great care be not used to cleanse it from Air, many Airy particles will remain mixed with it; which, while their Spring is Weak, are easily pressed by the Weight of the *Quick-Silver* so close as hardly to be discerned otherwise than by the Effect: but when, by the external Heat, their Spring is Strengthened, they Expand themselves, and cause the *Quick-silver*, wherein they are, to swell in Bulk, without increasing its Weight; and consequently to stand Higher though not to Press heavier.

And the same account, perhaps, may serve for its standing so High in Frosty Weather. Water we know, though it contract with Cold, yet when it comes to Freeze, doth Expand it self. (Which makes Ice lighter than Water, and to swim on the top of it.) Now whether this be purely of it self, or (in part at least,) from the Particles of Air lodged in it, may not perhaps be so easie to determine. However, if there be the like Effects on Air, as on Water, (namely that it Expands with Freezing,) or if in the *Quick-Silver* there be lodged particles of Water as well as of Air; we have, either way, an account of this *Phænomenon*. For, then the small Particles, whether of Air, or of Water, lodged in the *Quick-Silver* being thus Expanded by Freezing, will make the *Quick-Silver* Swell, and so stand Higher, without increasing its Weight; and consequently, without arguing a greater Weight of External Air pressing on the stagnant *Quick-Silver*.

*The Circulation
of Watry Va-
pours; by Mr.
Edm. Halley.
p. 192. p. 468.*

XXXIV. I have formerly attempted to explain the manner of the Rising of *Vapours* by Warmth, by shewing that if an Atom of Water were expanded into a Shell or Bubble so as to be ten times as big in Diameter as when it was Water, such an Atom would become *Specifically Lighter* than Air, and Rise so long as that *Flatus*, or warm Spirit, that first separated it from the Mass of Water, shall continue to distend it to the same degree; and that Warmth declining, and the Air growing cooler and withal *Specifically Lighter*, the *Vapours* consequently shall stop at a certain Region of the Air, or else Descend, which may happen upon several Accounts, as I shall by and by endeavour to make out. Yet I undertake not, that this is the only Principle of the Rise of *Vapours*, and that there may not be a certain sort of matter whose *Conatus* may be contrary to that of Gravity: as is evident in Vegetation, wherein the tendency of the Sprouts is directly upwards, or against the Perpendicular. But whatever is the true cause, it is in fact certain, that Warmth does separate the particles of Water, and emit them with a greater and greater Velocity, as the Heat is more and more Intense, as is evident in the Steam of a Boiling Cauldron, wherein likewise the Velocity of the Ascent of the *Vapours* does visibly Decrease till they disappear, being dispersed into and assimilated with the ambient Air.

Vapours being thus Raised by Warmth, let us for a first Supposition put, that the whole Surface of the Globe were all Water very deep, or rather that the whole Body of the Earth were Water, and that the Sun had his Diurnal course about it: I take it, that it would follow that the Air of it self would Imbibe a certain quantity of Aqueous *Vapours*, and Retain them like Salts dissolved in Water; that the Sun warming the Air, and Raising a more plentiful *Vapour* from the Water in the Day time, the Air would Sustain a greater proportion of *Vapour*, as Warm Water will hold more dissolved Salts, which upon the absence of the Sun in the Nights would be all again discharged in *Dews*, analogous to the Precipitation of Salts on the Cooling of the Liquors; nor is it to be believed that in such case there would be any diversity of Weather, other than periodically, every Year alike, the mixture of all Terrestrious, Saline, Heterogeneous *Vapours* being taken a way: which as they are variously compounded, and brought by the Winds, seem to be the Causes of those various *Seasons* which we now find. In this case the Airy Regions, every where at the same height, would be equally replenished with the proportion of Water it could contain, regard being only to be had to the different degree of Warmth, from the nearness or distance of the Sun; and an Eternal East-Wind would Blow all round the Globe, inclining only to the same side of the East, as the Latitude doth from the *Equator*; as is observed in the *Ocean* between the *Tropicks*.

Next let us suppose this *Ocean* interspersed with wide and spacious Tracts of Land, with high Ridges of Mountains; such as the *Pyrenean*, the *Alps*, the *Apennine*, the *Carpathian* in *Europe*; *Taurus*, *Caucasus*, *Imaus*, and several others in *Asia*; *Atlas* and the *Montes Lunæ*, with other unknown Ridges in *Africa*, whence come the *Nile*, the *Nigre*, and the *Zaire*; and in *America* the *Andes*, and the *Apalatean* Mountains: each of which far surpasses the usual Height to which the Aqueous *Vapours* of themselves Ascend, and on the Tops of which the Air is so Cold, and Rarified, as to Retain but a small part of those *Vapours* that shall be brought thither by the Winds. Those *Vapours* therefore that are Raised copiously in the Sea, and by the Winds are carried over the low Land to those Ridges of the Mountains, are there compelled by the Stream of the Air to Mount up with it to the Tops of the Mountains, where the Water presently *Precipitates*, gleeing down by the Crannies of the Stone; and part of the *Vapour* entring into the Caverns of the Hills, the Water thereof gathers as in an *Alembick* into the Basons of Stone it finds, which being once filled all the overplus of Water that comes thither runs over by the lowest place, and breaking out by the sides of the Hills, forms single *Springs*; Many of these running down by the Valleys, or Guts between the Ridges of the Hills, and coming to unite, form little *Rivulets* or *Brooks*; many of these again meeting in one common Valley, and gaining the plain Ground, being grown less rapid, become a *River*; and many of these being united into one common Channel, make such *Streams* as the *Rhine*, the *Rhone*, the *Danube*; which latter one would hardly think the Collection of Water condensed out of *Vapour*, unless we consider how vast a Tract of Ground that *River* drains,

drains, and that it is the sum of all those *Springs* which break out on the South side of the *Carpathian* Mountains, and on the North side of the immense Ridge of the *Alps*, which is one continued Chain of Mountains from *Switzerland* to the *Black Sea*. And it may almost pass for a Rule, that the *Magnitude* of a *River*, or the Quantity of Water it Evacuates, is proportionable to the Length and Height of the Ridges from whence its *Fountains* arise. Now this *Theory* of *Springs* is not a bare *Hypothesis*, but founded on Experience, which it was my luck to gain in my abode at *St. Helena*; where in the Night time, on the Tops of the Hills, about 800 yards above the Sea, there was so strange a Condensation, or rather Precipitation of the *Vapours*, that it was a great Impediment to my *Celestial Observations*; for in the Clear Sky the *Dew* would fall so fast as to cover, each half quarter of an hour, my Glasses with little drops, so that I was necessitated to wipe them off so often, and my Paper, on which I wrote my Observations, would immediately be so wet with the *Dew* that it would not bear Ink: by which it may be supposed how fast the Water Gathers in those mighty High Ridges I but now named.

Thus is one part of the *Vapours* blown upon the Land returned by the *Rivers* into the *Sea*, from whence they came. Another part by the Cool of the Night falls in *Dews*, or else in *Rains*, again into the *Sea* before it reaches the Land; which is by much the greatest part of the whole *Vapour*, because of the great Extent of the *Ocean*, which the Motion of the Winds does not traverse in a very long space of time: And this is the Reason why the *Rivers* do not return so much into the *Mediterranean* as is extracted in *Vapour*. A third part falls on the lower Lands, and is the *Pabulum* of *Plants*, where yet it does not rest, but is again exhaled in *Vapour* by the Action of the Sun, and is either carried by the Winds to the *Sea*, to fall in *Rain* or *Dew* there; or else to the Mountains to be there turned into *Springs*: and though this does not immediately come to pass, yet after several Vicissitudes of Rising in *Vapour* and Falling in *Rain* or *Dews*, each particle of the Water is at length returned to the *Sea*, from whence it came. Add to this, that the *Rain-Water*, after the Earth is fully sated with moisture, does, by the Valleys or lower parts of the Earth, find its way into the *Rivers*, and so is compendiously sent back to the *Sea*. After this manner is the *Circulation* performed: and I doubt not but this *Hypothesis* is more reasonable, than that of those who drive all *Springs* from the *Rain-Waters*, which yet are perpetual and without diminution, even when no *Rain* falls for a long space of time: Or than that that derives them from a Filtration, or *Percolation*, of the *Sea-Waters* through certain imaginary Tubes or Passages within the Earth, wherein they lose their Saltness; This besides many others labouring under this principal Absurdity, that the greatest *Rivers* have their most copious *Fountains* farthest from the *Sea*, and whether so great Quantities of Fresh Water cannot reasonably be derived any other way than in *Vapour*. This, if we may allow *Final Causes*, seems to be the design of the *Hills*, that their Ridges being placed through the midst of the *Continents*, might serve as it were for *Alembicks*, to distill *Fresh Water* for the use of Man and Beast, and their Heights to give a Descent to those *Streams* to run gently,
like

like so many veins of the *Macrocosm*, to be the more beneficial to the Creation. If the Difference between *Rain* and *Dew*, and the Cause why sometimes 'tis *Cloudy* at other times *Serene*, be enquired, I can offer nothing like a proper Solution thereof, only with submission to propose Conjectures, which are the best I can find, *viz.* That the Air being heap'd up with the meeting of two contrary Winds, when the *Mercury* is High, the *Vapours* are the better sustained and kept from Coagulating or Condensing into Drops, whereby *Clouds* are not so easily generated: and in the Night the *Vapours* Fall down single as they arose in *Imperceptible* Atoms of Water. Whereas when the *Mercury* is Low, and the Air Rarified by the Exhaustion thereof, by two contrary Winds blowing from the place, the Atoms of Air keep the *Vapours* not so well separated, and they Coalesce into *Visible Drops* in the Clouds; and from thence are easily drawn into greater Drops of *Rain*. To which 'tis possible, and not improbable, that some sort of Saline or Angular particles of Terrestrial Vapour being immixt with the Aqueous, which I take to be Bubbles, may cut or break their Skins or Coats, and so contribute to their more speedy Condensation into *Rain*.

XXXV. The *Trade* or *Tropick Winds* seem in great part to arise from the daily and constant Breath of the *Sargosse*, or *Lenticula Marina*, which grows in vast Quantities from 36 to 18 Degrees Northern Latitude, and elsewhere upon the deepest Seas: because the Matter of that *Wind*, coming (as we suppose) from the Breath of only one Plant, it must needs make it constant and Uniform; Whereas the great Variety of Plants and Trees at Land must needs furnish a Confused Matter of *Winds*. Again the *Levant Breezes* are briskest about Noon, the Sun quickning the Plant most then, causing it to breath faster and more vigorously; and that Plants mostly languish in the Night is evident from many of them, which contract themselves and close at that time; also from the Effects of our Winters upon them, which cause them to cast both Fruit and Leaves too; whereas they are said (the same Plants for Kind) universally to Flourish all the year alike within the *Tropicks*.

The Cause of Trade-Winds, by Dr. M. Lister. n. 156. p. 494.

As for the Direction of this *Breeze* from East to West, it may be owing to the General *Current* of the Sea; for a gentle Air will still be led with the Stream of our Rivers, for Example. Again every Plant is in some measure an *Heliotrope*, and bends it self and moves after the Sun, and consequently emits its Vapours thitherward; and so its Direction is in that respect also owing in some measure to the Course of the Sun.

XXXVI. 1. It is generally known that there are continual Eastern Winds under the *Line*, which they call *Brises*, and therefore the accounts of Spanish Voyages bear, that in their going to the *West-Indies* they sail Southwards from *Spain*, along the Coast of *Africk*, till they be beyond the *Tropick* of *Cancer*, within 20 Deg. of the *Line*, where they presently find an Easterly Wind, and so they sail on Westwards with full Winds, so as they have scarce any need to touch their Sails in the whole Voyage: and this they give as the

The Cause of Winds, and of the Change of Weather; by Dr. George Gard. n. 175. p. 1148.

reason why the Voyage from *Spain* to the *West Indies* is shorter, more easie, and more assured, than the Return to *Spain*. In the *South-Sea* also, going from *New Spain* or *Peru* to the *Philippines* or *China*, their Voyage is easie, Sailing always from East to West near the *Line*, where the Easterly Winds blow in their Poop. *Acosta* reports, that in the Year 1584, there went a Ship from *Calloa* in *Lima* to the *Philippines*, which sailed 2700 Leagues without sight of Land, and this in two Months, their Course being almost under the *Line*.

Now these continual Easterly Winds between the *Tropicks*, I suppose to proceed both from the Motion of the Earth and the Vertical Influences of the Sun, after this manner. As you know the Vast Fluid and *Æther*, in which the Earth floats in its Annual Motion, moves forward with the Earth in that Motion, or rather carries the Globe of the Earth along with it; even so the *Atmosphere*, and a large Vortex of *Æther* beyond the Moon, goes round with the Earth in its Diurnal Motion, which tho' according as it is removed from the Earth it may be proportionably slower in its Motion, yet that portion of the *Atmosphere*, which is nearest the Earth and surrounds it, may be supposed to keep equal pace with the Earth in its Motion; and if there were no changes in the *Atmosphere's* Gravity, I suppose it would always go along with the Globe of the Earth from West to East in an Uniform Motion, which would be wholly insensible to us. But that portion of the *Atmosphere* under the *Line*, being extremely Rarified, its Spring expanded, and so its Gravity and Pressure much Less than the neighbouring parts of the *Atmosphere*, and consequently incapable of the Uniform Motion to the East, it must needs be prest Westwards, and make that continual *Briſe* from East to West between the *Tropicks*.

2. The same accounts bear, that on this side the *Tropick*, about 28 or 30 deg. there are to be found constant Westerly Winds, and therefore the *Spanish* Fleets from the *West Indies* do not Return the way they went, but those both from *Peru*, and *New-Spain*, Sail along the Coast Northward till they touch at *Havana* in *Cuba*, and being joyned together there, they seek their Height without the *Tropicks*, where presently they find Westerly Winds which serve them till they come in view of the *Azores*, and from thence to *Sevill*. In like manner in the *South-Sea*, those which return from the *Philippines*, or *China*, to *Mexico*, to the end they may recover the Western Winds, mount a great Height till they come right against the Islands of *Japan*; and discovering *California* they return by the Coast of *New-Spain* to the Port of *Acapulco*, from whence they parted. So that tho' they Sail easily from East to West, in both Seas, within the *Tropicks*, for that the Eastern Winds reign there; yet returning from West to East they must seek the Western Winds without the *Tropicks* in the height of 27 Degrees.

Now the Reason of this seems to me clearly deducible from the former; for the Pressure of Air between the *Tropicks* being continually less than the neighbouring parts of the *Atmosphere*, and so consequently by them pressed Westward, way being thereby given to the neighbouring Air for some Deg. without the *Tropicks*, its motion from West to East is proportionably increas'd

creas'd beyond that uniform motion it would have if the whole *Atmosphere* were of an equal Pressure, and consequently there will blow a constant Wind from West to East for some *Degrees* beyond the *Tropicks*.

3. Those Easterly Winds between the *Tropicks*, by what I can collect from the accounts of *Eastern Voyages*, do not Blow constantly from the same Point, nor directly from the East; but for the one Half of the Year, *viz.* from *April* to *November* or thereabouts, they come from the South East, and for the other Half of the Year, *viz.* from *November* to *April*, they Blow from the North East. And these I suppose they call their *Monsoons*, and *Trade-Winds*. Hence it is that they who Sail from *China*, *Japan*, &c. to *Bantam*, must wait the Northerly *Monsoon*, which falls between *November* and *April*; and they who return from *Bantam*, must go back again when the Southerly *Monsoon* comes, which is between *April* and *November*; and the *Currents* of the *Seas* are said to observe the same Motion, and Changes, with the Winds. I know not whether these *Monsoons* do Blow exactly from the same Points, in all parts, for it is like where there are Bays, High-lands, and Islands, &c. the *Monsoons* may Blow from different Points; but this is chiefly to be understood of Open Seas.

Now these *Monsoons* I think may be easily accounted for from what has already been said, anent the Cause of the continual Easterly Winds between the *Tropicks*, for seeing the lessening of the Air's Pressure under the *Line*, and the Pressure of the Neighbouring parts of the *Atmosphere* thereupon, occasion these continual *Brisés*, if the Sun were constantly in the *Equinoctial Line*, it is like the Wind would Blow still directly from the East, but in that he is the one Half of the Year on the one side of the *Line*, and the other Half on the other, there must of necessity follow a Change of these *Brisés* into stated *Monsoons*. For Imagine the *Atmosphere* to be divided into two equal Hemispheres by the *Equinoctial Plane*, if the Sun were always in the Plane, there would be still an Equal Pressure from both these Hemispheres upon the Air under the *Line*, and the *Brise* should be directly from the East. But now when the Sun comes on the North side of the *Line*, as far as the *Tropick* of *Cancer*, and back again, there is not an Equal Ballance, but the Pressure of the Southern Hemisphere of the Air must needs be greatest, and consequently the *Brise* must Blow all that Season from the South East, and when the Sun returns again to the Southward of the *Line*, as far as *Capricorn*, and back again, the Pressure of the Northern Hemisphere must needs preponderate, and make the Wind Blow all that Half Year from the North East. And this seems to accord very well with Experience, for their Northern *Monsoons* are in our Winter Season, when the Sun is in the Southern *Signs*, and their Southern ones in our Summer when he is in the Northern *Signs*.

4. The Rivers of *Indus* and *Ganges*, where they enter the Ocean, do contain between them a large *Chersonesus*, which is divided in the middle by a Ridge of high Hills, which they call the *Gate*, which run along from East to West and quite thorough to the *Cape Comori*. On the one side is *Malabar*, and on the other *Coromandel*. On the *Malabar* side between that Ridge of Mountains and the Sea, it is after their appellation Summer from *September* till *April*; In

which time it is always a clear Skie, without once, or very little, Raining. On the other side the Hills, on the Coast of *Coromandel*, it is at the same time their Winter, every day and night yielding abundance of Rain. And from *April* to *September* it is, on the *Malabar* side, their Winter, and on the other side their Summer: so that in little more than 20 Leagues Journey in some places. as where they cross the Hills to *St Thomas*, on the one side of the Hill you Ascend with a fair Summer; on the other you Descend with a Stormy Winter. The like is said to be at *Cape Razalgate* in *Arabi*. And *Dr. Trapham* relates the same of *Jamaica*, intimating that there is a Ridge of Hills which runs from East to West thro' the midst of the Island, and that the Plantations on the South-side of these Hills have from *November* to *April* a continual Summer, whilst those on the North side have as constant a Winter, and *e contra* from *April* to *November*.

From these and such like accounts it seems evident, that a bare lessening of the *Atmosphere's* Gravity will not occasion Rain, but that there is also needful either a sudden Change of Winds, or a Ridge of Hills to meet the Current of the Air and Vapours, whereby the Particles of the Vapours are driven together; and so fall down into drops of Rain. And hence it is, that whilst the Wind Blows from the North East, *v z.* from *November* to *April*, there are continual Rains in the Northerly Plantations of *Jamaica*, and on the side of *Coromandel* in the *East-Indies*, because the Winds beat against that side of the Hills; and so there is fair Weather on the other side of these Hills, in *Malabar* and the Southern Plantations of *Jamaica*, there being no Winds to drive the Vapours together. But in the Southerly *Monsoon*, *viz.* from *April* to *November*, *Malabar* and the Southern Plantations of *Jamaica* have floods of Rains, the Wind beating against that side of the Hills, whilst in *Coromandel* and the other side of *Jamaica* there is Fair and Clear Weather. The Maps make those Mountains of *Gate* run South and North, and if so the *Monsoons* must Blow from other Points by reason of the neighbouring Countries and Islands, or else this is not the true cause of these *Seasons*.

This serves also to clear the *Singularity* of *Seasons* in *Peru*, beyond any other parts of the Earth, and seems to be assigned by *Acosta* as the Cause of it. *Peru* runs along from the *Line* Southwards about 1000 Leagues. It is said to be divided into three Parts, long and Narrow, which they call *Lanos*, *Sierras*, and *Andes*; the *Lanos*, or Plains, run along the *South-Sea* Coast; the *Sierras* are all Hills with some Vallies; and the *Andes*, steep and craggy Mountains. The *Lanos* have some ten Leagues in breadth, in some parts less and in some more, the *Sierra* contains some 20 Leagues in breadth, the *Andes* as much, sometimes more sometimes less; they run in length from North to South, and in breadth from East to West. This Part of the World is said to have these Remarkable things. 1. All along the Coast, in the *Lanos*, it Blows continually with one only Wind, which is South and South West, contrary to that which usually Blows under the *Torrid Zone*. 2. It never Rains, Thunders, Snows, or Hails, in all this Coast, or *Lanos*, tho' there falls sometimes a small Dew. 3. Upon the *Andes* it Rains almost continually, tho' it be sometimes more Clear than other. 4. In the *Sierra*, which lies betwixt both

Both the Extrems, it Rains from *September* to *April*, but in the other Seasons it is more Clear, which is when the Sun is farthest off, and the contrary when it is nearest. Now the reason of all seems to be this. The Eastern *Brisés*, which Blow constantly under the *Line*, being stop't in their Course by the *Sierras* and *Andes*, and yet the same *Brisés*, being to be found in the *South-Sea* beyond *Peru*, as appears by the easy Voyages from *Peru* to the *Philippines*, a Current of Wind Blows from the South on the *Plains* of *Peru* to supply the Eastern *Brise* in the *South-Sea*: and there being but One constant Gale in these *Plains*, and no contrary Winds, nor Hills for it to beat upon, this seems to be the reason why the Vapours are never, or very seldom, driven into Rain. And the *Andes*, being as High perhaps in many places as the Vapours Ascend, in the highest degree of the *Atmosphere's* Gravity, this may probably be the Reason why the Eastern *Brise*, beating constantly against these Hills, occasion Rains upon them at all Seasons of the Year. And the *Sierras* being it seems lower than the *Andes*, therefore from *September* to *April*, when the Sun is nearest, and so the *Atmosphere's* Gravity less and the Vapours lower, they are driven against the *Sierras* into Rain.

6. The Causes of those Particular, Various, Uncertain, and Unconstant Winds, which do Blow in the Countries without the *Tropicks*, and that most frequently in Mountainous Places, and more seldom in great Plains such as *Poland*, I cannot so easily conjecture: but those General Winds, which usually fall out every where about both *Aequinoctials*, seem to proceed from some General Cause; and this I take to be the Change of the *Monsoons*, and *Trade-Winds*, about these times between the *Tropicks*. For there must needs be about these Seasons a Change of the Ballance of the *Atmosphere*, according to what I have discoursed on the *third* Head, and this I think cannot but occasion Strong Winds over all the Earth.

2. Dr. *Garden* endeavours to Explain and give an Account of the *Trade-Winds*, within the *Tropicks*, from the different Gravity of the *Atmosphere* at divers times of the Year. And yet it is asserted by Dr *Lister*, That the *Mercury* is not affected with the Weather, or very rarely, let it be Cloudy, Rainy, Windy, or Serene, in *St. Helena*, or the *Barbadoes*, and therefore probably not within the *Tropicks*, unless in a Violent Storm or *Hurricane*. Now if the *Mercury* move little or nothing in the *Baroscope*, 'tis likely there is little or no Change in the Gravity of the *Atmosphere*, within the *Tropicks*.

By Mr. Will. Molyneux. n. 177. p. 1237.

vid. Sect. X. 1.

3. The Universal *Ocean* may most properly be divided into three Parts; viz. 1. The *Atlantick* and *Aethiopic* Sea. 2. The *Indian Ocean*. 3. The great *South-Sea*, or the *Pacific* Ocean.

By Mr. Halley n. 183. p. 153.

1. In the *Atlantick* and *Aethiopic* Seas, between the *Tropicks*, there is a general Easterly Wind, all the Year long, without any considerable Variation; excepting that it is subject to be Deflected therefrom, some few Points of the Compass, towards the North or South, according to the Position of the Place.

1. Near the Coast of *Africa*, as soon as you have passed the *Canary Isles*, you are sure to meet a Fresh Gale of N. E. Wind, about the Latitude of 28° North, which seldom comes to the Eastwards of the E. N. E. or passes the N. N. E. This Wind accompanies those bound to the Southward to the Latitude of 10° North, and about 100 Leagues from the *Guinea Coast*, where till the 4° of North Latitude, they fall into *Calms* and *Tornadoes*. 2. Those

2. Those bound to the *Carribbe Isles*, find, as they approach the *American* side, that the aforesaid *N. E.* Wind becomes still more and more Easterly, so as sometimes to be *E.* sometimes *E. b. S.*, but yet most commonly to the Northward of the East, a Point or two, seldom more. 'Tis likewise observed, that the Strength of these Winds does gradually decrease, as you Sail to the Westwards.

3. That the *Limits* of the *Trade* and *Variable* Winds, in this *Ocean*, are farther extended on the *American* side, than the *African*: for whereas you meet not with this Certain Wind till after you have passed the Latitude of 28° on this side; on the *American* side it commonly holds to 30 , 31 , or 32° of Latitude; and this is verified likewise to the Southwards of the *Equinoctial*, for near the *Cape of good Hope* the *Limits* of the *Trade-Winds*, are 3 or 4° nearer the *Line*, than on the Coast of *Brazile*.

4. That from the Latitude of 4° North to the aforesaid *Limits* on the South side of the *Equator*, the Winds are generally and perpetually between the South and East, and most commonly between the South-East and East, observing always this Rule, that on the *African* side, they are more Southerly, on the *Brasilian* more Easterly, so as to become almost due East, the little Deflection they have being still to the Southwards. In this Part of the *Ocean* it has been my fortune to pass a full Year, in an Employment that obliged me to regard more than ordinary the Weather, and I found the Winds constantly about the South-East, the most usual point *S. E. b. E.*; when it was Easterly it generally Blew Hard, and was Gloomy, Dark, and sometimes Rainy Weather; if it came to the Southwards, it was generally Serene, and a Small Gale next to a Calm; but this not very common. But I never saw it to the Westwards of the South, or Northwards of the East.

5. That the Season of the Year has some small Effect on these *Trade-Winds*, for that when the Sun is considerably to the Northwards of the *Equator*, the South-East Winds, especially in the Streight of this *Ocean* (if I may so call it) between *Brasile* and the Coast of *Guinea*, do vary a Point or two to the Southwards, and the North-East become more Easterly; and on the contrary when the Sun is towards the *Tropick* of *Capricorn*, the South Easterly Winds become more Easterly, and the North-Easterly Winds on this side the *Line* were more to the Northwards.

6. There is in this *Ocean* a Traet of Sea, wherein the Southerly and South-West Winds are perpetual, *viz.* all along the Coast of *Guinea*, for above 500 Leagues together, from *Sierra Leona* to the Isle of *St. Thomas*; for the South-East *Trade-Wind* having passed the *Line*, and approaching the Coast of *Guinea* within 80 or 100 Leagues inclines towards the Shore, and becomes *S. S. E.* and by degrees, as you come nearer, it veers about to South, *S. S. W.* and in with the Land South-West, and sometimes *W. S. W.*; which Variation is better expressed in the Map than it can well be in words. These are the Winds which are observed on this Coast when it Blows True, but there are frequent Calms, Violent sudden Gusts called *Tornado's*, from all Points of the Compass, and sometimes unwholsom foggy Easterly Winds called *Hermitaa* by the Natives, which too often infest the Navigation of these Parts.

Fig. 20.

7. That

7. That to the Northwards of the *Line*, between 4 and 10 *deg.* of *Latitude*, and between the Meridians of *Cape Verde*, and of the Eastermost Islands that bear that name, there is a Tract of Sea wherein it were improper to say there is any *Trade-Wind*, or yet a *Variable*, for it seems condemned to perpetual Calms, attended with terrible Thunder and Lightning, and Rains so frequent, that our Navigators from thence call this Part of the Sea the *Rains*: the little Winds that are, be only some sudden uncertain Gusts, of very little Continuance and less Extent; so that sometimes each Hour you shall have a different Gale, which dies away into a Calm before another succeed; and in a Fleet of Ships in sight of one another, each shall have the Wind from a several Point of the Compass; with these weak *Briefes*, Ships are obliged to make the best of their way to the Southward through the aforesaid six *Degrees*, wherein 'tis reported some have been detained whole Months for want of Wind.

From the three last Observables is shewn the reason of two notable occurrences in the *East-India* and *Guinea* Navigations. The one is, why notwithstanding the narrowest part of the Sea between *Guinea* and *Brasile* be about 500 Leagues over, yet Ships bound to the Southward, sometimes, especially in the Months of *July* and *August*, find a great difficulty to pass it. This happens because of the South-East Winds, at that time of the Year commonly extending some *deg.* beyond the Ordinary Limit of 4 *deg.* North *Lat.* and withal they come so much Southerly, as to be sometimes South, sometimes a Point or two to the West; there remains then only to Plie to Wind-ward, and if on the one side they stand away *W. S. W.* they gain the Wind still more and more Easterly, but there is danger of not weathering the *Brasilian* Shore, or at least the Shoals upon that Coast. But if upon the other Tack they go away *E. S. E.* they fall into the neighbourhood of the Coast of *Guinea*, from which there is no departing without running Easterly, as far as the Isle of *St. Thomas*, which is the constant practice of all the *Guinea* Ships, and which may seem very strange, without the consideration of the 6th Remark, which shews the reason of it. For being in with the Coast the Wind Blows generally at *S. W.* and *W. S. W.* with which Winds they cannot go to the Northward for the Land, and on the other Tack they can lie no nearer the Wind than *S. S. E.* or *S.* and with these Courses they run off the Shore, but in so doing they always find the Winds more and more contrary; so that when near the Shore, they could lie South, at a greater distance they can make their way no better than *S. E.* and afterwards *E. S. E.* with which Courses they fetch commonly the Isle of *St. Thomas* and *Cape Lopez*, where finding the Winds to the Eastward of the South, they keep them favourable by running away to the Westward in the South *Lat.* of 3 or 4 *Deg.* where the *S. E.* Winds are Perpetual.

For the sake of these General Winds, all those that use the *West-Indian* Trade, even those bound to *Virginia*, count it their best Course to get as soon as they can to the Southwards, that so they may be certain of a Fair and Fresh Gale, to run before it to the Westwards; and for the same reason those homewards bound from *America*, endeavour to gain the Latitude of 30 *Deg.* as soon

as soon as possible; where they first find the Winds begin to be Variable; though the most ordinary Winds in the Northern part of the *Atlantick Ocean* come from between the South and West.

As to those furious Storms called *Hurricanes*, which are as it were peculiar to the *Caribbe Isles*; and which so dreadfully afflict them in the Month of *August*, or not much before or after, they do not so properly belong to this place, both by reason of their small Continuance and Extent, as likewise because they are not Anniversary; some Years having more than one, and sometimes for several Years together there being none at all. But their Violence is so unconceivable, and their other *Phænomena* so surprizing, that they merit well to be considered apart.

What is here said, is to be understood of the Sea-Winds, at some distance from the Land; for upon and near the Shores, the *Land* and *Sea-Brizes* are almost every where sensible; and the great Variety which happens in their Periods, Force, and Direction, from the Situation of the Mountains, Vallies, and Woods, and from the various texture of the Soil, more or less capable of Retaining and Reflecting Heat, and of Exhaling or Condensing Vapours, is such, that it were an endless Task, to endeavour to account for them.

2. In the *Indian Ocean*, the *Winds* are partly *General*, as in the *Æthiopick Ocean*, partly *Periodical*, that is half the Year they Blow one way and the other half near upon the opposite Points; and these Points and times of Shifting are Different in Different parts of this *Ocean*.

1. Between the *Latitudes* of 10 *deg.* and 30 *deg.* South, between *Madagascar* and *Hollandia Nova*, the *General Trade-Wind* about the *S. E. b. E.* is found to Blow all the Year long, to all intents and purposes after the same manner as in the same *Latitudes* in the *Æthiopick Ocean*, as it is described in the 4th Remark aforegoing.

2. That the afore said *S. E.* Winds extend to within two *deg.* of the *Equator*, during the Months of *June*, *July*, and *August*, &c. to *November*, at which time between the South *Latitudes* of 3 and 10 *Deg.* being near the Meridian of the North End of *Madagascar*; and between 2 and 12 South *Latitude*, being near *Sumatra* and *Java*; the contrary Winds from the *N. W.* or between the North and West, set in and Blow for half the Year, *viz.* from the beginning of *December* till *May*: and this *Monsoon* is observed as far as the *Molucca Isles*, of which more anon.

3. That to the Nothward of 3 *Deg.* South *Latitude*, over the whole *Arabian* or *Indian Sea* and *Gulf* of *Bengall*, from *Sumatra* to the Coast of *Africa*, there is another *Monsoon*, Blowing from *October* to *April* upon the *N. E.* Points; but in the other half Year, from *April* to *October*, upon the opposite Points of *S. W.* and *W. S. W.* and that with rather more force than the other, accompanied with Dark, Rainy Weather, whereas the *N. E.* Blows Clear. 'Tis likewise to be noted, that the Winds are not so constant, either in Strength or Point, in the *Gulph* of *Bengall*, as they are in the *Indian-Sea* where,

where a certain steady Gale scarce ever fails. 'Tis also remarkable, that the *S. W.* Winds in these Seas are generally more Southerly on the *African* side, more Westerly on the *Indian*.

4. There is a Tract of *Sea* to the Southwards of the *Equator*, subject to the same changes of the Winds, *viz.* near the *African* Coast, between it and the Island *Madagascar* or *St. Lawrence*, and from thence Northwards as far as the *Line*: wherein from *April* to *October* there is found a constant Fresh *S. S. W.* Wind, which as you go more Northerly, becomes still more and more Westerly, so as to fall in with the *W. S. W.* Winds mentioned before in those Months of the Year to be certain to the Northward of the *Equator*: What Winds blow in those Seas for the other half Year, I have not yet been able to obtain to my full satisfaction: The account which has been given me is only this, that the *Winds* are much Easterly hereabouts, and as often to the North of the true East as to the Southwards thereof.

5. That to the Eastward of *Sumatra* and *Malacca*, to the Northwards of the *Line*, and along the Coast of *Camboia* and *China*, the *Monsoons* blow North and South: that is to say, the *N. E.* Winds are much Northerly, and the *S. W.* much Southerly. This Constitution reaches to the Eastwards of the *Philippine* Isles, and as far Northerly as *Japan*. The Northern *Monsoon* setting in, in these Seas, in *October* or *November*, and the Southern in *May*, blowing all the Summer Months. Here it is to be noted, that the Points of the Compass from whence the Winds come in these Parts of the World, are not so fixt as in those lately described; for the Southerly will frequently pass a Point or two to the Eastwards of the South, and the Northerly as much to the Westwards of the North, which seems occasioned by the great quantity of Land which is interspersed in these Seas.

6. That in the same *Meridians*, but to the Southwards of the *Equator*, being that Tract lying between *Sumatra* and *Java* to the West, and *New-Guinea* to the East, the same Northerly and Southerly *Monsoons* are observed; but with this difference, that the Inclination of the Northerly is towards the *N. W.* and of the Southerly towards the *S. E.* but the *Plagæ Venti* are not more constant here than in the former, *viz.* *Variable* 5 or 6 Points: Besides, the times of the change of these Winds are not the same as in the *Chinese* Seas, but about a Month or 6 Weeks later.

7. That these contrary Winds do not shift all at once, but in some places the time of the Change is attended with *Calms*, in others with *Variable* Winds; and it is particularly remarkable, that the End of the Westerly *Monsoon* on the Coast of *Coromandel*, and the two last Months of the Southerly *Monsoon* in the Seas of *China*, are very Subject to be *Tempestuous*: The Violence of these *Storms* is such, that they seem to be of the Nature of the *West-India Hurricanes*, and render the Navigation of these Parts very unsafe about that time of the Year. These *Tempests* are by our Seamen usually termed, the *Breaking up of the Monsoons*.

By reason of the Shifting of these Winds, all those that Sail in these Seas, are obliged to observe the Seasons proper for their Voyages, and so doing to

fail not of a Fair Wind and speedy Passage; but if so be they chance to outstay their time, till the contrary *Monsoon* set in, as it frequently happens, they are forced to give over the hopes of accomplishing their intended Voyages, and either return to the Port from whence they came, or else put into some other Harbour, there to spend the time till the Winds shall come favourable.

3. That Navigation that there is on the *Mare Pacificum* is by the *Spaniards*, who go Yearly from the Coast of *New-Spain* to the *Manilba's*: but that is but by one beaten Tract; so that I cannot be so particular here as in the other two. What the *Spanish* Authors say of the Winds they find in their Courses, and what is confirmed by the old accounts of *Drake* and *Candish*, and since by *Schooten*, who Sailed the whole breadth of this Sea in the Southern *Latitude* of 15 or 16 *deg.* is, that there is a great Conformity betwixt the Winds of this Sea, and those of the *Atlantick* and *Aethiopic*; that is to say, that to the Northwards of the *Equator*, the predominant Wind is between the *E.* and *N. E.* and to the Southwards thereof, there is a constant steady Gale between the *E.* and *S. E.* and that, on both sides the *Line*, with so much Constancy that they scarce ever need to attend the Sails, and Strength that it is rare to fail of Crossing this vast *Ocean* in ten weeks time, which is about 130 Miles *per diem*: besides, 'tis said that Storms and Tempests are never known in these Parts; Wherefore some have thought it might be as short a Voyage to *Japan* and *China*, to go by the *Streights* of *Magellan*, as by the *Cape* of *Good-Hope*.

The Limits of these *General* Winds are also much the same as in the *Atlantick* Sea, *viz.* about the 30th. degree of *Latitude* on both sides; for the *Spaniards* Homewards bound from the *Manilba's*, always take the advantage of the Southerly *Monsoon*, blowing there in the Summer Months, and run up to the Northwards of that *Latitude*, as high as *Japan*, before they meet with *Variable* Winds, to shape their Course to the Eastwards. And *Schooten* and others, that have gone about by the *Magellan Streights*, have found the Limits of *S. E.* Winds, much about the same *Latitude* to the Southwards; besides, a farther Analogy between the Winds of this *Ocean* and the *Aethiopic*, appears in that, that upon the Coast of *Peru* they are always much Southerly, like as they are found near the shores of *Angola*.

Fig. 20.

To help the Conception of the Reader in a matter of so much difficulty, I believed it necessary to adjoyn a *Scheme*, shewing at one view all the various *Tracts* and *Courses* of these Winds. The *Limits* of these several *Tracts* are Designed every where by prickt Lines, as well in the *Atlantick* and *Aethiopic*, where they are the Boundaries of the *Trade* and *Variable* Winds, as in the *Indian Ocean*, where they also shew the extent of the several *Monsoons*. The Course of the Winds is exprest by Rows of stroaks in the same *Line* that a Ship would move, going always before it; the Sharp End of each little stroak pointing out that part of the *Horizon*, from whence the Wind continually comes; and where there are *Monsoons*, the Rows of the stroaks run alternately backwards and forwards, by which means they are thicker there than elsewhere. As to the great *South-Sea*, considering its vast extent, and the little Variety there is in its *Winds*, and the great Analogy between them, and those

Of the *Atlantick* and *Æthiopick-Oceans*; besides that the greatest part thereof is wholly unknown to us; I thought it unnecessary to lengthen the *Mapp* therewith.

In the foregoing History are contained several Problems, that Merit well the Consideration of our acutest Naturalists, both by reason of the constancy of the effect, and of the immense extent thereof; near half the Surface of the Globe being concerned; wherein if I am not able to account for all particulars, yet 'tis hoped the thoughts I have spent thereon, will not be judged wholly lost by the Curious in Natural Inquiries.

1. *Wind* is most properly defined to be the Stream or Current of the Air; and where such Current is Perpetual and Fixt in its Course, 'tis necessary that it proceed from a Permanent unintermitting Cause, capable of producing a like Constant Effect, and agreeable to the known properties of the Elements of *Air* and *Water*, and the Laws of the Motion of Fluid Bodies. Such an one is, I conceive, the Action of the Sun's Beams upon the *Air* and *Water*, as he passes every day over the *Oceans*, considered together with the Nature of the Soil and Situation of the adjoining *Continents*. I say therefore, *First*, That according to the Laws of *Statics*, the Air which is less Rarified or expanded by Heat, and consequently more Ponderous, must have a Motion towards those parts thereof which are more Rarified, and less Ponderous, to bring it to an *Equilibrium*; and, *Secondly*, That the presence of the Sun continually shifting to the Westwards, that part towards which the Air tends, by reason of the Rarefaction made by his greatest Meridian Heat, is with him carried Westward, and consequently the tendency of the whole Body of the lower Air is that way. Thus a *General Easterly Wind* is formed, which being Impressed upon all the Air of a vast Ocean, the parts impel one the other, and so keep moving till the next return of the Sun, whereby so much of the Motion as was lost, is again restor'd, and thus the Easterly Wind is made *Perpetual*.

2. From the same Principle it follows, that this Easterly Wind should on the North side of the *Equator*, be to the Northwards of the East, and in *South Latitudes* to the South thereof; for near the *Line*, the Air is much more Rarified, than at a greater distance from it; because of the Sun's being twice in a Year Vertical, and at no time distant above 23 *deg.* and a half, at which distance the Heat, being as the Sine of the Angle of Incidence, is but little short of that of the Perpendicular Ray. Whereas under the *Tropicks*, though the Sun stay long Vertical, yet he is as long 47 *deg.* off; which is a kind of Winter, wherein the Air so Cools, as that the Summer Heat cannot Warm it to the same degree with that under the *Equator*, wherefore the Air to the Northwards and Southwards, being less Rarified than that in the Middle, it follows, that from both sides it ought to tend towards the *Equator*. This Motion compounded with the former Easterly Wind, Answers all the *Phænomena* of the *General Trade-Winds*; which if the whole Surface of the Globe were Sea, would undoubtedly blow all round the world, as they are found to do in the *Atlantick* and *Æthiopick Oceans*.

3. But seeing that so great *Continents* do interpose and break the Continuity of the *Oceans*, regard must be had to the Nature of the Soil and the Position

of the High Mountains, which I suppose the two Principal Causes of the several *Variations* of the *Winds*, from the former General Rule: for if a Country lying near the Sun prove to be Flat, Sandy, Low Land, such as the *Deserts* of *Lybia* are usually reported to be, the Heat occasioned by the Reflection of the Sun's Beams, and the Retention thereof in the Sand, is incredible to those that have not felt it; whereby the Air being exceedingly Rarified, it is necessary that the Cooler and more Dense Air should run thitherwards to restore the *Equilibrium*. This I take to be the Cause, why near the Coast of *Guinea* the Wind always sets in upon the Land, blowing Westerly instead of Easterly, there being sufficient Reason to believe, that the Inland Parts of *Africa* are prodigiously Hot, since the Northern Borders thereof were so Intemperate, as to give the Antients Cause to conclude, that all beyond the *Tropick* was made *Uninhabitable* by excess of Heat. From the same cause it happens, that there are so constant *Calms* in that part of the Ocean, called the *Rains*, (described in the 7th Remark on the *Atlantick Sea*;) For this Tract being placed in the middle, between the Westerly Winds blowing on the Coast of *Guinea*, and the Easterly *Trade-Winds* blowing to the Westwards thereof, the tendency of the Air here, is indifferent to either, and so stands in *Equilibrio* between both; and the Weight of the incumbent *Atmosphere* being diminished by the continual contrary Winds blowing from hence, is the reason that the Air here holds not the copious Vapour it receives, but lets it fall into so frequent *Rains*.

4. But as the Cool and Dense Air, by reason of its greater Gravity, presses upon the Hot and Rarified, 'tis demonstrative that this latter must Ascend in a continued stream as fast as it Rarifies, and that being Ascended it must disperse it self to preserve the *Equilibrium*; that is, by a *contrary Current*, the upper Air must move from those parts where the greatest Heat is: So by a kind of Circulation, the *N. E. Trade-Wind* below, will be attended with a *S. W.* above, and the *S. E.* with a *N. W.* Wind above. And that this is more than a bare conjecture, the almost instantaneous Change of the Wind to the opposite Point, which is frequently found in passing the Limits of the *Trade-Winds*, seems to assure us; but that which above all confirms this *Hypothesis* is the *Phænomenon* of the *Monsoons*, by this means most easily Solved, and without it hardly explicable. Supposing therefore such a Circulation as above, 'tis to be considered that to the Northward of the *Indian Ocean* there is every where Land within the usual Limit of the *Latitude* of 30. *viz.* *Arabia, Persia, India, &c.* which for the same reason as the Mediterranean Parts of *Africa* are subject to Unsufferable Heats when the Sun is to the North, passing nearly Vertical; but yet are Temperate enough when the Sun is removed towards the other *Tropick*; because of a Ridge of Mountains at some distance within the Land, said to be frequently in Winter covered with Snow, over which the Air, as it passes, must needs be much chilled. Hence it comes to pass, that the Air coming, according to the General Rule, out of the *N. E.* in the *Indian Seas*, is sometimes Hotter sometimes Colder than that which by this Circulation is returned out of the *S. W.* and by consequence, sometimes the under *Current* or *Wind* is from the *N. E.* sometimes from the *S. W.* That this has

no other Cause, is clear from the times wherein these Winds set in: *viz.* in *April*, when the Sun begins to warm those Countries to the North, the *S. W.* *Monsoon* begins, and blows during the Heats till *October*, when the Sun being retired, and all things growing Cooler Northward, and the Heat increasing to the South, the *N. E.* Winds enter and blow all the Winter till *April* again.

5. And it is undoubtedly from the same Principle that to the Southwards of the *Equator*, in part of the *Indian Ocean*, the *N. W.* Winds succeed the *S. E.* when the Sun draws near the *Tropick of Capricorn*. But I must confess, that in this latter occurs a difficulty, not well to be accounted for, which is, why this Change of the *Monsoons* should be any more in this *Ocean*, than in the same *Latitudes* in the *Aethiopic*, where there is nothing more certain than a *S. E.* Wind all the Year.

6. 'Tis likewise very hard to conceive, why the Limits of the *Trade-Wind* should be fixt about the 30th *Deg.* of *Latitude* all round the Globe; and that they should so seldom transgress or fall short of those Bounds; as also that in the *Indian Sea*, only the Northern part should be Subject to the changeable *Monsoons*, and in the Southern there be a constant *S. E.*

These are particulars that merit to be considered more at large, and furnish a sufficient Subject for a just Volume.

XXXVII. Mr. *Henshaw* has Observed, That *Dew* newly gathered, and Filtred through a clean Linnen Cloth, though it be not very Clear, is of a Yellowish Colour, somewhat approaching to that of *Urine*.

Observations
upon May-Dew;
by Mr. Thomas
Henshaw. n. 3.
p. 33.

That having endeavour'd to Putrify it, by putting several proportions into *Glass-Bodies* with *Blind-Heads*, and setting them in several Heats, as of *Dung*, and gentle Baths, he quite failed of his intention: for Heat, though never so gentle, did rather Clarify and preserve it Sweet, though continued for two Months together; than cause any Putrefaction or separation of parts.

That Exposing of it to the Sun for a whole Summer in *Glasses* that holds about 2 Gallons, with narrow Mouths that might be stopped with *Cork*, the only considerable Alteration, he Observed to be produced in it, was that store of *Green stuff* (such as is seen in Summer in *Ditches* and standing Waters) floated on the Top, and in some places grew to the sides of the *Glass*.

That putting 4 or 5 Gallons of it into a *Half-Tub*, as they call it, of *Wood*, and straining a *Canvas* over it to keep out *Dust* and *Insects*, and letting it stand in some shady Room for 3 Weeks or a Month, it did of it self Putrify and Stink exceedingly, and let fall to the Bottom a black *Sediment* like *Mudd*.

That coming often to see what Alterations appeared in the Putrefaction, He Observed, that at the beginning, within 24. Hours, a Slimy Film floated on the top of the Water, which after a while falling to the Bottom there came another such Film in its Place.

That if *Dew* were put into a long narrow Vessel of *Glass*, such as formerly were used for *Receivers* in distilling of *Aqua-Fortis*, the slime would Rise to that Height, that he could take it off with a *Spoon*; and when he had put a pretty Quantity

Quantity of it into a Drinking Glass, and that it had stood all Night and the Water drained from it, if he had turned it out on his Hand, it would stand upright in Figure of the Glass, in substance like boyled white starch, though somewhat more transparent, if his Memory (*saith he*) fail him not.

That having once gotten a pretty Quantity of this Gelly, and put it into a Glass-Body and Blind-Head, he set it into a gentle Bath, with an Intention to have Putrified it, but after a few Days he found the Head had not been well Luted on, and that some Moisture exhaling the Gelly was grown almost Dry, and a large *Mushroom* was grown out of it within the Glass; It was of a loose watrish Contexture, such an one as he had seen growing out of Rotten Wood.

That having several Tubs with good Quantity of *Dew* in them, set to Putrify in the Manner abovesaid, and coming to pour out of one of them to make use of it, He found in the Water a great Bunch, bigger than his fist, of those Insects commonly called *Hog-Lice* or *Millepedes*, tangled together by their long Tails, one of which came out of every one of their Bodies about the bigness of a Horse Hair. The Insects did all Live and Move after they were taken out.

That emptying another Tub, whereon the Sun it seems had used sometimes to shine, and finding upon the Straining it through a clean Linnen Cloath two or three Spoonfuls of Green stuff, though not so thick nor so Green as that above mentioned found in the Glasses purposely exposed to the Sun, he put this Green stuff in a Glass and tyed a Paper over it, and coming some Days after to view it, he found the Glass almost filled with an innumerable Company of small *Flies*, almost all Wings, such as are usually seen in great Swarms in the Air in Summer Evenings.

That setting about a Gallon of this *Dew* (which, he saith, if he misremember not, had been first Putrified and Strained) in an open Jarre-Glass with a wide Mouth, and leaving it for many Weeks standing in a South-window on which the Sun lay very much, but the Casements were kept close shut; after some time coming to take Account of his *Dew*, he found it very full of little *Insects* with great Heads and small Tapering Bodies, somewhat resembling *Tadpoles*, but very much less. These, on his approach to the Glass, would sink down to the Bottom, as it were to hide themselves, and upon his retreat wriggle themselves up to the Top of the Water again. Leaving it thus for some time longer, He afterwards found the Room very full of *Gnats*, though the Door and Windows were kept shut. He adds, that he did not at first suspect, that those *Gnats* had any Relation to the *Dew*, but after finding the *Gnats* to be multiplied and the little watry Animals to be much lessened in quantity, and finding great Numbers of their empty skins floating on the Face of his *Dew*, He thought he had just Reason to perswade himself that the *Gnats* were, by a second Birth, produced of those little Animals.

That vapouring away great quantities of his Putrified *Dew* in Glass Basons, and other Earthen Glased Vessels, he did at last obtain, as he remembers, above two Pound of Grayish Earth, which when he had washed with more of the same *Dew* out of all his Basons into one, and vapoured to Siccity, lay in
Leaves

Leaves one above another, not unlike to some kind of Brown Paper, but very Friable.

That taking this Earth out, and after he had well ground it on a Marble, and given it a smart Fire in a coated *Retort* of Glass, it soon Melted and became a Cake in the bottom when it was Cold, and looked as if it had been Salt and Brimstone in a certain Proportion Melted together; but, as he remembers, was not at all *inflamable*. This ground again on a Marble, he saith, did turn Spring Water of a Reddish Purple Colour.

That by often Calcining and Filtring this Earth, he did at last extract 2 Ounces of a fine small White Salt, which looked on through a good *Microscope*, seemed to have Sides and Angles in the same Number and Figure, as *Roch-Petre*.

XXXVIII. 1. We had of late, in the County of *Limerick* and *Tipperary*, Showers of a sort of Matter like Butter or Grease: If one rub it upon one's hand it will Melt, but lay it by the Fire and it Dries and grows Hard, having a very stinking smell. Some of it fell here at *Kilkenny*, Nov. 14. 1695. which I did see my self the next Morning.

A kind of Dew like Butter, in Ireland; by Mr. Rob. Vans, n. 220. p. 223.

2. Having very diligently enquired concerning a very odd Phænomenon, which was observed in many parts of *Munster* and *Leinster*, the best account I can collect thereof, is as follows: For a good part of the Winter 1695. and Spring following, there fell in several Places a kind of Thick Dew, which the Country People call'd Butter, from the Consistency and Colour of it, being Soft, Clammy, and of a Dark Yellow; it fell always in the Night, and chiefly in Moorish Low Grounds, on the top of the Grass, and often on the Thatch of Cabbins; 'twas seldom observ'd in the same Places twice; it commonly lay on the Earth for near a Fortnight without changing its Colour, but then Dried and turned Black, Cattle fed in the Fields where it lay indifferently as in other Fields. It fell in Lumps, often as big as the end of ones Finger, very thin and scatteringly; it had a strong Ill Scent, somewhat like the smell of Church-yards or Graves: And indeed we had during most of that Season very stinking Fogs, some Sediment of which might possibly occasion this stinking Dew, tho' I will by no means pretend to offer that a Reason of it. I cannot find that it was kept long, or that it bred any *Worms* or *Insects*: yet the Superstitious Country People, who had Scal'd or Sore Heads, rubb'd them with this Substance, and said it Healed them.

By the Bishop of Cloyne. ib.

XXXIX. Dec. 6. 1631. Being in the *Gulf* of *Volo* riding at Anchor, about 10 of the Clock that Night, it began to rain Sand or Ashes, and continued till two of the Clock the next Morning. It was about two Inches thick on the Deck; so that we cast it overboard with Shovels, as we did Snow the Day before. There was no Wind stirring when these Ashes fell; it did not fall only in the places where we were, but likewise in other Parts, as Ships were coming from *St. John D'Acree* to our Port; they being at that time 100 Leagues from us. We compared the Ashes together, and found them both one.

A Shower of Ashes, in the Archipelago; by Capt. Will. Badily, n. 21. p. 377.

N B. This Shower of Ashes was upon an *Eruption* of Mount *Vesuvius*.

A Shower of Ivy-Berries Mistaken for Wheat; by Mr. Will. Cole. n. 188. p. 281.

X L. This City of *Bristol* and the Country round, is filled with reports of Raining *Wheat* about *Warminster* in *Wiltshire*, and other places within 6 or 8 Miles of it, and many believe it. I have procured several parcels of it, and find it to be the Seed of *Ivy-Berries*, which from Towers, and Churches, Chimneys, Walls and high Buildings, were lately by very fierce Tempests of Wind and Hail driven away from the Holes, Chinks, and other parts, where Birds had brought them, especially *Sterlings* and *Choughs*. It was (among many other Prodigious Stories) confidently affirmed, that those Grains were found in the Hail, as Seeds in Comfits. I have by all ways I can imagine examined and compared them with the Seeds of *Ivy-Berries*, by the Taste, Smell, Size; and Figure; with the Assistance of *Magnifying Glasses*, viewing them in both the superficial and inward parts.

A Shower of Fishes, in Kent; by Dr. Rob. Conny. n. 243. p. 289.

X L I. On *Wednesday* before *Easter. An. 1696.* a Pasture Field at *Cranstead* near *Wrotham* in *Kent*, about two Acres, which is far from any part of the Sea or Branch of it, and a Place where are no Fish-Ponds, but a scarcity of Water, was all over spread with little *Fishes*, conceived to be Rained down, there having been at that time a great Tempest of Thunder and Rain. The *Fishes* were about the length of a Man's little Finger, and judged by all that saw them to be young *Whitings*, many of them were taken up and shewed to several Persons. The Field belonged to one *Ware* a Yeoman, who shew'd some of them, among others, to Mr. *Lake* a *Bencher* of the *Middle-Temple*, who had one of them and brought it to *London*. The Truth of it was averr'd by many that saw the *Fishes* lye scattered all over that Field, and none in the other Fields thereto adjoining. The Quantity of them was estimated to be about a Bushel, being all together.

I had this Account from a worthy Gentleman of this Country, who had a Box full of the *Fishes*.

Hail-Stones of an Extraordinary bigness; by Dr. Nath. Fairfax. n. 26. p. 481.

X L II. *July 17. 1666.* About 10 in the Forenoon, there fell a violent Storm of *Hail* upon the Coast-Towns of *Suffolk*, tracing along *Seckford-Hall*, *Wood-bridge*, *Snape-bridge*, *Aldborough*, &c. more to the North-ward. The *Hail* was small near *Yarmouth*; but at *Seckford-Hall*, one *Hail-Stone* was found by measure to be 9 Inches about. One of this Town (*viz. Wood-bridge*) found one at *Melton*, 8 Inches about. At *Snape-bridge* a Man affirmed, that he lighted on one about 12 Inches about. A Lady of *Friston-Hall*, putting one of them into a Ballance, found it Weigh 12 s. and 6 d. Several Persons of good Credit in *Aldborough* affirmed some *Hail-Stones* to have been full as big as *Turkeys Eggs*; (an ordinary Hen's Egg weighs but about 9 s.) *J. Baker* of *Rumborough*, had his Head broken by the Knocks of them through a stiff Country Felt; in some places his Head bled, in others bunneys arose: The Horses were so pelted that they hurried away his Cart beyond all command. They seemed all White, Smooth without, Shining within. 'Tis somewhat strange, methinks, that their Pillar of Air should keep them aloft, if they were not clapt together in

in the Falling; especially at such a time of the Year, when the Air is less Thickned, and its Spring Weaker.

XLIII. In *May* 1686. There fell at *Lisle* in *Flanders*, Hail of so great a bigness, that the least exceeded Pidgeon's Eggs. Several of them were a quarter of a Pound weight and more. One among the rest was observed to contain a dark Brown matter in the Middle thereof; and being thrown into the Fire, it gave a very great Report. Others were Transparent, which Melted before the Fire immediately. This Storm passed over the Cittadel and Town, and left not a whole Glass in the Windows on the Windward side. The Trees were broken, and some Beat down; and the *Partridges* and *Hares* kill'd in abundance.

Large Hailstones, in *Flanders*; by n. 203. p. 858.

XLIV. 1. A very Extraordinary Hail fell in these Parts *Apr.* 29. 1697. The Vapour that disposed the Aqueous parts thus to Congeal, came with a South West Wind out of *Carnarvan-shire*, passing near *Snowdon* with a horrid black Cloud, attended with frequent *Lightnings* and *Thunder*. As yet I hear no further of it Westward than out of *Denbigh-shire*, where it left *St Asaph* to the Right, and did much damage between it and the Sea, breaking all the Windows on the Weather-side, and killing Poultry and Lambs, and at *Sr. John Conway's* at *Desert*, a stout Dog; and in the North part of *Flint-shire* several People had their Heads broke, and were grievously Bruised in their Bodies. From *Flint-shire* it crossed over the Arm of the Sea that comes up to *Chester*, and was only felt in *Cheshire*, at the very N. W. Corner of the Peninsula, call'd *Wirall*, between the *Aestuaria* of *Chester* and *Liverpoole*, at a Town called *W. Kirkby*, where it Hailed but for three Minutes, it being on the extream Point thereof, on the Right Hand, but it Thundred dreadfully, and was here at *Chester* about 3 in the Afternoon; but the main Body of it fell upon *Lancashire*, in a right Line from *Ormskirk* to *Blackborn*, which is on the Borders of *York-shire*; but whether it crossed the Ridge of Hills into *Yorkshire*, we know not. The Breadth of the Cloud was about 2 Miles; within which Compass it did incredible Damage, Killing all sorts of Fowl and small Creatures; and scarce leaving any whole Panes in any of the Windows where it passed; but which is worse, it plowed up the Earth, and cut off the Blade of the Green Corn so as utterly to destroy it, the Hailstones burying themselves in the Ground; and the Bowling Greens, where the Earth was any thing soft, were quite defaced, so as to be rendred unserviceable for a Time. This I had from an Eye Witness, The Hailstones, some of which weighed 5 Ounces, were of differing Forms, some Round, some half Round, some Smooth, others Embossed and Crenulated, like the Foot of a Drinking Glass, the Ice very Transparent and Hard, but a Snowy Kernel was in the midst of most of them, if not all; the Force of their Fall argued them to fall from a great Height. What I take to be most Extraordinary in this Phænomenon is, that such a sort of Vapours should continue undisperst for so long a Tract, as above 60 Miles together, and in all the way of its Passage occasion so Extraor-

Extraordinary Hail in *Wales*, *Cheshire*, &c. by *Mr. Edm. Halley*. n. 229. p. 570.

dinary a *Coagulation* and *Congelation* of the Watry Clouds, as to encrease the *Hailstones* to so vast a Bulk in so short a Space as that of their Fall.

By -----ib.
p. 572,

2. We had only the extream Skirt of the Shower here, and there Fell not above 100 *Hailstones* in our Court, but they were much Larger and Harder than the Oldest of us had seen. A Gentlewoman found one of them by Measure to be about 5 *Inches* about. A little while after the Shower was over, I found the *Stones* had fallen at good Distances one from another, and that they were melting very fast, the Weather being very Hot, scarce any of them was so little as a Musquet Bullet, but most of them far bigger, and of that Figure.

A Servant who was then at *Bootle-Mill*, tells me, That the Sea seemed to be risen to an unwonted Height, and to bear the Appearance of a Wood; That he found *Hailstones* as big as Poot Eggs. And that many Sea-Fowl and Land-Fowl were killed: and as an Instance of it, he took up a *Sea Swallow* on *Bootle Marsh*, whose Wing was broken with an *Icy Pellet* and brought her home. Upon this story, I rid towards the Grounds which had shared most in the *Storm*. When I came to *Bootle*, I saw *Jane Mutche's* Windows ill battered; I found the *Storm* had been as Violent at *Linaker*, I saw what Breaches it had made upon *Will Halsal's* Barns, what Boughs it had broke off from his Apple-Trees, and what Wounds the *Hailstones* had made in the Green Brow by his House. I measured several of the Holes and found them generally an Inch deep, and some an Inch and a half. *Will Halsal* told me, that the great *Stones* fell so violently into the Marl Pit besides his House, that Spouts of Water rose a Yard and a half high. This unriddled my Man's Story, that the Sea appeared like a Wood. *Dr. Tarleton* took up *Hailstones* as big as Duck-Eggs upon *Aughton Common*: And *Mr. Shepherd* professes that the Church-Yard at *Sephton* seem'd as strew'd with Duck-Eggs; and that one of them was weigh'd, which amounted to full half a pound; two *Hailstones* were weigh'd at *Ormskirk* which came to $\frac{3}{4}$ of a Pound a piece. At *Ince* the *Stones* were part as big as Duck and part as Goose-Eggs.

I sent some People the next Morning early to the Sea-side, and they brought in seven sorts of Fowls, as *Curlew*, *Sea Pye*, *Sea Swallow*, *Gorre*, and other we want Names for: and we hear that at the little Towns next the Sea they were picked up by Bushels.

No *Hail* fell at *Everton*, *Lowbill*, or *Leverpool*, the *Storm* ending near *Walton*, but there was so thick a Darknes before the *Storm*, that in *Leverpool* many People ran out of their Houses into the Street to look at the Face of the Sky; and it was marvellous Dark here. The Neighbours tell doleful Stories of the Effects of this Hail; As a Young Woman at *Bootle* was running for Shelter her Hat fell off, and a *Hailstone*, that hit her behind the Ear, made her Tumble; a man was knockt off his Horse by the *Hail*, but presently got up again; Another having pulled down his Hat to save his Face, a *Stone* fell which tore the Brim from the Crown, so far that he could put his hand through the Hole; at *Ormskirk* 4 Pounds Damage was done to one Inn, and the Glass broke by the *Storm* in the whole Town could not be repaired for 60 l. the *Stones* there rebounded, many of them, two Yards high; at *Ince* two Horses were

were knockt down in the Plough, and a Man fell at the same time ; at *Crosby* some Beasts were knock'd down ; One *Jo. Holland* was found dead in *Skirmsdale* after the *Shower*, but whether by the *Hail* or *Lightning* (for it came with *Thunder* and *Lightning*) I have not yet heard ; Two Women were so beaten by it, in a little while before they got covert, that they could hardly turn them in their Beds next Morning ; They could hardly pass the Lanes for Baskets, Panniers, Sacks, and People, which the Horses had thrown down in their return from *Ormskirk-Market*.

XLV. On *Tuesday, May. 4. 1697.* (at *Hitchin* in *Hartfordshire*) about 9 a Clock in the Morning, it began to *Lighten* and *Thunder* extreamly, some great Showers intervening ; it continued till about two of the Clock in the Afternoon, when on a sudden a Black Cloud arose *S. W.* of us, the Wind being East and blew hard : then fell a sharp Shower, with some *Hailstones*. I measured some of them 7 and 8 Inches about : but the extremity of the *Storm* fell about *Offley*, where a Young Fellow was killed, one of his Eyes stuck out of his Head, his Body was all over Black with the Bruises ; another Person nearer to *Offley* escaped with his Life, but much Bruised ; there was in the House of *Sir Jo. Spencer*, 7000 Quarries of Glass broke, and there was great Damage done to all the Neighbouring Houses thereabouts ; the *Hail* fell in such vast Quantities, and so great, that it tore up the Ground, split great Oaks and other Trees in great Numbers ; it cut down great Fields of Rye, as with a Scyth, and has destroyed several Hundred Acres of Wheat, Barley, &c. in so much that they Plough it up, and sow it with Oates. The *Tempest* was such when it fell, that in 4 Poles of Land, from the Hills near us, it carried away all the Staple of the Land, leaving nothing but Chalk ; the *Hail* broke vast Numbers of Pidgeons Wings, Crows, Rooks and other Birds ; the Flood came down, spreading 4 or 5 Acres of Land, rowling like the *Bay of Biscay* ; and which is very strange, all this fell in the Compass of one *English Mile*. I was walking in my Garden, which is very small, perhaps about 30 Yards square, and before I could get out, it took me to my Knees, and was through my House before I could get in, which I can modestly speak was in the space of a Minute, and went through all like a Sea, carrying all Wooden things like Boats on the Water, the greatest part of the Town being under this Misfortune ; the Surprize was so great, that we had scarce time enough to save our Children and Wives. There fell some Hundred thousand Cart Loads : I saw them 4 days after ; and if the Beds of *Hail* had not been broke by People's coming, and trampling of Horses, it might have lain till *Michaelmas*. They have been measured from one to Thirteen and Fourteen Inches certain : Some People talk largely of it, Seventeen and Eighteen Inches ; but the other is certain Truth. The Figures of them are various, some Oval, others Round, others Picked, some Flat. We were not so curious to weigh them. The Damage about us and in our Town, is near 4000 *l.*

A Storm of Hail in Hartfordshire, May. 4. 1697 ; by Mr. Rob. Taylor. ib. p. 577.

XLVI. 1. In the Parish of *Westhide*, not far from *Hereford*, there fell on the 6 of *June 1697.* so great a Quantity of *Hail*, that it destroyed all the Poultry, Garden-stuff, Corn, Grats, and most of the Fruit-Trees in the Parish,

A Storm of Hail in Herefordshire, June. 6. 1697 ; by . . . ib. 579.

but killed no Men nor Cattle; but hurt several, and broke most of the Windows. Many of the *Stones* were measured above 9 Inches in Compass.

By Mr. Ed.
Lhwyd. *ib.*

2. We had at *Ponty Pool* in *Monmouthshire*, Jun. 6. 1697. an Extraordinary Shower of *Hail*, which extended about a *Mile*, and lasted near Half an Hour. It broke the Stalks of all the Beans and Wheat within that Circumference, and Ruined as much Glass at Major *Hanbury's* House, as cost 4 Pounds repairing; some of the *Hail* were 8 Inches about, their Figure very Irregular and unconstant, several of the *Hail-stones* being Compounded.

An Unusual sort
of Snow; By
M. Joh. Chr.
Beckman.
n. 39. p. 773.

XLVII. The first of *March* (1667) there fell an unusual sort of *Snow* at *Franckfort* in the *Oder*. It had none of the ordinary *Figures*, but was made up of little Pillars, whereof some were *Tetragonal*, some *Hexagonal*, with a neat *Basis*. On the Top they were somewhat larger, as the *Heads* of *Columns* are. Considering the whole Shape, we thought fit to give it the name of *Nix Columnaris*.

Red Snow near
Genoa; Com-
municated by
Sig. Sarotti.
n. 139. p. 976.

XLVIII. On St. *Joseph's* Day, upon the Mountains called *Le Langhe*, there fell upon the *White-Snow*, that was there already, a great quantity of *Red*, or if you please of *Bloody-Snow*; From which, being squeezed, there came a Water of the same Colour.

Observations on
Snow; by Dr.
Jo. Beale n. 56.
p. 1138.

XLIX. I have seen the Water of dissolved *Snow* perform a quick Cure, in taking out the Fire when the *Flesh* was Burnt by a Warming-Pan of Brass; which Metal commonly makes the Burning more difficult to be cured: Which did put me in mind, to examine the *Figures* of the *Snow*, which now fell in this extreme *Frost*. I expected, that we might see through the small Particles, at least as through Lice, Fleas, Cheese-mites, &c. By some kind of Transparency: But I was deceived; my Assistants could make nothing of it, either by an ordinary or extraordinary *Microscope*.

The Nature of
Snow; by Dr.
Nehemiah
Grew. n. 92.
p. 5193.

L. He that will enquire of the Nature of *Snow*, will do it best, not by the pursuit of his Phancy in a Chair, but with his Eyes abroad; where if we use them well fixed, and with good Caution, and this in a Thin, Calm, and Still *Snow*, we may by Degrees observe;

1. With M. *Des Cartes*, and Mr. *Hook*, that many parts hereof are of a Regular Figure; for the most part, as it were, so many little Rowels, or Stars, of 6 Points; being perfect and transparent *Ice*, as any we see upon a Pool or Vessel of Water. Upon each of these 6 Points, are set other Collateral Points; and those always at the same Angles as are the main Points themselves.

2. Amongst these Regular Figures, many others alike Regular, but far less, may likewise be discovered.

3. Looking still more warily we shall perceive, that there are divers others, indeed Irregular, yet chiefly but the Broken Points, Parcels and Fragments of the Regular ones.

Lastly, That, besides the Broken parts, there are some others, which seem

to have lost their Regularity, not so much in being Broken, as by various Winds, first gently Thaw'd, and then Froze into little Irregular Clumpers again.

From whence the true Notion and External Nature of *Snow* seemeth to appear, *viz.* That not only some few parts of *Snow*, but Originally the whole Body of it, or of a *Snowy* Cloud, is an infinite Mass of *Icicles* Regularly Figur'd; not one particle thereof, I say, Originally, not one of so many Millions, being Indeterminate or Irregular: That is to say, a Cloud of Vapours being gathered into Drops, the said Drops forthwith descend; upon which Descent, meeting with a soft Freezing Wind, or at least passing through a Colder Region of the Air, each Drop is immediately Froze into an *Icicle*, shooting it self forth into several Points or *Striæ* on each hand from-ward its Center: But still continuing their Descent, and meeting with some sprinkling and intermixed Gales of Warmer Air, or in their continual Motion, and Wastage to and fro touching upon each other, some are a little Thaw'd, Blunted, Frosted, Clumper'd, others Broken, but the most Hanked and clung in several parcels together, which we call *Flakes* of *Snow*.

Hence we understand why *Snow*, though it seems to be Soft, yet 'tis truly Hard, because true *Ice*; the inseparable property whereof is, to be Hard; seeming only to be Soft, because upon the first touch of the Finger upon any of its Sharp Edges or Points, they instantly Thaw, or otherwise they would Pierce our Fingers as so many Lancets.

Why again, though it be true *Ice*, and so a Hard and Dense Body, yet very Light; because of the extream Thinness of each *Icicle* in comparison of its breadth. For so Gold, which though of all Bodies the most ponderous, yet being beaten into Leaves, rides upon the least breath of Air.

Also how it is White; because consistent of parts all of them singly Transparent, but being mixed together, appear White; as the parts of Froth, Glass, Ice, and other Transparent Bodies, whether Soft or Hard.

The *Essential Nature* of *Snow*, I think may be best understood, by comparing its general Figure with such Regular Figures as we see in divers other Bodies; in that, where we see the like Configurations, we may believe there is the like *Subject* wherein, or the like *Efficient* whereby, both those and these are made.

As for the *Figure* of *Snow*, 'tis generally one, *viz.* That which is above described: Rarely of Different ones, which may be reduced chiefly to two generals, Circulars and Hexagonals, either Simple or Compounded together: more rarely, either to be seen of more than 6 Points; but if so, then not of 8 or 10, but 12; Or in single Shoots, as so many short slender Cylinders like those of *Nitre*: Or by one of these Shoots, as the Axle-tree, and touching upon the Center of a Pair of Pointed *Icicles*, joyned together as the two Wheels: Or the same Hexagonal Figure, and of the same usual Breadth, but continued in thickness or profundity, like the Stone, which, as I remember, *Boetius* calls *Astroites*. All these I say are Rare; the first Described being the General *Figure*.

As for the *Configurations* of other Bodies, we shall find, that there are divers
which

which have some a less, others a more near resemblance hereunto. *Nitre* is formed, as is commonly known, into long Cylindrical Shoots, as also all *Lixivial Salts*, for the most part; resembling, though not perfectly, the several Points of each Starry *Icicle of Snow*. *Salt of Harts-Horn, Sal-Armoniac*, and some other *Volatile Salts*, besides their Main and longer Shoots, have others Shorter Branched out from them; resembling as those the Main, so these the Collateral Points of Snow. But the *Icicles of Urine* are still more near: For, in *Salt of Harts-Horn*, although the Collateral Shoots stand at Acute Angles with the Main, yet not by Pairs at Equal Height; and in *Sal-Armoniac*, although they stand Diametrically opposite, or at Equal Height, yet with all at Right, not Acute Angles; Whereas in the *Icicles of Urine* they stand at Equal Height, and at Acute Angles both: In both, like those of *Snow*. And it is observable, that the *Configuration of Feathers* is likewise the same: the Reason whereof is, because Fowls having no Organs for the Evacuation of *Urine*, the *Urinous* Parts of their Blood are Evacuated by the Habit or Skin, where they produce and nourish *Feathers*.

From hence it should seem, That every Drop of Rain aforesaid, containing in it self some *Spirituos* Particles (as from the Height to which they are advanced, the Prolifque Virtue of *Rain*, and its easy tendency to Putrefaction above other Water, is argued they do,) and meeting with others in their Descent of a *Saline*, and that partly *Nitrous*, but chiefly *Urinous*, or of an *Acidosalinous* Nature, the said *Spirituos* Parts are apprehended by them, and with those the Watry, and so the whole Drop is fixed: yet not into any indifferent and Irregular shape, depriving the *Spirituos* parts of their Motion in an instant; but according to the *Energy* of the *Spirituos* as the Pencil, and the specific Nature or determinate possibility of the *Saline* parts as the Ruler, 'tis thus Figured into a little *Star*.

A Freezing
Rain in Somers-
setshire; by Dr.
J. Beal. n. 90.
p. 5138.

LI. 1. The *Freezing Rain*, which fell here the 9th, 10th, or 11th of *December* 1672, (for I cannot confine the time exactly) hath made such a Destruction of Trees, in all the Villages and High-Ways from *Bristol* toward *Wells*, and towards *Shepton-Mallet*, and towards *Bath* and *Bruton*, and in other places of the *West*, that both for the manner and Matter it may seem incredible; and is more strange than I have found in any *English* Chronicle. You have the Proof and manner and best Measure of it in the following Transcript. "The late Prodigious Frost (saith a very worthy Person of unquestionable Credit) hath much disabled many old Orchards, exposed to the North-East; Had it concluded with some Gusts of Wind, it might have been of sad importance; I weighed the Sprigg of an Ash-Tree of just three quarters of a pound, which was brought to my Table; the Ice on it weighed 16 pounds, besides what was melted off by the hands of them that brought it. A very small Bent at the same time was produced, which had an *Icicle*, encompassing it, of 5 Inches round by measure. Yet all this while, when Trees and Hedges were loaden with Ice, there was no Ice to be seen on our Rivers, nor so much as on our standing Pools. The like, or worse and more strange com-

complaints, I received from several other places, and from Eye Witnesses of Credit. Some Travellers were almost lost by the Coldness of the *Freezing Air*, and *Freezing Rain*. All the Trees, Young and Old, on the High-way from *Bristol* to *Shepton*, were so torn and thrown down on both sides the Ways, that they were unpassable. By the like Obstructions the Carriers of *Bruton* were forc't to return back. Some were affrighted with the noise in the Air, till they discerned that it was the clatter of *Icy Boughs*, dashed one against another by the Wind. Some told me that riding on the *Snowy Downs*, they saw this *Freezing Rain* fall upon the *Snow*, and immediately *Freeze* to *Ice*, without sinking at all into the *Snow*; so that the *Snow* was covered with *Ice* all along, and had been dangerous, if the *Ice* had been strong enough to bear them. Others were on their Journey when the *Ice* was able to bear them in some places, and they were in great distress.

Dec. 8. much *Snow* fell here; the 9th much *Rain* fell here; and all the *Snow* passed away, not leaving an *Icicle* amongst us. The 10th Day, we had suddain fits of Cold and relaxing Warmness. On *Wednesday* (Dec. 11.) I saw a Young Man, who returning home from a Journey of 5 Miles, and coming into a Warm room, cryed out of extream Torments in all parts of his Body. He affirmed, that the Air, and the Winds (which were then somewhat high) were so unsufferably Cold, that he was in utter Despair of coming home alive; yet all that day nothing but moist *Dew* fell under our Feet. If we say, the Earth did send forth Warm Steams to keep this *Freezing Rain* dissolved on her Surface; whence shall we say, the Air, and Rain and Winds got these *Freezing Icicles*, which oppressed Men and Plants? When the *Candid Frosts* do cover our Fruit-Trees perfectly white (as I have oftentimes seen it hold for some Weeks together) it is so far from doing hurt to the Trees, that we have it in a Proverb for a good Sign of abundance of Fruit, in the ensuing Year: But this *Freezing Rain*, as soon as it touched any Bough, settled into *Ice*, and by multiplying and enlarging the *Icicles* (especially where it could lay hold on Moss or other asperities of the Tree) it broke all down with the Weight.

This shews that a *Frost* may be very Fierce and Dangerous in the Air, and on the Tops of some Hills and Plains, whilst in many other places it keeps at two, three, or four foot distance above the Ground, Rivers and Lakes; and may wander, at some difference of time, in some places very Furious; in other places intermediate and not far asunder, very Remiss and abated; where it was Fierce always at the height of Trees at least, never on the ground Vehement, that I could hear of, but on *Salisbury Plains*, which are very High Grounds. n. 116. p. 357.

As soon as these *Frosts* were over, we had *Glowing Heats*, which caused a general complaint amongst us of excessive Sweating, by Night and Day. The Bushes and many Flowers in the Garden appeared in such forwardness, as if it were in *April* or *May*. I saw Young Coleworts growing; and not far from my abode, an Apple-Tree Blossomed before *Christmas*. This I do not mention for extraordinary; but I think 'tis more than ordinary, that before *New Years-Tide* this Apple-Tree bore Apples perfectly knitted, and as big as ones Fingers end. n. 90. p. 5140.

At Oxford, by
Dr. Wallis.
n. 92 p. 5196.
n. 231. p. 654.

2. The like strange *Frost* was with us at *Oxford*. It was rather a *Raining of Ice*, or at least *Rain Freezing* as it fell; which made strange *Iceicles* hanging on *Trees*, and a strange *Noise* by the rattling of them upon the *Boughs* motion by the *Wind*: but not so much as at the places you mention in *Somersetshire*. Yet more in the *Country* about us (as from several *Relators* I have heard,) than with us here. And the great *Warmth* soon after was also with us; in so much that not only *Blossoms*, but (as was then certainly affirmed, though I was not so curious as to get a sight of any,) green *Apples* were observ'd on divers *Trees*; particularly in the *Parish* of *Holywell*.

Effects of Cold
in the Northern
Countries; by
M. Joh. Schefferus.
n. 19.
p. 350.

LII. 1. Mr. *Joh. Schefferus*, a Professor in the *Sweedish University* at *Upsal*, writes, That he hath seen and had *Hares*, which about the Beginning of *Winter* and *Spring* were half *White*, and half of their *Native Colour*: that in the midst of *Winter* he never saw any but all *White*. That *Foxes* also are *White* in *Winter*; and *Squirrels* *Grayish*, mixt of a *Dark* and *White Colour*.

That *Fishes* are killed by reason of the *Ice* not being broken: but first, in *Ponds* only or narrow *Lakes*: next, in such *Lakes* only, where the *Ice* is pretty thick; for, where 'tis thin, they Dy not so easily: Lastly that those *Fishes* that lye in *Slimy* or *Clayie Ground* Dy not so soon as others.

That in *Great Lakes*, when 'tis a very bitter *Frost*, *Ice* is wont to be broken, either by the *Force* of the *Waves*, or of the imprisoned *Vapours*, raised by the *Agitation* of the *Water*, and then bursting out with an *Impetuosity*; Witness the noise made by the *Rupture* of the *Ice* through the whole *Length* of such *Lakes*, which he affirms to be not less *Terrible* than if many *Guns* went off together. Whereby it falls out, that *Fishes* are seldom found *Dead* in *Great Lakes*.

That neither *Oil*, nor a strong *Brine* of *Bay-Salt*, is truly congealed into *Ice*, in those *Parts*: That the *Frost* pierces into the *Earth*, two *Cubits* or *Sweedish Ells*; and what *Moisture* is found in it, is *White*, like *Ice*. That *Waters*, if *Standing*, *Freeze* to a greater *Depth*, even to three such *Ells* or more; but those that have a *Current*, less: That *Rapid Waters* *Freeze* not at all; nor ever *Bubbling Springs*; and that these latter seem even to be *Warmer* in *Winter*, than *Summer*.

By M. Fehre. ib.
p. 351.

2. M. *Fehre*, Chief Secretary to Prince *Radzivil*, Assures us, that in the War against the *Muscovites* and *Cossacks* in *Jan. 1655*. at the *Siege* of *Bichow* in *White-Russia*; all their *Provisions* of *Spanish Wines* or *Petersimen*, and *Beer*, were in one *Night Frozen* upon the *Sleds*, notwithstanding they were covered with *Straw*; in so much that they were constrained to carry them into a *Stove*, to Thaw them, which they could not do in two whole *Days*, and were obliged to break the *Vessels*, and put pieces of the *Icy Wine* into *Kettles* to Thaw them over the *Fire*, for *Drink*. But he observed that the *Hungarian Wine* resisted the *Cold* better than the *Petersimen*: for it was not so much *Frozen*; unless it be that the *Butler* transported it sooner into the *Stove*. That the *Scru* of a *Flagon* of *Aqua-vitæ* being put to his *Mouth*, stuck close to his *Lips*, that he could not draw it off without drawing *Blood*. That the *Pool* of the *Village* (where

(where they Quartered) was so thoroughly Frozen, that there was but very little Water left between the Ice and the Bottom.

That Jan. 2. 1665. the Frost was so Bitter in Poland, That 3 Souldiers dyed of it in passing a long Ditch; and that divers Persons lost some of their Limbs.

ib. p. 352.

LIII. i. The past Winter 168 $\frac{3}{4}$. has been so Severe in my Territories, and where it could expugne the more defensible and such as were inclosed, it has Ravag'd all that lay open, and were abroad, without any mercy.

The Effects
of the Frost
168 $\frac{3}{4}$; by
Mr. J. Evelyn.
n. 158. p. 559.

As to *Timber-Trees*; I have not many here of any considerable Age or Stature, except a few *Elms*, which (having been decayed many Years) one cannot well find to have received any fresh Wounds, distinguishable from old Cracks and Hollownesses; and indeed I am told by divers, that *Elms* have not suffered as the great *Oaks* have done; nor do I find amongst innumerable of that Species (*Elms*) which I have Planted, and that are now about 25 and 30 Years standing, any of them Touched: The same I observe of *Limes*, *Walnuts*, *Ash*, *Beach*, *Horn-beams*, *Birch*, *Chestnut*, and other Forresters. But as I said, mine are Young comparatively; and yet one would think, that should less Protect them, because more Tender: so as it seems the Risting so much complain'd of, has happen'd chiefly among the overgrown Trees, especially *Oaks*. My Lord *Weymouth* made his Lamentation to me, and so has the Earl of *Chesterfield*, Lord *Ferrers*, Sir *William Fermor*, and others concerned in the same Calamity; which I mention, because of their distant habitations. But if rightly I remember, one of these Noble Persons lately told me, that since the *Thaw*, the Trees which were exceedingly Split, were come together and closed again, and I easily believed it; but that they are really as Solid as before, I doubt will not appear, when they shall come to be examined by the Axe, and converted to use. Nor has this Accident happen'd only to Standing Timber, but to that which has been Fell'd and Season'd, as Mr. *Shish*, the Master Builder in his Majesty's Ship-Yard here, inform'd me.

As for *Exotics*; I fear my *Cork Trees* will hardly recover. The *Constantinopolitan* or *Horse-Chestnut* is Turgid with Buds, and ready to explain its Leaf. My *Cedars* I think are lost: The *Ilex* and *Scarlet-Oak* not so; The *Arbutus*, doubtful, and so are *Bays*; but some will Escape, and most of them repullulate and Spring afresh, if cut down near the Earth, at the latter end of the Month. The *Scotch-Fir*, *Spruce*, and *White Spanish* (which last uses to suffer in their Tender Buds by the *Spring Frosts*) have received no damage this Winter; I cannot say the same of the *Pine*, which bears the greater Cone, but other *Norways* and *Pinasters* are Fresh. *Laurel* is only discoloured, and some of the woody Branches Mortified, which being cut to the quick will soon put forth again, it being a Succulent Plant. Amongst our *Shrubs*, *Rosemary* is intirely Lost; and so universal (I fear) is the destruction of this excellent Plant (not only over *England*, but our Neighbour Countries more Southward) that we must raise our next hopes from the Seed. *Halimus*, or *Sea-Purflan*, (of which I had a pretty hedge) is also Perished, and so another of *French-Furfses*; The

Cypress are all of them Scorched, and some to Death, especially such as were kept Shorn in Pyramids; but amongst great Numbers, there will divers escape, after they are well *Chastiz'd*, that is with a tough Hazel or other Wand, to beat off their Dead and Dusty Leaves, which growing much closer than other Shrubs, hinder the Air and Dews from refreshing the Interior parts. This Discipline I use to all my *Tonsile Shrubs* with good success, as oft as a Winter parches them. The Berry-bearing *Sarvine* (which if well understood and cultivated were the only best *Succedaneum* to *Cypress*) has not suffered in the least; it perfectly resembles the *Cypress* and grows very Tall and Thick. I think the *Arbor Thuya* is Alive, and so is the *American Acacia*, *Acanthus*, *Paliurus*, *Pomgranate*; my *Laurustinus* looks suspiciously; Some large and old *Alaternus's* are Kill'd, especially such as were more exposed to the Sun, whereas those that grow in the Shade escape; the reason of which I conjecture to be, from the Reciprocations of being somewhat Relaxed every Day, and then made Rigid and Stiff again all Night, which bending and unbending so often, opening and closing the Parts, does exceedingly Mortify them, and all other tender Plants, which growing in shady places undergo but one Thaw and Change. Most of these yet will Revive again at the Root, being cut close to the ground. The *Phillyrea's angusti*, and *Serratifolio's* (both of them incomparably the best for Ornamental Hedges of any the *Perennial Greens* I know) have hardly been sensible of the least Impression, more than Tarnishing of their Leaves, no more have the *Spanish Jasmines*, and *Persian*; and I enumerate these particulars the more minutely, that Gentlemen who are curious, may take notice what Plants they may trust to abroad, in all Events; for I speak only of such as are exposed.

I need say nothing of *Holly*, *Yew*, *Box*, *Juniper*, &c. (Hardy, and spontaneous to our Country) and yet to my Grief I find an *Holly* Standard of near 100 Years old, Drooping and of Doubtful Aspect; and a very beautiful Hedge (tho' indeed much younger) being Clip'd about *Michaelmas*, is Mortified near a foot beneath the Top, and in some places to the very ground; so as there's nothing seems proof against such a *Winter*, which is late Cut, and Expos'd. This Hedge does also grow against the South, and is very Ruffet, whilst the contrary side is as Fresh and Green as ever; and in all other places of my Plantations that are Shaded, the Unshorn *Hollies* maintain their Verdure, and are I judge Impregnable against all Assaults of *Weather*.

Among the *Fruit-Trees*, and *Murals*, none seem to have suffer'd save *Figs*; but they being Cut down, will Spring again at the Root. The *Vines* have escaped; and of the *Esculent Plants* and *Salads* most, except *Artichokes*, which are universally lost; and (what I prefer before any *Salad* whatever Eaten Raw, when young) my *Sampier* is all Rotted to the very Root: How to repair my loss, I know not, for I could never make any of the Seed, which came from the *Rock Sampire* (tho' mine were of the very Kind) to Grow.

The *Arborescent* and other *Sedums*, *Aloes*, &c. (tho' Hous'd) perished with me; but the *Yucca*, and *Opuntia* escaped. *Tulips* many are lost, and so the *Constantinople Narcissus*, and such *Tuberose* as were not kept in the Chimney-Corner where was continual Fire. Some *Anemonies* appear, but I believe many are Rotted: But I have made no great search in the Flowery Parterr,
only

only I find that most Capillaries Spring, and other Humble, and Repent Plants, notwithstanding all this Rigorous Season.

My *Tortoise* (which by his constant burying himself in the Earth at approach of Winter, I look upon as a kind of Plant-Animal) hapning to be obstructed by a *Vine-Root*, from Mining to the Depth he was usually wont to Interr, is found stark Dead, after having many Years escaped the Severest Winters. Of *Fish* I have lost very few; and the *Nightingales* (which for being a short winged Bird, and so exceeding Fat, at the time of the Year, we commonly suppose them to change the Climate, (whereas indeed they are then hardly able to Flee an Hundred Yards) are as Brisk and Frolic as ever, nor do I think they alter their Summer Stations, whatever become of them all Winter.

2. In this Rigid Season nothing seemed more Surprising to us, nor more generally known to be true, than the Cleaving or *Splitting* of Trees; as of the *Elms* by Mr. *Langley's* House the Minister of *Tamworth*; and *Ashes* of considerable Bulk and Value, designed for and capable of diverse uses, as *Wind-Mill-Posts*, *Dresser-boards*, and other necessary occasions. Also *Walnut-Trees* in diverse places have suffered by this Calamity, and proved extreamly *Cleft*; tho' indeed it hath been most frequent among *Oaks*, many of which have been Divided to great Detriment in *England*, some being so Rent that a Man may see through them, and that many times the Cracks came with so great Noise, that as it is related from *Needwood-Forrest* they made such a *Noise*, that the Keepers there thought that the Deer were shot by the People of the Country, and that in several parts they were heard as loud as Guns, some having been cruelly affrighted especially in the Evenings or Nights, as they have passed within the hearing of this so unexpected and surprizing a *Noise*. Which *Rifts* or *Clefts* were not at all to the same Point of the Compass, but sometimes on one side only, sometimes 2, and sometimes 3, and sometimes 4 several places, Dividing or quartering the Tree, and sometimes quite through: And these *Clefts* were not only in the Bodies, but continued into the larger Boughs and Limbs of the Tree, and sometimes Descended into the Superficial Roots, but not to those very deep in the Earth; the *Frost* though extream, not reaching considerably deep, comparatively to the Roots of Trees, and the hard binding of the Earth being so *Frozen*, would not easily admit of compressure: But several shallow Roots so knotted and knurled as not to be wrought upon with Beetle and Wedges, are known to be *Cleft* by the Frost. But it is much to be doubted and suspected whether any such *Cloven* Trees were so perfectly Sound and Faithful Timber, if proved by the Saw and Axe, as they ought to be; for if so, all might equally suffer, the Air having impartial access to one as well as the other, but some being taken with this Disease, and others left untouched, there certainly was some Cause or Defect in those Liable to it, rather than the rest. A great part of the Cause of it is supposed to be Imperfection in such a Tree, and that generally from the too large *Sap-Vessels* and unnatural Cavities therein, which some call *Wind-shaken*, and some *Lagg'd* Trees; the Cause whereof remains yet to be examined, whether the *Shaking* of the Wind may not, with its great Weight and Force, taking the whole Tree

By Mr. Jacob
Bobart. n. 1658
p. 766.

with its Boughs Limbs and Body, having one End firmly fixed in the Earth at some age or other, as well Work Wrack and make Splintering and stretch'd Pores, Passages, Cavities and such like, in a Live and Growing Tree, at sometime of continuance of its force with its oft repeated Beating, Twisting, and Pressing Blasts, as well as the best chosen Mast of a Ship may suffer damage by the same Cause, even to Total Fraction. By some this is supposed to proceed from Earthquakes, but whether or not, is yet to be examined. But the Opinion of some seems not to be extravagant, who think it to be an Original Distemper in the Tree, and to proceed from the *Soil*, or rather an Innate Disease from some tho' undiscernable Imperfection in the *Seed* it self; and yet not so much but that they Live many Years, and Grow to great Bulk and Stature, but are observed to bear lesser Leaves and smaller Acorns; but whether the *Soil* be concerned, may be urged, the Trees about *Oxford* Westward, being generally affected with this Disease, and those from the East side prove excellent Sound Timber, and the *Soils* seeming to resemble one another.

But by what means soever this may come, it is certain that some Trees are much more Sound than other, and that some prove full of Inbred Diseases and Cavities, before they are Cut down, which Cavities and stretch'd Vessels being fill'd with too great a quantity of Aqueous and undigested *Sap*, as it were *Hydropical* (for it is thought that the Genuine and Natural *Sap* of these our Native Trees, though undergoing Condensation, will remain secure and safe as may be supposed from those that are well and firmly standing) are thereby rendred capable of not only Condensation but *Glaciation* also by the continuance and severity of the Airs *Frigefactive* Power; which being sufficiently known to employ more room being *Ice*, than formerly Liquid, might probably Cause these *Breaches*, and if we consider the Expansive Motion and Spring of the Air included in the Cavities of the *Air Vessel*, suffering more Pressure than they are patient of, from the *Coagulated* and Contiguous Aqueous parts then *Congeaed*, may be induced to suppose these *Strepitous* Eruptions to proceed from thence. But whether Mr. *Hobb's* Hypothesis will certainly hold, that the Swelling is caused by the Intrusion of the Air, is somewhat to be doubted.

It need not prove troublesome to any to think the *Ice* to be able to *Tear* the *Oaks* or other Trees, who shall consider the great Force and Elastick Power thereof; whereof that most Excellent and Curious Philosopher of our Age Esquire *Boyle* hath, in his *History of Cold*, set forth several Experiments and Examples, as Vessels of several kinds of Metals being made strong on purpose, and fill'd with Water, close stopp'd and exposed to the *Cold*, which being not capable of withstanding the Expansive Force of the inclosed *Ice*, having been found *Cleft* and Broken; as for instance, the strong Barrel of a Gun close stopped, with Water in it, and *Frozen*, hath proved Kent long ways, and never a cross the Vessel, nor Bodies of the Trees we here mention. Another time a Brass Vessel of a Cylindrical form being made not more than 5 Inches deep and not 2 Diameter, filled with Water and afterwards *Frozen*, in one Night Lifted off the Cover prepar'd and closely fitted, with a Weight of 56 pounds that was laid upon it. *Olearius*, Secretary to the Duke of *Holstein's* Embassy
into

into *Russia*, tells us that in the City of *Mosco* he observed (the *Cold* being very Intense) the Earth to be *Cleft* many Yards in length, and a Foot broad, which according to conjecture was occasioned by the Heaving and Swelling thereof to enlarge its room, as here we see *Ice Crackt* and *Cleft* considerably long and broad according to its thickness along the Ridge or Turgid part thereof. And that the Earth doth so Rise when *Frozen* is easily made manifest by little Sticks or Plants set into the Ground against the approaching Winter, which being Risen 2 or 3 inches or more according to the depth and strength of the *Frost*, and upon the *Thaw* the Earth sinking to its former Station leaves the unfixed Plants with their Roots naked above ground, as it were spewed out. And not such Moist Bodies only, but Metals, as Brass, Iron, &c. have been Swelled in the time of being *Frozen*, as hath been proved by Clocks, Locks and other Instruments, and become Laxed and plyant again upon the *Thaw*. Many more Examples might be easily produced to induce us to the thoughts, that the *Sap* is not right and Genuine in such Ill-disposed Trees, and that *Ice* might upon due examination be found in any such *Bursten* Bodies, as we are informed hath been found and observed by some; and if *Ice*, then Pressure, and if Pressure then Breaking and *Explosion*.

It may be doubted too, whether some of these Trees thus liable to the Fury of the *Frost*, have not been *Coltie*? A Term commonly used among Timber Merchants and by them avoided; which is, towards the middle of the Tree, among the *Annual Circles*, some one is much larger than the rest, and the *Sap-Vessels* there seem much extended beyond their fellows, and upon Cleaving or Sawing such a Tree, that inclosed or inward Heart, part thereof where that *Circle* is, will slip and drop from the other part oftentimes without any Force to Divide it, as an Instrument out of a Case or Mould made fit for it.

Some suppose that these *Wind-shaken* or *Lagg'd* Trees may be known or neerly guessed at by the outside, when growing, by the great Ribbs, 2, 3, or 4, in a Tree from the Bottom to the Branches, and that they have been affected somewhat considerably with this Disease before, and perhaps *Cleft* (tho' not in so great a measure as now) and the Fissures closed up again; as we see these to do quickly after the *Frost*, in so much that it is scarce discernable already, and the *Bark* having not been divided from the Body, upon coming together again each Turn and Twist of the Grain fitting its place prove fresh and vigorously growing: But that ever such Trees will prove Whole and Sound doth scarcely consist with Reason or our present thoughts. And this Calamity hath not been found in only Trees that were Fresh and Standing, but also in Trees Cut down, as is affirmed by Mr. *Shish* and others, but notwithstanding it is thought to be only among such Diseased Trees as are before mentioned.

But it is yet to be Questioned whether *Vines* have proved *Cleft* and Crackt along the Bodies by the same way and reason as *Timber-Trees*, which Decay is especially to be seen on Walls exposed to the Southern Aspect, so that the Sun our accustomed Friend now proved our great Enemy, by *Thawing* and Relaxing the *Sap* every Day, and then being *Frozen* and made Stiff again every Night: which often repetition of Bending and Unbending, Softning and Hardning,
the

the Vivid Spirituous *Juice* being destroyed, and Day and Night the Drought vigorously acting, (the *Sap* being this Year disordered and surprized, not gradually seasoned, even before *Michaelmas* day, and the fresh *Sap* to supply its Defects being wholly detained from Arising, there then being none or very little Exhalations or Evaporations arising out of the *Frozen* and bound Earth) these poor Slender bodies fill'd only with Thin and not Viscous *Sap*, have proved as great sufferers as if by Amputation they had been deprived of their Natural sustenance; for if they could have none from the Earth, and their own true Juice Mortified, and it be certain that *omne Siccum appetit Humidum*; it will follow, that such Branches will by the constancy and continuance of such Severity (the Day being as bad as the Night) prove as Dry as sticks cut off long before: whereas those of this kind and other sorts also Growing in more Shadowy parts, and undergoing but one Change, have remained in good condition, especially among *Red Grapes*, which seem much more Hardy than *White* ones.

We see other *Wall-Fruits* on the same position, as *Apricocks*, *Peaches*, *Plums*, *Cherries*, &c. are not at all injured or prejudiced by the Weather, which are of a more clammy *Viscous* juice: These we see Run sometimes and give Gum; but the Leakage of *Vines* is as Thin as Water, which different *Juices* and *Saps* in other Trees and the degrees thereof, as well those with *Deciduous Leaves*, as *Ever-greens*, may prove some Cause of the weakness and Decay of some, whilst that of another sort standing by, remains Fresh and Vigorous, only stagnated sedate and quiet, waiting for the benign Sun's Beams to actuate, Lenifie, and put its Spirits in motion, and its comfortable Refreshment to arise in due Season: And perhaps according to the degree of this Qualification in Trees and Plants (some being much more sluggish than other) may be the Cause of their Earlier or Later *Germination*.

It is easily observed that in Dry, Mountainous, Rocky and Barren Plantations, where Trees, Greens, and other Plants having been sparingly fed, and not pamper'd with such Luxuriance and freeness of *Sap*, as in the Valleys and Richer Soils, have escaped tolerably well: and by this which in other Years proves their Poverty and Disease, now make them insult over those growing in the Fatter Vallies, proportional to the Height of the Hills they grow on.

We may observe Trees all the Winter, while the *Sap* remains Condensed, to be safe and well, but if a flattering too early Glance happens in the Spring to set their parts in Action, and the *Juices* to become fluid, and a sudden mutation of that Warmth to a fresh return of Winter, (which too frequently happens in *England*) that then we have not only our hopes of that Years Fruit blasted, but even the passages in the Branches and Boughs stopped, and the crude *Sap* settling; commonly called *Bliting* (tho' there be many Causes of the Effects which go under that notion) becomes a Disease in Trees equal to that of *Child-blanes* in Juvenile Blood, which sometimes takes whole Trees, and sometimes Branches only: Hence is supposed the decay of the *Glastenbury-Thorn*, whose arising time being between *Michaelmas* and *Christmas*, being Sappily pre-

prepared, by the beginning of the *Hard Frost*, which hath almost affrighted it out of its Life.

Some *Trees* and *Shrubs* seem to have their *Vessels* and passages so streightned and as it were shrunk with *Cold*, that they appear equal to a Humane body *Sinew-shrunk* or *Paralytick*, that is not without much trouble able to move or bear his *Decaying Limbs*; Thus we see *Trees* with their *Bark* shrivel'd, with their passages half stopt, whose *Sap* now only squeezing and difficultly passing, hath much ado to force its way through the *Dryed* and narrow *Pores* and passages of the *Body* and *Branches*: and sometimes this *Distemper* is so prevalent, that whole *Branches* of a *Tree* are killed, when the other part is indifferent well.

Some *Liquids*, such as *Essential Oyls*, do rather *Shrink* than encrease being *Frozen*, and *Empereumatical Oyls* will hardly *Freeze* but *Waste*; which considerations may introduce the thoughts of what some *Trees* are made of, or do abound in, as *Firrs*, *Pines*, &c. which are capable of enduring the *Cold* of *Norway* and other *Countries*.

What *Timber-Trees* have suffered, are above specified, but divers others of our *Native Trees* and *Shrubs* have scarcely proved able to withstand the Force of so rude an *Enemy*. *Yew* and *Holly* (things whose *Tenderness* was never suspected) were in some places quite *Kill'd*, and in many places so discouraged, loosing their *Leaves* and blemishing the *Bark*, that it is to be feared they will never take on their *pristine Splendour* and *Verdure*. The *Furze* in many places quite *Killed*, and in most places cut down and *Spring* again, but often the *Resurrection* in vain expected. *Common Broom* proves a degree *Hardier*. In some places the *Sunny* side of a *Juniper-Bush* proves *Scorcht* between *Sun* and *Cold*, but that proves one of the most *Hardy* of our *Native Greens*; so that it is hard to say what is *Winter-proof* even among our *Natives*, except *Box* and *Ivy*, which stand in *Defiance* of all.

In the *Gardens* (which generally are *Nurseries* of *Exoticks*, and from *Warm Countries*) this *Calamity* hath principally bent its *Force* against *Winter-Greens*, such as *Alaternus* (commonly known by the Name of *Phillurea*) and the true *Phillurea* also, which are generally *Kill'd*; though some upon *Cutting* down *Spring* again. Also *common Bays* seen in most places to be *Kill'd* down, and *Lawrel* seldom proving *impatient*, is in some places *Kill'd*, in some places *Half-dead*; *Rosemary*, *Laurustine*, *Halimus*, *Arbutus*, *White Jasmine*, and other which seldom fail, are generally *Kill'd* through the whole *Country*. But in all these and other such like, in *Mountainous* and *Dry* places (as was before observed) there is *brisk Life* and *Verdure* yet remaining, though rarely to be met with, but however enough to retain the several *Species* among us. But if for the future in such times of *Extremity*, the *Superficies* of the *Ground*, and *Bodies* of such things here recited, and *Fig-Trees*, were well covered with *Strawy* matter to keep off the *Frost*, it might so preserve them as to *Spring* out plentifully the *Spring* following, though their whole *Tops* being too large and high, and thereby incapable of such covering, might lose their present *Leaves* and *Beauty*; which might from such *respringing* be easily repaired, and prove much more *satisfactory* than to begin the *World* anew, as we are generally forc'd to do

do for *Cypresses*, which were used to be excellent Ornaments both in Summer and Winter, now it proving a very rare thing to see one well Alive; In some places there appears some lingering Life, but scarcely sufficient to recover the whole, but in most places they are quite dead, that have faced 40, 50, or 60, Winters before.

Also among those with *Deciduous Leaves*, divers have been sufferers, as *Arbor-Judæ*, *Young Plane Trees*, though those of considerable Stature have pretty well escaped, *Paliurus*, the *Aleppo Ash*, in some places the *Locust-Tree*, and in most Hedges the great Common *Bramble*, and some other, which upon Cutting do some or most of them Spring again.

But such *Greens* also as we receive from, and are the Glory of Warmer Countries, and very rare curious and pleasant with us, such as *Oranges*, *Lemons*, *Myrtles*, *Pomegranates*, and the Perfuming *Jasmines*, and divers other Rarities, which are usually kept in Pots and Cases for the convenience of removing them into *Green-Houses* and *Conservatories*, not being able to endure our Milder Winters, have in many places extremely suffered, especially in Houses of weaker defence: but where the Skill Care and due Management of their Keepers, have met with the convenience of good warm Houses, with keeping constant Fires, (which is a matter to be regulated with great discretion,) according to the Proportion of which Combining Qualifications, the Plants have escaped; as in some Places most of them are well, in some places half, and in some places all dead.

Among *Plants*, *Herbs*, and *Flowers*, there hath been great Destruction also, and many of Common Use, as most of the *Artichokes* in *England*, and *Winter-Coleflowers*, *Sage*, *Tyme*, *Mastick*, *Lavender*, *Laven-Cotton*, and divers other were generally Kill'd: Except such as happened to be new planted that Year, and so Low that they had the Enjoyment of the kind covering of a little *Snow*, which proves the most Natural Feeding and Warm Covering, of any thing to be mention'd; but what peeped its head above it seemed in great danger of being Killed; and as we may see in the *Corn-fields*, that those sides of the Lands of Corn facing the South, where the *Snow* was melted and the Corn deprived of its Covering, the want proved deadly, and in many places Husbandmen were forced to begin again in the Spring to Plough and Sow other Grain; which may easily teach us rather to heap *Snow* upon our Herbs, and Flowers, than fancy it a Cold unkind Enemy.

But after all this Repetition of Sorrows, we are to comfort our selves that such Destruction and Calamity happens but very rarely, the like having not been known in the Memory of man, if ever before; and that with due Care and Observance the growing Cold might be kept off from such things as are proved to be impatient of it; which are not all *Greens* in our Gardens, some being able to endure all the Cold that ever came, as *Firrs*, *Pines* of divers sorts, *Cedars* of *Libanus* and *Virginia* (though that of *Bermudas* proves tender) *Arbor Vitæ*, all the *Savins*, whereof the Upright or *Berry-bearing* is the best *Succedaneum* to *Cypress*, capable of finer cutting into *Pyramids* or other Figures, or Hedges 6 or 8 Foot high, and is one of the best of the *Tonsile Shrubs*; also the *Pyracantha* proves exceeding Hardy, and makes good Hedges.

LIV. The *Snow* and *Ice-Houses* at *Livornè*, are commonly built on the side of a Steep Hill, being only a deep Hole in the Ground, by which means, they easily make a Passage out from the Bottom of it, to carry away all the Water, which if it should remain stagnating therein, would melt the *Ice* and *Snow*: But they Thatch it with Straw, in the shape of a Sauce-pan Cover, that the Rain may not come at it. The Sides (supposing it Dry) they line not with any thing, as is done in *St. James's Park*, by reason of the moistness of the Ground. This Pit they fill full of *Snow* or *Ice* (taking care that the *Ice* be made of the purest Water, because they put it into their Wine) overspreading first the Bottom very well with *Chaff*, but without any part of the Straw; I think they use *Barley-Chaff*. This done, they further, as they put in the *Ice*, or the *Snow*, (which latter they ram down,) line it thick by the Sides with such *Chaff*, and afterwards cover it well with the same; and in half a Year lying so, 'tis found not to want above an 8th part of what it weighed, when first put in. Whenever they take it out into the Air, they wrap it in this *Chaff*, and it keeps it to Admiration.

To Preserve Ice and Snow; by Mr. Will. Ball. n. 8. p. 139.

LV. Among several Ways, by which I have made *Infrigidating* Mixtures with *Sal-Armoniack*, the most simple and facile is this: Take one Pound of Powder'd *Sal-Armoniack*, and about three Pints (or Pounds) of Water, put the *Salt* into the Liquor, either altogether, if your design be to produce an Intense, though but a short *Coldness*; or at two, three, or four several times, if you desire that the produced *Coldness* should rather last somewhat longer than be so Great. Stir the Powder in the Liquor with a Stick or Whalebone (or some other thing, that will not be injured by the Fretting Brine that will be made,) to hasten the Dissolution of the *Salt*; upon the Quickness of which depends very much the Intensity of the *Cold*, that will ensue upon this Experiment.

Cold produced with Sal-Armoniack; by Mr. Rob. Boyle. n. 15. p. 255.

That a considerable Degree of *Cold* is really produced by this Operation, is very evident: *First*, to the Touch; *Secondly*, by this, that if you make the Experiment (as for this Reason I sometimes chuse to do) in a Glass-Body, or a Tankard, you may observe, that whilst the Solution of the *Salt* is making, the out side of the Metalline Vessel will, as High as the Mixture reaches within, be bedewed (if I may so speak) with a multitude of little Drops of Water, as it happens when Mixtures of *Snow* and *Salt*, being put into Glasses or other Vessels, the Aqueous Vapours, that Swim to and fro in the Air, and chance to glide along the sides of the Vessels, are by the *Coldness* thereof Condensed into Water. But *Thirdly*, the best and surest way of finding out the *Coldness* of our Mixture, is by plunging into it a good seal'd *Weather-Glass* furnish'd with Tincted Spirit of Wine. For, the Ball of this being put into our *Frigo-rifick* Mixture, the Crimson Liquor will nimbly enough Descend much lower, than when it was kept either in the open Air, or in common Water, of the same Temper with that wherein the *Sal-Armoniack* was put to Dissolve. And if you remove the Glass out of our Mixture into common Water, the Tincted

Spirit will Reascend; And this has also succeeded with me when I remov'd it into Water newly impregnated with *Salt Petre*.

This *Cold* in Summer and Hot Weather will soon decay and Expire: But if the Quantity of the *Salt* and *Water* be great, the Effect will be as well more lasting, as more considerable. I have reason too to suspect, that there may be a considerable Disparity, as to their fitness to produce *Cold*, betwixt several Parcels of *Salt* that are without Scruple look't upon as *Sal-Armoniack*. I have also often found that when the Tincted Liquor subsided but slowly, or was at a Stand, by putting in from time to time two or three Spoonfuls of Fresh *Salt*, and stirring the *Water* to quicken the Dissolution, the *Spirit of Wine* would begin again to Descend, if it were at a stand or rising, or subside much more swiftly than it did before. And if you would lengthen the Experiment, it may not be amiss, that part of the *Sal-Armoniack* be but grossly Beaten, that it may be the longer in Dissolving, and consequently in Cooling the *Water*. After this manner a sensible adventitious *Cold* has been made in the Spring, by a Pound of *Sal-Armoniack* at the utmost, to last about 2 or 3 Hours.

Experiments in March 27. The Tincted Spirit in the Seal'd *Weather-Glass* when first put into the *Water*, rested $8\frac{5}{8}$ Inches: Being suffered to stay there a good while, and now and then stirr'd to and fro in the *Water*, it descended at length a little beneath $7\frac{5}{8}$ Inches. Then the *Sal-Armoniack* being put in, within about a Quarter of an Hour or a little more it Descended to $2\frac{1}{8}$ Inches, but before that Time, in Half a Quarter of an Hour it began manifestly to Freeze the Vapours and Drops of *Water* on the outside of the *Glass*. And when the *Frigorifick* Power was arrived at the height, I several times found, that *Water* thinly placed on the outside, whilst the Mixture within was nimbly stirr'd up and down, would Freeze in a Quarter of a Minute (by a Minute Watch.) At about $\frac{3}{4}$ of an Hour after the *Infrigidating* Body was put in the *Thermoscope*, that had been taken out a while before, and yet was risen but to the lowest *Freezing* Mark, being again put in the Liquor fell an inch beneath the Mark. At about $2\frac{1}{2}$ Hours from the first Solution of the *Salt*, I found the Tincted Liquor to be in the midst between the *Freezing* Marks, whereof the one was at $5\frac{1}{2}$ Inches (at which height when the Tincture rested, it would usually be, some, though but a small, *Frost* abroad; and the other at $4\frac{3}{4}$ Inches; which was the Height, to which strong and durable *Frosts* had reduced the Liquor in the Winter. At 3 Hours after the beginning of the Observation, I found not the *Crimson* Liquor higher than the upper *Freezing* mark newly mentioned; after which it continued to rise very slowly for about an Hour longer; beyond which Time I had not occasion to observe it.

2. This *Frigorifick Mixture* having been made in a *Glass-Body* (as they call it) with a large and flattish Bottom, a Quantity of *Water*, which I (purposely) spilt upon the Table, was by the Operation of the Mixture within the *Glass*, made to Freeze, and that strongly enough, the Bottom of the *Cucurbite* to the Table; that Stagnant Liquor being turned into solid *Ice*, that continued a considerable while unthaw'd away, and was in some places about the Thickness of a Half Crown piece.

3. At another time the same Spring the *Weather Glass*, which before it touched the common Water stood at $8\frac{1}{8}$, having been left there a considerable while, and once or twice agitated in the Water, the Tincted Liquor sunk but to $7\frac{7}{8}$, or, at furthest, to $7\frac{6}{8}$, then the *Frigorifick* Liquor being put into the Water with Circumstances Disadvantagious enough, in (about) half a Quarter of an Hour the Tincted Liquor fell beneath $3\frac{3}{4}$; and the *Thermoscope*, being taken out, and then put in again, an Hour after the Water had been first *Infrigidated*, subsided beneath 5 Inches, and consequently within $\frac{1}{4}$ of an Inch of the Mark, of the Strongly *Freezing-Weather*.

The grand thing that is like to keep this Experiment from being generally useful, is the dearness of *Sal-Armoniack*. But to lessen this Inconvenience, two things may be offered. First, that *Sal-Armoniack* might be made much Cheaper, if instead of fetching it beyond Sea, our Country men made it here at Home. Secondly, that though an *Armoniack* Solution being boyl'd up in Earthen Vessels (for Glass ones are too chargeable) will, by piercing them, both lose some of the more Subtile parts, and thereby somewhat impair the Texture of the Rest; yet I was not deceived in Expecting, that the Dry Salt, remaining in the Pipkins, being re-dissolved in a due Proportion of Water, would very considerably *Infrigidate* it; as may further appear by the following Experiment.

4. *Mar. 29.* The *Thermoscope* in the Air was at $8\frac{7}{8}$ Inches; being put into a somewhat large Evaporating Glass, fill'd with Water, it fell (after it stayed a pretty while, and had been agitated in the Liquor) to 8 Inches: then about half the *Salt*, or less, that had been used twice before, and felt much less Cold than the Water, being put in and stirr'd about, the Tincted Spirit subsided with a Visible Progress till it was fallen manifestly beneath 4 Inches; and then having caused some Water to be Freshly pump'd and brought in, though the newly mentioned Solution were mixt with it, yet it presently made the Spirit of Wine manifestly to Ascend in the Instrument, much faster, than one would have expected.

The Length of the Cylindrical Pipe of the *Seal'd Thermoscope* wherewith these Observations were made was 16 Inches; the Ball, about the Bigness of a somewhat large Walnut, and the Cavity of the Pipe, by Guess, about an *8th* or *9th* part of an Inch Diameter.

To *Cool Drinks* with this Mixture, you may put them in thin Glasses, the thinner the better; which (their Orifices being stopp'd, and still kept above the Mixture) may be moved to and fro in it, and then be immediately poured out to be Drunk. By the Help hereof pieces of Crystal, or Bullets, for the *Cooling* of the Mouth or Hands of those Patients, to whom it may be allowed, may be potently *Cooled*; and other such Refreshments may be easily procured. In which and many other Uses it will not be requisite, to employ near so much as a whole Pound of *Sal-Armoniack* at a time. For, you may easily observe by a *Seal'd Weather Glass*, that a very few Ounces, well powder'd and nimbly Dissolv'd in about 4 times the Weight of Water, will serve well enough for many purposes.

Experiments about Freezing; by S. Carolo Rinaldini. n. 72. p. 2169.

By Dr. Lister. n. 167. p. 836.

LVI. 1. A little Water being left on the Top of the *Mercury* in the *Toricellian* Experiment, and exposed to the Air in *Frosty* Weather, was in one Night Congeal'd into *Ice* of a very good Consistence. Afterwards *Rinaldini*, having compared this *Ice* with that which was produced in the Open Air, found, that the *Ice* in the Cane was in Substance altogether like that of *Hail*; that is, an Opaque and Whitish Body: Whereas that which was made in the Air was transparent like *Crystal*. Besides, he observed that the *Ice* made in the Cane was *Heavier in Specie* than that in the Ambient Air: Which he discovered by putting it into a Fluid, which was *in Specie* lighter than Water, but heavier than *Ice* made in the open Air; whereby he found, that, whereas the *Ice* made in the Cane Sunk, that in the Air Floated therein.

2. Decem. 3. 1684. at Night, I expos'd 4 Glass Bottles in the Open Air upon the ground to Freeze; viz. of the *Red-Natron-Water* from *Aegypt*; of a strong Solution of *Nitrum Murarium* in fair Water, of *Sea-Water* taken up at *Scarborough* and more than half Evaporated; of the *Sulphur-Well* at *Knasborough*, that is, of *Natural-Brine* Evaporated to the same Height with the *Sea-Water*.

The 4th in the Morning, the Solution of *Nitrum Murarium* was half of it *Ice*, but not any of the rest.

The 6th in the Morning, the Bottle of *Nitrum Murarium* was most *Ice*; the *Sulphur-Water* had no *Ice* that I could perceive at all in it; the *Natron* had much *Ice* at the Bottom of the Bottle; and the *Scarborough-Sea-Water* was not without Flakes of *Ice*.

Fig. 21, 22.

The *Icicles* of the *Natron* were prettily Figured, as is represented in *Fig. 21*. The *Icicles* of the *Sea-Water* were also Figured in oblong Squares, as in *Fig. 22*. And were brittle and Transparent. I set the drained *Icicles* of *Natron* before the Fire, which did readily enough Melt and dissolve into Water again; this *Ice* was both alike Salt in *Ice* and in *Water*, much like the Water, to the Taste, out of which it was *Frozen*. In like manner having drained the *Sea-Water-Ice*, and expos'd it before the Fire; these *Icicles* became Soft and moist by Degrees, but at length rather Evaporated, than quite Melted away; and having taken up a good thick lump of common *Ice*, at least 100 times their Thickness and Bulk, this in a few Moments at the same Distance before the Fire, grew wetter and wetter, and dissolved into Water, whereas the *Salt-Icicles* after 3 Quarters of an Hour, lying before the Fire, did at length dry into a White Powder perfect Salt, the Moisture Totally Evaporating. Also the *Sea-Water Icicles* tasted very Salt, when first taken out of the Water.

I repeated the same Experiment of exposing to Freeze the Bottles of *Natural-Brine* of *Knasborough-Sulphur-Well*, half Evaporated, and *Scarborough-Sea-Water*, the same as formerly, the 7th and 8th Instant at Night, and with the like Success; viz. no *Icicles* in the *Natural-Brine*, but the same large ones as above described I had in the *Sea-Water*, but not till after the 2d Night's keen Freezing.

These *Salt Icicles* continued unthawed in the Bottles, though they were brought into the House, and kept in a Warm Room, long after all other *Ice* within

within



within Doors was gone; viz. 'till the 12 Instant at Night, when the *Icicles* also were dissolved and vanish'd.

From these Experiments we Note, 1. That there may be *Salt-Ice* from *Sea-Water Frozen*, which the Experiments of this S. of the last year did not seem to favour.

2. That there is a real Difference betwixt *Natural-Brine*, and *Sea-Water*; as there is betwixt the Salts themselves, which they yield.

3. That the great Floating Mountains of *Ice* in the *Northern-Seas* (if upon strict Tryal they shall be found to be Salt, which should be further enquired into,) are not only the Effects of many years *Freezing*, but also much of their Magnitude may be owing to the Natural Duration of that sort of *Ice*.

3. A Tube of $\frac{1}{4}$ of an Inch Diameter being filled with Water, to the Height of 2 Inches, and set to *Freeze* in a Mixture of Snow and Salt, the Water, when perfectly *Frozen*, appeared $\frac{1}{2}$ of an Inch, above the Mark it stood at before *Freezing*.

By M. Des
Masters. n. 215.
p. 384. n. 247.
p. 439.

Another Tube, of almost an Inch Diameter, being fill'd with Water to the Height of 6 Inches, and set to *Freeze* as before, rose $\frac{7}{8}$ of an Inch above the Mark. The Water made use of in these Tryals, was, a sort of rough *Pump-Water*; which, according to what Tryals have been made with it, does, upon the Effusion of *Oyl of Tartar per Deliquium*, immediately turn Milky and Turbid. And the *Ice* made of this Water was a sort of very Rarified White *Ice*.

The Tube of almost an Inch Diameter being fill'd to the height of 6 Inches (as before) with *River-Water*, which would readily mix with *Oyl of Tartar* without the least Precipitation, and set to *Freeze* in a Mixture of Snow and Salt, it gained but $\frac{5}{8}$ of an Inch after it was *Frozen*; whereas the *Pump-Water* got $\frac{7}{8}$ of an Inch.

It was Observable, that when the Water (in all these Experiments) began to *Freeze*, a great many small *Bubbles* continually rose from the Bottom.

A Tube being fill'd with *Boyled-Pump-Water*, to the height of 6 Inches, and set to *Freeze* as before, it rose hardly to $\frac{6}{8}$ of an Inch above the Mark; when as the same Water *Unboyl'd* rose to $\frac{7}{8}$.

LVII. In *July* 1653. It was so furiously Hot in *Poland*, that in the Regiment of Foot which was the King's Guard, marching most of them Bare-foot upon Sands, more than 100 fell down altogether disabled, whereof a Dozen Dyed outright, without any other Sickness.

Excessive Heats
in Poland; by
M. Fehre. n. 19.
p. 352.

LVIII. If the Action of the *Sun* be considered as the only Cause of the Heat of the *Weather*, I see no reason but that under the *Pole*, the Solstitial Day ought to be as Hot as it is under the *Aequinoctial*, when the Sun comes Vertical or over the *Zenith*: for this reason, that for all the 24 Hours of the Day under the *Pole*, the Sun's Beams are inclined to the Horizon, with an Angle of $23\frac{1}{2}$ Deg. and under the *Aequinoctial*, though he come Vertical, yet he Shines no more than 12 hours, and is again 12 Hours absent, and that for

The Proportio-
nal Heat of the
Sun, in all La-
titudes; by Mr.
Edm. Halley.
n. 203. p. 878.

3 Hours 8 Min. of that 12 Hours he is not so much Elevated as under the *Pole*; so that he is not 9 of the whole 24 higher than 'tis there, and is 15 hours lower. Now the simple Action of the *Sun* is, as all other Impulses or Stroaks, more or less Forceable, according to the *Sines* of the *Angle* of *Incidence*, or to the Perpendicular let fall on the Plain; whence the *Vertical* Ray (being that of the greatest *Heat*) being put Radius, the force of the Sun on the Horizontal Surface of the Earth will be to that, as the *Sines* of the Sun's Altitude at any other time. This being allowed for true, it will then follow, that the time of the Continuance of the Sun's Shining being taken for a *Basis*, and the *Sines* of the Sun's Altitudes erected thereon as Perpendiculars, and a Curve drawn through the Extremities of those Perpendiculars, the Area comprehended shall be Proportionate to the Collection of the *Heat* of all the Beams of the Sun in that space of time. Hence it will follow, that under the *Pole* the Collection of all the *Heat* of a *Tropical* Day, is Proportionate to a *Rectangle* of the *Sine* of $23\frac{1}{2}$ gr. into 24 Hours, or the Circumference of a Circle; that is, the *Sine* of $23\frac{1}{2}$ gr. being nearly $\frac{4}{10}$ of *Radius*; as $\frac{8}{10}$ into 12 Hours. Or the *Polar* *Heat* is equal to that of the Sun continuing 12 Hours above the *Horizon*, at 53 gr. height, than which the Sun is not 5 Hours more Elevated under the *Equinoctial*.

Fig. 23.

But that this matter may be the better understood, I have exemplified it by a Scheme, where in the Area $ZGHH$, is equal to the *Area* of all the *Sines* of the Sun's Altitude under the *Equinoctial*, erected on the respective Hours from Sun-rise to the Zenith; and the Area $\ominus HH \ominus$ is in the same proportion to the Heat for the same 6 Hours under the *Pole* on the *Tropical* Day; and $\odot HH Q$, is proportional to the collected Heat of 12 Hours, or half a Day, under the *Pole*; which space $\odot HH Q$ is Visibly greater than the other Area $HZGH$, by as much as the Area HGQ is greater than the Area $ZG\odot$; which, that it is so, is Visible to sight, by a great excess; and so much in proportion does the Heat of the 24 Hours Sun-shine under the *Pole*, exceed that of the 12 Hours under the *Equinoctial*: Whence *Cæteris paribus*, it is reasonable to conclude, that were the Sun perpetually under the *Tropick*, the *Pole* would be at least as Warm, as it is now under the *Line* it self.

But whereas the Nature of *Heat* is, to remain in the Subject after the Cause that Heated is removed, and particularly in the Air; under the *Equinoctial*, the 12 Hours absence of the Sun does very little still the Motion impress'd by the past Action of his Rays wherein *Heat* consists, before he arise again: But under the *Pole*, the long absence of the Sun for 6 Months, wherein the Extremity of *Cold* does obtain, has so chill'd the Air that it is as it were *Frozen*, and cannot, before the Sun has got far towards it, be any way sensible of his presence; his Beams being obstructed by the thick Clouds, and perpetual Fogs and Mists, and by that *Atmosphere* of *Cold*, as the late Honourable Mr. *Boyle* was pleased to term it, proceeding from the everlasting *Ice*, which in immense quantities does Chill the neighbouring Air, and which the too soon retreat of the Sun leaves *Untbawed*, to encrease again during the long Winter that follows this short Interval of Summer.

But the differing Degrees of *Heat* and *Cold* in differing Places, depend in a great

great measure upon the Accidents of the Neighbourhood of high Mountains, whose Height exceedingly Chills the Air brought by the Winds over them; and of the nature of the Soyl, which variously Retains the *Heat*, particularly the Sandy, which in *Africa*, *Arabia*, and generally where such *Sandy Desarts* are found, do make the *Heat* of the Summer incredible, to those that have not felt it.

In prosecution of this Thought, I have solv'd this *Problem* generally, *viz.* To give the Proportional Degree of Heat, or the Sum of all the Sines of the Sun's Altitude, while he is above the Horizon in any Oblique Sphere, by reducing it to the finding of the Curve Surface of a *Cylindrick Hoof*, or of a given part thereof.

Now this *Problem* is not of that difficulty as appears at first sight: for let the *Cylinder ABCD*, be cut obliquely with the *Ellipse BKDI*, and by the Center thereof *H*, describe the Circle *IKLM*; I say, the Curve Surface *IKLB* is equal to the Rectangle of *IK* and *BL*, or of *HK* and $2 BL$, or *BC*: And if there be supposed another Circle, as *NOPQ*, cutting the said *Ellipse* in the Points *P, Q*; draw *PS, QR*, parallel to the *Cylinder's* Axe, till they meet with the aforesaid Circle *IKLM* in the Points *R, S*, and draw the Lines *RTS, QVP*, bisected in *T*, and *V*. I say again, that the Curve Surface *RMSQDP* is equal to the Rectangle of *BL* or *MD* and *RS*, or of $2 BL$ or *AD* and *ST* or *VP*; and the Curve Surface *QNPD* is equal to $RS \times MD$ — the Arch *RMS* $\times SP$, or the Arch *MS* $\times 2 SP$: or, it is equal to the Surface *RMSQDP*, subtracting the Surface *RMSQNP*. So likewise the Curve Surface *QBPO* is equal to the Sum of the Surface *RMSQDP*, or $RS \times MD$, and of the Surface *RLSQOP*, or the Arch *LS* $\times 2 SP$.

Fig. 24.

This is most easily Demonstrated from the Consideration, That the *Cylindrick* Surface *IKLB* is to the Inscribed *Spherical* Surface *IKLE*, either in the whole or in its Analogous Parts, as the Tangent *BL*, is to the Arch *EL*; and from the Demonstrations of *Archimedes de Sphæra & Cylyndro, Lib. 1. Prop. 30, 37, and 38.* and Doctor *Barrow's* Learned *Lectures* on that Book, *Probl. 9.* and the Corollaries thereof.

Now to reduce our Case of the Sum of all the Sines of the Sun's Altitude in a given Declination and Latitude to the aforesaid *Problem*, let us consider the *Analemma* Projected on the Plain of the Meridian, *Z* the Zenith, *P* the Pole, *HH* the Horizon, *ææ* the *Equinoctial*, *⊖ ⊖ ♀ ♀* the two *Tropicks*, *⊖ I* the Sine of the Meridian Altitude in *⊖*; and equal thereto, but perpendicular to the *Tropick*, erect *⊖ 1*, and draw the Line *T 1* intersecting the Horizon in *T*, and the Hour Circle of *6*, in the Point *4*, and *6, 4* shall be equal to *6 R*, or to the Sine of the Altitude at *6*: and the like for any other Point in the *Tropick*, erecting a Perpendicular thereat, terminated by the Line *T i 1*. Through the point *4*, draw the Line *4 5 7* parallel to the *Tropick*, and representing a Circle equal thereto; then shall the *Tropick* *⊖ ⊖* in *Fig. 25.* answer to the Circle *NOPQ*, in *Fig. 24.* The Circle *4 5 7*, shall answer the Circle *IKLM*, *T 4 i* shall answer to the *Elliptick* Segment *QIBKP*, *6 R* or *6 4* shall answer to *SP*, and *5 1* to *BL*, and the Arch *⊖ T*, to the Arch *LS*,

Fig. 25.

LS, being the Semidiurnal Arch in that Latitude and Declination; the Sine whereof, though not expressible in *Fig. 25.* must be conceived as Analogous to the Line *TS* or *VP* in *Fig. 24.*

The Relation between these two *Figures* being well understood, it will follow from what precedes, That, the Sum of the Sines of the Meridian Altitudes of the Sun in the two *Tropicks*, (and the like for any two opposite Parallels) being multiplied by the *Sine* of the Semidiurnal Arch, will give an Area Analogous to the Curve Surface *RMSQDP*; and thereto Adding in Summer, or Subtracting in Winter, the Product of the length of the Semidiurnal Arch, (taken according to *Van Ceulen's* Numbers) into the Difference of the above-said *Sines* of the Meridian Altitude: the Sum in one Case, and Difference in the other, shall be as the Aggregate of all the *Sines* of the Sun's Altitude, during his appearance above the *Horizon*; and consequently of all his *Heat* or Action on the Plain of the *Horizon* in the proposed Day; and this may also be extended to the parts of the same Day, for if the aforesaid Sum of the *Sines* of the Meridian Altitudes, be Multiplied by half the Sum of the *Sines* of the Sun's Horary distance from Noon, when the times are before and after Noon; or by half their Difference, when both are on the same side of the Meridian; and thereto in Summer, and therefrom in Winter, be Added or Subtracted, the Product of half the Arch answerable to the proposed interval of Time, into the Difference of the *Sines* of Meridian Altitudes, the Sum in one case, and difference in the other, shall be Proportional to all the Action of the Sun during that space of time.

I foresee it will be objected, that I take the *Radius* of my Circle on which I erect my Perpendiculars always the same, whereas the Parallels of *Declination* are unequal; but to this I answer, that our said Circular Bases ought not to be Analogous to the Parallels, but to the Times of Revolution, which are equal in all of them.

It may perhaps be useful to give an Example of the Computation of this Rule, which may seem difficult to some. Let the *Solstitial Heat*, in \odot and ϖ , be required at *London*, *Lat.* 51, 32.

38° — 28'	<i>Co. Lat.</i>	<i>Diff. Ascen.</i> —————	33° — 11'
23 — 30	<i>Decl. ☉</i>	<i>Arc. Semidi. Æstiv.</i>	123 — 11
61 — 58	<i>Sinus = 0,882674</i>	<i>Arc. Semidiur. Hyb.</i>	56 — 49. <i>Sin.</i> 0,836923
14 — 58	<i>Sinus = 0,258257</i>	<i>Arc. Æstiv. mensura.</i>	2,149955.
	<i>Summa</i>	<i>Arc. Hyber. mensura.</i>	0,991683.
	<i>Diff.</i>		0,624417

Then 1, 140931 in, 0,836923 + 0,624417 in 2,149955 = 2,29734.
 And 1, 140931 in, 0,836929 — 0,624417 in 0,991638 = 0,33895.
 So that 2, 29734 will be as the *Tropical Summer's day's Heat*, and 0,33895 as the *Action* of the *Sun* in the Day of the *Winter Solstice*.

After this manner I computed the following Table, for every tenth *Deg.* of *Latitude* to the Equinoctial and Tropical Sun, by which an Estimate may be made of the Intermediate *Degrees*.

Lat ^s	Sun in $\gamma \approx$	Sun in δ	Sun in ψ
0	20000	18341	18341
10	19696	20290	15834
20	18794	21737	13166
30	17321	22651	10124
40	15321	23048	6944
50	12855	22991	3798
60	10000	22773	1075
70	6840	23543	000
80	3473	24673	000
90	0000	25055	000

From this Rule there follows several *Corollaries* worth Note: As, 1. That the *Aequinoctial Heat*, when the Sun comes *Vertical*, is as twice the Square of Radius, which may be proposed as a Standard to compare with in all other Cases. 2. That under the *Aequinoctial*, the *Heat* is as the Sine of the Sun's Declination. 3. That in the *Frigid Zones*, when the Sun sets not, the *Heat* is as the Circumference of a Circle into the Sine of the Altitude at 6. And consequently that in the same *Latitude* these *Aggregates of Warmth* are as the *Sines* of the Sun's Declinations; and in the same Declination of the Sun, they are as the *Sines* of the Latitudes; and generally they are as the *Sines* of the Latitudes into the *Sines* of Declination. 4. That the *Aequinoctial Day's Heat*, is every where as the *Co-sine* of the Latitude. 5. In all places where the Sun sets, the Difference between the Summer and Winter *Heats*, when the Declinations are contrary, is equal to a Circle into the *Sine* of the Altitude at 6, in the Summer Parallel, and consequently those Differences are as the *Sines* of Latitude into or multiplied by the *Sines* of Declination. 6. From the Table I have added it appears, that the *Tropical Sun* under the *Aequinoctial* has of all others the least Force. And under the *Pole*, it is greater than any other Day's *Heat* whatsoever, being to that of the *Aequinoctial*, as 5 to 4.

*Vid. D. Wallis.
de Calculo Cen-
tri Gravitatis.
Prop. 13. Cap. 5.*

From the Table and these *Corollaries* may a general Idea be conceived of the Sum of all the *Actions* of the Sun in the whole Year, and that Part of the *Heat* that arises simply from the Presence of the Sun, be brought to a *Geometrical Certainty*: And if the like could be performed for *Cold*; which is something else than the bare Absence of the Sun, (as appears by many Instances) we might hope to bring what relates to this part of *Meteorology* to a perfect *Theory*.

LIX. 1. May. 10. 1666. About 5 of the Clock afternoon, the *Thunder* (which I had before heard at some distance) coming nearer to us, it began to Rain, and soon after (the Rain withal increasing) the *Thunder* grew very Loud, *Accidents by Thunder and Lightning, at Oxford; by Dr. Wallis. n. 13. p. 222.*

Loud, and frequent, and with long *Ratling Claps* (tho' not altogether so great) as I have sometimes heard :) And the *Lightning* with *Flashes* very bright (notwithstanding the Clear Day-light) and very frequent, (when at the fastest, scarce a full Minute between one *Flash* and another; many times not so much, but a second *flash* before the *Thunder* of the former was heard :) The *Thunder* for the most part began to be heard about 8, or 10 second-Minutes after the *flash*; as I observed for a great part of the time by my Minute-watch; but once or twice I observed it to follow (in a manner) immediately upon it, as it were in the same Moment; and the *Lightning* extream *Red* and fiery; so that had it been by Night as it was by Day, it would have been very terrible. And though I kept within Doors, yet I sensibly discover'd a stinking *Sulphurous* Smell in the Air. About 7 of the Clock it ended, before which time I had News brought me of a sad Accident upon the Water at *Medley*, about a Mile or somewhat more distant from hence. Two Schollars of *Wadham-College*, being alone in a Boat (withour a Water-man) having newly thrust off from Shore, at *Medley*, to come homewards, standing near the Head of the Boat, were presently with a stroak of *Thunder* or *Lightning*, both struck off out of the Boat into the Water, the one of them stark dead, in whom, though presently taken out of the Water (having been by relation, scarce a Minute in it) there was not discerned any appearance of Life, Sense, or Motion: The other was stuck fast in the Mud (with his Feet downwards, and his upper parts above Water) like a Post, not able to help himself out; but, besides a present stonying or numbness, had no other hurt; but was for the present so disturbed in his Senses, as that he knew not how he came there out of the Boat, nor could remember either *Thundring* or *Lightning* that did effect it: And was very feeble and faint upon it; which, (though presently put into a warm Bed) he had not thoroughly recovered by the next Night; and whether since he have or no, I know not.

Others in another Boat, about 10 or 20 Yards from these (as by their description I estimate) felt a disturbance and shaking in their Boat, and one of them had his Chair struck from under him, and thrown upon him, but had no hurt. Those immediately made up to the others, and some (leaping into the Water to them,) presently drew them either into the Boat or on Shore; yet none of them saw these two fall into the Water (not looking that way) but heard one of them cry out for help presently upon the stroke, and smelt a very strange *stinking smell* in the Air, such as is perceived upon the striking of Flints together.

He that was dead, was the next Morning brought to Town; and Dr. *Willis*, Dr. *Millington*, Dr. *Lower*, and my self, with some others, went to view the Corps, where we found no *Wound* at all in the Skin, the Face and Neck Swart and black, but not more than might be ordinary, by the settling of the Blood: On the Right side of the Neck was a little Blackish Spot, about an inch long, and about a Quarter of an inch broad at the broadest, and was, as if it had been *Sear'd* with a Hot Iron; and, as I remember, one somewhat bigger on the Left side of the Neck, below the Ear. Straight down the Breast, but towards the Left side of it, was a large place, about three quarters of a foot

foot in Length, and about two Inches in breadth, in some places more, in some less, which was *Burnt* and Hard, like Leather Burnt with the Fire, of a deep Blackish Red Colour, not much unlike the Scorched Skin of a Roasted Pig: And on the fore-part of the Left Shoulder such another Spot about as big as a Shilling; but that in the Neck was Blacker, and seem'd more Sear'd. From the top of the Right Shoulder, sloping downwards towards that place in his Breast, was a narrow Line of the like Scorched Skin; as if somewhat had come in there at the Neck, and had run down to the Breast, and there spread broader.

The Buttons of his Doublet were most of them off; which some thought might have been torn off with the *Blast*, getting in at the Neck; and then Bursting its way out: For which the greatest presumption was (to me) that, besides 4 or 5 Buttons wanting towards the Bottom of the Breast, there were about half a Dozen together clear off, from the Bottom of the Collar downwards; and I do not remember, that the rest of the Buttons did seem to be near worn out, but almost new. The Collar of his Doublet, just over the fore-part of the Left Shoulder, was quite broken asunder, Cloath and Stiffening, Straight downwards, as if cut or chop'd asunder, by a Blunt Tool; only the inward Linnen or Fustian Lineing of it was whole, by which, and by the view of the ragged Edges, it seem'd manifest to me, that it was by a Stroak Inwards from without, not Outwards from within.

His Hat was strangely Torn, not just on the Crown, but on the side of the Hat, and on the Brim. On the side of it was a great Hole, more than to put in ones Fist through it: Some part of it being quite struck away, and from thence divers Gashes every way, as if Torn, or Cut with a Dull Tool, and some of them of a good length, almost quite to the Edges of the Brim. And beside these, one or two Gashes more, which did not communicate with that Hole in the side. This also I judg'd by a stroak Inwards; not so much from the view of the Edges of those Gashes (from which there was scarce any judgement to be made either way) but because the Lineing was not Torn, only ript off from the Edge of the Hat (where it was sow'd on) on that side, where the Hole was made. But his Hat not being found upon his Head, but at some distance from him, it did not appear against what part of the Head that Hole was made.

The Night following the three Doctors above mentioned and my self, with some Chirurgeons (besides a multitude of others) were present at the Opening of the Head, to see if any thing could be there discover'd; but there appear'd no sign of *Contusion*; the *Brain* full and in good order; the *Nerves* whole and sound; the *Vessels* of the *Brain* pretty full of Blood. But nothing was by any of them discern'd to be at all amiss. Some of them thought, that they discern'd a small *Fissure* or Crack in the *Skull*; and some who held it, while it was sawing off; said they felt it Jarring in their Hands, and there seem'd to the Eye something like it, but it was so small, as that by Candle-light we could not agree it certainly so to be.

Some of the *Hair* on the Right Temples was manifestly Singed, or Burnt; and the lower part of that Ear Blacker than the parts about it, but Soft; and

it might be only the settling of the Blood. The upper part of the Left Shoulder, and that side of the Neck, were also somewhat Blacker than the rest of the Body; but whether it were by the Blow, which broke the Collar, and *Scorched* the round red Spot thereupon, or only by settling of the Blood, I cannot say; yet I think, it might very well be, that both on the Head and on this side of the Neck, there might be a very great Blow, and a *Contusion* upon it, (and seems to have been so, by the Tearing of the Hat, and Breaking the Collar, if not also Cracking of the Skull) and yet no Sign of such *Contusion*, because Dying so immediately, there was not time for the Blood to gather to the Part, and Stagnate there, (which in Bruises is the cause of Blackness,) and it was but as if such a Blow had been given on a Body newly Dead; which does not use to cause such a Symptom of a Bruise, after the Blood ceases to Circulate.

Having done with the *Head*, they Opened the *Breast*; and found that *Burning* to reach quite through the Skin, which was in those *Scorched* places Hard and Horny, and Shrunk up, so as it was not so thick as the soft Skin about it: But no appearance of any thing deeper than the Skin; the Muscles not at all Disorder'd or Discolour'd (perhaps, upon the reason, that was but now said of the Head, Neck and Shoulder.) Having then taken off the *Sternum*, the *Lungs* and *Heart* appeared all well, and well Colour'd, without any Disorder.

In Hampshire;
by Mr. Tho.
Neal. n. 14.
p. 247.

2. Jan. 24. 166 $\frac{1}{2}$. one Mr. Brooks of Hampshire, going from Winchester towards his House near Andover, in very bad Weather, was himself slain by *Lightning*, and the Horse he rode on, under him. For about a Mile from Winchester he was found with his Face beaten into the ground, one Leg in the Stirrup, the other in the Horses Mane, his Cloaths all *Burnt* off his Back, not a piece as big as a Handkerchief left intire, and his *Hair* and all his Body *Singed*; with the force, that struck him down, his Nose was beaten into his Face, and his Chin into his Breast; where was a *Wound* Cut almost as Low as to his Navil. The torn pieces of his Cloaths were so scatter'd and consum'd, that not enough to fill the Crown of a Hat could be found. His Gloves were whole, but his Hands in them *Singed* to the Bone. The Hip bone and Shoulder of his Horse *Burnt* and *Bruised*; and his Saddle torn in little pieces. This was what appeared to the *Coroner's Inquest*.

At Stralsund in
Pomerania,
By..... n. 65.
p. 2084.

3. Jun. $\frac{12}{29}$: 1670 (being Sunday) after several less strong reports of *Thunder*, the whole Town, and particularly the Congregation in St. Nicholas Church, (when the Minister was Preaching) was strangely surpris'd with a most Terrible Flash of *Lightning* and a fearful *Thunder-Clap*, which lighted down through the lesser Steeple upon the Body of the Church, and through the large round Hole in the upper Vault within the same, in the shape (as some observ'd) of a Black Fiery *Ball*, directly upon the Altar, causing such an Hideous Crack, Fire Flash, Smoak, and Damp there, as if many Fire-Balls had been thrown down thither from the said Vault, and Bursted all at once; begetting a Dismal Consternation among the People, and leaving an ill *Sulphurous* smell behind.

The Candle on the South side of the Altar was put out by the Blow, the other remain'd burning. Two of the Chalicés there were overthrown, and the Wine Spilt, and the Wafers scatter'd about: But the Empty Chalice stood firm. All three were somewhat *Smuted* at the Foot, and one of them a little Bent there, and in two places *Pierced* through, as if it had been by Hail-shot: And the Wafer-boxes were likewise a little *Smuted* towards the Bottom: The Church Book was flung on the inner passage: The Covers of the Altar were *Singed* in divers parts, as by Powder, and somewhat *Burnt* and *Smuted* here and there, as also Torn in some places. A strong piece of Wainscot with a Picture upon it, behind the great Altar, was Split in two. Of the Church-Clock, in the West-end, at the same time, both the Brass and Iron Wires of the Whole and Quarter-hour Hammers, were partly broken, and the rest could not be found; and an Oaken Post, fixt in the Wall for the support of the Dial, was half Torn, and beneath the same divers Bricks were Struck out of the two Head-Pillars supporting the Steeple. On the Top of the Southern Steeple, an Oaken Gutter, and a Strong Beam and Supporter were shatter'd.

One of the Ministers, though sitting near the Altar to the South, had no Hurt at all. Divers of the People seated round about the Altar fell down to the ground with the Fright. One Youth that stood next the said Minister's Pew, not being able to recover his Senses, was carried home. On the North-side of the Altar, four Persons fell down, and one of the Oaken Seats being Split under him that sat thereon, that Person was much Hurt by it, and more than any other. Some that stood in or by the Belfrey, near the Clock, were slightly Hurt here and there; and among them a Mariner, leaning on a Lined Oaken Seat there, had his right Arm Bruised; and another man, though but slightly hurt, yet could not remember how he got home from Church.

There issued forth a huge Damp like unto Smoak out of the Southern Steeple: But the Church Carpenter upon search met only with a present Noise and thick Damp, which though it frightened him at first into an apprehension of *Fire*, yet getting to the Windows and opening them, the Damp issu'd with great Violence; but there appeared no *Fire* any where, save only a little in the shatter'd parts of the Steeple, which was soon Quenched.

The Church-Dial was also *Smuted* in sundry parts, soiling the Gilt Figures that they could scarce be discerned. The Gilt Weather-Cocks upon both the Steeples were likewise *Smuted* on the one side of their Tails, without any other mark. Nor could it be in the least discovered in either of the Steeples, which way the Claps entred by all the search that was made.

It was observ'd afterwards, that among the 8 Persons that were Hurt, one who stood in the Belfrey, had the upper back part of his Cloath-Coat, as also his Shirt and Skin, somewhat Torn; but the Lining of that Coat, which was Red Frieze, had no Hurt at all.

Another, sitting betwixt the rest, in a Pew under the Organs, and leaning on the Door, whilst the Pew-Lock (then close to his Body) was so violently Struck out, that it hung only by one Nail, had no dammage at all by it himself, nor any other

that

that fate or stood by there, when the Stroke happen'd; though they fell all to the ground by the Fright, at the instant when it was given.

And as for him that had his Arm Bruised, it was somewhat strange that afterwards there was found a *Hole* passing his Coat, Waist-coat, and Shirt, on the forepart of his Body, without in the least Hurting the Body; the *Hole* appearing just as shot through. His Waist-coat (being of a Red Sarcenet) kept its Colour every where, but at the place where the Arm was hurt: And the small Silver edging was *Smuted* almost every where, and about the Neck too, where the party wore a Cravat. One half of his Shoe was also Torn off, the Soal being *Pierced* as with Hail-shot: And a piece of his Stocking's foot on the same Foot struck away, near an Hand-breadth, without any other Hurt to either Foot or Leg, but that for some days that Foot was benumbed.

Lastly, one of them that fate by the Altar, had his Breeches and Leather drawers on both sides *Pierced* through as by Hail-shot, and part of it plainly *Scorch'd* and Shrunk up, as by *Fire*: And divers of such small *Holes* in his Shirt too, yet without any Hurt in his Body; save that he found some pain in his Foot. One side of his Shoe was also Torn, and the Soal sideways *Pierced* through, as 'twere with Hail-shot.

At Dantzick;
by Mr. Christ.
Kirby. n. 96.
p. 602.

4. About the latter end of *March* and *April*. 1673. we had much and violent *Thunder* and *Lightning*, which had this unhappy Effect upon all the parcels of Wheat and Rye, of the last Years growth, in our Granaries, that, though over-night they were Dry, Sweet, and fit for Shipping, the next morning they were become Clammy and Stinking; so that the *Owners*, if they would not lose their Grain, were forced to cause it to be Turned over two or three times a Day; and yet it required six Weeks, if not longer, before it was recovered. This is a thing which often happens to Corn that hath not lain in the Granary a whole Year, or not Sweat thoroughly in the Straw before it be thrash'd out.

At Portsmouth;
by n. 177.
p. 1212.

5. Oct. 23. 1685. On Board the *Royal James*, a Flash of *Lightning* and *Thunder* together took the Mast, which was put into her for Careening, being a made Mast, and bound with Iron Hoops from one end to the other, and *Shiver'd* it down to the Deck, breaking one of the Iron Hoops in the Body of the Mast, so that Splinters are forc'd out of the middle of the Mast a foot and $\frac{1}{2}$ long, (and a *Ball* of *Fire* to run to and fro on the Deck) insomuch that the Mast is wholly unserviceable and must be taken out.

On Board the *Coronation*, notwithstanding the Ships Head was to Windward, a great *Ball* of *Fire* came into the Gun room Ports, and threw a Boy out of one of the Ports, and he was drowned; and several Workmen being on Board, as Carpenters, Joyners, and Seamen, were struck down and made Senseless for some time; and the *Ball* of *Fire* ran up and struck on the Starboard side of the Wardrobe, and left a place *Scorched* round upon the side, and between the two Ring-bolts, as if it had been a Shot, and beat the Wainscot, over to the side, all *Scorch'd* as if with *Fire*; and run up against the Doors and Hinges, away, and run into several *Balls* of *Fire* on the Deck amongst

amongst the Men; and some part of it broke in at the Windows of the Round-House, and Shivered off a great deal of the Wainscot, and broke the Glasses of a Perspective Glass, and made a Hole through a Letter that lay in the Window eight double, the circumference of a Musket Bullet and no more; it also Shivered the Timber that holds the Ensign-Staff on the Poop.

6. *Mar.* 20. 1692. about 8 at Night there arose a very Violent Gust of Wind at South West, which lasted an Hour and an half, during which time it Rain'd very fast. A quarter of an Hour or thereabouts after Nine, fell a mighty Storm of Hail intermixed with Rain, which lay very white, and some depth on the Ground, and to me appeared to have Snow mixed with it. During that Storm happen'd two *Flashes of Lightning*, very Violent and strange; It was extraordinary *Blew*, and of a *Sulphurous* Smell; it seemed to stand still in the House some considerable time, and was so great that a Gentleman who sat below Stairs, thought that the House had been on *Fire* above and that the Flames rolled down Stairs, the Clap of *Thunder*, which immediately followed, seemed to all like the suddain discharge of five or six Field-pieces; not with that rolling deep noise *Thunder* usually carries along with it. The second *Flash* and *Clap* followed within a few Minutes of the first, but not with that Violence as the former: Which *Flash-Fired* the Steeple, cannot say, but a piece of Wood to which the Lead of the Windows was nailed was set on *Fire*, and kindled very fast, and might have done a great deal of Mischief, had not the Earliness of the Night, and timely help prevented it. This *Storm* seemed to run in a direct Course; for several of our side Towns perceived little of it; and I believe it broke chiefly over us. At *Kettering* one of their Bells, as some say, received some damage, and the Wires of the Chimes were twisted one with another. The Wind was very blustering all the Night after.

At Oundle; by
Mr. W. R.

7. *Aug.* 13. 1693. about 3 a Clock in the Morning, it began to *Thunder* and *Lighten*, and Rain; about 4 a Clock came a Clap of *Thunder* and *Lightning* all at the same moment of time; that was so smart and Violent, that I thought the Ship had been split in pieces; an Alarm went presently through the Ship, of *Fire! Fire!* the dreadfullest word that can happen on Board, and put us all into Confusion. But it happened to Rain briskly about that time, and so with the help of our Buckets, the *Fire* which was occasioned by the *Balls of Lightning* that came between Decks, was soon put out. In the Gangway was one man Knock'd down, and lay sometime before he recovered himself; a second near him was Blown almost the length of the Quarter-deck; a third was Burnt all down his Back with the *Lightning* in his Hammock. Our main-Top Gallant Mast was Split in pieces, our Top Mast not Touched; our Main Mast Split from the top down to the very Deck.

On board the
Suffolk in the
Bay of Biscay;
Dr. Oliver.
n. 204. p. 911.

8. *Jul.* 24. 1696. We had an extraordinary pleasant Forenoon, with continual Sunshine till about about half an Hour after three in the Afternoon, when we had some Rain, after which happened two Claps of *Thunder*, though not very great, and then a great Shower of *Hail*, in which time happen'd a third *Clap* which made all our loss. We were 16 in Number, none of us hapning to be out or absent at the time. The most part of them were standing about

Near Aberdeen
in Scotland;
by n. 227.
p. 311.

about me in the School, hard by my Chamber Door; The two forelaid Claps of *Thunder* being over, we thinking nothing of them; and now there being a great Shower of *Hail*, on a sudden there happened such a *Flash* of *Lightning* which I saw, and as I thought fill'd the whole House, but of the *Clap* I mind nothing, but only I think that I heard as it were some sharp *Clink* or *Sound*; but our Neighbours in the Town, such as the Minister and his Wife, told, they never heard a Louder: But however, I think all our Loss was by the *Fire*, which was over in an Instant, and after which we had *Darkness* in the School, by Reason of the *Smoak*, with a most violent *Sulphurous* Smell, and the Burning of some leaves of Books. There are five *Breaches* in the Walls, one in the Roof, exactly in Shape like a Cannon Ball; another under the Chimney; a third came through the back Wall, and quite through the other Wall opposite to it; and the Chimney was split in pieces, and some that came to the School Door and made a Breach there, renting the Stones in pieces, and carrying them out. There were 4 Killed: And many of the rest Hurt, having their Legs or Arms Ruined; but are all, I thank God, recovered. And as for my self, I never was in greater Danger, for there was one Killed before me, another at my left Hand, and not half a Foot from me there was a Breach made in the middle Wall of my Chamber, and yet I thank God I received no Hurt, only I was Bled in the Mouth, but how I cannot tell. As to the Childrens Bodies that were Kill'd, I found none of their Bones broken; my Brother had a *Cut* in his Head; and all of them, where they received the Strokes, had their Cloaths *Cut*, as if it had been eat out with Rats; they all received their Strokes on their Vital Parts, as about their Shoulders, which were in Colour of a Brownish Black. All the Children that were Killed were in different places, and as it were pick'd out.

At Smyrna; by
Mr. Rob. Maw-
gridge. n. 235.
p. 782.

9. Nov. 26. 1696. A sad and Astonishing Accident, happened to the *Trumbull Galley* by *Lightning* and *Thunder*. For as we lay at Anchor at *Smyrna*, about one of the Clock in the Morning, she was staved in several Places; The Bulk Head of her Round House was staved all to pieces into the Captain's Cabbin, and hurt his Shoulder; Her Mizzen Mast was staved all to Pieces; and the Spindle in the Head of the Mast was *Melted* at both Ends with the *Lightning*; The Main Top Sail Yard was lash'd in the Top, yet notwithstanding, the Yard was thrown out, and stuck in our Awning right an End. The Quarter Master (one *John Page*) was on the Deck by the Mizzen Mast, and one *John Allen*, who were both Struck down flat thereon with the *Lightning*; *Page* had one side of him stupified for three Days, but under God I recovered him in six Days; *Allen* was very well the next Day, when his Fright was over. The *Lightning* did strike the Plank for 6 Foot off of the outside of the Galley all to pieces, and the Timber was like a Brush; and three Planks of the Ceiling was started, whereof 2 Foot and 7 Inches was staved out from the Rest within 10 Inches of my Head; My Velvet Cap was hanging on a Nail in the same piece of Ceiling, the inside whereof, next unto the *Lightning*, had not one stitch amis, but the Outside had all the Seams burst to pieces; A great Weighty Nail was started out of the said Ceiling, and fell over my Head, and lay upon my Pillow; and I thought my Head with the

Lightning

Lightning had been in a Flash of Fire. Whilst I could but just shut my Eyes and open them again, the *Lightning* went down into the Hold, and ran out like a Train of *Wild-Fire*, and *Burst* out through the Galley's side, and Rent 10 or 11 Foot of the Outside Plank off, within a Foot of the Water's Edge. Some of the *Lightning* shot up between the Timbers and the Ceiling into the Gun-Room, and staved a Beam, and set 3 or 4 Bundles of armed Match all on Fire. The Gunner, *George Hardy*, was lying in his Cabbin at the same Time, and the *Lightning* Blistered one of his Feet, and Sing'd the Hair of his Head. The Master's Cabbin was between the Gunner's and mine, but had no Dammage.

10. Jul. 27. 1691. in *Everdon* Field, near *Darventry* in *Northamptonshire*, divers were at work reaping Corn. The Morning was Fair and Clear, but before Noon there came a Violent Storm of *Thunder*, *Lightning*, and *Rain*; which caused the Reapers, about 20 in all, to retreat for Shelter to a Quick-set-Hedge with a Ditch by the side of it. Of these Persons 4 were Kill'd, viz. *Simon Marriot*, *Rob. Marriot*, *Rich. Wells*, and *Tho. Burroughs*, and 8 others Dangerously Hurt, of the rest several were struck down but not much Hurt.

In Northamptonshire; by Dr. Wallis. n. 236. p. 5.

Upon the first Tidings of this Accident, Mr. *Edwards* (the Minister of *Badby*) repaired to the Place: Where *Robert Marriot* lay on his Back out of the Ditch, having *Struggled* (as was said by the By-standers) after the stroak. Mr. *Edwards* says, he saw no Marks or Sign of Hurt on the Body: But the Woman who laid out him and the rest says, there was a *Hole* about the Bigness of a Goose shot in the Pit of his Stomach, and many more about his Legs. There was in the Hedge a Pollard-Ash, under which sat *Simon Marriot* and *Richard Wells*; but *Thomas Burroughs* sat at the distance of two or three Yards from thence. In this Tree were Cut or Raised four (or more) Grooves or Furrows, from the Top to near the Bottom, (deeper than the Bark, and about an Inch broad each of them) on that side of the Tree on which the Men sat; but no Dammage appeared on the Tree elsewhere, there being a Knot on the opposite side, which is supposed to have diverted the Stream of the *Fiery Matter*. The Green Thorns were *Scorched*, and the Place smelt rank of *Sulphur*.

Simon Marriot had the Crown of his Hat Cut into the Shape as of a bearded Arrow, and at the Band-place cut smooth, almost round about from the Brim. His Cloaths on one Shoulder cut Jaggedly to the Skin; where was a Scar about 4 Inches in length, of a long Oval Figure; the Transverse Diameter whereof was deepest, of a Darkish Red Colour, as hard as *Horn* all over. He had Snuff on his Hand, as if just ready to take it.

Richard Wells had a little Dog on his Lap, or between his Legs, Dead: His Hand upon the Dog's Head; his Eyes Open, and with Bread and Cheese (or one of them) in his Hand, as if going to give the Dog a bit. His Shoulder (as his Relations say) was struck down, and in a manner sever'd from his Body.

Thomas Burroughs sat as looking up to the Heavens, his Head turning toward one side as viewing the Clouds, his Eyes Open. He had in his Pocket a

Copper Tobacco-box, which had one little round *Hole* struck quite through it; and a little of the Metal on one side, seemed to have *Run*. By these Postures, it is evident they Dyed in a *Moment*.

Mr. *Edwards* adds, that he took *Simon Marriot's* Hat, and some of his Cloaths, and held them against the Light, and they appeared full of *Holes*, as a Skimmer or Cullender. But (at which he wondered most) the Woman who laid them out told him, their Buttocks which sat upon the Ground were pitifully mangled, and their Privy-Members rent and Torn in pieces; and more especially those of *Thomas Burroughs*, as if small Bars of red Hot Iron had been thrust up into them in many Places.

The Hair of their Heads was *Burnt* very much. Some had no Harm that were hard by: But others were Wounded at a Distance, and their Wounds were Cured with more Difficulty than ordinary Burns.

It was (before the Storm) a pretty still Day. But before each *Thunder-Clap*, was heard a great Whirling-Noise in the Trees, like Wind. The *Lightning* was Observed, by Persons at a distance, as falling perpendicularly upon them. Those who recovered had their Cloaths full of *Holes*, as if they had been Shot through. Not a Drop of Blood appeared upon any of them. Their Hurts like Dry, Scorched, Scarred or Healed Wounds.

Simon Marriot and *Robert Marriot* were struk back: the other two (supported, as is supposed, by the Hedge at their back) continued in the Posture wherein they were Kill'd, three or four Hours after, when Mr. *Richard Butler* of *Preston* saw them.

Several of those who were Hurt, were taken up for Dead, but soon came to themselves without any Application: But some of them were fain to be carried home.

Will. Gregory's Wife had 4 little *Holes* in her Knee, like Shot-holes; which turned to *Sores*, and had *Cores* came out of them.

Mary Bird (a Woman with Child) had all over her Body, near an Hundred *Wounds*, some as large as a Man's Hand; on each Arm one, and one on each side of her Belly. Out of most of her *Wounds* came *Cores*, some bigger, some less; the biggest were bigger than a Walnut, Dry and Black like Leather. She had two *Sores* on the Soles of her Feet, but her Shoes and Stockings not touched. She fate next to those that were Kill'd; she was taken out of the Ditch for Dead, and was supposed to be Kill'd. She was sensible of the stroke, and sensible that her Husband looked Pale, and then swooned away. She and her Husband were both Blooded; she within an Hour after, and her Husband eight Hours after; and they Bled freely. Their Legs were mightily Swelled, before they were carried out of the Field. The Woman was very sore and full of Pain, so that she could hardly bear any Cloaths to touch her. She was three Weeks ill before she could Rise, and continued ill about a Quarter of a Year. No Medicines used for Burns did any Good, but occasioned great Torment to her. The first that they perceived to do Good was *Oil* of *St. John's-wort*; and after the *Cores* were come out, the *Black-Salve*. She went out her full Time: The Child had no Marks or Blemish at all upon this Occasion;

Occasion; and is yet Living. About that time of the Year, she hath been Blooded ever since. She finds a great Tingling, and hath little Pimples like Stinging of Nettles; and cannot be well till she hath been Blooded.

The *Wounds* of all those that were Hurt, were like those of this Woman; but Slighter; and some of them had no *Cores* came out of them.

This is the best account I can give you out of the broken Remarks which I had in writing from Mr. *Edwards* and Mr. *Butler*, the two Gentlemen above mentioned.

11. Dec. 22. 1698. *Jeremiah Skelton*, at *Warley* in the Vicaridge of *Hallifax* in *Yorkshire*, Observing a Storm coming upon him, step'd aside for Shelter within a Barn-Door, and while there, was struck with a dreadful *Flash* of *Fire*; a Young Woman that lived with her Father, in the House that belonged to this Farm, being sadly affrighted with the *Thunder* and *Lightning* (for part of the Sulphurous Matter came down the Chimney, and fill'd the House with a strong *Scent*, like that of Gunpowder after Firing) she leaves the House, and not seeing the Young Man about the Barn, goes with speed and tells the Family he was related to, that she fear'd he was slain. They came to the Barn and found it even so: A sad Spectacle; the Young Man cast down and many Stones about him; he was laid upon his Face, wholly Naked, save a small part of his Shirt about his Neck, and a very little of a Stocking upon one Foot, and so much of a Coat-Sleeve as covered the Wrist of one Arm; his Cloggs driven from his Feet, one not to be found, and the other Cloven; his Hat not to be found after Search; and the rest of his Garments Torn into small Shreds, and cast at considerable Distances one bit from another; the Hair of his Head and Beard Singed, as tho' it had been with a Candle, and a little Hole below his left Eye, which they supposed might be made with the Fall upon a Stone: for there was a great Breach made upon the Barn, the Door Tops, both of Stone, broken, and the Wall above them fallen, with the Slate and Water Tables.

In *Yorkshire*,
1698. by Mr.
Ralph Thores-
by. n. 249. p. 51

12. Apr. 27. 1700. We had (at *Leeds* in *Yorkshire*) a pretty severe Storm of *Thunder* and *Lightning*: One Clap particularly was very Loud, and seemed to me to be very low and near us. It fell upon a Cottage and broke down part of the Chamber Chimney, and thence made its way through a Chink or Nick in the Floor to the lower Room, whereby the Flame thus contracted was either more intensely Hot, or at least directed more immediately to a Shelf, where it Melted several Holes in two *Pewter* Dishes; it Melted also, and Run into little Lumps, several Places in a *Pewter* Candlestick, and of a *Brass* Mortar: Yet Burnt not some bits of Fringe, and other Combustible Matters within it; it Burnt also some Holes in a *Tinn* Vessel, and Smuted a white Stone Plate it stood upon, as if it had been with *Lamp-black*, and filled the Room with such a *Bituminous Smell* (like fired Gunpowder) as almost stifled the poor Woman, who was all alone in the House: But upon opening the Door received no further Damage. I bought the Candlestick to preserve as a Memorial of so uncommon an Accident;

In *Yorkshire*,
1700. by Mr. R.
Thoresby.
n. 264. p. 577.

I have enquired of one in that Neighbourhood concerning a more Fatal Accident, of which the *Parish-Register* has this Note. Sept. 2. 1672. *was Buried Thomas, the Son of James Lambert Junior, deceased, of Holbeek, Slain the Day before, being the Lords Day, by a Thunderbolt.* His Skin, (as I am informed) was perfectly *Burnt Black*, and was Shrunk up hard like Parchment or Leather burnt with Fire. There were other Children in Company, who were also cast down by the Storm, amongst whom the Party I spoke to had a Brother and Sister: He had a pair of new Stockings Burnt off his Legs, and himself was so Scorched, that he never recovered his Natural Complexion; She having a Waste-coat clasped before (as the Fashion then was) was so Burnt betwixt her Breasts, that the Scars thereof remains to this Day; Another had the stiffed Neck of his Doublet struck off.

But all recovered, except *Lambert's Boy*, who was found with his Face upward, whereas all the rest had theirs to the Earth: Which reminds me of our Cole-Miners Practice, who, when any Swoon away by their *Sulphurous Damps*, Dig a Hole in the Earth, and lay 'em on their Bellies with their Mouths in it, which (if it prove not an absolute *Suffocation*) recovers them.

The Direction of Ship Compasses Changed with Thunder and Lightning; by n. 127. p. 647.

LX. 1. Mr. *Haward*, who has been Master of several Ships, and is a Man of good Credit, tells me, That in a Voyage to *Barbadoes* in company of another Ship commanded by one *Grofton* of *New-England*, they were, in the *Latitude* (as I remember) of *Bermuda*, suddenly alarmed with a terrible Clap of *Thunder*, which broke this *Grofton's* Fore-Mast, tore his Sails, and did some dammage to his Rigging: But by that time the Noise, together with the danger of this frightful Accident was past, Mr. *Haward*, to whom this *Thunder* had been more favourable, was however no less surpris'd, to see his Companion's Ship steer directly homeward again. When they were almost out of Call, he Tack'd and stood after them, and found That Mr. *Grofton* did indeed steer, by the right Point of his *Compass*, but that the *Card* was Turn'd round, the *North* and *South* Points having *Changed Positions*; and though, with his Finger he brought the Flower de Lys to point directly North, it would immediately as soon as at Liberty return to this new unusual Posture; and upon Examination he found every *Compass* in the Ship of the same Humor: Which strange and sudden Accident he could impute to nothing else but to the operation of the *Lightning* or *Thunder* newly mentioned. He adds, that he lent *Grofton* one of his *Compasses* to finish the Voyage, and withal that those *Thunder-Strucken* ones, did never to his knowledge recover their right *Positions* again.

By Sir R. S. n. 157. P. 520.

2. *July 24. 1681.* The Ship called the *Albemarle*, whereof Mr. *Edward Lad* was then Master, being a hundred Leagues from *Cape-Cod*, in *Lat. 48°* about 3, h. p. m. met with a *Thunder Storm*; the *Lightning* burnt the Main-Top-Sail, split the Main-Cap in pieces, Rent the Mast all along; there was in special one Dreadful Clap of *Thunder*, in Report bigger than that of a great Gun, at which all the Ships Company were Amazed; then did there fall something from the Clouds, upon the Stern of the Boat, which broak into many

many small parts, Split one of the Pumps, the other Pump much hurt also; It was a Bituminous matter, *Smelling* much like Fired Gun Powder: it continued burning in the Stern of the Boat; they did with Sticks dissipate it, and poured much Water on it, and yet they were not able by all that they could do, to extinguish it until such time as all the matter was consum'd.

When Night came, observing the Stars, they perceived that their *Compasses* were *Changed*; as for the *Compasses* in the *Bittakle*, the *North Point* was turned clear *South*. There were 2 other *Compasses* unhung in the Locker in the Cabbin, in one of which the *North Point* stood *South*, like that in the *Bittakle*; as for the other, the *North Point* stood *West*; So that they sailed 1000 Leagues by a Needle, whose *Polarity* was quite *Changed*. As for the *Compass* wherein the *Lightning* had made the Needle to Point *Westward*, since it was brought to *New-England*, the *Glass* being broken, it has, by means of the Air's coming to it, wholly lost its *Virtue*.

Mr. *Edward Randolph* (who has been 4 times imployed to *New-England* in his Majesties Service) being enjoyned by Mr. *Flamsteed* to make enquiry into this matter, at his return to *Boston* in *Dec. 1683*. spoke with Mr. *Lad* himself. He affirmed the same thing, and dictated to him an account suitable to what you have. But that which you have, was in the hands of Mr. *Mather* a Minister, to whom Mr. *Lad* had also presented one of the *Compasses*, as he had done the other to an *English Merchant* in *Amsterdam*, who gave it to the Statehouse.

LXI. 1. About *Christmas* 1693. at *Harlech* in *Merioneth-shire*, 16 Ricks of Hay and 2 Barns, whereof one was full of Corn, the other of Hay, were set on Fire by a *Kindled Exhalation*, which was often seen to come from the Sea, and lasted at least a Fortnight or three Weeks; and it annoyed the Country, as well by *Poysoning* their Grass, as *Firing* the Hay, for the space of a Mile, or thereabouts. Such as have seen the Fire, say it was a blew weak Flame, easily extinguished, and that it did not the least harm to any of the Men, who interposed their Endeavours to save the Hay, though they ventured (perceiving it different from common Fire) not only close to it, but sometimes into it. All the Dammage sustained happen'd constantly in the Night. *Dec. 24.* *Richard Griffith* of *Lechweddu*; *Humphrey Owen* of *Garreg-wenn*, and *Richard Davydh* of *Erw-wenn*, each of these lost a Rick of Hay. 27. That Night was burnt one Rick of Hay of *John Philips* of *Tnyslanvibangel y Tral-thau*, two Ricks of Hay of *Griffith John Owen* of *Cefn-Trevorbach*, and *Katherine William*, Widow, of *Cefn-Trevor fvaawr*, lost 2 Ricks. 29. That Night *Francis Evans* of *Glas-vryn* had one Rick burnt. *Richard Davydh* of *Erw-wenn* had a Barn full of Hay of 3 Bayles of Buildings, burnt down to the Ground.

There are 3 small Tenements in the same Neighbourhood (call'd *Tydbin-Sion Wyn*) whereof the Grass is so *Infected*, that it absolutely kills all manner of Cattle that feed upon it. The Grass has been *Infectious* these three Years, but not throughly Fatal till this last.

A Fiery Exhalation or Damp by Mr. Maurice Jones. n. 208. p. 49.

By Mr. Edw.
Hawyd. n. 213.
p. 223.

2. An Intelligent Sober Person, that lives near *Harlech*, assures me that the *Fire* still [*Aug. 1694*] continues there; that it is observed to come from a place call'd *Morva bychan* in *Caernarvonshire*, about 8 or 9 Miles off [over part of the Sea.] That Cattle of all sorts, as Sheep, Goats, Hogs, Cows, and Horses, still *Dye* apace; and that for certain any great Noise, as Winding of Horns, Drums, &c. does *Repel* it from any House or Barn, or Stacks of Hay, upon account of which Kemedy, they have had few or no Losses since *Christmasts*; That it happened, during this Summer, at least one Night in a Week, and that commonly either *Saturday* or *Sunday*; but that now of late it appears something oftner. The place from whence it proceeds is both Sandy and Marshy.

Fairy-Circles;
by Mr. Jeffop.
n. 117. p. 394.

LXII. I have often been puzzled to give an Account of those *Phænomena*, which are commonly called *Fairy-Circles*. I have seen many of them, and those of two sorts; one sort *Bare*, of 7 or 8 Yards Diameter, making a Round path something more than a Foot broad, with Green Grass in the middle; the others like them, but of several bignesses, and encompassed with a Circumference of Grass, about the same breadth, much *Fresher* and *Greener* than that in the middle. But my worthy Friend Mr. *Walker*, gave me full Satisfaction from his own Experience; it was his chance one Day, to walk out among some Mowing Grass (in which he had been but a little while before,) after a great Storm of *Thunder* and *Lightning*; which seemed by the Noise and Flashes to have been very near him: He presently observed a *Round-Circle*, of about 4 or 5 yards Diameter, the Rim whereof was about a Foot broad, newly *Burnt Bare*, as the colour and brittleness of the Grass Roots did plainly Testifie. He knew not what to ascribe it unto but the *Lightning*, which, besides the odd *Capricious* remarkable in that Fire in particular, might without any wonder, like all other Fires, move Round, and Burn more in the Extremities than the Middle. After the Grass was Mowed, the next Year it came up more *Fresh* and *Green* in the place Burnt, than in the Middle, and at Mowing-time was much Taller and Ranker.

The Cause of
Lightning and
Thunder con-
sider'd; by Dr.
Lifter. n. 157.
p. 517.

LXIII. 1. There are two sorts of Instances (that often occur in History) which very much favour my Opinion, That *Thunder* and *Lightning* owe their Matter from the sole *Breach* of the *Pyrites*.

The first sort of them are those which tell us that in *Italy* it Rained Iron in such a Year, and in *Germany* a great Body of Iron-Stone fell at such a time; the like *Avicen* affirms. *Julius Scaliger* says that he had by him a piece of Iron which was Rained in *Savoy*, where it fell in divers places. *Cardan* reports 1200 Stones to have fallen from Heaven, and one of them Weighed 120 *l.* some of them 30 *l.* some 40 *l.* very Hard, and of the Colour of Iron. Now that which is very remarkable (says *Gilbert*, where those Instances are reckon'd up,) and a very probable Argument for the Truth of such like Instances, is that it is no where Recorded, that it ever Rained Gold or Silver Ore, or Tin, or Lead; but Copper hath been also said to have fallen from the Clouds.

But

But wherever the *Pyrites* is mentioned by the Antients, it is always to be understood of the *Copper Pyrites*; they scarce having had any Knowledge of the *Iron Pyrites*. And therefore the Raining of Copper makes it yet more probable, because of its great Affinity with Iron.

Now this *Ferrum* or *Æs Nubigenum*, if there was ever any such, was con-creted of the *Breath* of the *Pyrites*, which we have elsewhere shewn to be the *Pyrites, ex tota Substantia*.

The other Instance, (which is owing to our Registers) is of *Lightning* being *Magnetick*. This I am sure of, I have a Petrified piece of Ash, which is *Magnetick*; that is, the *Pyrites in Succo*; which makes it probable it may be *Magnetick* also in Vapour. Vid. Sup. §. LX.

2. *Thunder* and *Lightning* are so very like the Effects of Fired Gun powder, that we may reasonably judge them to proceed from like Causes. Now the Principal Ingredients in Gun-powder are *Nitre* and *Sulphur* (the Admission of Char-cole being chiefly to keep the parts separate, for the better Kindling of it.) So that if we suppose in the Air, a convenient Mixture of *Nitrous* and *Sulphurous* Vapours, and those by Accident to take Fire, such *Explosion* may well follow, with such Noise and Light, as in the Firing of Gun-powder. And being once Kindled it will run from place to place, as the Vapour leads it, as in a Train of Gun-powder, with like Effects. The Cause of Hail, Lightning and Thunder consider'd; by Dr. Wallis. n. 231. p. 655.

This *Explosion*, if High in the Air, and far from us, will do no Mischief, or not considerable; like a parcel of *Gun-powder* Fired in the open Air, where is nothing near to be Hurt by it: But if near to us (or amongst us) it may Kill Men or Cattle, Tear Trees, Fire *Gun-powder*, Break Houses, or the like; as *Gun-powder* would do in like Circumstances. This Nearness or Farness may be estimated by the Distance of time between seeing the *Flash* of *Lightning*, and Hearing the Noise of the *Thunder*. For though in their Generation, they be Simultaneous; yet (*Light* moving faster than *Sound*) they come to us successively. I have observed that commonly, the Noise is about 7 or 8 *Seconds* after the *Flash* (that is, about half a Quarter of a Minute); but sometimes much sooner, in a *Second* or two, or less than so, and almost immediately upon the *Flash*. And at such time, the *Explosion* must needs be very near us, or even amongst us. And, in such Cases, I have (more than once) Prefaged the Expectation of *Mischief*, and it hath proved accordingly.

Now, That there is in *Lightning* a *Sulphurous Vapour*, is manifest from the *Sulphurous Smell* which attends it, and a Sultry Heat in the Air which is commonly a Fore-runner of *Lightning* soon after. And that there is also a *Nitrous Vapour* with it, we may reasonably judge, because we do not know of any Body so liable to a sudden and Violent *Explosion*.

As to the *Kindling* of these Materials, in order to such *Explosion*, I am told that a Mixture of *Sulphur* and *Filings* of *Steel*, with the Admission of a little *Water*, will not only cause a great Effervescence, but will of it self break forth into an Actual Fire. I say a little *Water*, because too much will hinder the n. 233. P. 729. Operation, or quench the Fire; which I take to be the Cause of the *Bath Waters*.

Waters, and other *Hot Springs*, where *Steel* and *Sulphur* cause a great *Efferescence*, but no *Flame*.

n. 231. p. 657.

So that there wants only some *Chalybeat* or *Vitriolick Vapour* (or somewhat *Equivalent*) to produce the whole *Effect* (there being no want of *Aqueous Matter* in the *Clouds*.) And there is no doubt, but that amongst the various *Effluvia* from the *Earth*, there may be copious *Supplies* of *Matter* for such *Mixtions*.

n. 233. p. 730.

The same *Account* may be also given of *Ætna* (and other *Burning-Mountains*;) where the *Mixture* of *Steel* and *Sulphur* may give a *Flame*; which is oft attended with prodigious *Explosions* (and *Earthquakes*) from great *Quantities* of *Nitre*, as in *Springing* a *Mine*.

n. 231. p. 657.

This may also suggest somewhat as to the *Generation* of *Hail*, which is very oft an *Attendant* of *Thunder* and *Lightning*. 'Tis well known, in our *Artificial Congelations*, that a *Mixture* of *Snow* and *Nitre* (or even common *Salt*) will cause a present and very sudden *Congelation* of *Water*. And the same in *Clouds* may Cause that of *Hail-stones*. And the rather, because there seems somewhat like *Snow* rather than *Ice*, in the midst of them. And as to those in particular so very large (as to weigh *Half* a *Pound*, or three *Quarters* of a *Pound*) supposing them to fall from so great a *Height*, as 'tis manifest they did by the *Violence* of their *Fall*: 'Tis very possible, that, though their first *Concretion*, upon their sudden *Congelation*, might be but moderately great, as in other *Hail*, yet in their long *Descent*, if the *Medium* through which they fall were alike inclined to *Congelation*, they might receive a great *Accession* to their *Bulk*, and divers of them *Incorporate* into one. Like as in that strange *Shower* of *Hail* in *December*, 1672. Wherein there did hang on the *Trees* a great deal in the *Form* of *Icicles* a *Foot* or more in *Length*.

Vid. Sup. §. XLIV.

Vid. Sup. §. LI.

n. 236. p. 9.

Vid. Sup. §. LIX. 10.

These *Considerations* may also furnish us with some account of the *Natural Causes* of those particular *Circumstances*, which attended the *Accident* at *Everdon* where 4 *Persons* were *Kill'd*, and others *Hurt* with *Lightning*.

It seems to me that in and over the *Ditch* there was plenty of some *Caustick Vapour*, of a like *Nature* with the *Ingredients* of *Gun-powder*: And perhaps even under those who were *Killed* or *Wounded*. And if this *Explosive Quality* were attended with that of *Glaciation*, as *Thunder* is often accompanied with *Hail*, (*Nitre* being a proper *Efficient* of both,) there might be such *Concretions*, in the *Nature* of *Hail*, as might (by such *Explosion*) be scattered like *Hail-shot* out of a *Gun*, and cause such *Holes* as are said to have been in the *Cloaths* and *Flesh* of those *Persons*. And what is said to have been *Observed* by others at a *Distance*, like a *Ball* of *Fire* falling down directly upon the *Place*, might be a *Propagation* of the *Flame* kindled above, and continued, as the *Vapour* directed it, to the *Place* (as would be in a *Train* of *Gunpowder*) and might there hurt some and spare others, according as it was here or there more *Copious*. For we are not to presume that it was in all *places* equally mixed.

The *Cores* which came out of the *Wounds*, seem like *Escars* made by a *Caustick*

Cauftick or other Burnings. And I take them to be Scorched Skin, Mortified, (beat into the Flesh by that *Hail Shot*) and appearing like burnt Leather: Which must be worked out before the Wound could be healed; as is usual, when other Heterogeneous Matter is forced into the Flesh.

That some of the People not far off, might be thrown down, and not otherwise considerably Hurt, is not strange; who might be within the *Blast*, though not within the reach of the *Fire*; as we see in the *Explosion* of *Gunpowder*, (to which I take this to be very like) when Windows (and other things at a Distance) are shaken and shatter'd by the *Blast*, or great Concussion of the Air, though the *Flame* do not reach them.

LXIV. 1. Dec. 25. 1666. In the Evening here (*viz.* at *Madrid*) was a great *Halo* about the *Moon*; the Semidiameter whereof was about $23^{\circ} 30'$. *Aldebaran* was just in the North-East part of the Circle, and the two *Horns* of *Sries* just enclosed by the South West of the Circle, the *Moon* being in the Center. I note this the rather, because 5 or 6 Years ago, *viz.* Nov. 21. 1661. an hour after Sun-set, I saw a great *Halo* about the *Moon*, of the same Diameter, at *Tangier*, the *Moon* being very near the same place, where she was now.

Halo's, At Madrid; by E. of Sandwich. n. 22. p. 390.

2. May 12. 1667. An *Halo* or Circle about the *Sun*, was Observ'd by the *Philosophical Society* at *Paris*. The Diameter of this *Circle*, was found to be of 44 *Degrees*, and the Breadth of the Limb thereof, about half a *Degree*. The upper and lower part were of a *Vivid Red* and *Yellow*, with a little *Purple* Colour, but especially the upper, the *Red* was within the *Circle*. The other parts appeared but *Whitish* and of little Clearness. The Space within the *Halo* was a little Darker than that about it, especially towards the parts that were *Coloured*. Besides, there was seen the *Proportion* of another *Great Circle*, which touched the *Halo* above, and whole Extremities were bent downward, as is represented in the *Figure*. This *Portion* of a *Circle* had also its Colours like those of the *Halo*, but fainter. The Height of the *Sun* at the Beginning of the Observation, was about 46. *Deg.* There were in the Air little White Clouds, which somewhat Tarnish'd the Blew Colour of the Heavens, and lessened the Brightness of the *Sun*, which shone as in an *Eclipse*. The Weather was Cold, considering the Season of the Year; and it was affirmed for certain, that it had *Frozen* the Night before. This *Halo* appear'd in the same Beauty and Splendor of Colours unchanged from 9 in the Morning, (when it began to be Observ'd) until about half an Hour past 10; after which time it became Fainter and Fainter till two of the Clock in the Afternoon, (when it ended,) after it had resumed a little more Force sometime before it disappear'd.

At Paris; by M..... n. 60. p. 1065.

Fig. 26.

3. Jan. 1. St. N. 1676. H. 3. 46'. Durante *Eclipse*, ingens *Halo Lunam* cinxerit.

At Dantzick; by M. Hevelius. n. 124. p. 589.

4. Aug. 21. 1676. At 12. h. 40'. At Night a *Halo* encompassed the *Moon*, in whose Circumference was *Saturn*, the *Pleiades*, *Capella*, and the following of the Foot of *Perseus*.

At Oxford; by Mr. Halley. n. 129. p. 724.

Parhelia Observed, in France; by M..... n. 13. p. 219.

LXV. 1. *April 9. 1666.* About half an Hour past 9, there appeared three *Circles* in the Sky. One of them *SCHN*, was very great, a little interrupted, and *White* every where, without the Mixture of any other Colour. It passed through the midst of the *Sun's* Disk, and was Parallel to the *Horizon*. Its Diameter was above 100 *Degrees*, and its Center not far from the *Zenith A*.

Fig. 27.

The *Second DEBO*, was much less and Defective in some places, having the Colours of a *Rainbow*, especially in that part which was within the great *Circle*. It had the true *Sun R*, for its Center.

The *Third HDN*, was less than the *First*, but greater than the *Second*; it was not entire, but only an *Arch* or Portion of a *Circle*, whose Center was far distant from that of the *Sun*, and whose Circumference did by its Middle, joyn to that of the *Least Circle*, with which it was confounded at *D*, and intersected the *Greatest Circle*, by its two Extreams. In this *Circle* were discerned also the Colours of a *Rainbow*, but they were not so strong; as those of the *Second*.

At the Place, where the Circumference of this *Third Circle* did close with that of the *Second*, there was a great Brightness of *Rainbow-Colours*, mixt together: And at the two Extremities, where this *Second Circle* intersected the *First*, appeared two *Parhelia's* or *Mocksums*, *H*, *N*; which shone very bright, but not so Bright, or so well defined, as the *True Sun*. The Midst of these two *False Sun's* was *White* and very Luminous: And their Extremities towards *D*, were Tinged with the Colours of a *Rainbow*. The *False-Sun H*, that was towards the South, was bigger, and far more Luminous, than that towards the East.

There was also upon the *First Great Circle*, a *Third Mock-Sun*, *C*, Situated to the North, which was less, all *White*, and far less Shining than the Two others. There was a space very Dark betwixt *R* and *D*.

This Appearance is look'd upon as one of the Notablest that can be seen, by Reason of the Excentricity of the *Circle HDN*, and because that the *Parhelia* were not in the Intersection of the *Circle DEBO* with the great *Circle SCHN*, as they appear'd at *Rome, March 29. 1629.* but in that of the Semicircle *HDN*.

Cartesii Meteor. c. 10.

In Hungary; by Dr. Edw. Brown. n. 47. p. 953.

2. A Learned Jesuit call'd Father *Michael*, who lives at *Presbury*, communicated to me an Account of two *Parhelia's*, which were seen *Jan. 30. 1669.* *St. N.* about one of the Clock in the Afternoon, over the City of *Cassovia* in *Hungary*.

There was one on each side of the *True Sun*, and they were so resplendent, that the Naked Eye could not bear the Brightness thereof. One of them (the lesser of the two) began to Decay before the other, and then the other grew Bigger, and continued well nigh two Hours, projecting very long Rays from it self. They were both, on that part which was towards the *Sun*, Tinged with a pale *Yellow*, the other parts being somewhat Fuscous. There were at the same time seen several *Rainbows*, together with the Segment of a great *White Circle*, of a long

long Duration, passing through the two *Parhelia's* and the *Sun*: And all this at a time, when the Air was almost free from *Clouds*, though here and there were Scatter'd some very *Thin* ones.

3. *An.* 1670. *Oct.* 11. *St. N. H.* 7. 40'. *Tres Parhelia* apparuerunt.

At Dantzick;
by M. Hevelius.
n. 66. p. 2025.

4. *Feb.* 5. 1674. *St. N.* Not far from *Marienburg* in *Borussia*, I saw the *Sun* (in a *Sky* every where *Serene* enough) being yet some *Degrees* above the *Horizon*, and shining very bright, yet lancing out very long and *Reddish* Rays, 40 or 50 *Degrees* toward the *Zenith*. Under the *Sun*, towards the *Horizon*, there hung a somewhat dilute small *Cloud*, beneath which there appear'd a *Mock-Sun*, of the same bigness (to *Sense*) with the *True Sun*, and under the same *Vertical*, of a somewhat *Red* Colour. Soon after, the *True-Sun* more and more descending to the *Horizon* towards the said *Cloud*, the *Spurious Sun* beneath it grew *Clearer* and *Clearer*, so that the *Reddish* Colour in that *Apparent Solar* Disk Vanish'd, and put on the *Genuine* *Solar* Light, and that the more, the less the *Genuine* Disk of the *Sun* was distant from the *False Sun*: Till at length, the upper *True-Sun* passed into the lower *Counterfeit* one, and so remained alone.

At Marien-
burgh in Bo-
russia; *by M.*
Hevelius.
n. 102. p. 26.
Fig. 28.

Fig. 29.

Fig. 30.

Upon this appearance there soon followed here an exceedingly *Intense* and bitter *Frost*, whereby the whole *Sinus Puzensis* was *Frozen* up, from this *Town* of *Dantzick*, as far as *Hela* in the *Baltique Sea*, which lasted unto the 25 of *March*, and the *Bay* was *Frozen* so hard, that with great safety *People* run out into it with *Sleds* and *Horses*, for several of our *Miles*.

5. *Aug.* 28. 1698. about 8 a *Clock* in the *Morning*, some *Persons* at *Sudbury* in *Suffolk* saw the Appearance of *Three Suns*; 'tis said, then the *Apparition* was most *Full*, or a little after. About $\frac{1}{2}$ an *Hour* after 8, I my self saw it; there was in the *East*, a *Dark*, *Dusky*, *Watry* *Cloud*, and below it towards the *Middle*, was the *True Sun*, shining with fierce and piercing *Beams*, that *Persons* could not look upon it; on each side were the *Reflections*, with the *True Sun* in the *Middle*. Elsewhere much of the *Firmament* was of an *Azure*, *Light-Blew* Colour. The *Circles* which I saw, was not of *Rainbow-Colours*, but *White*. There was also, higher in the *Firmament*, more over our *Heads*, and toward the *South*, at the same time, at a considerable *Distance* from the other, the *Form* of a *Half Moon*; but I think it was more than twice the *Bigness* of a *Half Moon*, with the *Horns* turned upward, and within of a fiery *Red* Colour, and more like a *Rainbow Colour*, These all *Faded* gradually; They continued in all, I suppose, two *Hours*.

In Suffolk; *by*
Mr. Petto.
n. 250. p. 107.

6. *Feb.* 26. 1698. about half an *Hour* after 3. in the *Afternoon*, changing to look out of a *Window* that faced *South-East*, I saw not far from the *South* to the *Westward*, an Appearance of somewhat not much unlike the *Sun* when seen through *Clouds*, viz. with its *Periphery* not exactly defined: From which it likewise differed, in that one half of it was coloured *Deep Red* and *Yellow*, the other *White*. I went immediately into the *Garden*, and saw an Appearance exactly like the former, but on the *Opposite* side of the *Sun*. The *Distance* of this was 23°. from the *Sun*, to the *Westward*; but before I could take the *Distance* of the *Eastern* one, it *Vanished*, but soon after *Re-appear'd*,

At Canterbury;
by Mr. St.
Gray. n. 251.
p. 126.

and then I perceived manifestly, that they were both situate in the Extremities of a *Semicircle*, whose Center was the *Sun*, passing betwixt it and the *Zenith*. This Appearance continued about half an Hour.

At Canterbury;
by Mr. St.
Gray. n. 262.
p. 535.
Fig. 31.

7. *Apr.* 7. 1699. Between 4 and 5 a Clock, there appeared on each side the *Sun* *A*, a *Parhelion*, *B C*, connected by an *Halo* *B D C*, of the usual Diameter, they had each of them a *Tail* of a *Whitish* Colour, extended opposite to the *Sun*, of about 15 or 20 *Degrees* in Length, the upper part of the *Halo* was touched at *D*, by the Arch of a *Circle*, whose Ends were turned towards the *Zenith* *Z*; it had the Colours of the *Iris*, but faintly; betwixt this and the *Zenith* was another Portion of a *Circle* *E*, which had the Colours of the *Iris* with greater Vivacity than the former.

Rainbows Ob-
serv'd in
France; by M.
Estienne. n. 13.
p. 221.
Fig. 32.

LXVI. 1. *An.* 1665. *Aug.* 10. About half an Hour past 6 in the Evening two odd *Rainbows* appeared at *Chartres* in *France*, crossing one another almost at Right Angles. The *Rainbow*, which was opposite to the *Sun*, in the usual manner, was more deeply coloured, than that which Cross'd it: And its greatest Height, was about 45 *Degrees*. The Feebler *Rainbow* lost one of its Legs, by growing Fainter, about 20 *Degrees* above the stronger; and the Leg below appeared continued to the *Horizon*. This seem'd to be a Portion of a great *Circle*; and the Stronger was but a Portion of a small *Circle*, as usually.

The *Sun*, at their Appearance, was about 6 *Degrees* high above the *Horizon*. The River of *Chartres*, which runs very near from South to North, was betwixt M. *Estienne* (the Observer) and the *Rainbow*, and He stood Level with the River, whence he was distant not above 150 Paces.

At London; by
Mr. Edm. Hal-
ley. n. 240.
p. 195.

2. *Mar.* 11. 1696 It Rain'd pretty thick a small Rain, and the *Sun*, about 2 of the Clock, shone directly down *Abchurch Lane*, as I was passing along it with my Back to him, when I perceived the Arch of the *Primary Rainbow* in the Drops of Rain, spanning the Street like an Arch of a Building under which I was to pass, the Crown whereof was not much higher than my Head, and the Diameter thereof scarce so wide as the Street, which is but 5 Yards; and it moved along with me as fast as I went; the Colours being very Vivid and Distinct, though the Arch it self appear'd but narrow, and the Houses were every where behind it. This, tho' very uncommon, will not appear strange to those who have well considered the Nature of the *Iris*.

At Chester; by
Mr. Edm. Hal-
ley. n. 240.
p. 193.

3. *Aug.* 6. 1698. Between 6 and 7 a Clock in the Evening, I Observed an *Iris*, exceedingly Vivid, as to its Colours, at first on the Southside only, but in a little time with an entire Arch; and soon after, the Beams of the *Sun* being very strong, there appear'd a *Secondary Iris*, whose Colours were more than Ordinary Bright, but inverted, as usually: That is, the *Red* was inwards, which in the *Primary Iris* is outward, and *è contra* for the *Blews*. But what I took most notice of was, that with these two Concentrick Arches, there appear'd a third Arch, near upon as Bright as the *Secondary Iris*, but Coloured in the Order of the *Primary*, which took its Rise from the Intersection of the *Horizon* and *Primary Iris*, and went cross the Space between the two, and intersected the *Secondary*, as in the Figure *AFCG* Intersects the *Secondary Iris*

EFGD

EFGD, dividing the Arch *ED*, into three equal Parts, as near as I could then guess: But at first the Arch *AF*, did not appear, which afterwards became as Bright as the former. I Observed the Points *F*, and *G*, to arise, and the Arch *FG*, gradually to contract, till at length the two Arches *FHG*, and *FG*, became coincident; when, for a great space, the *Secondary Iris* lost its Colours, and appeared like a *White Arch* at the Top. I observed also, that at the Points *F*, and *G*, the Intersection of the Interior *Red* of the *Secondary Iris*, and the Exterior *Red* of the Arch, was much more intently *Red* than the outward Limb of the *Primary Iris*; and that during the whole Appearance, the upper part of the *Third Iris* was not at all Visible, beyond the Intersections, *F*, *G*. This uncommon Sight entertained me for about 20. *min.* when the Clouds blowing away, the whole Vanished. I was at first amaz'd with the Sight, but afterwards, recollecting that the *Sun* shone along the River *Dee*, which from thence empties it self into the *W. N. W.* where the *Sun* then was, I concluded this *Secondary Arch AFHGC*, was produced by the Beams of the *Sun Reflected* from that Water, which at that time was very Calm; and it had been much more Bright, had it been at that time about High, as it was Low-Water, when all the Sands were bare. I was soon confirmed that my Supposition was Right, and that it answered all the Appearance without any Scruple, and that the Arch *AFHGC*, was no other than that part of the Circle of the *Iris*, that would have been under the Earth, bent upwards by *Reflection*.

Fig. 33.

I Remember not to have read of any such *Iris* in any Author. *Des Cartes*, indeed speaks of an *Inverted Iris* by *Reflection*, but it is not possible to be seen as he Describes it: And I Quæry whether ever any such has been really Observed.

LXVII. The Observation of the *Halo*, which appeared at *Paris*, *May* 12. 1667. engaged *M. Hugen*s to propose to the *Academy* there, what he had Meditated some Years before, not only of these *Halo's* but also of the *Parhelia*. As for *Halo's*, he said, that they were formed by small round *Grains* made up of two Parts, one Transparent, the other Opaque; the latter being inclosed in the former, as a *Cherry-stone* is in a *Cherry*. Thus *AA*, represents one of these *Grains*, and *B*, the *Kernel* or Opaque part.

The Causes of
Halo's and Par-
helia Consider'd
by M. Hugen.
n. 60. p. 1066.
Vid. Sup.
§. LXIV.

He related the Observations of those who have seen *Hail* formed after this manner, and explain'd how that some of these little *Grains*, which swim up and down in the Air betwixt us and the *Sun*, being less distant from the Axis, which extends it self from the *Sun* to our Eye, than of a certain Angle, do necessarily hinder the Rays, which fall on them; from coming to our Eyes, in regard that the Opaque *Kernel* is the Cause that there is behind every such *Grain* a space of a Conical Figure, as *MNO*, in which the Eye of the Spectator being scituated cannot see the *Sun* through that *Grain*, though it may see him when posted elsewhere, as some where in *P*.

Fig. 34

And to make the Company the more distinctly to understand the Effect which these *Grains* suspended in the Air must produce, he drew the 35. Fig. in which *B*, is the place of the Eye; *BA*, the Axis which passeth from the Eye

Fig. 35.

to.

to the Sun: *C, M, F*, some of the *Icy Grains* with their *Kernel*, making them half Opaque: Among which the *Grain C*, being in the Axis, *BA*, and the Lines *CK, LH*, representing the Rays of the *Sun* nearest to the Axis, the passage of which is not hindred by the Opacity of the *Kernel*, 'tis certain, not only that the *Grain C*, will not be able to transmit any Ray of the *Sun* towards *B*, but also that, imagining the Superficies of a Cone, whose Top is in the Eye, and its sides *BD, BE*, Parallel to the Rays *CK, LH*; all the *Grains MM*, which this Superficies shall comprise, will likewise not suffer any Ray to pass to the Eye, because it must needs be in their Cone of Obscurity; but those that shall be without this Superficies, as the *Grains F, F*, will let them pass, because the Eye is without their Cone of Obscurity. Whence it follows, that the Angle of this Cone *BDE*, is that which Determines the Diameter of the *Halo*, which depends from the Proportion, the Opaque *Grain* hath to the Transparent, in which it is inclosed. For if this Diameter is of 44 *Degrees*, as is Observ'd in most *Halo's*, the bigness of the Opaque *Grain* will be to the Transparent, as 40 to 19. But he said, that this Proportion was not always the same, and that the Diversity of it was the Cause, that sometimes there were seen many *Halo's*, one about the other, all having the *Sun* for their Center.

He added, that it was easy to know, why these *Halo's* were always of a round Figure, whether the *Sun* be little or much raised above the *Horizon*; as also to give a Reason of their *Colours*, which is the same with that in the *Triangular Glass Prisms*; as is evident by the Tangents *AC*, drawn to the *Grain A*, at the Points, where the Ray *DA*, enters or comes out.

Further he took notice, that it was also manifest, why the *Red Colour* is in the Interiour Circumference of the *Halo*: and why the space, which it taketh in and chiefly near the most lively *Colour'd* parts, appears Obscurer than the *Air* about; *viz.* because it is there, where most *Grains* are, which transmit no Rays of the *Sun* to our Eyes, and so do nothing but darken the *Air*, as the Drops of *Water* when it Raineth.

As to the *Arch* of the *Circle*, which above touched the *Halo*, seen *May 12. 1667.* as also that the *Colours* were more Vivid in this place and in that below, than in the rest of the *Circle*; he said, that these Effects did not proceed from the *Grains*, he had been speaking of, but from another Cause, which did also serve for the Production of the *Parhelia*, and the *Circles* which almost always accompany them. Touching which *Circles* and *Parhelia's* he told the Company, that besides the Round and half Dark *Grains*, there were also formed in the *Air* certain little *Cylinders* of the like Nature: Which being suppos'd to be *Oblong Icy Grains*, and Roundish at both Ends, having the inner *Kernel* of the same shape, it was found, that from their different Dispositions all the Appearances of the *Parhelia* and their *Circles* did necessarily follow.

And first, that some of these *Cylinders* being erect, in the Situation which probably they ought to have in being formed, there must appear in the Heavens a great *White Circle*, Parallel to the *Horizon*, passing through the *Sun*, and of near the same breadth withhim; as hath been observed in the Phænomenon of

Rome.

Rome. An. 1629. of which *Gassendus* and *Des Cartes* have written, and which is here Exhibited.

That this Circle *L K N M*, is caused by the *Reflection* of the Rays of the Sun upon the Surface of these *Cylinders*; it being easy to Demonstrate, that there are none but those which are raised at the same Angle above the *Horizon* with that of the Height of the *Sun*, that can *Reflect* his Rays to our Eye. Whence it manifestly follows, that it must appear *White*, and throughout of equal Altitude with the *Sun* it self, and by Consequence Parallel to the *Horizon*. That considering afterwards the Transparency of these Perpendicular *Cylinders*, and their Opaque *Kernels*, it is easily seen, that those of the *White Circle*, which are distant from the *Sun* at a certain Angle, begin to give passage to his Rays to strike our Eyes, in the same manner as hath been said of the Round half Dark Grains. That these *Cylinders* are those, which on each side of the *Sun* make us see a *Parbelion* in the great *White Circle*, as hath been noted in the Observation of *Rome* (where they are mark'd with *K* and *N*) and in many others. That these *Parbelia* have commonly luminous *Tails*, because the *Cylinders*, which follow those first ones that form the *Parbelia*, and which are yet further distant from the *Sun*, let also pass his Rays to our Eye; so that these *Tails* may be 20 *Degrees* and more in length. That the same *Parbelia* are always *Colour'd*, because they are made by *Refraction*, as the *Halo*.

Fig. 37.

That besides, there are two other *Images* of the *Sun*, generated by these Perpendicular *Cylinders*, and so disposed in the great *White Circle*, that the Spectator, turning his Face towards the *True Sun*, hath them behind him; as in the *Roman* Observation are the *Parbelia* *L*, and *M*. That these are produced by two *Refractions* and one *Reflection* in these *Cylinders*, in the same manner as the Ordinary *Rainbow* in the Drops of Water, according as *M. Des Cartes* hath declared: So that the Opaque *Kernels* do nothing to the Production of these two *Suns*, but that they may be sometimes so big, as to make them not appear. That according to the *Altitude* of the *Sun*, more or less, these two *Parbelia* are more or less nigh to one another. That they should appear *Colour'd*, as the *Rainbow*, and that sometimes they have been seen such; but that when they are faint, they may also seem *White*, even as the *Halo's*, when they are not very Bright.

That these same Perpendicular *Cylinders* can also produce an *Halo* about the *Sun*, by Reason of the Rounding of their two Ends; which maketh, that being distant from the *Sun* at a certain Angle, on what side soever it be, they begin from thence to give Passage to the Rays, transmitting them to the Eyes of the Spectator.

And that these *Halo's* are probably those, we see almost always pass through the two *Parbelia* that are on the sides of the *True Sun*, as the *Halo* *G K N I*, in the Phænomenon of *Rome*.

That there is yet another Scituation of these *Cylinders* very considerable, which is of those that are *Couchant*, so as their Axes are Parallel to the Plane of the *Horizon*; but turned divers ways, some one some another way, like Needles confusedly thrown on the Ground: Which *Horizontal* Disposition, is very Natural to those *Cylindrick* Bodies supported by the Vapours, which rise
from

from the Earth, as may be made out Experimentally in Bodies thus Figur'd, being let fall in the Air.

That it is in these *Cylinders*, that the *Arches* which touch the *Halo's* above or below, are formed; such as there were in the *Phænomenon* observ'd at *Rome* *A.* 1630. which is described by *P. Schenir* in a Letter to *M. Gassendus*, as also in all those which *M. Hevelius* had related at the End of his *Mercurius in Sole*.

And that the *Arch*, which appeared upon the last *Halo* at *Paris*, *A.* 1667. was of the same kind. That the Figure of these *Arches* is different according to the different Altitudes of the *Sun*, and the several Magnitudes of the Diameters of the *Halo's*.

Fig. 38. That when the *Sun* is very nigh the *Horizon*, such an *Arch*, appearing upon ordinary *Halo* of 44 Degrees, must represent as 'twere two *Horns*, as in *Fig. 38.* *AB*, *AC*: But that the *Sun* Rising higher, those *Horns* become lower in Proportion, and make such *Arches* as are represented in the same *Fig.* where each Height of the *Sun* is mark'd near the *Arch*, which it is to make.

That the place of the *Arches* where they touch the *Halo's*, being more strongly enlightned and coloured than the rest, maketh us judge that there are *Parbelia* in those Places. That the Reason, why these *Arches* do ordinarily touch a *Parbelion*, was, that the same *Cylinders Couchant*, which produce the *Arch*, produce also that *Parbelion*, by the means of their two round and Transparent Ends, in the same manner as hath been said of the *Perpendicular Cylinders*. And that the *Parbelion* last seen at *Paris*, had been formed in these *Couchant Cylinders*. That that was also confirmed, by Reason that it was Brighter in the Superior and Inferior part, than any where else; which necessarily comes to pass in a *Parbelion* caused by *Cylinders* thus disposed, whereas when produced by the *Round Grains*, it must appear every where equally strong.

That in these same *Cylinders Parallel* to the *Horizon*, there is also found the Cause of the *White Cross*, observ'd together with the *Paraselenes*, or *Mock-moons*, by *M. Hevelius*, and exhibited at the End of his *Mercurius in Sole*: the *Perpendicular Fillet* of that *Cross*, coming from the Reflection of the Rays of the *Moon* upon the Surface of these *Cylinders*; as the other *Fillet*, Parallel to the *Horizon*, is produced by the Reflection of the *Perpendicular Cylinders* which make the great *White Circle*, of which this *Fillet* is a part. That yet the *Moon* must not be very High above the *Horizon*, to the End that the *Couching Cylinders* may produce this Effect: And that it should be well heeded, when the like *Meteor* shall appear, whether the *Perpendicular Fillet* be not narrower where it passeth through the *Moon*, than in other places, and especially upwards, where it must grow larger and disappear. That besides the *Perpendicular Cylinders*, and those that are *Couched Parallel* to the *Horizon*, there are often a great many, which move to and fro in the Air, in all sorts of Positions; and that those, by the same Reason that the *Round Grains* do, must produce an *Halo* about the *Sun*, and even a more Vivid one than that which is caused by the *Grains*, for as much as each *Cylinder* sends many more Rays to the Eye, than each of these little *Spheres*. That the little *Halo* *DEF*, in the *Roman Phænomenon* (*Fig. 37.*) may very well have been caused by such *Cylinders*.

Fig. 37.

As to those *Mock-suns*, which sometimes show themselves directly opposite to the *True-Sun*, (such an one as was published by M. *Hevelius*, and Observ'd Feb. 23. 1661,) that he could find nothing, neither in the *Round Grains* nor in the *Cylinders*, which should make these *Suns* necessarily to meet in the great white *Circle*, Parallel to the *Horizon*, and that, if that should be always verified by future Observations, the Cause of it must be look'd for elsewhere: But that in the mean time he did believe, that that happened not but by Chance; which being so, a Reason might be given of these *Suns* by the same supposition, which served also for the *Anthelion*, Observed by M. *Hevelius*. Sept. 6. 1661; in which there were two *Coloured Arches* of a *Circle*, opposite to the *Sun*, which did intersect one another, their Intersection being the place of the *False Sun*. Which although it be represented in the Figure of *Hevelius* at the same Height with the *True Sun*, yet it was in truth higher by 15 Degrees or more; as he hath acknowledged himself afterwards: So that, if there had been a great *White Circle* in this *Phænomenon*, the *Parbelion* was not at all to have been in it.

That for the Generation of these *Suns*, he did suppose a Number of small *Cylinders* with *Opaque Kernels*, as the precedent; which were carried in the Air, neither Perpendicularly, nor Couching, but inclined to the Plane of the *Horizon* at a certain Angle, being near a half Right one; to which were particularly appropriated those *Cylinders*, which M. *Des Cartes* saw fall from the Heavens, having *Stars* at both Ends: As may be seen Experimentally, by forming *Cylinders* of that Fashion, which is represented in Fig. 39. and letting them Descend in the Air, or in Water. That in these *Cylinders* was found, following the *Calculus* to be given in another Treatise of *Parbelia's*, not only the Cause of the *Anthelia* made by the Intersection of two *Arches*, as in Fig. 40. but also that of some other Extraordinary *Arches* and *Rods*, that are sometimes Observed near the *Sun*; of which notwithstanding there could nothing be as yet affirmed with certainty, for want of exact and faithful Observations.

Fig. 39.

Fig. 40.

To make all these different Effects of the *Cylinders* manifest to the Eye, M. *Hugens* produced one of Glass, a Foot long, of the Shape of that in Fig. 36. and for the *Kernel Opaque* in the middle a *Cylinder* of Wood, and the Ambient space filled with Water instead of transparent Ice: Which *Cylinder* being exposed to the *Sun*, and the Eye put in such places as was requisite, there were successively seen all those Reflections and Refractions, that have been discoursed of. Whence it might be concluded, that a great Number of the like *Cylinders*, although very small in Comparison to that, being found in the Air, and having the several Postures that have been supposed, all the Appearances of the *Parbelia* and their *Circles* must exactly follow.

Fig. 36.

It was wished, for an entire Confirmation of the truth of this *Hypothesis*, that some of those small *Cylinders* could be observed to fall to the Ground, at the time when any *Parbelia* do appear: Which yet he showed could not easily be done, because that the Vapours, which then Rise from the Earth upwards, and which are the Cause of their *Cylindrical* Figure, keep them also suspended in the Air. He added, that it was not to be thought strange, that such small *Grains* of *Hail* were thus kept in the Air by the Vapours, for as

much as these, by being Rarified and Dilated upwards, might have Motion enough for this Effect; And that that was much more easy to conceive, than to imagine how these same Vapours could keep suspended a very great and weighty *Circle of Ice*, such as *M. Des Cartes* supposeth to explicate the Cause of *Parhelia's*, and of the great *White Circle* of the *Roman Phænomenon*.

Optical Assertions concerning the Rainbow; by M. Fr. Linus. n. 117. p. 386.

LXVIII. 1. Minima quævis Pluviæ Guttula, Radiis Solaribus illustrata, mittit ex se *Iridem* perfectam, non solum quoad ipsos *Colores*, sed etiam quoad eorum *Ordinem*, *Situm*, ac *Figuram Circularem*, ei quam in *Cœlo* videmus simillimam.

2. Radii enim *Solares* Guttulam subintrantes, indeque post duas *Refractiones* & unam *Reflectionem*, iterum versùs *Solem* redeuntes, erumpunt è Guttula *Colorati*, iisdemque plane *Coloribus*, quos in *Iride* videmus, *Rubro*, *Flavo*, *Viridi*, *Ceruleo* & *Purpureo* imbuti.

3. Hi Radii sic *Colorati*, dum *Pluvioso Cœlo* à variis Guttulis *Sole* illustratis in *Oculum* transmittuntur, *Visionem*, quam de *Iride* habemus, efficiunt.

4. Dantur autem inqualibet Guttula duo *Annuli*, Major & Minor distinctis *Coloribus Irialibus* imbuti; quorum Minor distat ab *Axe* seu *Radio* transeunte per *Centrum* Guttulæ, *Gradibus* circiter 21; Major autem ab eodem *Axe* distat *Gr.* 78. Radii autem *Incidentes* in *Minorem Annulum*, inde resiliunt in *Majorem*; è quo erumpentes in *Aerem*, dictis *Coloribus Irialibus* imbutuntur.

5. Oriuntur igitur hi *Colores* a Radiis *Solaribus*; sed non ab iis solis (uti hætenus existimatum) sed etiam à Radiis ipsius *Aeris*, *Corpus Solare* ambientis.

6. Sed neque oriuntur hi *Colores* ab omnibus iis Radiis, sive *Solaribus* sive *Aëriis*, qui Guttulam subintrant; sed ab iis solummodò, qui emittuntur ab ipso *Limbo Solari* *Aereque* ei vicino.

7. Quin & ii Radii, qui sic a *Limbo Solari Aereque* vicino in Guttulam transmittuntur, non omnes spectant ad dictos *Colores*, nec erumpunt *Colorati*; sed illi duntaxat, quorum *Angulus Incidentiæ* nec minor est *Gradibus* 45, nec major *Gradibus* 75.

8. A *Limbo* itaque *Solari*, vicinoque *Aere* procedunt *Colores Iriales*, non tamen omnes quinque immediatè inde fluunt; sed quatuor duntaxat, nempe *Ruber*, *Flavus*, *Ceruleus* & *Pupureus*: *Viridis* enim oritur ex Radiis *Flavis* & *Ceruleis* inter se permixtis.

9. Oriuntur igitur hi quatuor *Colores* à dicto *Limbo*; non tamen omnes ab una eademque ejus parte: Sed duo ex iis ab una parte *Limbi*, & alii duo ab alia ei directè opposita; v. g. à *Limbo Superiore* oriuntur *Ceruleus* & *Purpureus*, & ab *Inferiore*, *Ruber* & *Flavus*.

10. Causa autem, cur à *Limbis* adeo inter se similibus oriantur *Colores* tam *Dissimiles*, non alia hic apparet, quàm quod in uno *Casu* *Limbus Aerius* sit supra *Limbum Solarem*; & in alio *Limbus Solaris* sit supra *Aerium*. Hoc autem *Discrimen* videtur hîc sufficere, eò quòd *Ratione* illius *Diversi Sitûs* nunc

Radii

Radii Solares incurventur per Refractionem supra Radios Aereos; nunc è contra Aerii supra Solares.

11. Oriuntur itaque hi Colores per dictos Radios Refractos, ita tamen Refractos ut per eam Refractionem valdè inter se constipentur. Nam omnes Radii à Gradu 45. Usque ad 60. ad Spatium unius Gradus in Minore Annulo contrahuntur: In quod etiam tam Angustum Spatium confluunt, per Retrogradationem, Radii omnes à Gradu 60. ad 75.

12. Quando plures Homines simul vident Iridem, tot videntur Irides, quot sunt Homines videntes.

13. Qui intuetur Iridem, videt Singulis Momentis aliam & aliam.

LXIX. Iridis Phænomena attentè respicientibus semper constabat, Solis Radios à Nube Aquosa Reflexos, sub certo quodam Angulo in oculum incurrere; unde forma ejus Arcuata: Colorum autem Causa, ut etiam magnitudinis Anguli istius, quo constanter ab opposito Solis Iridem distare deprehendimus, tam Modernos quam Veteres diu multumque torfit: Nec quicquam profecère, usque dum præclarus ille Cartesius, in auxilium collatis Mathematicis Disciplinis, speculationes has Physicas strictiori argumentandi Methodo tractari posse ac debere, pluribus Exemplis edocuit; Inter alia vero Iridis Theoriam exposuit. Ex Hujus Demonstratis constat, Iridem Primariam à talibus Solis Radiis produci, ubi Excessus duorum Angulorum Refractorum supra unicum Incidentiæ Angulum omnium possibilium fuerit Maximus: Secundariam vero Iridem formari ab iis Radiis tantum, ubi excessus trium Angulorum Refractorum supra unum Incidentiæ Angulum similiter sit omnium Maximus. Ac pergere licet ad Tertiam, Quartamve, vel quamvis aliam Iridem, quæ fiunt ubi Radii, post Tres, Quatuorve, vel plures Reflectiones è Guttulis emergunt. In omnibus autem his Regula est Generalis, ut Excessus Quatuor vel Quinque vel plurium Angulorum Refractorum (numero: Scil. Reflexionum unitate aucto) supra unum Incidentiæ Angulum sit omnium Maximus. Excessus autem iste Maximus Duplicatus ubique est distantia Iridis ab Opposito Solis, ubi numerus Reflexionum impar est: Si vero par sit iste Numerus, duplum Anguli istius Maximi sit distantia Iridis à Sole ipso.

Ut autem habeantur Excessus isti Maximi, data Liquoris alicujus Refractione, sive Ratione Sinus Anguli Incidentiæ ad Sinum Anguli Refracti, observandum est, Excessum duorum Angulorum Refractorum supra unum Incidentiæ Angulum, Maximum fieri ubi Augmentum Momentaneum Anguli Incidentiæ præcisè duplum est Augmenti Momentanei Anguli Refracti: Trium vero Angulorum Refractorum Excessum Maximum esse, ubi Augmentum Momentaneum Anguli Incidentiæ Triplum est Momenti Anguli Refracti: & sic de cæteris. Atque hoc per se satis evidens est: Angulos autem ipsos obtinebimus præmissis Lemmate sequente, quod Demonstrare oportet.

Lemma. Manentibus Cruribus Trianguli cujusvis Plani, si augeatur vel minuatür Angulus Verticalis Angulo quorvis dato minore, erunt Momenta sive Mutationes instantaneæ Angulorum ad Basim inter se reciprocè ut Segmenta Basim

The Colours and Diameter of the Rainbow, from the given Proportional of Refraction: And the Contrary; by Mr. Ed. Halley. n. 267. p. 714.

Fig. 41.

Sit ABC , Triangulum cujus Vertex A , Crura AB , AC , & Basis BC , in quam demittatur Perpendicularum AD : Dein augeatur Angulus BAC , Momento aliquo indivisibili CAc , ac ducantur lineæ Bcd , cD , quæ non nisi intellectu differunt à lineis BCD , CD . Dico Momentum Anguli ABC , nempe CBc , esse ad Momentum Anguli ACB , vel ACD , ut CD , ad BD , hoc est reciproce ut Segmenta Basis. Cum enim Angulus ACD , sit summa Angulorum ABC , BAC , Momentum ejus erit etiam summa Momentorum istorum Angulorum, sive $CAc + CBc$; sed CAc , æqualis est Angulo CDc , quoniam, ab Angulum Rectum ad D , puncta A , D , C , c , sunt in Arcu Circuli cujus Diameter est AC : per *Euclid*: 3. 9. ac proinde summa Angulorum CBc , CDc , hoc est Angulus Dcd , erit Momentum Anguli ACD , vel ACB ; Anguli autem isti CBc , Dcd , cum Minimi sint, sunt inter se ut latera sibi opposita, sive ut ccD vel CD , ad BD , hoc est, ut Segmenta Basis reciproce. *Q. E. D.* Quod si Angulus uterque B , & C , fuerit acutus, eodem modo demonstrabitur *Lemma* mutatis mutandis.

Corol. Hinc consequitur Momenta Angulorum ad Basim esse inter se, ut sunt Tangentes Angulorum ipsorum directè.

Fig. 42.

Hoc *Lemmate* muniti facili negotio cujusvis *Iridis Diametrum*, vel Constructione Geometrica vel Calculo, obtinere licet. Exposita enim Linea quavis rectâ CA , dividatur primum in D , ita ut CA , sit ad CD in Ratione *Refractionis*, quæ in Aqua fit, ut 250 ad 187, sive accuratius ut 529 ad 396. Deinde dividatur CA , in E , ita ut CE , sit ad AE , ut Unitas ad Numerum *Reflexionum* quas patitur Radius *Solis*, ad *Iridem* propositam producendam idoneus; ac Diametro AE , describatur Semicirculus ABE , ac Centro C , Radio CD , duc Arcum BD , Semicirculo ABE , in puncto B , occurrentem. Ductis denique Rectis CB , AB , demittatur in AB productam perpendicularis CF , eique parallela EB ; Dico Angulum CBF , esse *Angulum Incidentiæ*, ac Angulum CAB , esse *Angulum Refractum*, quos quærimus, quique producent *Iridem* propositam.

Demonstratio. Cum Triangula ACF , AEB , sint similia, erit AF , ad BF , ut AC , ad EC , hoc est ut Numerus *Reflexionum* Unitate auctus, ad Unitatem, per *Constructionem*; ac proinde Momentum Anguli CBF , erit ad Momentum Anguli CAF , in eadem ratione, per *Lemma præcedens*. Sed Sinus Anguli, CBF , est ad Sinum Anguli CAF , in ratione Laterum CA , CB , hoc est in ratione *Refractionis* datæ; etiam per *Constructionem*. Angulus itaque *incidentiæ* CBF , habet *Angulum Refractum*, sibi respondentem CAF , eorumque Momenta sunt in ratione proposita, quocirca sunt Anguli quæsitæ. *Q. E. D.* Jamque Multiplicando Angulum *Refractum* per Numerum *Reflexionum* Unitate auctum, & de Facto Subducendo Angulum *Incidentiæ*, habebitur Semissis *Distantiæ Iridis* a *Sole*, si Numerus *Reflexionum* fuerit par, vel à *Solis Opposito* si fuerit impar; prout jam diximus.

Hinc Constructione satis concinnâ nec ineleganti, omnium ordine *Iridum* Incidentias Synopticè exhibere possumus, in quolibet Liquore cujus *Refractionis* cognita est. Si enim Linea exposita AC , dividatur Bifariam in E , Trifariam in e , Quadrifariam in ε , ac Quinquifariam in ν , &c. ac Diametris AE , Ae , $A\varepsilon$, $A\nu$, describantur Semicirculi ABE , Abe , $A\beta\varepsilon$, $A\nu\nu$, Quibus omnibus

bus occurrat Arcus Circularis $DBb\beta v$ Centro C , Radio CD , descriptus (qui sit ad AC , in ratione *Refractionis* data) in punctis B, b, β, v ; dico quod ductæ lineæ $AB, Ab, A\beta, Av$, constituent cum linea AC Angulos $CAB, CA\beta, CAv$, æquales *Angulis Refractis*, ac cum Radiis $CB, Cb, C\beta, Cv$, respective, Angulos æquales *Angulis Incidentiæ* requisitis, nempe ABC , vel potius ejus complementum ad Semicirculum, pro *Primaria Iride*; AbC , pro *Secundaria*; $A\beta C$, pro *Tertia*, ac AvC , pro *Quarta*: & sic deinceps.

Quod si cui Calculo accurato hos Angulos investigare libeat, ex eodem fonte facile eruet Lector *Analysta*, quod posito Radio = 1, ac Ratione *Refractionis* ut r , ad s , Sinus *Incidentiæ* erit $\sqrt{\frac{4}{3} \frac{1}{3} \frac{r}{s}}$; Sinus vero *Anguli Refracti* $\sqrt{\frac{4}{3} \frac{r}{s}}$ a quibus Angulis provenit *Iris Primaria*. Pro *Secundaria* vero $\sqrt{\frac{9}{8} \frac{1}{8} \frac{r}{s}}$ erit Sinus *Incidentiæ*, ac Sinus *Anguli Refracti* $\sqrt{\frac{9}{8} \frac{r}{s}}$. Pro *Tertia*, Sinus *Incidentiæ* erit $\sqrt{\frac{16}{15} \frac{1}{15} \frac{r}{s}}$, Sinus *Refracti Anguli* $\sqrt{\frac{16}{15} \frac{r}{s}}$. Radii autem Lucis in *Iridem Quartam* Emergentes in guttulas *Incidunt* cum Angulo cujus Sinus est $\sqrt{\frac{25}{24} \frac{1}{24} \frac{r}{s}}$: Angulus autem *Refractus* Sinum habet $\sqrt{\frac{25}{24} \frac{r}{s}}$. & sic de cæteris. Invenies autem suscepto Calculo, admisâ Ratione *Cartesiana*, *Iridem Primariam* distare ab *Opposito Solis* $41^{\circ}.30'$; *Secundariam* $51^{\circ}.55'$. ab eodem *Opposito*; *Tertiam* vero $40^{\circ}.20'$; ac *Quartam* $45^{\circ}.33'$ ab ipso *Sole*; quas nescio an unquam aliquis videre possit ob *Lumen Solis* in singulis *Reflexionibus* ac *Refractionibus* magis magisq; attenuatum. Atq; hæc de *Magnitudine Iridum* in *Guttulis* perspicuis *Fluidi*, cujus *Vires Refractivæ* innotescant, dicta sunt. Restat ut nonnulla adjiciam de *Coloribus* quibus pinguntur *Irides* eorumque ordine in singulis, variatâ scilicet *Refractione* per omnes *Gradus* possibiles.

Sciendum autem in primis, *Lumen* omne generis *Cærulei* paulo plus *Refringi* quam *Lumen* quodvis *Rubens*, à quâ differentiâ oritur *Latitudo Iridum*, observatione quidem ægrè definienda, ob incertos *Colorum* in *Nube* limites. Quo autem majoris est inæqualitatis Ratio inter CA , & CD , sive quo major est *Refractione*, eo major provenit *Distancia Iridis* cujusvis a *Sole*, adeoque semper *Iridum* limites a *Sole* remotiores *Purpureo Colore* fulgent, propiores vero spissè *Rubent*: Uti semper videre est in *Iride Primaria*, quæ quidem evanescit in *Opposito Solis*, sic Sinus *Incidentiæ* fuerit ad Sinum *Anguli Refracti* sicut CA , ad CE , sive ut 2, ad 1. Quod si major fuerit Ratio illa, nulla omnino conspici potest *Iris Primaria*.

Vid. Sup. Vol. I.
Cap. III. §. I.

Secundariam autem *Iridem* notandum est in *Opposito Solis* in punctum abire, quoties Ratio *Refractionis* fuerit ut 1, ad 0,847487... Inde vero ad *Solem* ipsum recurrere, ibique evanescere, si dicta Ratio fuerit ut 3 ad 1, sive ut CA , ad CE . Intermediis vero Rationibus (quales habentur in omnibus *Fluidis* notis, *Aere* excepto) quo major est Ratio eo plus distat *Iris* ab *Opposito Solis*, vel potius a *Sole* ipso, numerato ultra Semicirculum Arcu: ac proinde *Colores* diverso à *Primariâ* ordine reperiri videbuntur, in his recursibus, nisi hoc in sensu sumatur *distancia Iridum* à *Sole*: quod quidem ubique in cæteris observandum.

Tertia Iris in *Opposito Solis* confunditur, existente Ratione *Refractionis* ut 1 ad 0,91855... Indeque ad *Solem* recurrit in Ratione 1, ad 0,6825... Unde iterum,

iterum, restituto *Colorum* ordine, in Ratione 4, ad 1, sive ut *CA*, ad *Ce*, definit in *Solis Opposito*. *Iris* autem *Quarta* a *Sole* incipiens in Ratione æqualitatis, ad *Oppositum* ejus transit in Ratione 1, ad 0,94895... indeque ad *Solem* regreditur, si Ratio fuerit ut 5, ad 4. Hinc iterum spargitur ad *Solis Oppositum* in Ratione 1, ad 0,56337...: quo spatio clauduntur omnium Fluidorum *Refractiones* notæ. Denique Ratione existente ut 5, ad 1, sive ut *CA*, ad *Cn* in ipso *Sole* evanescit. *Coloribus* ubique quo ad visum inversis in regressu ad *Solem*, uti rectis in *Egressu*.

Hinc in *Nimbus Aqueis*, *Primaria* ac *Quarta Iris* *Coccineos Colores Soli* objiciunt, *Secundaria* vero ac *Tertia Purpureos*.

Unde autem oriatur diversa Fluidorum *Vis Refractiva*, non levis momenti Problema est, interque *Arcana Naturæ* nondum sensibus nec Ratiociniis nostris objecta meritò censendum: *Aqua* ebonim Pura, inter Fluida omnium minimè *Radios Lucis Refringit*; ac *Salibus* quibusvis solutis imbuta, secundum quantitatem *Salis Pondusque* suum, auget *Refractiones*: ac *Spiritus Corrosivi* *Aqua* multo graviores, etiam *Radios Lucis* multo plus *Detorquent*; nec mirum cum *Corpora Densiora* sint, eoque magis *Luminis* transitus obstruere concipi possunt: Cur autem in *Spiritibus Ardentibus* aut *Oleis* quibusvis reperiatnr tanta *Refractio*, presertim in *Sp. Terebinthinæ* aut *Vini* cum Fluida sint respectu *Aquæ* admodum Levia, ac particulis æthereis plurimum Constantia pari argumento non patet; Sed *Luminis* ac *Materiæ* ipsius interiorem cognitionem postulare videtur.

Ex data autem *Iridis* a *Sole* distantia *Refractionis* Rationem eruere, Curiosis Ansam præbet observandi accuratissime ac parvo negotio cujusvis Fluidi *Refractionem*: Si enim ab inferiori parte exilis *Cannulæ Vitreæ* dependeat *Guttula* alicujus Fluidi perspicui, ac *Sole* prope *Horizontem* constituto sed fortiter splendente, observetur sub quo *Angulo* cum *Opposito Solis* in *Guttula* conspiciantur *Iridis Colores*, habebitur levi *Calculo* Ratio quæsitæ: *Cubica* autem est æquatio, unica *Radice* explicabilis, quâ ex datâ *Iride Primaria* supputatur Ratio: nempe $T^3 - 3 T t^2 \dots 4 r r t = 0$, ubi *T*, est *Tangens Anguli Incidentiæ* requisitæ; *t* autem, *Tangens* semissis distantiæ *Iridis* ab *Opposito Solis* ad *Radium* $r = 1$: Unde juxta *Cardani* Regulas, provenit *Theorema*. viz. De *Cubo* ipsius *t*, *Subducatur Productum* ex $2 t r$ in excessum *Secantis* ejusdem arcus supra *Radium*: *Differentia* erit *Cubus minor*. *Eorundem* autem *summa*, adjectis $4 t r r$ erit *Cubus major*. *Summa Laterum* utriusque *Cubi* atque ipsius *t* æquabitur *Tangenti Anguli Incidentiæ*, ejusque *semis* erit etiam *Tangens Anguli Refracti* unde constat Ratio quam quærimus.

Hujus rei cape *Exemplum*. In *Guttula Olei Terebinthinæ* observatur distantia *Iridis Primariæ* ab *Opposito Solis*. $25^\circ. 40'$ quæritur Ratio *Refractionis*.

$$t = \text{Tang. } 12^\circ. 50'. = 0,2278063$$

$$s = \text{Secant. ejusdem} = 1,0256197$$

$$t t t = 0,01182217$$

$$s - r \text{ in } 2 t r = 0,01167265$$

Diff. Cubus minor: 0,00014952: $\sqrt[3]{0,0530773}$

Summa 0,02349482

4trr 0,91122525

Cubus major: 0,93472007 $\sqrt[3]{0,9777486}$

0,2278063

T=Tang. Incid. 51°. 32' 1,2586322

$\frac{1}{2}$ T=Tang. Refr. 52. 11. 0,6293161

Denique ut $\sqrt{TT} + 4$, ad $\sqrt{TT} + 1$: ita r, ad s : ita 1, ad 0,68026. Quæ quidem Ratio proxime accedit ad illam, quam in Vitro ac plurimis Solidis pellucidis Experimento inesse constat: *Adamas* autem non tantum Duritie ac pretio Diaphana omnia præcellit, sed etiam hac *Vi Refractivâ*, cum sit Ratio ejus ut 5, ad 2, proxime, vel rectius ut 100 ad 41. Sed de his fortasse suo loco uberius.

Dum in his scribendis occupatus tenerer, meo hortatu peritissimus Geometra, *Dominus de Moivre* similem æquationem pro investiganda Ratione à data *Iridis Secundariæ* Semidiametro inquisivit: qua quidem paulo accuratius determinatur Ratio, sed cum Biquadratica sit, pari facilitate Calculus non absolvitur: Hæc autem est $T^4 + \frac{2}{3}T^3t + 2TTrr - \frac{1}{3}r^4 = 0$. Ubi T, est Tangens *Anguli Refracti*; t, Tangens semissis distantiae *Iridis* ab *Opposito Solis* ad Radium $r = i$. Hæc autem *Æquatio* ejus formæ est, ut semper Affirmativa unâ ac unâ Negativa Radice explicari possit, quarum altera ac Minor est Tangens *Anguli Refracti* in Regressu ad *Solem*, vix: cum *Purpurei Colores Soli* propiores sunt. Major autem Radix est Tangens *Anguli Refracti*, in *Iride* à *Sole* egrediente, ut supra observavimus; nempe in *Fluido minoris Rationis*. In *Oleo Terebinthinæ* observatur distantia hujus *Iridis* ab *Opposito Solis* 81°. 30', unde eruere potest Lector Curiosus Radices 0,80822.. ac — 2,98131.. Tangentes *Angulorum Refractorum*; hinc supputatur Ratio majoris inæqualitatis ut i, ad 0,67995.. qualis est in *Oleo Terebinthinæ*: A Majori autem Radice provenit Ratio minor, ut i, ad 0,9540.. proxime, quanta daretur in *Fluido Iridem Secundariam* ejusdem Diametri exhibente, sed quæ *Rubentibus Coloribus* more *Primariæ Solem* respiceret.

LXX. A. 1679. in *Maido*, juxta *Civitatem Founkoping* in colle quodam altiori, cui ad spatium quadrantis *Milliaris* subjacet *Lacus* aqua dulci *Wetter* dictus, in cujus Superficie tum placidissima, nulla *Ventorum Vi* agitata, representabatur mihi *Insula Wisingsburg*, in eo *Lacu* sita, tam vividè, ut à peritissimo *Pictore* melius vix depingi posset; *Fenestras* enim & *Homines*, cujus essent *Sexus*, discerni potui; cum tamen ipsa *Insula* in aspectum meum nondum pervenerat, propter interjacentes *Colles*, & distabat à me per tria *Milliaria* cum *Quadrante* ad minimum, ubi decem *Milliaria Suecica* conficiunt fere unum *Gradum*. Erat tum temporis *Sol* primum *Ortus*, & *Oculus* meus inter locum istum in *Lacu*, ubi hæc representabantur, & *Solem*: ab hoc loco dum digrederer, nihil

A Strange Appearance near Upsal; by Dr. And. Spole. Pii. Col. n. 5. p. 146.

nihil tale in Lacu visum est; sicut & altera Die cum ad eundem Locum me contuli eodem tempore, tale quid non comparuit, neque Lacus tanta *Halcyonia* erat.

An Unusual
Meteor; by Dr.
Wallis. n. 135.
p. 263.

LXXI. Sept. 20. 1676. about 7 of the Clock at Night, or soon after, there appeared a sudden *Light*, equal to that of Noon-day; so that the smallest Pin or Straw might be seen lying on the Ground. And above in the Air, was seen (at no great distance as was supposed) a long appearance as of *Fire*; like a long Arm (for so it was described to me) with a great Knob at the end of it; shooting along very swiftly: And at its disappearing, seem'd to break into small Sparks or Parcels of *Fire*, like as *Rockets* and such *Artificial Fireworks*, in the Air are wont to do. 'Twas so surprizing, and of so short continuance, that it was scarce seen by any who did not then happen to be abroad. I am told, by some, that it scarce continued longer than while one might tell 15 or 20 at the most; which will be less than half a *Minute*. All this might happen well enough from some *Fiery Meteor* in our Air; as a *Draco Volans* (as some have been pleas'd to call this) or the like. But that which makes it to me the more surprizing, is this; that I find the same to have been seen in most Parts of *England*, and at or near the same time: As, not only at *Oxford* and in *Oxfordshire*, but also in *Northamptonshire*, *Gloucestershire*, *Worcestershire*, *Somersetshire*, *Devonshire*, *Hampshire*, *Sussex*, *Surrey*, *Kent*, *Essex*, and (particularly) by the Watermen on the *Thames*, in their passage between *Graves-end* and *London*.

This is a great breadth of Ground, and too much for any Ordinary *Meteor* in our lower Region of the Air, to be seen in at once; Which Argues, that either it was *Higher* than it was imagin'd to be (though the *Light* of it reach'd the Earth,) or else, that it had a very *Swift Motion*. This made me then conjecture that it might be some small *Comet*, whose *Linea Trajectoria* pass'd very near our Earth, or upon it: And might, when further distant from us, appear as a *Comet*. And that *Comet* which hath since appeared in *April* and *May* confirms me in the same opinion; which I conjecture may be the very same which pass'd by us in *September* last. Why it was not sooner seen, I cannot tell; save what is the common fate of most *Comets*, that they are seldom observed till after their nearest distance from us: And, perhaps, it may have been so near the *Sun* (as to its visible place) as not to be much above our *Horizon* save in the day time. And for the like reason it may be, that in *September* last, when it pass'd by us, it was not more seen abroad in other Parts; it might pass them in the day time, being but in the *Twy-light* with us; and, had it been one hour sooner, the *Daylight* would have hindred us from seeing it. Which way its motion was when near us, I cannot conclude, so as to satisfie my self. For most that saw it, being suddenly surpris'd, took little more notice of it, than that it suddenly appear'd, and was suddenly gone, but saw it so little time as scarce to mark which way. By the account I had from one in *Northamptonshire* (between *Brackly* and *Banbury*) it should seem to have moved there towards the South-west. By the account I had from one who saw it in *Hampshire* (between *Winchester* and *Southampton*) it should seem to

be towards the South-east; from others I have nothing of certainty, and therefore can conclude nothing. Its *Motion* might then seem to us the *Swifter*, if its proper *Motion* were then one way; and the *Earth's* motion here, at the same time, contrary to it. And it is not impossible, that its dashing against the *Earth* might disturb its *Motion*; as when *Clouds*, in their passage, meet with *Mountains*.

LXXII. r Some Members of the *R. Society* did, with two different Sorts of *Instruments*, make divers Experiments for finding the Proportions of the *Compression* of *Air* under *Water*, in the Month of *July*, at *Sheerness*, in the Mouth of the River of *Medway*, at the time of High-Water, where the Depth was then about 19 *Fathom*, and the Proportion of the Weight of the *Salt-water* to that of the same Quantity of *Fresh water*, taken out of the River *Thames*, was as 41 to 42.

One of the *Instruments* was a *Glass-Bottle*, that held a *Quart* of *Water*, having a *Brass Ring* fastened to the Mouth of it, with a *Valve*, or *Flap*, that opened inward, so well fitted, that the *Bottle* being filled more or less with *Water*, none dropped out though forcibly shaken. This, let down 33 *Foot* into the *Water*, the Mouth downwards, and after a little stay drawn up, was found to be so very near *Half* full of *Water*, at several Tryals, that it was thought fit to *State* the *Compression* of *Air* at that Depth to that Measure.

The *Quantity* of *Compression* was known by *Weighing* the *Bottle* with the *Water* in it, after that a forcible *Depression* of the *Flap* had made way for the *Eruption* of the *Comprest Air* (which kept it up even when the *Bottle* was placed with the Mouth upwards,) and then filling the *Bottle* full of the same *Water*, and weighing it again; and lastly, by weighing the *Bottle* after the *Water* was all let forth; the *Weight* whereof being deducted, the first *Quantity* of *Water* weighed just *Half* as much as the *Second*, or so near it that the *Fraction* was not considerable. Whence it was concluded, that the *Quantity* of the *Air*, that filled the *Bottle* before it was immersed in the *Water*, was at the *Depth* of 33 *Feet*, *Compressed* into *Half* the space it took up before, and so proportionably at other *Depths*.

The other *Instrument* was a *Cylinder* of *Glass*, some two foot long, close at one end, and having the other end drawn small with a *Lamp*, and turn'd down a little way, after the manner expressed in the *Figure*. This *Cylinder* was immersed perpendicularly with the crooked end uppermost; by which, as it sunk in the *Water*, the *Pressure* thereof did gradually force in so much *Water*, as *Comprest* the *Air* proportionable to every *Depth*; till the *Cylinder* was so far immersed, that the *Hole* of the crooked part of it was just 33 *Feet* under *Water*; and then it being drawn up, by *Measuring* from the bottom of the *Cylinder* to the height of the *Hole* in the crooked part, by a pair of *Compasses*, the *Water* was found to fill the *Cylinder* so near the *Half*, that, the *Motion* of the *Superfice* of the *Water*, and the minuteness of the difference being consider'd, it was thought fit to *State* it to just *Half*.

According to these Experiments confirmed by Tryals at other Depths, the ensuing Table was computed.

The Compression of Air, under Water; by Mr. n. 73; p. 2192.

Fig. 43.

The Proportion of the *Weight* of *Salt-Water* to that of *Fresh*, was found by *Weighing* some *Ounces* of both in a *Bottle*, whereof the *Weight* was exactly known, and which was made with so small a *Neck*, that the *Addition* or *Diminution* of one single drop in it was discernable.

n. 75 p. 2240.

The *Table* is on these *Grounds* computed, upon the supposed *Depths*, from the *Surface* of the *Water* to the bottom of the *Air* included in a *Cylinder* of 60 inches, closed at one *End* and having the open *End* downward.

Depths in Water. Air Comprest, to				Depths in Water. Air Comprest, to			
Feet.	Fathoms.	parts.	inches.	Feet.	Fathoms.	parts.	inches.
00	00	1	60	32	0	$\frac{33}{65}$	$30 \frac{30}{65}$
1	0	$\frac{33}{34}$	$58 \frac{4}{17}$	33	$5 \frac{1}{2}$	$\frac{1}{2}$	30
2	0	$\frac{33}{35}$	$56 \frac{7}{7}$	66	11	$\frac{1}{3}$	20
3	$\frac{1}{2}$	$\frac{33}{36}$	55	99	$16 \frac{1}{2}$	$\frac{1}{4}$	15
4	0	$\frac{33}{37}$	$53 \frac{19}{7}$	132	22	$\frac{1}{5}$	12
5	0	$\frac{33}{38}$	$52 \frac{2}{19}$	165	$27 \frac{1}{2}$	$\frac{1}{6}$	10
6	1	$\frac{33}{39}$	$50 \frac{10}{3}$	198	33	$\frac{1}{7}$	$8 \frac{4}{7}$
7	0	$\frac{33}{40}$	$49 \frac{1}{2}$	231	$38 \frac{1}{2}$	$\frac{1}{8}$	$7 \frac{1}{2}$
8	0	$\frac{33}{41}$	$48 \frac{4}{11}$	264	44	$\frac{1}{9}$	$6 \frac{4}{9}$
$8 \frac{1}{4}$	0	$\frac{4}{3}$	48	297	$49 \frac{1}{2}$	$\frac{1}{10}$	6
9	$1 \frac{1}{2}$	$\frac{33}{42}$	$47 \frac{1}{7}$	330	55	$\frac{1}{11}$	$5 \frac{8}{11}$
10	0	$\frac{33}{43}$	$46 \frac{2}{43}$	363	$60 \frac{1}{2}$	$\frac{1}{12}$	5
11	0	$\frac{33}{44}$	45	396	66	$\frac{1}{13}$	$4 \frac{8}{13}$
12	2	$\frac{33}{45}$	44	429	$71 \frac{1}{2}$	$\frac{1}{14}$	$4 \frac{2}{7}$
13	0	$\frac{33}{46}$	$43 \frac{1}{23}$	462	77	$\frac{1}{15}$	4
14	0	$\frac{33}{47}$	$42 \frac{6}{47}$	495	$82 \frac{1}{2}$	$\frac{1}{16}$	$3 \frac{3}{4}$
15	$2 \frac{1}{2}$	$\frac{33}{48}$	$41 \frac{1}{3}$	528	88	$\frac{1}{17}$	$3 \frac{9}{17}$
16	0	$\frac{33}{49}$	$40 \frac{20}{49}$	561	$93 \frac{1}{2}$	$\frac{1}{18}$	$3 \frac{1}{3}$
$16 \frac{1}{2}$	0	$\frac{2}{3}$	40	594	99	$\frac{1}{19}$	$3 \frac{3}{19}$
17	0	$\frac{33}{50}$	$39 \frac{3}{50}$	627	$104 \frac{1}{2}$	$\frac{1}{20}$	3
18	3	$\frac{33}{51}$	$38 \frac{42}{51}$	660	110	$\frac{1}{21}$	$2 \frac{6}{7}$
19	0	$\frac{33}{52}$	$38 \frac{1}{17}$	693	$115 \frac{1}{2}$	$\frac{1}{22}$	$2 \frac{8}{11}$
20	0	$\frac{33}{53}$	$37 \frac{10}{53}$	726	121	$\frac{1}{23}$	$2 \frac{14}{23}$
21	$3 \frac{1}{2}$	$\frac{33}{54}$	$36 \frac{2}{3}$	759	$126 \frac{1}{2}$	$\frac{1}{24}$	$2 \frac{1}{2}$
22	0	$\frac{33}{55}$	36	792	132	$\frac{1}{25}$	$2 \frac{2}{5}$
23	0	$\frac{33}{56}$	$35 \frac{17}{56}$	825	$137 \frac{1}{2}$	$\frac{1}{26}$	$2 \frac{4}{13}$
24	4	$\frac{33}{57}$	$34 \frac{42}{57}$	858	143	$\frac{1}{27}$	$2 \frac{2}{9}$
25	0	$\frac{33}{58}$	$34 \frac{4}{29}$	891	$148 \frac{1}{2}$	$\frac{1}{28}$	$2 \frac{1}{7}$
26	0	$\frac{33}{59}$	$33 \frac{33}{59}$	924	154	$\frac{1}{29}$	$2 \frac{2}{29}$
27	$4 \frac{1}{2}$	$\frac{33}{60}$	33	957	$159 \frac{1}{2}$	$\frac{1}{30}$	2
28	0	$\frac{33}{61}$	$32 \frac{28}{61}$	990	165	$\frac{1}{31}$	$1 \frac{29}{31}$
29	0	$\frac{33}{62}$	$31 \frac{26}{31}$	1023	$170 \frac{1}{2}$	$\frac{1}{32}$	$1 \frac{9}{16}$
30	5	$\frac{33}{63}$	$31 \frac{3}{3}$	1056	176	$\frac{1}{33}$	$1 \frac{9}{11}$
31	0	$\frac{33}{64}$	$30 \frac{15}{16}$	1089	$181 \frac{1}{2}$	$\frac{1}{34}$	$1 \frac{13}{17}$

Depths in Water.		Air Comprest, to		Depths in Water.		Air Comprest, to	
Feet.	Fathoms.	parts.	inches.	Feet	Fathoms	parts	inches
1122	187	$\frac{1}{35}$	$1\frac{5}{7}$	1551	$258\frac{1}{2}$	$\frac{1}{48}$	$1\frac{1}{4}$
1155	$192\frac{1}{2}$	$\frac{1}{36}$	$1\frac{2}{3}$	1584	264	$\frac{1}{49}$	$1\frac{1}{49}$
1188	198	$\frac{1}{37}$	$1\frac{23}{37}$	1617	$269\frac{1}{2}$	$\frac{1}{50}$	$1\frac{1}{5}$
1221	$203\frac{1}{2}$	$\frac{1}{38}$	$1\frac{11}{19}$	1650	275	$\frac{1}{51}$	$1\frac{9}{51}$
1254	209	$\frac{1}{39}$	$1\frac{7}{13}$	1683	$28\frac{1}{2}$	$\frac{1}{52}$	$1\frac{1}{13}$
1287	$214\frac{1}{2}$	$\frac{1}{40}$	$1\frac{1}{2}$	1716	286	$\frac{1}{53}$	$1\frac{7}{53}$
1320	220	$\frac{1}{41}$	$1\frac{9}{41}$	1749	$291\frac{1}{2}$	$\frac{1}{54}$	$1\frac{1}{9}$
1353	$225\frac{1}{2}$	$\frac{1}{42}$	$1\frac{1}{7}$	1782	297	$\frac{1}{55}$	$1\frac{11}{55}$
1386	231	$\frac{1}{43}$	$1\frac{7}{43}$	1815	$302\frac{1}{2}$	$\frac{1}{56}$	$1\frac{1}{14}$
1419	$236\frac{1}{2}$	$\frac{1}{44}$	$1\frac{4}{11}$	1848	308	$\frac{1}{57}$	$1\frac{1}{17}$
1452	242	$\frac{1}{45}$	$1\frac{1}{3}$	1881	$313\frac{1}{2}$	$\frac{1}{58}$	$1\frac{1}{23}$
1485	$247\frac{1}{2}$	$\frac{1}{46}$	$1\frac{7}{23}$	1914	319	$\frac{1}{59}$	$1\frac{1}{29}$
1518	253	$\frac{1}{47}$	$1\frac{13}{47}$	1947	$324\frac{1}{2}$	$\frac{1}{60}$	1

2. Let *E D*, represent the *Tube*. = *x*.

A B, the Distance of the upper part of the *Tube* from the Surface of the *Water*, above or under it = *b*.

FC, the *Depth* of the *Water* from its Surface to the Bottom of the *Air* within the *Tube* = *a*.

BC, that part of it, which remains fill'd with *Air*, within the *Water*.

CD, the rest thereof which is full of *Water*.

And any two of the three first, *x*, *b*, and *a*, being given, the other is known; and consequently the rest also.

For, if by the Incumbent *Weight* of 33. *Feet* *Depth* in *Water*, the *Air* in the *Tube* is *Comprest* into *Half* the *Space* it filled before, then the said 33 *Feet* *Depth* of *Water* equals the *Weight*, or *Pressure*, of the *Incumbent* *Air* on the *Surface* of the *Water*. Now, as the *Weight*, or *Pressure*, of the *Air* on the *Surface* of the *Water*; is to the *Depth* of the *Water*, from the *Surface* thereof to the *Bottom* of the *Air* within the *Tube*: So is the *Length* of the *Tube* fill'd with *Air*, to the *Length* thereof fill'd with *Water*. That is, according to the said *Experiments*, putting *x* for 33, or whatever, at other times or places, shall be found to be the *Weight*, or *Pressure*, of the *Incumbent* *Air* on the *Surface* of the *Water*, (for it is not always the same exactly;) $x : a :: a + b : a^2 + ab = CD$.

$$\frac{a^2 + ab + xa + xb}{x} = x.$$

Wherefore $\frac{x}{x+a} x - a = b$.

And $bb + xb + xx + xx + b - x = x$.

The Calculation
by M.
n. 75. p. 2239.
Fig. 44.

Therefore a , and b , being given, x is known by the *First Equation*; And a and x , being given, b is known by the *Second*; and b and x being given, a is known by the *third*.

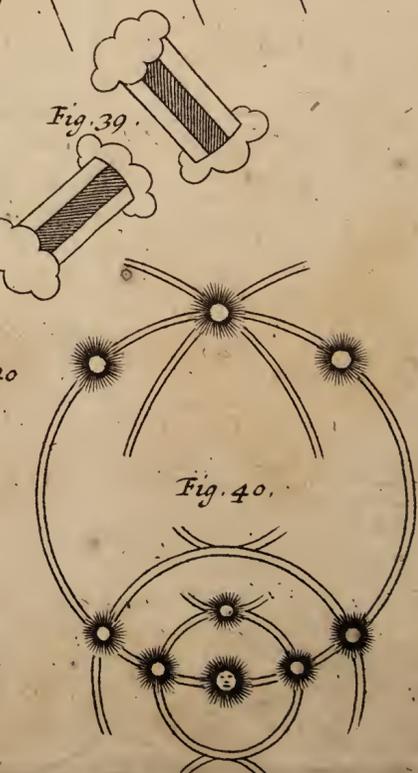
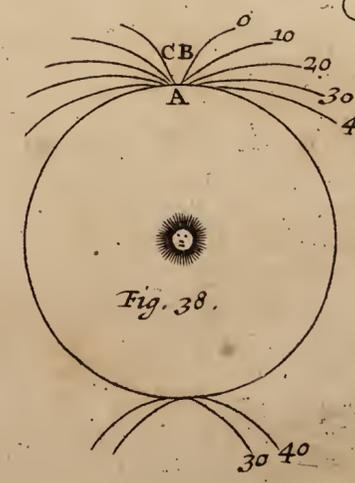
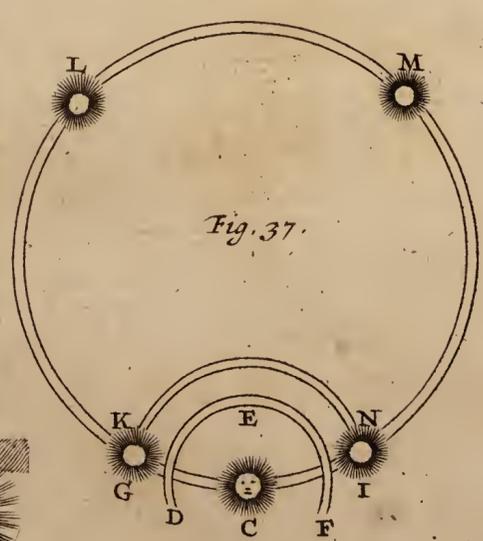
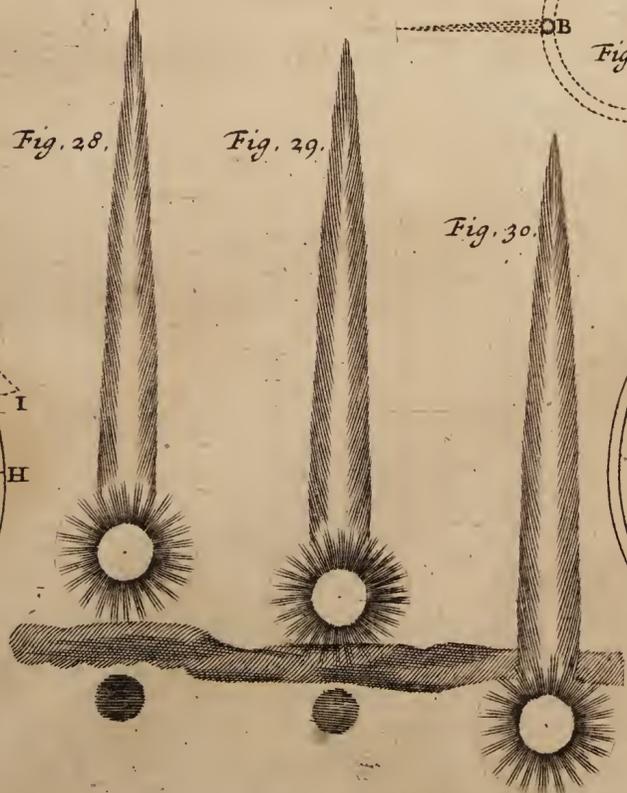
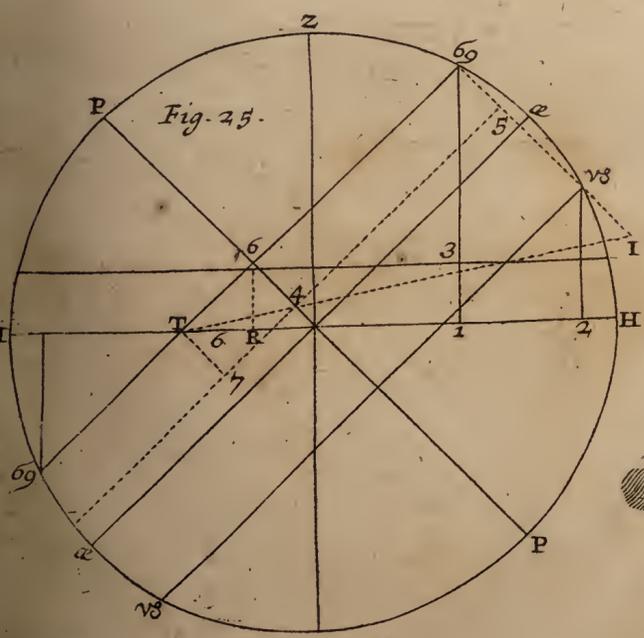
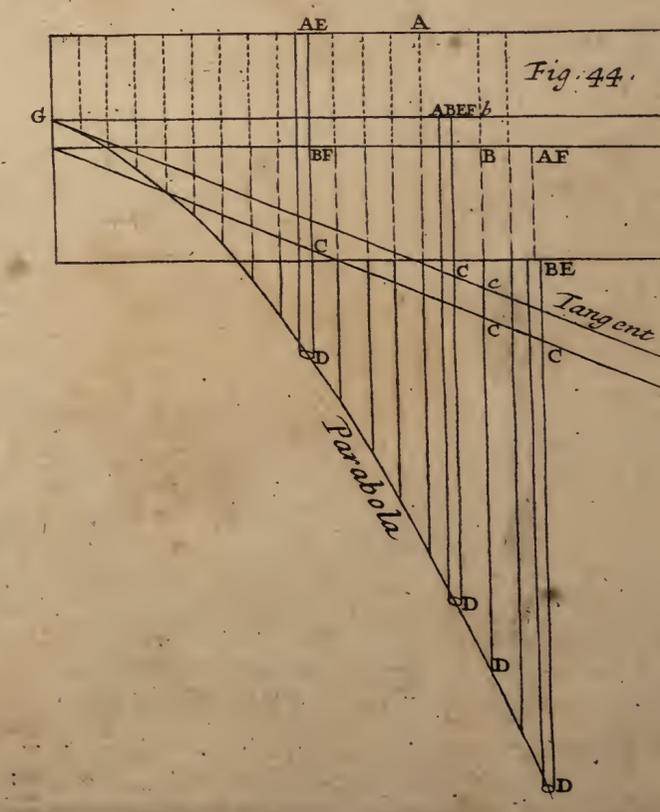
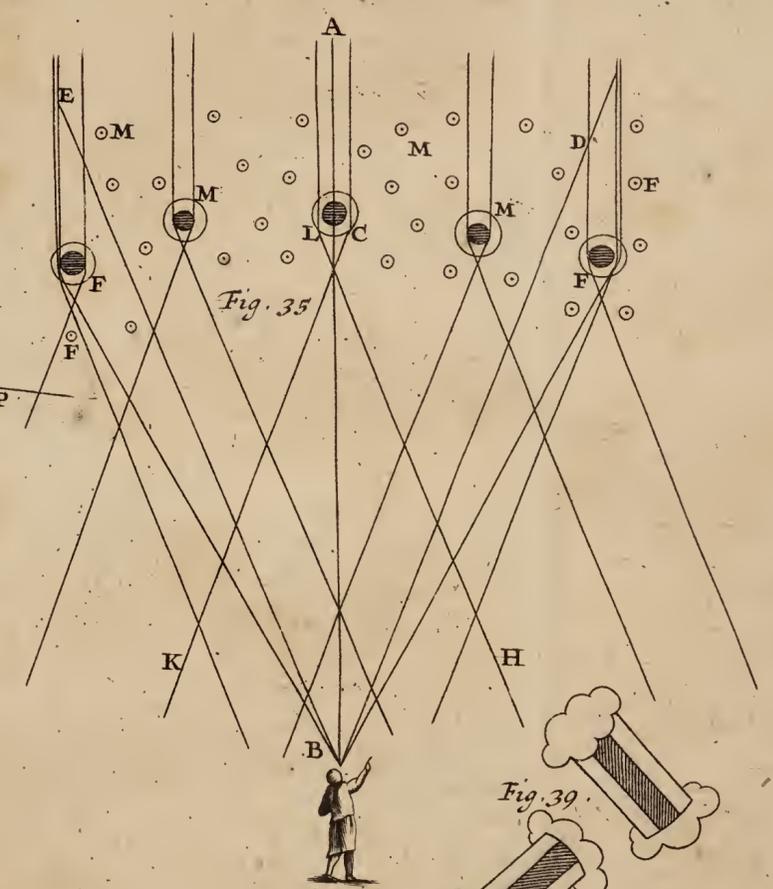
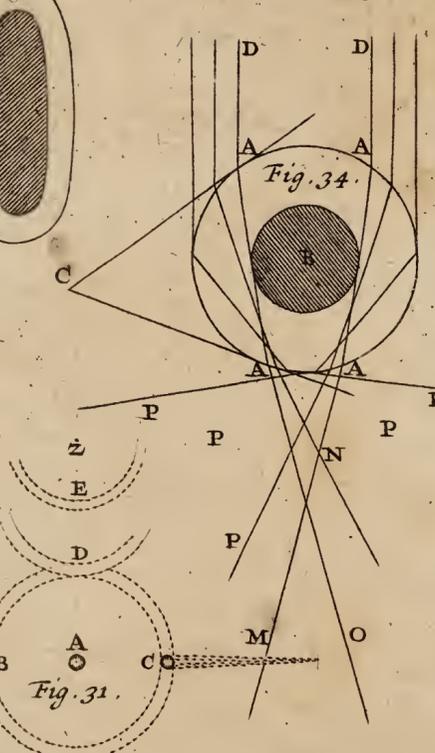
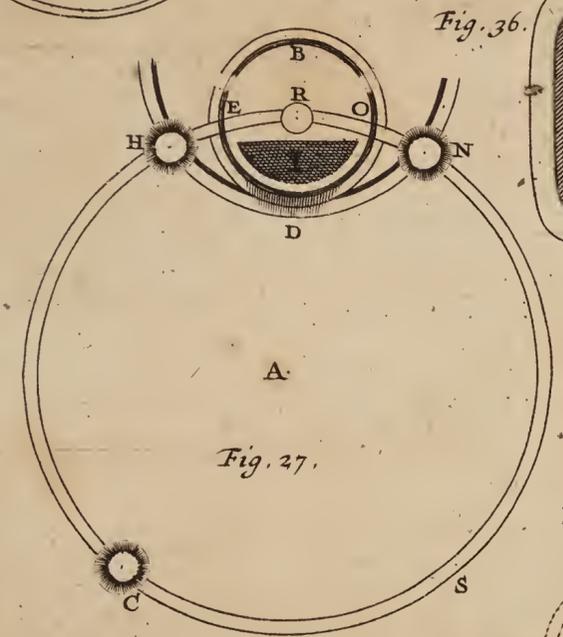
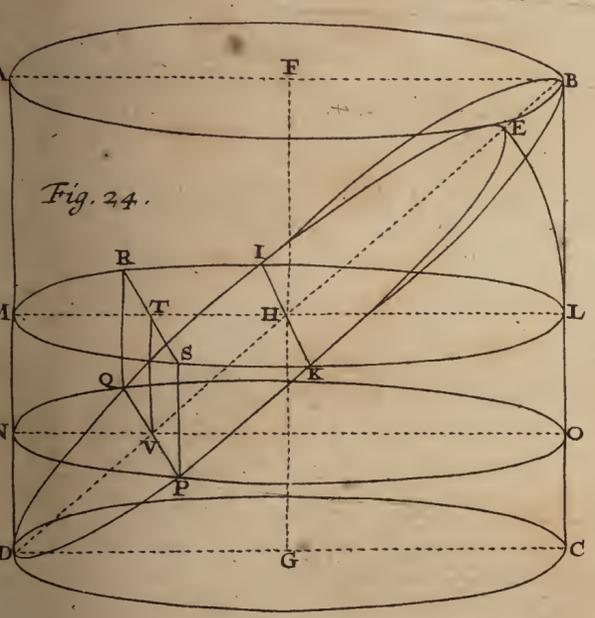
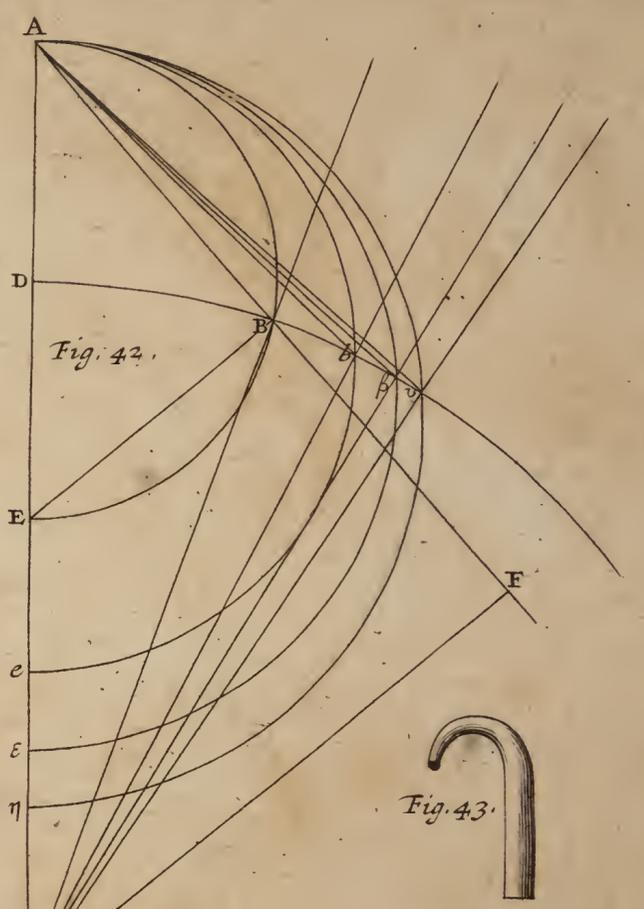
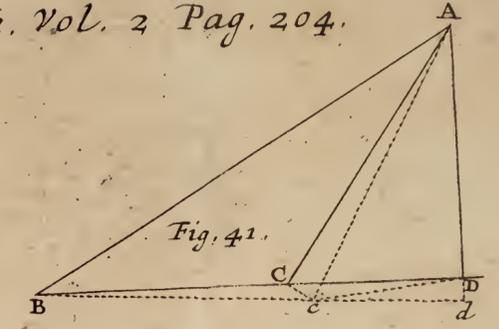
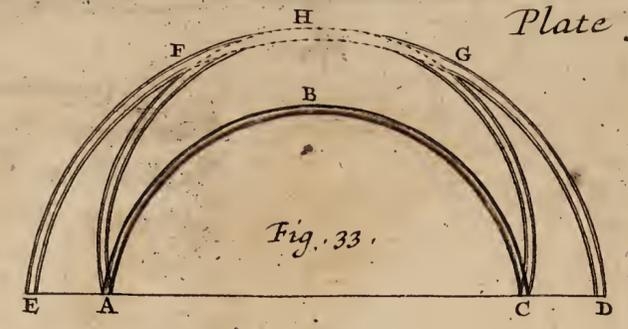
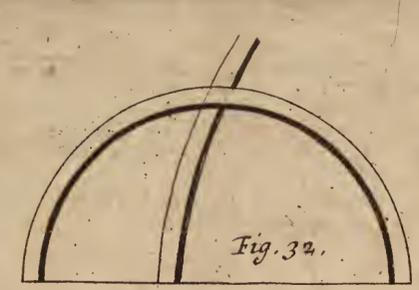
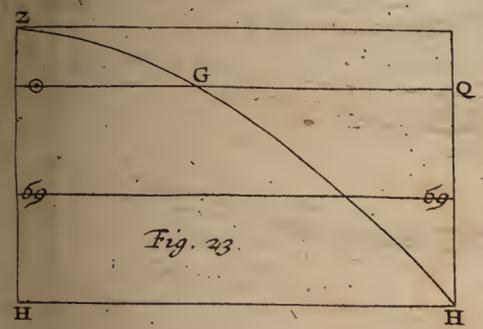
The Horizontal Line $BFAF$, is substituted for $GABEFb$, when the *Close end of the Tube* is not even with the Surface of the *Water*, to avoid the Breach $cC = bB = \frac{1}{4} b^2$, in the Length of the *Tube*.

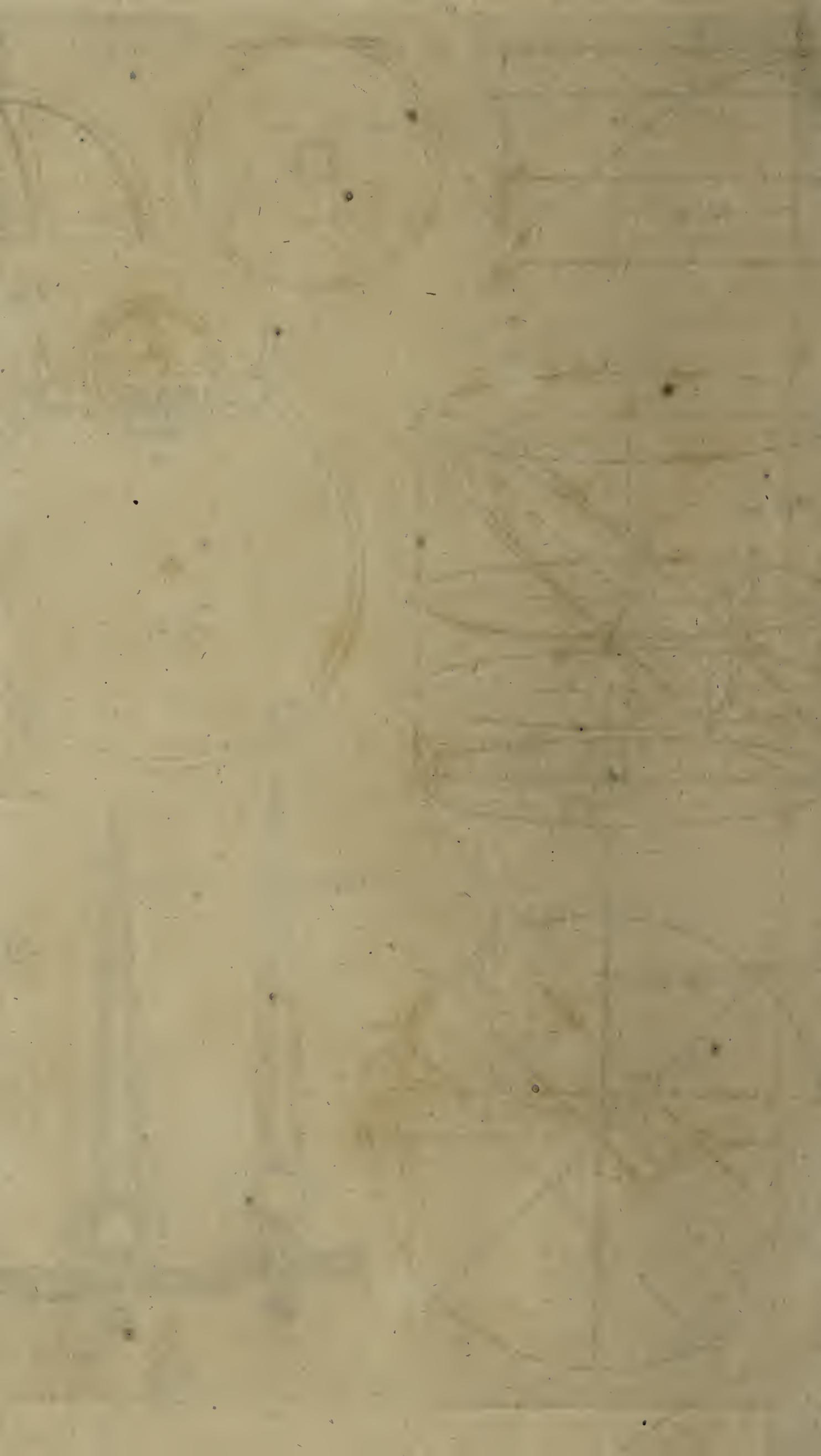
Effects of the
Varying Weight
of the Atmos-
phere upon Bo-
dies under Wa-
ter; by Mr.
Rob. Boyle.

n. 91. p. 5156.

LXXIII. I caused to be blown at the Flame of a Lamp three small round *Glass-Bubbles*, about the bigness of Hazel-nuts, and furnished each of them with a short and Slender *Stem*, by whose means they were so nicely *Poised* in *Water*, that a very small *Change* of *Weight* would make them either *Emerge*, if they but lightly leaned on the *Bottom* of the *Vessel*, or *Sink*, if they floated on the *Top* of the *Water*. This being done at a time when the *Atmosphere* was of a convenient *Weight*, I put them in a wide-mouth'd *Glass* furnish'd with common *Water*, and leaving them in a quiet place, where yet they were frequently in my *Eye*, and were suffer'd to continue many *Weeks* (or some *Months*.) I observed, as I expected, that sometimes they would be at the *Top* of the *Water*, and remain there for divers *Days*, or perhaps *Weeks*; and sometimes would fall to the *Bottom*, and after having continued there for some time (longer or shorter) they would again *Emerge*. And though sometimes (especially if I removed the *Vessel* that contain'd them to a *Southern Window*.) they would rise to the *Top* or fall to the *Bottom* of the *Water*, according as the *Air* was *Hot* or *Cold*; yet 'twas not difficult to distinguish these *Motions* from those produced by the *Varying Gravity* of the *Atmosphere*. For when the *Beams* of the *Sun*, or *Heat* of the *Ambient Air*, by raryfying the *Air* included in the *Bubbles*, made that *Air* drive out some of the *Water*; and consequently made the whole *Bubble* (consisting of *Glass*, *Air* and *Water*) somewhat *Lighter* than a *Bulk* of *Water* equal to it, though the *Bubble* did necessarily *Swim* as long as the included *Air* was thus *Rarified*, yet when the *Absence* of the *Sun*, or any other *Cause* made the *Air* lose its *Adventitious Warmth*, there would ensue a *Condensation* of the *Air* again, and thereupon an *Intrusion* of more *Water* (to succeed the *Air*) into the *Glass*, and consequently a *Sinking* of the *Bubble*, and this would commonly happen at *Night*, if it did not happen sooner. But when it was upon the account of the *Varying Weight* of the *Atmosphere* that the *Bubbles* either *Rose* or *fell*, it appeared by the *Baroscope*, that the *Atmosphere* was so *Heavie* or so *Light*, that they ought to do so. Inasmuch that I divers times predicted; whether I should find the *Mercury* in the *Baroscope* high or low, by observing the *Situation* and *Posture* of the *Bubbles*; and consulting that *Instrument*, it verified my *Conjectures*. And though whilst the *Atmosphere* was not too considerably either *Light* or *Heavy*, the *Changes* of the *Air* as to *Heat* or *Cold*, would (as I was saying) place the *Bubbles* sometimes at the *Top* and sometimes at the *Bottom* of the *Water*, within the *Compass* of a *Day*; yet if the *Atmosphere* were either very *Heavy* or very *Light*, the *Bubbles* would continue at the *Bottom* or at the *Top* of the *Water* for many *Days* together, in *Case* the *Atmosphere* did not in all that time *Change* its *Gravity*. And I remember, that I did for *Curiosity's sake*, when the *Quicksilver*

was





was high in the *Baroscope*, put the *Glass* two or three Days in a South-Window about Noon (and for a good while after) and that in Sunshining *Weather*, and yet even then the Bubbles did not Emerge, though it appeared by a good *Seal'd Weather-Glass*, which I kept in the same Window, that the Ambient *Air* was much *Warmer* than at other times, when I had Observed the Bubbles to keep at the Top of the Water.

N. B. 1. It being very difficult to *Poise* several Bubbles precisely, as well one as another, I thought it not strange, that all the three Bubbles did not constantly (though for the most part they did) Rise and Fall together, but sometimes two of them, and now and then (though seldom) one alone, would Sink or Emerge, when the Change of the *Weight* of the *Atmosphere* was not considerable enough to Operate sensibly upon the rest. And therefore 'tis not amiss to *Poise* a great Number of Bubbles together, that after tryal made of all, the fittest may be chosen. For I have observed it sometimes to happen, that a Bubble that Floated when 'twas first *Poised*, would after a while Subside, without any manifest cause, or if it were made to Sink by such a Cause, it would continue at the Bottom of the Water, though that Cause were removed; Which difficult *Phænomenon* seeming to depend upon a kind of Imbibition made of certain particles of an Aereal Nature by the *Water*, the Consideration of it belongs to another place, not to this; where it may suffice, that the *Experiment* did sometimes actually answer Expectation, as that above related did; wherein my main Drift was to shew, that since, as the *Atmosphere* is *Heavier* or *Lighter*, 'tis capable to work upon Bodies under *Water*, so as to procure their Sinking, or their Emerision; the *Air* (though a Fluid a thousand times *Lighter*) must lean or press upon the *Water* it self, by whose Intervention it produces these Effects; which confirms what I elsewhere Teach, that the *Atmosphere* is Incumbent, as a Heavy Body, upon the *Terra-queous Globe*.

LXXIV. I caused the Edges of my *Recipient* to be well Ground, so as that being apply'd, it every where touched a *Glass Plate*, which had also been very smoothly Ground to serve for a *Cover* to the same; and I spread a piece of *Lamb-Skin* wetted, over the said Plate, and having thus applyed it to the *Engine*, I put my *Recipient* over it: But in one place there was a Hail-shot of *Lead*, which kept the *Receiver* from being exactly applyed to its *Cover*, that so the *Air* might more freely get out. And having afterwards whelmed another great *Receiver* over all, I caused the *Pump* to be plyed. All being well *Evacuated*, I shook the *Engine* so as that the little *Receiver* fell off from the Hail shot, and stood every where close to the *Skin*, expanded over the *Cover* of the *Glass plate*. Then I had no more to do but to suffer the *Air* to re-enter into the great *Receiver*, and this *Air* Pressing upon the little one, kept it so closely fastened to its *Cover*, that it was impossible for me to sever them. And I am assured, that the *Air* enters not into the small *Receiver*, when 'tis thus applyed upon the *Skin*; for I have often put *Gages* in them, which always kept at the same Height, altho' the *Air* was permitted to repass into the great *Receiver*. You might also let alone the putting under of the Hail-shot to keep up the little

To take Exhausted Receivers away from the Air-Pump; by M. Papin. n. 120. P. 477.

n. 121. P. 544.

Recipient,

Recipient, because the *Air* by its *Spring* would lift it up sufficiently; but then the *Vacuum* would not be so perfectly made.

When I first began to keep *Receivers* thus *Void* of *Air*, I apply'd *Eel-Skins* to the *Cover*. But I found them not proper for things that are intended to be conserved a long time, because by *Drying* they grow *Springy*, and this *Spring* is capable to raise the whole *Pillar* of *Air* that presses the *Receiver* against its *Cover*; and so the *Air* gets in between, and fills the place *Exhausted*.

Afterwards I employed *Mutton-Skins*; but that sticks yet less close than an *Eel Skin*. For, as soon as the *External Air* comes to press upon it, it makes all the *Water*, which Wetteth the *Skin*, that stands over without, enter into the emptied *Receiver*; and you may see little *Drops* of *Water* coming out of the *Pores* of the *Skin* that is under the *Receiver*; and after the *Water* is all entered, the *Air* quickly gets in, the same way.

At Length I took a *Lamb-Skin*, and by means thereof I have kept *Receivers* empty 8 Days together, and never perceived it fail. Yet, for greater security, I do put *Turpentine* round about such *Receivers* as I mean to keep staunch a long time. Mean while, this Difference betwixt the *Skins* of *Mutton* and *Lambs* is somewhat remarkable, and confirms what *Physitians* say of the different Constitution of Bodies in *Youth* and *Old-Age*. I afterwards found that *Paper* Wetted serves as well as a *Lamb Skin*; but you must put *Turpentine* about it before it be *Dry*.

Seeds Sown in
the Exhausted
Receiver; by
....: n. 23.
p. 425.

LXXV. Some *Lettice Seed* being Sown upon some Earth in the *Open Air*, and some of the same *Seed* at the same time upon other Earth in a *Glass Receiver* of the *Pneumatick Engine*, afterwards *Exhausted* of *Air*, the *Seed* exposed to the *Air* was grown up an Inch and a half high, within 8 Days: But that in the *Exhausted Receiver*, not at all. And, *Air* being again admitted into the said *Emptied Receiver*, to see whether any of the *Seed* would then come up, it was found, that in the space of one Week it was grown up to the Height of two or three Inches.

Experiments
concerning the
Relation be-
tween Light
and Air (in Shi-
ning Wood and
Fish); by Mr.
Rob. Boyl.
n. 31. p. 581.

LXXVI. Exp. I. Oct. 29. 1667. Having procured a piece of *Shining Wood*, about the bigness of a *Groat* or less, that gave a *Vivid Light* (for *Rotten Wood*;) we put it into a middle-sized *Receiver*, so as it was kept from touching the *Cement*; and the *Pump* being set a-work, we observed not, during the 5 or 6 first *Exsuctions* of the *Air*, that the *Splendour* of the included *Wood* was manifestly lessened (though it was never at all increased); but about the 7th *Suck*, it seem'd to grow a little more *Dim*, and afterwards answered our Expectation, by losing of its *Light* more and more, as the *Air* was still further *Pumped* out; till at length about the 10th *Exsuction* (though by the removal of the *Candles* out of the *Room*, and by black *Cloaths* and *Hats* we made the place as dark as we could, yet) we could not perceive any *Light* at all to proceed from the *Wood*.

Exp. II. Wherefore we let in the outward *Air* by Degrees, and had the pleasure

pleasure to see the seemingly Extinguished *Light* revive so fast and perfectly, that it looked to us all, almost like a little *Flash of Lightning*, and the *Splendour* of the *Wood* seemed rather greater than at all less, than before it was put into the *Receiver*.

But partly for greater certainty, and partly to enjoy so Delightful a Spectacle, we repeated the Experiment with the like Success as at first. Wherefore being desirous to see how soon these Changes might be produced, we included the *Wood* into a very small Receiver of clear Glass, and found, That in this the *Light* would begin to grow faint at the Second, or at least at the 3d. *Exsuction* of the *Air*, and at the 6th or 7th would quite disappear. And we found by a *Minute-Watch*, that the sending the Candles out of the Room, the *Pumping* out the *Air* till the *Wood* would *Shine* no more, the Readmitting of the *Air* (upon which it would in a trice Recover its *Light*) and the sending in for the Candles to consult the *Watch*, did in all take up but 6 *Minutes*.

Exp. III. Having *Exhausted* this new *Receiver*, till the *Wood* quite disappeared, we staid somewhat above a quarter of an Hour in the Dark, without perceiving that the *Wood* had Regained any thing of *Light*, though about the end of this time, we made the place about it as Dark as we could; and then it (being too late at Night to protract the *Experiment*;) we let in the *Air*, upon whose Admission the *Wood* presently Recovered *Light* enough to be conspicuous at a distance, though it seemed to me somewhat less Vivid than before; which yet may be either a Weakness in my Sight, or an Effect of the Steams of the Cements, unfriendly perhaps to the *Luminousness* of the *Wood*.

The Night following we put in a piece of *Wood* bigger than the former (this being above an Inch long) and that shone very vigorously; And having by a few *Sucks* quite Deprived it of *Light*, we left it in the *Exhausted Receiver* for full half an Hour, and then coming into the Dark Room again, we found all had not continued so stanch, but that some small Portion of *Air* had insinuated it self into the *Receiver*. This we concluded to be but a small Portion of *Air*, because the *Wood* was but Visible to an Attentive Eye: And yet, that it was really some *Air*, which was got in, that caused the little *Glimmering Light* which we perceived, may appear by this, that it did presently (as we expected) Vanish at the first or second *Suck*; and then the *Air* being let into the Dark *Receiver*, the included *Wood* presently *Shone* again as before; though I suspected that I discerned some little Diminution of its brightness; which yet, till further Trials of the like kind, and for a longer time, have been made, I dare not affirm.

Exp. IV. Having observed, on another Occasion, That sometimes the Operation, which the Withdrawing the *Air* hath upon a Body included in the *Receiver*, proves more considerable some *Minutes* after we have ceased *Pumping*, than immediately after the Exercise is left off, I imagined, that even in such cases, where the *Light* is not made wholly to disappear (though it be made almost quite to do so) by the emptying of the *Pneumatical Glass*, the suffering the Body to remain a while there, though without any *Pumping* (unless now
and

and then a very little to remove the *Air*, that might have stolen in in the mean time) the remaining *Light* of the Body might probably be further impaired, if not reduced quite to Vanish. To examine this Conjecture, we put in a Body that was not *Wood*, which had some parts much more *Luminous* than the rest; and having drawn out the *Air*, all the others disappeared, and even the formerly brighter ones Shone but faintly, when the *Pneumatical Glass* seemed to be Exhausted. But keeping the included Body a while in that unfriendly place, we perceived the parts that had retained *Light*, to grow more and more Dim, some of them disappearing, and that which was formerly the most conspicuous, being now but just Visible to an Attentive Eye, and that scarce without dispute; for if we had not known beforehand, that a *Shining* matter had been included in the *Receiver*, perhaps we should not have found it out. (And he that had the youngest Eyes in the Company could not at all discern it;) But the *Air* being let in, the Body began to *Shine* again.

Exp. V. The *Rarefaction* or *Expansion* of the *Air*, having so notable an Operation upon our *Shining Wood*, I thought it would not be amiss to try, what the *Compression* of the *Air* would do to it: For which purpose we included a piece of it in such a little Instrument to *Compress* as hath been devised and proposed by Mr. *Hook*. But though we impell'd the *Air* Forcibly enough into the *Glass*, yet by reason of the thickness requisite in such Glasses, and the Opacity thence Arising, we were not able then to determine, whether or no any change was made in the *Luminousness* of the *Wood*. Which I thought the less strange, because by some *Experiments* purposely devised I had long since observed, That even a great *Pressure* from a Fluid Body, which Presseth more uniformly against all the parts it toucheth of the consistent Body, does Work a far less manifest *Change* even on soft or tender Substances, than one would expect from the Force wherewith it *Compresseth*.

Exp. VI. Thinking fit to try, Whether a small Quantity of *Air*, without being ventilated or renewed, might not suffice to maintain this *Cold Fire*, though it will not that of a *Live Coal*, or a piece of Match, we caused a piece of *Shining Wood* to be *Hermetically Sealed* up in a Pipe of clear and thin *Glass*; but though Carrying it into the Dark we found it had quite lost its *Light*, yet imagining that that might proceed from its having been over-heated (being *Sealed* up in a Pipe not long enough to afford it a due Distance from the Flame of the Lamp we employ'd to Seal it) we caused 2 or 3 pieces of Fresh *Wood*, amounting all of them, to the length of about 2 Inches, to be *Seal'd* up in a slender Pipe between 4 or 5 Inches in length; which being warily done, the *Wood* retained its *Light* very well, when the Operation was over; and afterwards laying it by my Bed-side, when the Candles were carried away out of the Room, I considered it a while before I went to sleep, and found it to *Shine* Vividly.

The next Morning when I awaked, though the Sun was Risen, yet forbearing to draw open the Curtains of my Bed 'till I had look'd upon the Seal'd *Glass*, which I had fenced with a piece of Cloath held between it and the Window, my Eyes having not yet been exposed to the Day-light since the Darkness they had been accustomed to during the Night, made me think the

Wood Shined brighter than ever. And at Night, after 10 of the Clock, looking on it in a Dark place, it appeared *Luminous* all its length, though not so much as in the Morning.

The Morning after, and the Night after that, the same *Wood* did likewise manifestly, though not vigorously *Shine*, especially one piece, whose *Light* was much more Vivid than the rest; And, for ought I know, I might have observed them to *shine* longer, if one of the Sealed Ends of the Glass had not been accidentally broken.

Exp. VII. I caused a piece of *Iron* to be Forged, whose top was of the bigness of a Nutmeg; the rest being a Stem, of an Inch, or an Inch and a half long, for which we provided a little Candlestick of Tabacco-Pipe-Clay, which would not yield any Smoak to fill and darken the *Receiver*. Then having heated the *Iron* Red-hot, and placed it in this Clay, so that the round part was clearly protuberant, we conveyed it into a *Receiver* of White Glass, which was so placed, as to keep the sides at as good a distance as we could from the *Iron*, lest the excessive *Heat* should (as we much feared it would) break the Glass. Then sending away the Candles, and making the Room dark, we hastily *Pumped* out the *Air*, but could not perceive the withdrawing of it had any Operation on the *Glowing Iron*. And though it continued *shining* long enough to give us an opportunity to Pump out and let in the *Air* three several times, yet we could not observe, that the *Air* had any manifest Operation one way or other. For though upon the withdrawing of the *Air* the *Iron* grew Dimmer and Dimmer, yet that I attributed to the *Cooling* of it; and the rather because having (to examine the Conjecture) let in two or three times the *Air*, when the *Receiver* had been *Exhausted*, there appeared no manifest Increase of *Light* upon the sudden admission of it.

Exp. VIII. Some Curious persons would perhaps, if they had been present, have desired to see a Tryal made, whether or no a small piece of *Shining Wood*, being so included in the *Receiver* as that the *Pumping* out of the *Air* should have no Injurious Operation upon the Body of it, its *Light* would, upon the Withdrawing of the *Air*, be manifestly diminished; This was I was the less backward to try, because it did not readily occur to my Memory, that by any manifest Experiment it appeared, that a Body more thin than *Air* will or can transmit *Light*, as well as other Diaphanous Mediums. Wherefore having *Hermetically Sealed* up a piece of *Shining Wood* in a slender Pipe, and placed it in a small *Receiver* that was likewise made of clear Glass, we *Exhausted* it of *Air*, and afterwards let in again that which we had Excluded. But by neither of the Operations could we perceive any sensible Decrement or Increase of the *Light* of the *Wood*, though by that very Observation it appeared, that the Glass had been well *Sealed*, since otherwise the included *Air* would have got out of the Pipe into the *Receiver*, and have left the *Wood* without *Light*.

Exp. IX. I took an old but thin Glass, *Sealed* at one end, whose shape was pretty Cylindrical, and whose Bore was about the bigness of a Man's little Finger, and whose length was about a Foot or more. Into this Pipe, near the *Sealed* end, we put a piece of *Shining Wood*, wedged in with a piece of Cork to keep it from falling; and having inverted the Nose of it into another Slen-

der Glas; but not Cylindrical, wherein was pretty store of *Quicksilver*, we put them both into a long *Receiver*, shaped almost like a Glas Churn, and having *Pumped* a while, that the *Air* Included in the Pipe expanding it self, might depress the *Quicksilver*, and so make escapes into the *Receiver* as long as we thought fit; we then let in the Outward *Air*, that the *Stagnant Quicksilver* might be impelled into the Cavity of the Pipe now freed from much of the *Air*, to the Height requisite for our purpose.

This done, we plied the *Pump* again, and observed, That as the *Air* in the Pipe did by its own *Spring* expand it self more and more, and grow Thinner and Thinner, the *Shining Wood* grew Dimmer and Dimmer, till at length it ceased to *Shine*, the Internal *Air* being then got a good way lower than the Surface of the external *Quicksilver*; whereupon opening the Commerce between the Cavity of the *Receiver*, and the *Atmosphere*, the *Quicksilver* was driven up again, and consequently the *Air* above it was restored to its former Density; upon which the *Rotten Wood* also recovered its *Light*. What the greatest Expansion of this *Air* was, we could not certainly determine, because the Expansion raised the external *Quicksilver* so high, as to hinder us to see and measure it: But we guessed, that the *Air* reached to about a foot or more from the top of the Pipe to the Surface of the *Quicksilver* near the bottom of it. But when that *Rarified Air* was impell'd into its former Dimensions, we measured it, and found, that the upper part of the Tube, unpossessed by the *Quicksilver*, was about 3 Inches; and the *Wood* being about an Inch long, there remained two Inches or somewhat better for the *Air*. But this Experiment ought to be repeated, when exacter Instruments can be procured.

Exp. X. Thinking it fit to try, as well, Whether *Stinking Fish* that *Shines* be of the same Nature; as to *Luminousness*, with *Rotten Wood* that *Shines* too; as, whether the withdrawing of the *Air* will Extinguish or Eclipse the *Light* of a considerable Bulk of *Luminous Matter*, as in the Experiments hitherto made, we found it would do to a small one: We took a *Fish* that we had kept, and caused to be watched till it was almost all over *Luminous*, though much more in the Belly, and some parts of the Head than elsewhere: And having suspended him in a conveniently shaped *Receiver*, we found him to give so great a *Light*, that we suspected before hand that the withdrawing of the *Air*, would hardly have its full Operation upon a Body, whose Bulk was considerable as well as its *Light* very Vivid, and which had many *Luminous* parts retired to a pretty distance from the *Air*. Accordingly having *Exhausted* the *Receiver* as much as we were wont, it appeared indeed, especially towards the latter end of the Operation, that the absence of the *Air* did considerably Lessen, and in some places Eclipse the *Light* of those parts that *Shone* less Strongly: But the Belly appeared not much less *Luminous* than before. Wherefore supposing, that upon the turning of the *Sto-cock*, the *Air* coming in much more hastily than it could be drawn out, we should have the best advantage to discern, what Interest it had in the *Luminousness* of the *Fish*, we readmitted it: And upon its Rushing in, perceived the *Light* to be as it were Revived and Encreased; those parts of the *Fish* that were scarce

Visible before, or *Shone* but *Dimly*, receiving presently their former *Splendour*.

And not to leave unprofecuted the remaining part of the Experiment, which was to try, Whether it was the *Kind* of the *Luminous Body*, or only the *Greatness* of the *Bulk*, and the *Vividness* of *Light*, and, if I may so speak, the *Tenacity* of the Substance it resided in, that made the difference between the *Fish* and the *Wood*: we put part of the *Fish* of another *Kind*, that *Shone* much more faintly than that hitherto spoken of, and but in some places; and by the withdrawing the *Air*, we made some of the *Luminous* parts disappear, and the others so *Dim*, as scarce to be discerned, and yet both the one and the other Regained their former *Light* upon the return of the *Air*.

And to pursue the *Experiment* a little further, we put in such a piece of the first *Fish*, as though it were *Bright*, was yet but *Thin*, and not considerably great, and upon Pumping out the *Air*, we found it, according to our expectation, quite *Eclipsed*, though it recovered its *Light* upon the *Air's* re-entry.

'Tis probable that some will make use of this Discourse to countenance their Opinion, That notwithstanding the *Coldness* (at least as to sense) of *Fishes* and other *Animals*, there may be in the *Heart* and *Blood* a *Vital* kind of *Fire* which needs *Air*, as well as those *Fires* which are sensibly *Hot*: Which may lessen the wonder, that *Animals* should not be able to *Live* when robb'd of *Air*.

Exp. XI. To examine the Conjecture mentioned in the last *Experiment*, That the durableness of the *Light* in the *Shining Fish*, in spite of the withdrawing the *Air*, might proceed in great part from the *Vividness* of it, and the beauty of the matter it resided in, rather than from the *Extent* of the *Luminous Body*, in comparison of the small pieces of *Shining Wood*, I hitherto had made my Tryals with; In *Dec. 1667*. I got a large piece of *Wood*, whose *Luminous* Superficies might be perhaps 10 or 12 times as great as that which the Eye saw at once of the Surface of such Fragments of *Shining Wood* as I was wont to employ: And though some parts of this large Superficies *Shined* *Vividly* enough (for *Rotten-Wood*, for the *Light* was usually inferiour to that of our *Fish*) yet this great piece being put into a convenient *Receiver*, was, upon the *withdrawing* of the *Air*, deprived of *Light*, as the smaller ones had been formerly; the *Returning Air* Restoring its *Light* to the one, as it had done to the other.

Exp. XII. I took some small pieces of *Rotten-Fish*; that shone some of them more faintly, and some of them more *Vividly*, in reference to one another, but none as strongly as some that I could have employed; and having in a very small and clear *Receiver* so far drawn off the *Air*, as to make the included Body *Disappear*, we so ordered the Matter, that we kept out the *Air* for about 24 *Hours*; and then allowing the *Air* to re-enter, in a dark place and late at *Night*, upon its first admittance the *Fish* regained its *Light*.

Exp. XIII. This, compared with some of my former Observations about *Putrefaction*, put me upon a Tryal, which, though it miscarried, I shall here

make mention of, that in case you, who are better furnished with Glasses, think it worth while, you may get reiterated by the Society's Operator; Considering how great an Interest *Putrefaction* hath in the *Shining* of *Fishes*, and *Air* in the *Phænomena* of *Putrefaction*, I thought it might be somewhat to the Purpose, to take a *Fish* that was, according to the common course I had observed in Animals, not far from the State, at which it would begin to *Shine*; and having cut out a piece of it, I caused the rest to be hung up again in a Cellar, and the expected piece to be put into a small and transparent *Receiver*, that we might observe, if a day or two, or more, after the *Fish* in the Cellar should begin to *Shine*, that in the *Exhausted Receiver* would either also *Shine* or (because that seem'd not likely) would, notwithstanding the Check which the Absence of the *Air* might be presumed to give the *Putrefaction*, be found to *Shine* too, either immediately upon the Admission of the *Air*, or not long after it.

But this *Experiment*, was only designed and attempted, not compleated; the *Receiver* being so thin, that upon the *Exhaustion* of the internal *Air*, the Weight of the External broke it; and we could ill spare another of that kind from Trials, we were more concern'd to make: Notwithstanding which, we made one Trial more, which succeeded no better than the former, but miscarried upon a quite differing account, *viz.* Because neither the included piece of *Fish*, nor the remaining, though it were of the same sort with the *Fishes* I usually employed, would *Shine* at all, though kept a pretty while beyond the usual time, at which such *Fishes* were wont to grow *Luminous*. But that this Paragraph may not be useless to you, I'll take this Occasion to give you a couple of *Advertisements*, that may relate not only to this Experiment, but also more generally to those whether precedent or subsequent, where *Shining Fish* are employed.

Advertisement I. In the first place then, I will not undertake, that all the Experiments you shall make with *Rotten Fish*, shall have just the same Success with these I have related. For, as I elsewhere observed, that the Event of divers other Experiments is not always certain, so I have had occasion to observe the like about *Shining* of *Fishes*. And I remember, that having once designed to make Observations about the *Light* of *Rotten Fishes*, and having in order thereunto caused a competent Number of them to be bought, not one of them all would *Shine*; though they were bought by the same Person I was wont to employ, and hung up in the same place where I use to have them put, and kept not only 'till they began to *Putrifie*, but beyond the time that others used to continue to *Shine*; although a Parcel of the same kind of *Fishes*, bought the Week before, and another of the same kind, bought not many days after, *Shined* according to Expectation. What the reason of this Disappointment was, I could not determine, only I remember, that at the time it happen'd, the Weather was variable, and not without some days of *Frost* and *Snow*.

Adver. II. Notice must also be taken in making Experiments with *Shining Fish*, that their *Luminousness* is not wont to continue very many days. Which *Advertisement* may be therefore useful, because without it we may be apt sometimes

times to make Trials, that cannot be soon enough brought to an Issue; and so we may mistake the loss of *Light* in the *Fish* to be a Deprivation of it caused by the *Experiment*, which indeed is but a Cessation according the usual Course of Nature.

Exp. XIV. We put a piece of *Shining Fish* into a wide mouthed Glass, about half filled with fair Water, and having placed this Glass in a *Receiver*, we *Exhausted* the *Air* for a good while, to observe, Whether, when the *Pressure* of the *Air* was removed, and yet (by reason of the Water that did before keep the Air from immediately touching the *Fish*) the *Exhaustion* of the *Receiver* did not deprive the *Fish* of that Contact of *Air*, which it had lost before: Whether, I say, in this case the absence of the *Air* would have the same Influence on the *Shining Body*, as in the former *Experiments*:

And here, as far as the numerous Bubbles excited in the Water would give us leave to discern it, we could not perceive, that either the absence or return of the *Air* had any great Operation upon the *Light* of the *Immersed Body*.

I shall here inform you, that though, when I formerly put together some Notes about *Luminous Bodies*, I confined not my Observations to one or two sorts of *Fishes*, yet these *Experiments* were all of them (except a Collateral one or two) made with *Whitings*, which, among the *Fishes*, I have had occasion to take Notice of, is (except one sort that I cannot procure) the fittest for such Trials.

Exp. XV. To prosecute the I. and IX. *Experiments* in one Trial, we took somewhat late at Night a piece of *Rotten Fish*, which we judged to *Shine* too strongly to be quickly deprived of all its *Light*, and having put it into a small and clear *Receiver*, we found (as we had foreseen) that the *Light* was much impaired, but nothing near suppressed by the withdrawing of the *Air*. Wherefore having removed the *Receiver* into a convenient place, I caused it to be brought to me about Midnight, and having made the place pretty dark; I perceived the included Body to continue to *Shine* more vividly than one would have expected, (and, if I mistake not, I saw it shining in the Morning whilst it was dark;) but the Night after, coming to look upon it again, its *Light* appeared no more: Notwithstanding which, I made a shift to keep out the Air about 24 *Hours* longer, and so after 48 *Hours* in all, we opened the *Receiver* in a dark place, and presently upon the *Ingress* of the *Air* were pleasantly saluted with so Vivid an Apparition of *Light*, that the included Body continued to *Shine*, when carried into a Room, where there was both Fire and Candle, if it were but by a Hat screen'd from the Beams.

Being encouraged, as well as pleased with this Success, we forthwith *Exhausted* the *Air* once more out of the same *Receiver*, and having kept it about 4 *Hours* longer, we lookt upon it again in a dark place, and finding no appearance of *Light*, let the *Air* in upon it, whereby it was made to *Shine* again and that vigorously enough.

The suddenness, with which the included Body appeared to be, as 'twere, *rekindled* upon the first contact of the *Air*, revived in me some suspicions I have had about the possible Causes of these *Short liv'd Apparitions* of *Light* (for I speak not now of real Lamps found in Tombs, for a Reason to be told
you

you another time) which disclosing themselves upon Mens coming in, and consequently letting in Fresh Air into *Vaults*, that had been very long close, did soon after Vanish.

These thoughts, as I was saying, occurred to me upon what I had been relating by reason of the *Sudden Operation* of the *Fresh Air* upon a Body, that but a Minute before disclosed no *Light*. For though the *Lights* reported to have been seen in *Caves*, quickly Disappeared, which that of our *Fish* did not; yet that difference might possibly proceed from the *Tenacity*, or some other disposition of the matter, wherein the *Luminousness* of the *Fish* resides: For I remembered that I had more than once observed a certain Glimmering and small *Light* to be produced in a sort of Bodies, upon putting them out of their former Rest, and taking them into the *Air*; which sparks would vanish themselves, sometimes within one *Minute*, sometimes within a few *Minutes*. But as these thoughts were but transient Conjectures, so I shall not entertain you any longer about them, but rather contenting my self with the hint already given, take notice of what may be more certainly deduced from our Experiment, which is, That the *Air* may have a much greater interest in divers odd *Phænomena* of Nature, than we are hitherto aware of.

And for Confirmation of our *Experiment*, I shall add, that having in another *Receiver* Eclipsed a piece of *Fish*, that *Shone* when 'twas put in more languidly than divers others that we had tried, I kept it about 3 *days* and 3 *Nights* in a *Receiver*; after which I opened it in the dark, and upon letting in the *Air* upon this Body, that *Shined* but faintly at first, it immediately recovered its so long suppressed *Light*. And having included another piece that was yet more faint than this, when it was put into the *Receiver*, and having kept this piece also 3 *days* and 3 *Nights* in the *Exhausted Glass*, I let in the *Air* upon it, and notwithstanding the darkness of the place, nothing of *Life* was thereupon Revived. But this being little other than I expected from a Body that *Shined* so faintly, when 'twas put into the *Receiver*, and had been kept there so long, I resolved to try, Whether the Appulse and Contact of the *Air* would have that Operation after some time, that it had not at first; and accordingly, after having waited a while, I observed the *Fish* to disclose a *Light*, which though but dim, was yet manifest enough.

I shall only add, That having included in small *Receivers* two pieces of *Rotten Whitings*, whereof the one, before it was put in, scarce *Shone* so Vividly as did the other after the *Receiver* was *Exhausted*; and having ordered the matter so, that we were able to keep out the *Air* for some days, at the end of about 48 *Hours*, we found, that the more *strongly Shining* Body retained yet a deal of *Light*; but afterwards looking upon them both in a dark place, we could not perceive in either any show of *Light*. Wherefore having let in the *Air* into that *Receiver*, whereinto the Body that at first *Shined* the faintlier had been put, there did not ensue any *Glimmering* of *Light* for a pretty while: Nay, upon the rushing in of the *Air* into the other *Glass*, the Body that at first *Shone* so *Strongly*, and that continued to *Shine* so long, shewed no *Glimmering* of *Light*. But within less than a quarter of an *Hour* we saw a manifest *Light* in the Body last named, and a while after the other also became *Visible*, but by

a *Light* very dim. The more *Luminous* of these *Bodies* I observed to retain some *Light* 24 *Hours* after; and the hitherto recited *Experiment* had this peculiar instance in it, That the 2 *Receivers* were uninterruptedly kept *Exhausted* no less than 4 *Days*, and as many *Nights*.

LXXVII. I. 1. We put a full grown *Duck* into a *Receiver*, whereof she fill'd, by our Guess, a third part or somewhat more, but was not able to stand in any easie *Posture* in it; then *Pumping* out the *Air*, within the short space of one *Minute* she appeared much discomposed, and between that and the second *Minute*, her *Strugling* and *Convulsive* *Motions* increased so much, that, her *Head* also hanging carelessly down, she seem'd to be just at the point of *Death*: So that, it did not appear, that, notwithstanding the peculiar structure of some *Vessels* about the *Heart*, which enables these and other *Water Birds* to continue without *Respiration* for some time under the *Water*, this *Duck* was able to hold out considerably longer than a *Hen*, or other *Bird* not *Aquatick*, might have done.

This *Duck*, being revived upon the admission of *Fresh Air*, and again shur up in the same *Receiver* with the *Air* in it, continued five times as long as before, without appearing any ways discomposed.

2. We convey'd a *Duckling*, that was not yet *Callow*, into the same *Receiver*, and Observ'd, that before the first *Minute* was quite ended, she gave manifest tokens of being much disordered, and before a *Second Minute* was expired, several *Convulsive Motions* oblig'd us to let the *Air* in upon her, whereby she quickly recover'd.

N. B. When the *Receiver* was pretty well *Exhausted*, she appeared manifestly bigger, than before the *Air* was with withdrawn, especially about the *Crop*, though that was very *Turgid* before. We kept the same *Duckling* in the same *Receiver* very close, to keep out all *External Air*, and to keep in the *Excrementitious* *Stems* of her *Body* for above 6. *Min.* without perceiving her to grow *Sick* upon her *Imprisonment*.

II. 1. *Jan.* 2. 166 $\frac{2}{3}$. We included a *Viper* in a small *Receiver*, and as we drew out the *Air*; she began to *Swell*, and afforded us these *Phænomena*.

1. It was a good while after we had left *Pumping*, e're the *Viper* began to *Swell* so much as to be forced to *Gape*, which afterwards she did.

2. That she continued, by our Estimate, above 2 $\frac{1}{2}$ *Hours* in the *Exhausted Receiver*, without giving clear *Proof* of her being *Kill'd*.

3. That after she was once so *Swelled*, as to be compelled to open her *Jaws*, she appeared slender and lank again, and yet very soon after appear'd *Swell'd* again, and had her *Jaws* disjoyn'd as before.

2. We took a *Viper*, and including her in the greatest sort of small *Receivers*, we emptied the *Glass* very carefully, and the *Viper* mov'd up and down within, as it were to seek for *Air*, and after a while foamed a little at the *Mouth*, and left of that *Foam* sticking to the inside of the *Glass*. Her *Body* *Swelled* not considerably, and her *Neck* less, till a pretty while after we had left *Pumping*; but afterwards the *Body* and *Neck* grew prodigiously *Tumid*, and a *Blister* appeared upon the *Back*. An *Hour* and an *half* after the *Exhaustion* of
the

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Experiments; by
Mr. Boyle.
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Upon Ducks.

Vipers.

the *Receiver* (which we then by Trial found to be pretty staunch) the distended *Viper* did give by Motion manifest Signs of *Life*; but we observed none afterwards. The Tumor reached to the Neck, but did not seem much to *Swell* the under Chap. Both the Neck and a great part of the Throat, being held betwixt the Eye and the Candle, were transparent enough, where the Scales did not darken them. The jaws remained mightily opened, and somewhat distorted; the *Epiglottis* with the *Rimula Laryngis* (which remained gaping) was protruded almost to the further end of the nether-Chap. As it were from beneath this *Epiglottis* came the black Tongue, and reached beyond it, but seemed by its posture not to have any *Life*, and the Mouth also was grown blackish within. But the *Air* being readmitted after 23 *Hours* in all, the *Viper's* Mouth was presently clos'd, though soon after it was open'd again, and continued long so; and scorching or pinching the Tail made a Motion in the whole Body, that argued some *Life*.

3. *April* 25. We included an Ordinary harmless *Snake*, together with a Gage, in a pretty portable *Receiver*, which, being *Exhausted* and well secur'd against the *Ingress* of the *Air*, was laid aside in a quiet place, where it continued from 10. or 11. a Clock in the Forenoon, till about 9. the next Morning; and then, though he seem'd to be dead, and gave no Signs of *Life* upon the Shaking of the *Receiver*, yet upon holding the Glass at a convenient Distance from a moderate Fire, he did in a short time manifest himself to be *Alive* by several tokens, and even by putting forth his *Forked Tongue*. In that Condition I left him, till the next Day early in the Afternoon; at which time he was grown past recovery, and his Jaws, which were formerly shut, gaped exceeding wide, as if they had been stretched open by some External force.

Frogs.

III. 1. *Sept.* 9. 1662. We took a large lusty *Frog*, and having included her in a small *Receiver*, we drew out the *Air*, and left her not very much *Swell'd*, and able to move her Throat from time to time, though not so fast as when she freely breathed before the *Exsuction* of the *Air*. She continued *alive* about 2 *Hours* that we took notice of, sometimes removing from the one side of the *Receiver* to the other; but she *Swell'd* more than before, and did not appear by any Motion of her Throat or Thorax to exercise *Respiration*, but her Head was not very much *Swell'd*, nor her Mouth forced open. After she had remained there somewhat above 3 *Hours* (for it was not $3\frac{1}{2}$ *Hours*) perceiving no *Sign* of *Life* in her, we let in the *Air* upon her, with which the formerly Tumid Body shrunk very much, but seem'd not to have any other Change wrought in it; and though we took her out of the *Receiver*, yet in the *Free Air* it self, she continued to appear stark *Dead*. Nevertheless to see the utmost of the *Experiment*, having caused her to be laid upon the Grass in a Garden all Night, the next Morning we found her perfectly *Alive* again.

2. *Jun.* 29. 1660. About 11. of the Clock in the Forenoon, we put a *Frog* into a small *Receiver*, containing about $15\frac{1}{4}$ Ounce Troy Weight of *Water*, out of which we had tollerably well drawn the *Air*, (so that when we turned the Cock under Water, it sucked in about $13\frac{1}{4}$ Ounce of *Water*;) The *Frog* continued in it (the *Receiver* all the while under Water) *lively* enough till about

5 of the Clock in the Afternoon, when it expir'd. The *Frog* at the first seem'd not to be much altered by the *Exsuction* of the *Air*, but continued *Breathing* both with her *Throat* and *Lungs*.

3. Sept. 6. 1662. We included into a large *Receiver* a couple of *Frogs* newly taken, the one not above an *Inch* long, and proportionally *Slender*; the other, very large and lusty. Whilst the *Air* was *Drawing* out, the lesser *Frog* Skipt up and down very lively, and somewhat to our wonder, clambered up several times to the sides of the *Receiver*, in so much that he sometimes rested himself against the side of the *Glass*; when his *Body* seem'd to be *Perpendicular* to the *Horizon*, if not in a *Reclining* Posture. He continued to Skip up and down a while after the *Exsuction* of the *Air*, but within a *Quarter* of an *Hour* (measured by a *Minute Watch*) we perceived him to lye stark *Dead*, with his *Belly* upwards. The other *Frog*, that was very large and strong, though he began to *Swell* much upon the *withdrawing* of the *Air*, and seem'd to be *Distressed*, by his frequently leaping up, after the *Air* was *drawn out*, which he did not before, yet being as we said very lusty, he held out *half* an *Hour*; at which time the *Weight* of the *outward Air* broke the *Receiver* and thereby brought him a *Reprieve*.

4. Sept. 11. We took a small *Frog*, and having conveyed her into a very small *Portable Receiver*, we began to Pump out the *Air*. At first she was *Lively* enough, but when the *Air* began to be considerably withdrawn, she appeared to be very much *Disquieted* (leaping sometimes after an odd manner, as it were to get out of the uneasy *Prison*;) but yet not so, but that, after the *Operation* was ended and the *Receiver* taken off, the *Frog* was perfectly *alive*, and continued to appear so (if I am not mistaken) near an *Hour*, though the *Abdomen* was very much, and the *Throat* somewhat extended; this latter part having also left that wonted panting Motion, that is supposed to argue and accompany the *Respiration* of *Frogs*. At the End of about $3\frac{1}{4}$ *Hours*, after the Removal of the *Receiver* from the *Pump*, the *Air* was let in; whereupon the *Abdomen*, which by that time was strangely *Swell'd*, did not only subside, but seem'd to have a great *Cavity* in it, as the *Throat* also proportionably had; which *Cavities* continued, the *Frog* being gone past all *Recovery*.

5. Apr. 14. A large *Frog* was conveyed into a plated *Receiver*, and the *Air* being *withdrawn*, her *Body* by Degrees was *Distended*. The *Receiver* with the *Gage* were kept under *Water* near 7 *Hours*; at the End of which I found the *Receiver* staunch, but the *Frog* *Dead*, and exceedingly *Swell'd*: upon the *letting in* of the *Air* she became more hollow and *Lank* than ever.

IV. Being desirous to try, whether *Animals*, that had lately been accustomed to *Live* either without any, or without a full *Respiration*, would not be more difficultly, or slowly kill'd by the *Want* of the *Air*, than others, which had been longer used to a free *Respiration*; we took a *Kitling* that had been kitten'd the *Day* before, and put it into a very small *Receiver* (that we guessed to hold about a *Pint* or less) that it might be the sooner *Exhausted*. Within one *Minute*, or a little more, after the *Air* first began to be *withdrawn*, the little *Animal*, who in the mean time had gasped for *Life*, and had some violent

Kitlings;

Convulsions, lay as *Dead*, with his Head downwards, and his Tongue out; but upon letting in of the *Air*, he did in a Trice shew Signs of *Life*, and being taken out of the *Receiver*, quickly recovered.

Another of the same Litter, being put into the same *Receiver*, quickly began, like the other, to have *Convulsions*, after which he lay as *Dead*. But, though we continued *Pumping*, and could not perceive that the Engine leaked more than in the former Experiments; the *Kitling* began to stir again, and after a while had stronger and more general *Convulsions* than before; till at the end of full 6 *Minutes* after the *Exsuction* of the *Air* was begun, the Animal seeming quite *Dead*, was taken out of the Vessel, and lay with its Mouth open, and his Tongue lolling out without any sensible *Breathing*; and *Pulsation*; till having ordered him to be pinched, the Pain, or some Internal Motion produced by the External Violence done to him, made him immediately give manifest Signs of *Life*, though there was yet no sensible Motion of the *Heart* or the *Lungs*; but afterwards gaping and fetching his Breath in an odd manner, and with much straining, as I have seen some *Fœtus's* do when Cut out of the *Womb*, he by little and little, within about a *Quarter* of an *Hour* recover'd.

Inclosing another *Kitling* kitten'd at the same time, in the same *Receiver*, we Observ'd, that divers violent *Convulsions*, as it were gasping for Breath, into which he began to fall at the second or third *Suck*, ended in a seeming *Death*, within about a *Minute* and a *half*. A while after, notwithstanding our continuing to *Pump*, the *Kitling* gave manifest Signs of *Life*, which was not till it had endured divers *Convulsions*, as great as those of the first *Fit*, if not greater. When 7. *Min.* from the beginning of the *Exhaustion* were completed, we *Let in* the *Air*; upon which the little Creature, that seemed stark *Dead* before, made us expect that he might recover; but though we took him out of the *Receiver*, and put *Aqua vitæ* into his Mouth, yet he irrecoverably *Died* in our Hands.

By what has been related it appears, that those Animals continued 3 times longer in the *Exhausted Receiver*, than other Animals of that bigness would probably have done.

The Air Con-
ceal'd in the
Pores of Li-
quors.

V. 1. We put some *Water* in an open Tube, and suffer'd the *Air Latitant* in it, to escape in an *Exhausted Receiver*, without any Artifice to catch it; by which Trial the *Water* did not part with any thing of its bulk, that made a Diminution sensible to the Eye.

2. A Chymical Pipe, seal'd at one End, and 36 *Inches* (or somewhat less) in length, was fill'd with *Water*, and inverted into a Glass Vessel, not two *Inches* in Diameter, and but $\frac{1}{4}$ of an *Inch* or little more in Depth. These Glasses being conveyed into a fit *Receiver*, and the *Air* being leisurely *Pump'd* out, and somewhat slowly *Readmitted*, the numerous *Bubbles*, that had Ascended during the Operation, constituted at the Top an *Aerial Aggregate*, mounting to $\frac{3}{10}$ wanting about 100 part of an *Inch*.

3. Presently after another Tube was fill'd again with the same *Water*, and inverted, and the *Water* being drawn down to the Surface of the vesselled Wa-
ter,

ter, and the *Air* let in again, the *Water* was impell'd up to the very Top within a *10th* and *half* a *10th* of an *Inch*.

4. The Tube for measuring the *Air* latent in the *Water*, was $43\frac{1}{2}$ *Inches* above the Surface of the Stagnant *Water*: The *Air* collected out of the *Bubbles* at the top of the *Water*, was the *first* time $\frac{3}{4}$ of an *Inch*, and somewhat better; the *Second* time we estimated it but $\frac{1}{2}$ and $\frac{1}{8}$. The *First* time the *Water* in the *Pipe* was made to subside full as low as the Surface of the Restagnant *Water*: The *Second* time, the lowest we made it subside seem'd to be 4 or 5 *Inches* above the Surface of the *Water* in the open Vessel.

I must here *Advertise* that the *Air* at the Top of the *Tube* did possess more room than it's Bulk did absolutely require, because it was somewhat defended from the Pressure of the *Atmosphere* by the Weight of the Subjacent Cylinder of *Water*, which might be about three or four *Foot* long.

5. We provided a clear round *Glass*, furnished with a *Pipe* or *Stem* of about 9 *Inches* in length, the *Globulous* part of the *Glass* being on the outside about $3\frac{1}{2}$ *Inches* in Diameter; the *Pipe* of this *Glass* was within an *Inch* of the Top, melted at the Flame of a *Lamp*, and drawn out for two or three *Inches* as slender as a *Crow's Quill*, that the Decrement of the *Water* upon the Recess of the *Air* harboured in its Pores, might, if any should happen, be the more easily Observed and estimated. Above this *Slender* part of the *Pipe*, the *Glass* was of the same largeness (or near it) with the rest of the *Pipe*, that the *Aerial Bubbles*, ascending through the *Slender* part, might there find room to break, and so prevent the overflowing, or loss of any part of the *Water*.

This Vessel being not without Difficulty and some Industry fill'd, till the *Liquor* reached to the Top of the *Slender* part, where not being uniformly enough drawn out, it was somewhat broader than elsewhere; we conveyed the *Glass*, together with a *Pedestal* for it to rest upon, into a tall *Receiver*, and *Pumping* out the *Air*, there disclosed themselves numerous *Bubbles* Ascending nimbly to the upper part of the *Glass*, where they made a kind of Froath or Foam; but, by Reason of the above mentioned Figuration of the Vessel, they broke at the Top of the slender part, and so never came to overflow. This done, the *Pump* was suffered to rest a while, to give the *Aerial* Particles, lodged in the *Water*, time to separate themselves and Emerge, which when they had done a pretty while, the *Pump* was plyed again, for fear some *Air* should have stolen into so large a *Receiver*.

These Vicissitudes of *Pumping* and *Resting* lasted for a considerable Time, till at length the *Bubbles* began to be very rare, and we weary of waiting any longer, soon after which the *External Air* was let in to the *Receiver*, and it appear'd somewhat strange to the Spectators, that notwithstanding so great a Multitude of *Bubbles*, as had escaped out of the *Water*, I could not by attentively comparing the Place where the Surface of the *Water* rested at first (to which a Mark had been affix'd) with that where it now stood, I could not, I say, discern the Difference to amount to above, if so much, as an Hair's breadth; and the Chief Operator in the Experiment professed that for his part, he could not perceive any difference at all.

6. Filling a Glass of the same *Shape*, and much of the same bigness, with *Claret Wine*, and placing it upon a convenient *Pedestal*, in a tall *Receiver*, we caused some of the *Air* to be *Pumped* out; whereupon in a short time there Emerg'd, through the *Slender Pipe*, so very great a Multitude of *Bubbles*, that were darted as it were upwards, as did not a little both please and surprise the *Beholders*: But it forced us to go warily to work, for fear the *Glass* should break, or the *Wine* overflow. Wherefore we seasonably left off *Pumping*, before the *Receiver* was any thing near *Exhausted*, and suffered the *Bubbles* to get away as they could, till the present *Danger* was over passed, and then from time to time we *Pumped* a little more *Air* out of the *Receiver*, till we were weary, the withdrawing of a moderate *Quantity* of *Air* at a time sufficing, even at the latter end, to make the *Bubbles* not only copiously, but very swiftly *Ascend*, (by a *Minute Watch*) for above a *Quarter* of an *Hour* together.

Shell-Fishes.

V I. 1. An *Oyster* being put into a very small *Receiver*, and kept in long enough to have successively *Kill'd* three or four *Birds* or *Beasts*, &c. Was not thereby *Kill'd*, nor, for ought we could perceive, considerably disturb'd; only at each *Suck* we perceived, that the *Air* contain'd between the two *Shells* broke out at their *Commiffure*; as we concluded from the *Foam* which at those times came forth all round that *Commiffure*. About 24 *Hours* after, I found that both this and another, that had been put into the *Receiver* at the same time, were *Alive*.

2. We put a pretty large *Craw-Fish* into a pretty large *Receiver*, and found, that though he had been injur'd by a *Fall* before he was brought thither, yet he seem'd not to be much *incommoded* by being included, till the *Air* was in great Measure *Pump'd* out, and then its former *Motion*, presently ceased, and he lay as *Dead*; till upon the letting in a little *Air* into the *Receiver*, he began forthwith to move a fresh; and upon the withdrawing the *Air* again, he presently, as before, became moveless. Having repeated this *Trial* two or three times, we took him out of the *Receiver*, where he appear'd not to have suffer'd any *Harm*.

3. Having put an *Oyster* into a *Viol* full of *Water*, before we included it in the *Receiver*, it prov'd so strong as to keep it self close shut, and repress'd the *Eruption* of the *Bubbles*, that in the other did force open the *Shells* from time to time; and kept in its own *Air* as long as we had *Occasion* to continue the *Trials*.

4. Moreover a *Craw-Fish*, that was thought more vigorous, being substituted in the place of the former *Craw-Fish*, though once he seem'd to lose his *Motion* together with the *Air*, yet afterwards he continued moving in the *Receiver*, in spite of our *Pumping*.

A Scale Fish.

V II. We took a *Receiver* shap'd almost like a *Bolthead*, containing by Estimation near a *Pint*, and the *Globulous* part of it being almost half full of *Water*, we put into it, at the *Orifice* (which was pretty large) a small *Gudgeon*, about 3 *Inches* long, which when it was in the *Water* swam nimbly up and down therein. Then having drawn out the *Air* so well, that we guessed by a *Gage*, that

that about 19 parts of 20 or more might be *Exhausted*, we secured our selves that the Regress of the *Air* should not injure our Experiment; about which we Observ'd that,

1. The Neck of the Glass being very Long, though there appear'd great store of *Bubbles* all about the *Fish*; yet the rest of the *Water*, notwithstanding the withdrawing of so much *Air* as had been mention'd, emitted no *Froth*, and but few *Bubbles*.

2. The *Fish* both at his Mouth and Gills did, for a great while, discharge such a Quantity of *Bubbles* as appear'd strange, and for about half an *Hour* or more (for much longer I had not Opportunity to watch it;) whenever he rested a while, new *Bubbles* would adhere to many Parts of his Body (as if they were generated there) especially his *Fins* and *Tail*: So that he would appear almost beset with *Bubbles*; and if, being excited to *Swim*, he was made to shake them off, he would quickly, upon a little Rest, be beset with new ones as before.

3. Almost all the while, he would gape and move his *Gills*, as before he was included; though towards the end of the time that I watch'd, it often happened, that he neither took in, nor Emitted any *Aerial* Particles that I could perceive.

4. After a while, he lay almost constantly with his Belly upwards, and yet would in that Posture *Swim* briskly as before.

5. Nay, after a while, he seem'd to be more *Lively* than at first putting in; whether by Reason, that by Discharge of so many *Bubbles*, which by their Dissension, perhaps, put him to Pain, he found himself relieved, or for some other Cause, I examine not.

6. About an *Hour* and an *Half* after he had been Seal'd up, I found him almost free from *Bubbles*, and with his Belly upwards, and seeming somewhat Tumid, but yet *Lively* as before. But an *Hour* and a *Quarter* after that, he seem'd to be moveless and somewhat stiff; yet upon shaking the Glass, observing some faint Signs of *Life* in him by some Languid Motions, he attempted to make when excited to them, I opened the *Receiver* under *Water*, to try if that Liquor and *Air* would recover him; and the External *Water* rushing in, till it had fill'd the vacant part of the Ball, and the greatest part of the Stem too, the *Fish* Sunk at the Bottom of it, with a greater appearance than ever of being *Alive*; in which State after he had continued a pretty while, I made a Shift, by the help of the *Water* he swam in, to get him through the Pipe into a *Bason* of *Water*, where he gave more manifest Signs of *Life*: But yet for some *Hours* lay on one side or other, without being able to swim or lye on his Belly, which appeared very much Shrunk in, as if something, during the time of its being Seal'd up, had been broken in his Body, or his Belly had been exceedingly distended, beyond Restitution of its former Tone.

All the while he continued in the *Bason* of *Water*, though he moved his *Gills* as before he had been Seal'd up; yet I could not perceive, that he did, even in his new *Water*, Emit, as formerly, any *Bubbles*, though two or three times I held him by the Tail in the *Air*, and put him into the *Water* again, where at length he grew able to lye constantly upon his Belly, which
yet

yet retained much of its former Lankness. He lived in the Basin, 8 or 10 Days, though divers other *Gudgeons* dy'd there in much fewer Days.

Wounded Animals.

VIII. 1. *Sept.* 12. A small *Bird*, having the *Abdomen* open'd almost from Flank to Flank, without injuring the *Guts*, was put into a small *Receiver*, and the *Pump* being set a-work, continued for some time without giving any Signs of Distress: But at the end of about a *Minute* and a *half* from the Beginning of the *Exhaustion*, she began to have *Convulsive* Motions in the *Wings*; and though the *Convulsions* were not Universal, or did appear Violent, as is usual in other *Birds* from whom the *Air* is withdrawn by the *Engine*, yet at the end of two full *Minutes*, letting in the *Air*, and then taking off the *Receiver*, we found the *Bird* irrecoverable; notwithstanding which we did not find any notable Alteration in the *Lungs*, and found the *Heart* (or at least the *Auricles* of it) to be yet beating, and so it continued for a while after.

2. We took also a pretty large *Frog*, and having, without violating the *Lungs* or the *Guts*, made two such Incisions in the *Abdomen*, that the two curl'd *Bladders* or *Lobes* of *Lungs* came out almost totally at them, we suspended the *Frog* by the *Legs* in a small *Receiver*, and after we had *Pump'd* out a good part of the *Air*, the Animal Strugled very much, and seem'd to be much disorder'd, and when the *Receiver* was well *Exhausted*, she lay still for a while as if she had been *Dead*, the *Abdomen* and *Thigh* very much Swell'd, as if some *Rarified Air* or *Vapour* forcibly distended them. But as, when the *Frog* was put in, one of the *Lobes* was almost Full, and the other almost shrunk up, so they continued to appear, after the *Receiver* had been *Exhausted*; but upon letting in of the *Air*, not only the Body ceased to be Tumid, but the *Plump Bladder* appear'd for a while Shrunken up as the other, and the *Receiver* being remov'd, the *Frog* presently *Reviv'd*, and quickly began to fill the *Lobe* again with *Air*.

The separated Hearts of Cold Animals.

IX. 1. The *Heart* of an *Eel* being taken out and laid upon a Plate of *Tin* in a small *Receiver* when we perceived it to *Beat* there as it had done in the open *Air*, we *Exhausted* the *Vessel*, and saw, that though the *Heart* grew very Tumid, and here and there sent forth little *Bubbles*, yet it continued to beat as manifestly as before, and seem'd to do so more swiftly; as we tryed by numbring the *Pulsations* it made in a *Minute*, whilst it was in the *Exhausted Receiver*, and when he had readmitted the *Air*, and also when we took it out of the *Glass* and suffered it to continue its Motion in the open *Air*.

2. The *Heart* of another *Eel*, after having been included in a *Receiver*, first *Exhausted* and then accurately secur'd from leaking, though it appear'd very Tumid, continued to *Beat* there an *Hour*; after which looking upon it, and finding its Motion very Languid, and almost ceas'd, by *breathing* a little upon that part of the *Glass* where the *Heart* was, it quickly regained Motion, which I observ'd a while, and an *Hour* after, finding it to seem almost quite Gone, I was able to renew it by the Application of a little more *Warmth*.

At the End of the 3^d *Hour*, I could no more excite it by *Warmth*: Wherefore I suffer'd the outward *Air* to rush in, but could not discern, that thereby the *Heart* regained any sensible Motion, though assisted with the *Warmth* of my *Breath* and *Hands*.

X. A sufficient Number of Instances of *Animals* kill'd in the *Exhausted Receiver*, is to be met with in our other *Experiments*: And therefore I shall now subjoyn some *Trials*, about the *Times* wherein *Animals* may be kill'd by that want of *Respiration*, which, in those that are *Drowned*, is caused by the *Water* that Suffocates them. Animals
Drowned and
Deprived of
Air.

1. *Sept. 10.* A *Green Finch*, having his *Legs* and *Wings* tyed to a *Weight*, was gently let down into a *Glass body* fill'd with *Water*; and at the end of *half a Minute* he was found quite *Dead*.

2. A *Sparrow*, that was lusty and quarrelsome, was let down after the same manner; but though he seem'd to be under *Water* more vigorous than the other *Bird*, and continued struggling almost to the very end of *half a Minute* from the time of his being totally *Immersed* (during which stay under *Water* there Ascended from time to time, pretty large *Bubbles* from his *Mouth*.) yet notwithstanding that as soon as ever the *half a Minute* was completed he was drawn up, we found him, to our Wonder, *irrecoverably gone*.

3. A small *Mouse*, being held under *Water* by the *Tail*, Emitted from time to time divers *Aerial Bubbles* out of his *Mouth*, and at last, as one of the *Spectators* affirmed he saw, at one of his *Eyes*; being taken out at the end of *half a Minute* and some few *Seconds*, he yet retained some *Motions*: But they proved but *Convulsive* ones, which at last ended in *Death*.

4. We took the *Duck* (mentioned above) and so tyed a considerable *Weight* of *Lead* to her *Body*, as it did not hinder her *Respiration*, and yet would be sure to keep her down under *Water*. With this *Clog* she was put into a *Tub* full of clear *Water*, under whose *Surface* she continued about a *Minute* by my *Watch* quietly enough, but afterwards began to appear for a while much disturbed; which fit being over our not perceiving any *Motion* in her made us, at the end of the *Second Minute*, take her out of the *Water*, to see in what *Condition* she was, and finding her in a good one, after we had allow'd her some *Breathing* time to recruit her self with *Fresh Air*, we let her down again into the *Tub*, which in the mean time had been fill'd with *Fresh Water*. After a while, she begun, and from time to time continued, to Emit divers *Bubbles* at her *Beak*. There also came out at her *Nostrils* divers real *Bubbles* from time to time; and when the *Animal* had continued about *two Minutes* or better under *Water*, she began to *Struggle* very much, and to endeavour either to *Emerge*, or change *Postures*; the latter of which she had liberty to do, but not the former. After *Four Minutes* the *Bubbles* came much more sparingly from her: Then also she began to *Gape* from time to time, (which we had not *Observ'd* her to do before,) but without *Emitting Bubbles*; and so she continued *gaping* till near the end of the *6th Minute*, at which time all her *Motions*, some of which were judg'd *Convulsive*, and others that had been excited by our rousing her with a *Forceps*, appear'd to cease, and her *Head* to hang carelessly down as if she were quite *Dead*. Notwithstanding which, we thought fit for greater security to continue her under *Water* a full *Minute* longer, and then finding no *Signs of Life* we took her out; and being hung by the *Heels*, and gently press'd in convenient places, she was made to void a pretty *Quantity of Water*. But all the *Means* that were used, to recover the Vid. Sup. 1.
Exp. 1.
Bird.

Bird to Life, proving Ineffectual, we concluded, she had been *Dead* a full *Minute* before we remov'd her out of the *Water*: So that to Sum up the Event of our *Experiment*, even this *Water-Bird* was not able to *Live* in *Cold Water*, without taking in *Fresh Air*, above 6 *Minutes*.

Vid. Sup. 1.
Exp. 2.

5. The *Duckling*, (mentioned above,) having a Competent Weight ty'd to her Legs, was let down into a *Tub* of *Water*. There came out store of *Bubbles* at her Nostrils, but there seem'd to come out more and greater from a certain place in her Head almost equidistant from her Eyes, but somewhat less remote from her Neck than they. After much struggling and frequent gaping, she had divers *Convulsive* Motions, and then let her Head fall down backward, with her Throat upwards. To which moveless Posture she was reduced at the End of the *third Minute*, if not a little sooner; but a while after there appear'd a manifest but tremulous Motion in the two parts of her Bill, which continued for some time, but afforded no Circumstances, whereby we could be sure, that they were not *Convulsive* Motions; but these also ceasing upon the end of the *fourth Minute*, the Bird was taken out and found *irrecoverable*.

From these two Experiments it appears, that tho' *Water Fowl* (at least *Ducks*) could not in our *Receivers* endure the want of *Air* much longer than other *Birds*; Yet by that Contrivance of Nature mention'd about the *Heart*, they are enabled to continue much longer under *Water*.

6. A *Viper*, that was kept so many *Hours* in an *Exhausted Receiver* till it was concluded to be stark *Dead*, and to have been so for a good while, was kept all Night in a *Glass-body* upon a warm *Digestive Furnace*: Whereupon the *Viper* was found, the next Morning, to be very *lively*. We then put her into a tall *Glass Body*, fitted with a *Cork* to the *Orifice* of it, and depressed with *Weight*, so that she could come at no *Air*. And after she had been *duckt* a while, she lay with a very little Motion for a considerable space of time. At an *Hour* and a *Quarter* she often put out her black *Tongue*; At near 4 *Hours* she appear'd much *alive*, and, as I remember, about that time also put out her *Tongue*, *Swimming* all this while, as far as we Observ'd, above the *Water*. At the end of about 7 *Hours* or more, she seem'd yet to have some *Life* in her; her Posture being manifestly changed in the *Glass* from what it was a while before, unless that might proceed from some difference made in her Body as to *Gravity* and *Levity*. Not long after she appear'd quite *Dead*. Her *Head* and *Tail* hanging down movelessly, and directly towards the *Bottom* of the *Vessel*, whilst the middle of the *Body* floated as much as the above mentioned *Cork* would permit it.

I must here take Notice, that though some of the above mentioned Animals seem by the Relations we have given of them, to have been a little sooner destroy'd by *Drowning*, than any we have mention'd were by our *Engine*, yet that is no sure proof, that *Suffocation* does kill Animals faster than the *Deprivation* of *Air*, they are expos'd to in our *Engine*. For in *Drowning*, that which destroys is apply'd to its full *Vigour* at the very first, and all at once: Whereas our *Receivers*, being made for several Purposes, the *Deprivation* of the *Air*, that they make cannot be made all at once, but the *Air* must be *Pamp't* out by

by Degrees; so that till the last the *Receiver* will be but partly emptied. For Confirmation of which I have this to alledge, that, having in the presence of some *Virtuosi*, provided for the Nonce a very small *Receiver*, wherein yet a *Mouse* could Live some time if the *Air* were left in it, we were able to evacuate it at *one Suck*, and by that Advantage we were enabled, to the Wonder of the Beholders, to kill the Animal in less than *half a Minute*.

XI. 1. *Aug.* 16. A *Linnet* being put into a *Receiver*, capable to hold about $4\frac{1}{2}$ *Pints* of Water, the *Glass* was well clos'd with Cement and a Cover; but none of the *Air* was drawn out with the *Engine* or otherwise. And though no new *Air* was let in, nor any change made in the imprison'd *Air*, yet the *Bird* continu'd there 3 *Hours* without any apparent approach to *Death*; And though it seem'd somewhat *Sick*, yet being afterwards taken out it recovered, and Liv'd several *Hours*.

*Animals in Ra-
rify'd Air. n. 63.
p. 2036:*

2. *Aug.* 18. From the above mention'd *Receiver* about *half* the *Air* was drawn out, a *Linnet* being then in the *Glass*, and in that *Rarified Air* (which appear'd by a *Gage* to continue in that State) the *Bird* lived an *Hour* and near a *Quarter* before it seem'd in danger of *Death*; after which the *Air* being let in without taking off the *Receiver*, she manifestly recover'd, and leaped against the side of the *Glass*; being taken out into the *open Air* she flew out of my Hand to a pretty Distance.

3. *Sept.* 9. We convey'd into a *Receiver*, capable to hold about $4\frac{1}{2}$ *Pints* of Water, a *Lark*, together with the *Gage*, by the Help whereof we Pump'd out of the *Receiver* $\frac{3}{4}$ of the *Air* that was in it before; then heedfully observing the *Bird*, we perceived it to pant very much, so that a Learned Physician (from whom I yet dissented,) judg'd those Beatings to be *Convulsive*: Having continued thus for a little above a *Minute* and a half; the *Bird* fell into a true *Convulsive Motion*, that cast it upon the Back. And although we made great Hast to let in the *Air*; yet before the Expiration of the *Second Minute*, and consequently in less than *half a Minute* from the time immediately preceeding the *Convulsion*, the *Lark* was gone past all Recovery.

4. Presently after we put into the same *Receiver* a *Greenfinch*, and having withdrawn the *Air*, till it appeared by the *Gage* there remained but *half*, we took Notice, that, within a *Minute* after, she appeared to be very *Sick*, and shaking her Head, threw against the inside of the *Glass* a certain Substance, which I took to be *Vomit*, and which afterwards appear'd so; upon this *Evacuation* the *Bird* seem'd to recover, and continue pretty well (but not without panting) till about the end of the *4th Minute*, at which growing very *Sick*, she vomited again (shaking her Head as at first,) but much more unquestionably than before, and soon after eat up again a little of her *Vomit*; at which time (whether that contributed to her Recovery or no) she very much recovered. And though she had, in all, three fits of Vomiting, yet for the last 7 or 8 *Minutes* that we kept her in the *Receiver*, she seem'd to be much more *lively* than was expected: Which may in part be attributed to a little *Air* that by an Accident got in, tho' it were immediately Pump'd out again. At the end of a full

Quarter of an Hour from the first Exhaustion of the Receiver, the Bird appearing not likely to Dye in a great while, we took her out.

5. Apr. 12. A Viper was included, together with a Gage, in a Portable Receiver, capable to hold $3\frac{1}{2}$ Pints of Water. This Vessel being Exhausted, and secured against the Regress of the Air, the Imprisoned Animal was observ'd not only to be *alive*, but nimbly to put out and to draw back its Tongue, about 36 Hours after it was first shut up. At the end of 60 Hours as I was going to Bed she appear'd very dull and faint, and not likely to live much longer; the next Day after Dinner, I found her Stark dead, with her Mouth open'd to a strange wideness: Wherefore suffering Water to be impelled by the outward Air into the Cavity of the Receiver, we found that 4 parts of 5, or rather 5 of 6 of the Vessel'd Air had been Pumped out.

Difficult Respiration at the Tops of Mountains.

6. I shall here add, that, an Ecclesiastical Person, who had visited those high Mountains of Armenia, (on one of which, because of their Height, the Tradition of the Natives will needs have the Ark to have rested;) told me, that those Mountains were really exceeding high, and that he could not come to the Top, (because of the unpassable Snows. And that whilst he was in the upper part of the Mountain, he plainly perceived, that he was reduced to fetch his Breath much oftener than he was wont, and than he did before he Ascended the Hill and after he came down from it; And that, having exprest some wonder to find himself so short winded, the People told him, that it was no more than happen'd to them when they were so high above the plain; it being a Common Observation among them. He also told me, that he made the like Observation upon the Top of a Mountain in the Country of Sevennes, in or near the Province of Languedock.

A Learned Travailer, who was a Person very Curious and Intelligent, told me, that being invited, about the Beginning of September to visit a Neighbouring Mountain, that is at least one of the Highest of the Pyreneans, which is commonly call'd *Pic de Midi*, they found the Air there not so fit for Respiration as common Air, and were fain to breath shorter and oftner, than usual; and because I suspected, that might come from their Motion, I ask'd, whether they observ'd it to cease when they came down to the Bottom of the Hill, which he told me they plainly did; besides that, they staid many Hours at the Top, too long to continue out of Breath.

It is worth further Inquiry, whether the Sicknes, if not also the Difficulty of Breathing, that some have been obnoxious to in the uppermost parts of *Pariacacha*, and perhaps some other high Mountains, may not be imputed, not so precisely to the Thinness and Rarity of the Air in places so remote from the lowermost part of the Atmosphere, as to exclude certain Steams of a peculiar Nature, which in some places the Air may be Imbued with? For an Intelligent Person Informed me, that he had attempted to go up to the Top of the *Pic of Teneriffe*: But that, though some of the Company were able to do so, he and some others, before they had reached near so high, grew so Sick upon the Operation they felt of the sharp Air, and Sulphurous Exhalations which infected it, that they were fain to stay behind their Companions, he having already found

found this Effect of those *piercing Steams* upon his Face, that the Skin began to be of a pale-Yellow, and even his Hair to be discoloured.

XII. We included a *Mouse* in a fine limber and clear *Bladder*, made more Transparent by being anointed with *Oyl*, on the Outside that the smell of it might less offend him.

Animals in the same Air, Vary'd as to Density.

Then, to make up so large an Orifice without Wrinkles, (at which the *Rarify'd Air* may escape) we provided a round stick, somewhat less than the Orifice, which we laid over with a close and yielding Cement, (for Pitch, or the like common Stuff, will not alwayes serve the turn) and ty'd the *Bladder* fast and close enough upon it, leaving in the *Bladder* as much *Air* as we thought might suffice him for as long a time as the *Experiment* was to last. Then putting this Limber or *Extensible Receiver*, if I may so call it, into an ordinary one of *Glass*, and placing this *Engine* near a Window, that we might see through both of them; the *Air* was by Degrees Pumped out of the *External Receiver*, (as for Distinctions sake I shall call it, and thereupon the *Air* included in the *Bladder* did proportionally expand it self, and so distend the *Internal Receiver*, till being arrived at a Degree of *Rarefaction*, which rendred it unfit for the included *Mouse's Respiration*, I perceived, though with some Difficulty, in this Animal the Signs of his being in great Danger of *Sudden Death*. Whereupon the outward *Air*, being hastily let into the *External Receiver*, compressed the swelled *Bladder* to its former Dimensions, and thereby the *Included Air* to its former *Density*, by which means the *Fainting Mouse* was quickly revived. Having given him some convenient time of *Respite*, the *Experiment* was reiterated with the like Success; and we doubted not but the *third Trial* we made, would have ended as the two former did: But that, whilst we were considering of the Sickness of the *Mouse*, which, by Reason of some Opacity that could scarce be avoided in the Wrinkled *Bladder*, was not, as to its Degree, so easily taken notice of, it grew *irrecoverable* by the subsequent *Condensation* of the *Air*.

XIII. 1. We took a good Company of *Tadpoles*, and put them with a convenient *Quantity* of *Water* into a *Portable Receiver* of a round Figure, and Observ'd, that at the first *Exsuction* of the *Air*, they did rise to the top of the *Water* though most of them subsided again, till the next *Exsuction* raised them. They seem'd by their Active and Wrigling Motion to be very discomposed. The *Receiver* being *Exhausted* they continued restless, moving all of them in the top of the *Water*, and tho' some of them seem'd to endeavour to go to the Bottom, and dived some part of the way, especially with their Heads, yet they were immediately buoyed up again. Within an Hour or a little more they were all moveless, and lay floating on the *Water*; wherefore I opened the *Receiver*, upon which the *Air* rushed in, and almost all of them (which were many) presently sunk to the Bottom, but none of them recovered to *Life*.

The Production and Growth of Animals, in an Exhausted Receiver.

2. A little after these, we included a lesser Number of *Tadpoles* in a smaller *Glass*, which was also *Exhausted* with the like Circumstances with the former. And when I found the other *Tadpoles* to be *dead*, I hastened to these which did not, except perhaps one, give any Sign of *Life*, but upon letting in the *Air*, these having not been long kept from it, some few of them did recover, and

swam up and down lively enough for some time; though after a while they also Dy'd.

3 Some years after, I repeated the same *Experiment*: And though after the *Exhaustion* was perfected, the *Tadpoles* did for a while move briskly enough on the top of the *Water*, (none of them appearing able to Dive or Swim under *Water*) yet coming to look on them after the end of an *Hour*, they seem'd to be all of them quite *Dead*, yet continued floating. And though within *half* an *Hour* after that, I let in the *Air* upon them, yet all the Effect of it was, that the most of them immediately sunk to the *Bottom*, as the rest of them did a very little while after; none of them, that I could Observe, recovering any *Vital Motion*.

4. Having, after much watching and with much ado, got 4 or 5 of those odd *Aquatick Insects*, whereof *Gnats* are generated, about the end of *August*, after a Shower of *Rain* which dropt from a House into a Vessel laid on purpose for it, we included them with some of their *Water* into a small *Glass Receiver*, which being very exactly closed we kept in a *South-Window*, where those little Creatures continued to Swim up and down for some few *Days*, without seeming to be much incommodated by so unusual an Habitation; and at the end of that time, and much about the same Day, they Divested the Habit they had whilst they lived as *Fishes*, and appear'd with their *Exuviae*, or cast Coats, under their Feet, shewing themselves to be perfect *Gnats*, that stood without sinking upon the Surface of the *Water*, and discovered themselves to be *alive* by their Motion, when they were excited to it: But I could not perceive them to fly in that *Thin Medium*, to which Inability, whether the *Viscosity* of the *Water* might contribute, I know not; though they lived a pretty while, till Hunger or Cold destroy'd them.

The Expansion of
Blood and other
Animal Juices,
and of the Soft
Parts of the Bo-
dy.

1. The warm *Blood* of a *Lamb*, or a *Sheep*, being taken as it were hastily brought from the Butchers, where the *Fibres* had been broken to hinder the *Coagulation*, was in a wide Mouth'd *Glass* put into a *Receiver*, made ready for it; and the *Pump* being early set on Work, the *Air* was diligently drawn out. After a long Expectation, the more subtle parts of the *Blood* would begin to force their way through the more Clammy ones, and seem to boyle in large Clusters, some as big as great Beans or Nutmeggs; and sometimes, to the wonder of the by-standing *Physitians*, the *Blood* was so Volatile, and the Expansion so Vehement, that it boyled over the containing *Glass*; of which, when it was put in, it did not, by our Estimate, fill above a *Quarter*.

Having also included some *Milk*, warm from the Cow, in a Cylindrical Vessel of about 4 or 5 Inches high, when the *External Air* was fully withdrawn, the white Liquor began to boyle in a way that was not so easy to describe, as pleasant to behold: And this it did for a pretty while, with so much Impetuosity, that it threw up several parts of it self out of the wide mouthed *Glass* that contained it (and could have contained as much more) though there were not above two or three *Ounces* of the Liquor.

A yet greater Disposition to the *Intumescence* we thought we observ'd in the *Gall*, which was but suitable to the *Viscosity* of the Texture.

Note, that the two foregoing Experiments were made with an Eye cast upon the Inquiry, that I thought might be made, Whether, and how far, the Destructive Operation of our *Engine* upon the *Included Animal*, might be imputed to this, that upon the *withdrawing* of the *Air*, besides the removal of what the *Air's* presence contributes to *Life*, the little *Bubbles* generated upon the absence of the *Air* in the *Blood*, *Juices*, and *Soft Parts* of the *Body*, may by their vast Number and their conspiring Distension, variously Streighten in some places, and stretch in others, the *Vessels*, especially the smaller ones, that convey the *Blood* and *Nourishment*; and so by choaking up some Passages and vitiating the Figure of others, disturb or hinder the due *Circulation* of the *Blood*? Not to mention the Pains that such *Distensions* may cause in some *Nerves*, and *Membranous Parts*, which by irritating some of them into *Convulsions*, may hasten the *Death* of *Animals*, and destroy them sooner by *Occasion* of that Irritation, than they would be destroyed by the bare absence, or loss, of what the *Air* is necessary to supply them with. And to shew, how this Production of *Bubbles* reaches even to very minute Parts of the *Body*, I shall add on this Occasion, (hoping that I have not prevented myself on any other,) what may seem somewhat strange, what I once observed in a *Viper*, furiously tortured in our *Exhausted Receiver*, namely, that it had manifestly a conspicuous *Bubble* moving to and fro in the *Waterish Humor* of one of its *Eyes*.

2. And to shew, that not only the *Blood* and *Liquors*, but also the other *Soft Parts*, even in *cold Animals*, have *Aerial Particles* latent in them; we took the *Livers* and *Heart* of an *Eel*, as also the *Head* and *Body* of another *Fish* of the same kind, cut asunder cross ways somewhat beneath the *Heart*, and putting them into a *Receiver*, upon the *withdrawing* of the *Air* we perceived, that the *Liver* did manifestly *Swell* every way, and that both the upper and lower Parts did so likewise; and at the place where the Division had been made there came out, in each portion of the *Fish*, divers *Bubbles*, several of which seemed to come from the *Medulla Spinalis*, or the *Cavity* of the *Back-bone*, or the adjoining Parts, and the *External Air* being let in, both the Portions of the *Eel* presently shrunk, some of the *Skin* seeming to be grown *Empty* or *Flaccid* in each of them.

XIV. 1. We included in a round *Viol* with a wide *Neck*, (the whole *Glass* being capable of containing about 8 *Ounces* of *Water*) a *Young* and small *Mouse*, and then tyed strongly upon the upper part of the *Glasses Neck* a fine thin *Bladder*, out of which the *Air* had been carefully expressed, and then conveyed this *Phantastical Vessel* into a middle sized *Receiver*, in which we also placed a *Mercurial Gage*. The *Air* was by *Degrees* pumped out, till it appeared by the *Gage*, that there remained but a 4th part in the *External Receiver* (as for *Distinctions* sake I call it;) whereupon the *Air* in the *External Receiver* Expanding it self, appear'd for to have blown the *Bladder* almost half full, and the *Mouse* seeming very ill at ease by his *Leaping*, and otherwise endeavouring to pass out, at the *Neck* of his uneasy *Prison*; we did, for fear the over-*Thin Air* would dispatch him, let the *Air* flow into the *External Receiver*, whereby

Assuefaction to
Rarify'd Air.

whereby the *Bladder* being compress'd, and the *Air* in the *Viol* reduced to its former *Density*, the little *Animal* quickly recover'd.

2. A while after, without removing the *Bladder*, the *Experiment* was repeated, and the *Air* by the help of the *Gage*, was reduced to its former Degree of *Rarefaction*; and the *Mouse* was kept in that *Thin Air* for full 4 *Minutes*; at the end of which he appeared so *Sick*, that, to prevent his *Dying* immediately, we remov'd the *External*, and took out the *Internal Receiver*. Whereupon, though he recovered, yet 'twas not without much *Difficulty*; being unable to stand any longer upon his *Feet*, and for a great while after continued manifestly *Trembling*.

3. But having suffered him to rest a reasonable space of time, presuming that *Assuefaction* had accustomed him to greater *Hardships*, we convey'd him again into the *External Receiver*, and having brought the *Air* to the former Degree of *Expansion*, we were able to keep him there for a full *Quarter* of an *Hour*. And 'tis worth *Noting*, That, till near the latter end of the *Quarter* of an *Hour*, not only the *Animal* did scarce at all appear *distressed*, remaining still very quiet; but, which is more, whereas when he was put in, the *Tremblings* formerly mention'd were yet upon him and continued so for some time, yet afterwards, in spite of the *Expansion* of the *Air* he was then in, they left him early enough. And when the *Internal Receiver* was taken out, he did not only recover from his *Fainting Fit* sooner than before, but escaped those subsequent *Tremblings*.

4. After we had allow'd him some time to recollect his *Strength*, we reconveyed him into the *Receiver*, and *Pump'd* out the *Air*, till the *Mercury* in the *Gage* was not only drawn down as low as formerly, but near half an *Inch* lower. And though this did at first seem to discompose our little *Beast*, yet after a while he grew very quiet, and continued so for a full *Quarter* of an *Hour*; when we caused 3 *Exsactions* more to be made by the *Pump*, before we discovered him to be in manifest *Danger* (at which time the *Bladder* appeared much fuller than before:) But then we were oblig'd to let the *Air* into the *outward Receiver*; whereupon the *Mouse* was more speedily revived than one would have suspected.

And these *Trials* of the Power of *Assuefaction* seem'd the more considerable, because the *Air*, in which the *Mouse* had all this while lived, had been clogged and infected with the *Excrementitious Effluvioms* of his *Body*; for 'twas the same all along, we having purposely forbore to take off the *Bladder*.

Unfit for Respiration, yet retaining its Density.

XV. 1. We took a *Mouse* of an ordinary *Size*, and having (not without some *Difficulty*) conveyed him into an *Oval Glass* fitted with a somewhat long and considerably broad *Neck*, we conveyed in after him a *Mercurial Gage*, in which we had diligently Observ'd and marked the *Station* of the *Mercury*, and which was so fastened to a *Wire* reaching to the *Bottom* of the *Oval Glass*, that the *Gage*, remaining in the *Neck*, was not in danger to be broken by the *Motions* of the *Mouse* in the *Oval* part: The upper part of the long *Neck* of the *Glass* was, notwithstanding the wideness of it, *Hermetically Seal'd*: And though by Reason of the largeness of the *Vessel* in Comparison of so small an

Animal,

Animal, he seem'd to me rather drooping than very near *Death* at the end of the *Second Hour*; yet coming to look upon him about *half an Hour* after, he was judged by the Spectators quite *Dead*, notwithstanding our shaking of the Vessel to rouze him up. This made me cast my Eyes upon the *Gage*, wherein I could not perceive any sensible Change of the *Mercuries* Station. But having caused the *Seal'd* part of the *Glass* to be broken off, and *fresh Air* to be blown in by a pair of *Bellows*, the gasping Animal *reviv'd*, tho' but slowly.

2. Such an Experiment as the former we made with like Success upon a small *Bird* included with a *Gage* in a *Receiver* holding about a *Quart* of *Water*. The *Bird* in about *half an Hour* appeared to be *Sick* and drooping, and the Faintness and Difficulty of Breathing increased for about *two Hours* and an *half* after that, at which time the Animal *Dyed*, the *Gage* being not sensibly altered.

3. In a *Glass Viol*, capacious enough to hold about 3 *quarts* of *Water*, we *Hermetically Seal'd* up a small *Bird*, and found, that in a few *Minutes* he began to be *Sick* and *Pant*; which *Symptoms* I suffered to continue and increase against the Mind of a *Learned* Bystander, (who thought the Animal would not hold out so long) till they had lasted just *half an Hour*; at which time having provided a Vessel of *Water*, made exceeding *Cold* with *Sal Armoniack*, newly put into it, the *Viol* with the *Sick Bird* was immers'd in it, and kept there in that Condition for 6 *Minutes*; and yet it did not appear, that this great *Refrigeration* did sensibly *Refresh* the drooping Animal. So that this *Remedy* proving ineffectual, the *Viol* was removed out of the *Water*, and the *Bird* sometime after did, as I foretold, make many strains to *Vomit* (though she brought up little) followed by *Evacuations* downward, before she quite *Expired*, which she did within a *Minute* or *two* of a just *Hour*, after the beginning of her *Imprisonment*.

XVI. We made by *Distillation* a *Blood-Red* Liquor, which I have with very little variation communicated in the *History of Colours*, and which chiefly consists of such *Saline* and *Spirituos* Particles, as may be Obtained from the *Mass* of *Blood* in *Humane* Bodies; this Liquor is of such a Nature, that if a *Glass Viol*, about half fill'd with it, be kept well *stopp'd*, the *Red* Liquor will rest as quietly as any ordinary one, without sending up any *Smoak* or visible *Exhalation*; But if the *Viol* be *Unstopp'd*, so that the *External Air* be permitted to come in, and touch the *Surface* of the Liquor, within a *Quarter* of a *Minute* or less, there will upon this Contact be elevated a copious white *Smoak*, which will not only fill the upper part of the *Glass*, but plentifully pass out into the open *Air*, till the *Viol* be again *stopp'd*. This Experiment may serve to illustrate the Office of the *Air* to carry off in *Expiration* the *Fuliginous* Steams of the *Lungs*. For, in our Experiment we manifestly see, that the very *Contact* of the *Air* may give the *Corpuscles* of moist Bodies a peculiar Volatility, or Facility to Emerge in the form of *Steams*. It may here suffice to take Notice of these two things: The one is, That when the *Viol* has lain *Stopp'd* and *Quiet* a competent time, the upper half of it will appear destitute of *Fumes*, of which the *Air*, it seems, will imbibe, and constantly retain but a certain moderate *Quantity*, which may give some Light towards the Reason,

The use of Air in Respiration.

Why

Why the same *Air*, which will be quite Clogged with *Steams*, will not long serve for *Respiration*, which requires frequent Supplies of *fresh Air*: The other is, That if the *unstopped Viol* were placed in our *Vacuum*, it would not Emit any visible *Steams* at all, nor so much as to appear in the upper part of the *Glass* it self that held the *Liquor*; whereas, when the *Air* was by Degrees restored at the *Stopcock*, without moving the *Receiver* it self, to avoid injuring its closeness, the returning *Air* would presently raise the *Fumes*, first into the *Vacant* part of the *Viol*, whence they would Ascend into the Capacity of the *Receiver*; and likewise, when the *Air*, that was requisite to support them, was Pumped out, they also accompanied it, as their unpleasant Smell evinced, and the *Red Spirit*, tho' it remain'd *unstopped*. Emitted no more *Fumes* till the *Air* was let in.

Snails, Efts,
and Leeches.

XVII. 1. Two *White Snails without Shells* of differing Sizes (the biggest about an *Inch* and a *half*, and the other about an *Inch* in length) were Included in a small portable *Receiver*, which was carefully *Exhausted*, and secured against the Return of the *Air*. Presently after 'twas Remov'd from the *Engine*, it was easy to discern, that both the *Snails* thrust out and retracted their *Horns* (as they are commonly call'd) at pleasure, though their Bodies had in the softer places pretty store of newly generated *Bubbles* sticking to them: But though they did not lose their Motion near so soon, as other Animals were in our *Vacuum* want to do; yet coming to look on them after some *Hours*, they appear'd moveless and very *Tumid*, and at the end of 12 *Hours* the Inward Parts of their Bodies seem'd to be almost vanished, and they seem'd to be but a couple of small full blown *Bladders*; and on the letting in of the *Air* they immediately so shrunk, as if the *Bladders* having been pricked, the receding *Air* had left behind it nothing but *Skins*; nor did either of the *Snails* afterwards, though kept many *Hours*, give any Signs of *Life*.

2. We included in a *Receiver*, whose Globular part was about the bigness of a large *Orange*, one of that sort of Animals that they vulgarly call *Efts*: Having withdrawn, but not solicitously, the *Air*, we kept him there about 48 *Hours*; during all which time he continued *alive*, but appeared somewhat *Swelled* in his *Belly*; his under-chap moving the very first *Night*, but not the *Day* and *Night* following. By opening the *Receiver* at length under *Water*, we perceived, that about *half* the *Air* had been drawn out. As soon as the *Water* was impelled into the *Glass*, the Animal, that was before *Dull* and *Torpid*, seem'd, by very nimble and extravagant Motions, to be strangely *Reviv'd*.

3. We took a *Leech*, that was of a moderate bigness, or somewhat short of it, and having included it together with some *Water* in a Portable *Receiver*, that was guessed to be capable of holding about 10 or 12 *Ounces* of that *Liquor*; the *Air* was Pumped out after the usual manner, and the *Receiver* being remov'd to a lightsome Place, we observed, as we expected, that the *Leech* keeping her self under *Water*, there Emerged from divers Parts of her Body store of *Bubbles*, some of them in a dispersed way, but others in Rows or Files, if I may so speak, that seem'd to come from determinate Points: Though this Production of *Bubbles* lasted a pretty while, yet the *Leech* did not seem to be
very

very much *discomposed* by her present Condition: For after 5 Days (tho' the *Receiver* continued well *Exhausted*) we found her very *Lively*.

XVIII. 1. We took 5 or 6 *Caterpillars* of the same sort; and had the *Air* drawn from them, and carefully kept from Returning. About an *Hour* after, I found them Moving to and fro in the *Receiver*; and even above *two Hours* after that, I could by shaking the Vessel, excite in them some Motions, that I did not suspect to be *Convulsive*. But about 10 *Hours* after they were first Included, they seem'd to be quite *Dead*; yet the *Air* being forthwith restored to them, I found the *next Day* that 3 or 4 of them, were perfectly *Alive*. *Creeping Insects.*

2. We took from a Hedge a Branch, that had a large Cobweb of *Caterpillars* in it, and having divided it into two parts, we put them into like *Receivers*; and in One of them shut up the *Caterpillars* together with the *Air*, which from the other was *Exhausted*. The Event was, That in that which had the *Air*, the little and difficultly *Vilible Insects*, after a small time, appeared to *Move* up and down as before, and so continued to do for a *Day* or *two*, whereas that *Glass* whence the *Air* had been drawn out, and continued kept out, shewed after a very little while no *Motion* that we could perceive.

XIX. 1. Nov. 12. 8. at Night, There were taken 4 middle siz'd *Flesh-flies*, which having their Heads cut off were inclosed in a *Portable Receiver*, furnished with a pretty large Pipe and a Bubble at the end. As soon as the *Receiver* was *Exhausted*, those *Flies* lost their *Motion* (which was not brisk before); an *Hour* or *two* after, I approached them to the Fire, which restored not their *Motion* to them (but as to one of them I suspected it had a Languid Motion for a while); wherefore I let in the *Air* upon them, after which in a very short time (though not immediately they began one after another to *Move* their Legs, and one or two of them to *Walk*). *Winged Insects.*

2. Sept. 11. About Noon, we closed up divers ordinary *Flies*, and a *Bee* or *Wasp*; all which, when the *Air* was fully withdrawn, lay as *Dead*, save that for a very few *Minutes* some of them had *Convulsive* Motions in their Legs: They continued in this state 48 *Hours*, after which the *Air* was let in upon them, but none of them *Recovered*.

3. Decem. 11. At Night, we put a great *Flesh-Fly* into a very small portable *Receiver*, where at first it appear'd to be very *brisk* and *Lively*, but as soon as the *Air* was Drawn out, fell on his back, and seem'd to have *Convulsive* Motions in her Feet and *Proboscis*, from whence she presently *Recover'd*, upon the letting in of the *Air*; which being drawn out again, she lay as *Dead*: but a while after, (within a *Quarter*, or *half* an *Hour*) I perceived, that upon shaking the *Receiver*, she stirred up and down, but faintly. The next Night, by Warmth and letting in the *Air*, the *Fly* recovered: But being next Morning *Seal'd-up* again in that *Glass*, and kept 48 *Hours*, though over the *Chimney*, she *Died* for good and all.

4. We took a large *Grass-hopper*, whose Body, besides the Horns and Limbs, was about an *Inch* in length, and of a great Thickness in proportion to that length: This we conveyed into a *Portable Receiver* of an *Oval Form*,

and capable of holding (by our Guess) about a *Pint* of Water. When the *Air* began to be considerably *Rarified*, he appeared to be very ill at ease, and seemed to *Sweat* out of the *Abdomen* many little drops of Liquor, which being united trickled down the Glass like a little Stream, which made at the Bottom a small Pool of clear Liquor, amounting to near a *quarter* of a *Spoonful*, and by that time the *Receiver* was ready to be taken off, the *Grass* hopper was fallen upon his Back, and lay as *Dead*, and continued so for 3 *Hours*; After which the *Air* being let in upon him, He continued without any Signs of *Life* for a *quarter* or *half* an *Hour*: But being carried to a Sunshiny place, the Beams of a Declining Sun presently began to make him *Stir* his Limbs, and in a short time brought him perfectly to *Life* again.

5. *Apr.* 15. We took one of those *Shining Beetles* they call *Rose Flies*, and having included it in a very small round *Receiver*, which we *Exhausted*; and though it struggled much whilst the *Air* was withdrawing, yet presently after, I could perceive but little *Motion* (and part of that seemed almost *Convulsive*). About 6 *Hours* after, it seem'd quite *dead*, and upon the Return of the *Air* no Sign of *Life* ensued for a pretty while, but 3 or 4 *Hours* after I found him *Lively* enough.

6. Having observed *Butterflies*, not only to *Live* but to *Move* longer than was expected, I included divers of them in somewhat large *Receivers*. And though whilst the *Air* continued in the Glasses, they *Flew* actively as well as freely up and down; and though after the *Exhaustion* of the *Air*, they continued to *Live* and were not *Moveless*; nay though at the Bottom of the *Receiver* they would even *Move* their *Wings* and a little *Flutter*; yet I could not perceive any of them to *Fly*, by which I mean, perform any *Progressive Motion* supported by the Medium only. And by frequently inverting the *Receiver* (which I took care should be pretty long to let them fall from one extrem to the other,) they would fall like *Dead Animals* without displaying their *Wings*, though just as they came to touch the bottom, some of them would sometimes seem to make some use of them, but not enough to sustain themselves, or to keep their falls from being *Rude* enough.

Ants and Mites. XX. 1. A Pretty number of *Ants* were included in a small *Portable Receiver*, *Exhausted* Yesterday about Noon. They grew almost *moveless* as soon as the *Air* was *Exhausted*: And between 6 and 7 in the Afternoon, they seem'd to be all quite *Dead*. Whereupon I opened the Glass, and though no Sign of *Life* appeared for a great while, yet this Morning I found many of them *Alive* and *Moving* to and fro.

2. We conveyed a pretty Number of *Mites*, which are reputed but *Living Points*, together with the mouldy Cheese they were bred in, to nourish them, into 3 or 4 very small *Receivers*. One of them with the *Air* in it was *Seal'd* up at a Lamp-furnace: And from all the Rest we *withdrew* the *Air*. This done we observ'd the following *Phænomena*; *viz.*

1. Those *Mites*, that were inclosed in the small *Glass* that never came near the Engine, continued *Alive*, and able to walk up and down for above a full *Week*, after they had been put in, and possibly would have continued much longer, if the *Glass* had not been broken.

2. Though

2. Though just before the *withdrawing* of the *Air*, the *Mites* were seen to *Move* up and down in it; yet within a few *Minutes* after the *Receiver* was applied to the *Engine*, I could discern in them no *Life* at all, though my *Eye* was assisted with a double *Convex Glass*. About an *Hour* after, I could not perceive any of them to *Stir*; 2 or 3 *Hours* after that, I let in the *Air*, and left the *Receiver* unstopt in a *Window*.

3. About 2 or 3 *Days* after I found a Number of my little *Animals Revived*, as an attentive *Eye* might easily perceive by the *Motion* of certain little white *Specks*, and they continu'd to appear *alive* for 2 or 3 *Days* after that, if not longer.

4. One of the *Receivers* was kept *Exhausted* from *Monday* to *Thursday* after all which time, our attentive *Eyes* being unable to discover any *Signs of Life* among the *Included Mites*, the *Air* was let in upon them, and after a long time, I could plainly see them *Creep* up and down in the *Glasses* again.

LXXVIII. We took *Filings* of crude *Copper*, and put them into a *Cry-*
stallin Glass of a *Conical Shape*, into which we poured some strong *Spirit* of
Salt, (that was fitted for our peculiar purpose) to the height of about a *Fingers*
breadth above the *Filings*; and then closeing the *Vessel* with a *Glass-stopple* exqui-
sitely fitted to it, we suffered it to continue unmoved in a *Window* for some *Days*,
 till the *Liquor* had both obtained a high and darkish *Brown Colour* by the
Solution of some of the *Copper*, and lost that *Colour* again, growing clear like
 common *Water* (which is it self a somewhat odd *Phænomenon*), and then ta-
 king out the *Stopple*, (without shaking the *Liquor*) and thereby giving *Access*
 to the *outward Air*, we perceived, (as we had conjectured) that the upper *Sur-*
face of the *Liquor* did in a few *Minutes* re-acquire a darkish *Brown Colour*,
 which penetrating deeper and deeper, at the end of about a *quarter* of an *hour*,
 the whole *Body* of the *Liquor* appeared to be likewise *Tinged*. The *Conical*
Glass being again well stopt, the *Menstruum* did again in very few *days* let fall
 or otherwise lose its *Tincture*; which, the *Stopple* being taken out, it regained
 as before. Nor were these two the only *Trials* I made with the like *Success*
 for the main; but afterwards, being desirous by a further *Trial* to resolve a
Doubt I had, I kept the *Glass* yet longer in the same place with the same *Fi-*
lings and *Menstruum* in it, for (if I misremember not) a *Month* or *two* toge-
 ther; but observed not, that the *Liquor* would any more grow *Clear*.

2. Having taken another *Conical Glass*, wherein the *Liquor* was grown
 clearer than is usual, and had probably been so a good while before, for the
Vessel, having been hid by others which stood before it, had been for some
Weeks forgotten;) we took out the *Stopple* and left it out for about *half* an
Hour, but did not perceive the *Liquor* to have acquired any *Colour*, so much
 as at the *Top*. But putting in the little *Stopple*, I left the *Vessel* closed for
 two or three *Hours*, and at my return to *Visit* it, I perceived, that it had
 acquired a *Faint Colour* tending to a *Green*; wherefore taking out the *Stopple*
 again, I opened its *Commerce* with the *outward Air*, leaving the *Glass* unstopt
 for 20 or 24 *hours*, but found that in all that time it had not regained it's wont-

Experiments a-
 bout the Weak-
 ned Spring and
 some unobserved
 Effects of the
 Air; by Mr.
 Rob. Boyle.
 n. 120. p. 467.

ed dark Colour, but was only arriv'd at a *Green*, deep enough, but not true nor very *Transparent*.

This Observation being made in the same Vessel that had been formerly employ'd, suggested to us an Enquiry, whether the advanced time of the Year, which was the middle of *October*, might not have an interest in the slow and imperfect Success of this Trial.

3. Some strong *Spirit of Salt* having been kept upon *Filings of Copper* till the Solution was come to be of a dark *Brown* Colour, about three Spoonfulls of it, by guess, was put into a *Receiver* that might hold 8 or 10 times as much: Being kept *in Vacuo* (if the time be rightly remember'd) about *half a Year*, it retain'd its Colour; but the Vessel being open'd, and the *Extern^l Air* permitted a free Access to it, the Solution in about an *hour* was turned into a fine *Transparent Green*, though no *Precipitation* of any muddy substance appeared by any Sediment to be made.

4. In one of that sort of Conical Glasses that has been already describ'd, we had put upon some *Filings of Copper* a convenient quantity of our *Spirit of Salt*; and though we observ'd, that for a great while it would not part with its deep and somewhat *Muddy Tincture*; yet we left it in the Window for many *Weeks* longer, and at length, towards the latter end of *December*, we found it to have lost its *Tincture*, so much that the Liquor appeared like common *Water*. Upon which observation, though the time of the Year were unpromising, I thought fit to Try, whether the *Air* in that Season would not have some, though perhaps but a slow, Operation on the *Saline Spirit*, and accordingly taking out the Glass Stopple to give free Access to the *outward Air*, we observ'd, that in some hours its Operation on the Liquor was scarce sensible; but within about 24 *hours* the *Menstruum* had acquired not just its former Colour, but a somewhat *Faint* and moderately *Transparent Green*: So that this *Tincted Menstruum* as it had been very slow in losing its Colour, so it did but slowly and imperfectly reacquire it.

5. We took some *Filings of Copper* and putting them, together with a *Mercurial Gage*, in a Conical Glass fitted with an exactly ground Stopple of the same matter, (which was *CrySTALLINE*) we poured on the *Filings* as much rectified *Spirit of Fermented Urine* made *per se*, as sufficed to swim an inch or better above them; then carefully Stopping the Glass, coming to look on it many *hours* after, we perceived that the *Mercury* in the Sealed Leg was considerably Depress'd, and gently drawing out the Stopple, to let in the *outward Air*, we perceived that Access to have a manifest effect upon the *Mercury*.

6. We took a Crystal Glass of an almost Conical shape, and capable of containing between 5 or 6 *Ounces* of Water, and furnished with a Stopple of the same matter, that by grinding was exactly fitted to it. Into this we put a considerable Quantity of clean *Filings of good Copper*, on which we poured as much strong *Spirit of (Fermented or rather) Putrify'd Urine*, as served to swim about an *inch* above the *Copper*; and having let down a *Mercurial Gage*, so that it leaned upon the bottom and side of the Glass, we closed it very well with a Stopple, and set it in a quiet and well enlightned place, having taken good notice

notice at what Mark the *Quicksilver* rested in the Open Leg of the *Gage*. This done, we let the *Menstruum* alone to work upon the *Filings*; which it did as we foresaw, somewhat slowly and very calmly without producing any *Noise* or sensible *Bubbles*, acquiring by degrees a very pleasant *Blew* Colour, and the *Glass* being kept quiet in the same place for 2 or 3 *days* longer, the *Liquor*, as I conjectured would happen, began to lose of the *Intensness* of its *Colour*, which by Degrees grew fainter and fainter, till at the end of 3 or 4 *Days*, the *Liquor* was grown very *Pale*, and left me little doubt but that, if I would have staid some days longer, it would have lost the remaining Eye of *Blew*, and have lookt almost like common *Water*. But being unwilling to tarry so long, I took out the *Stopple*, that the *Air* without the *Glass* might have access to that within; and leaving the *Vial* in the same place and posture, my expectation was somewhat answered by finding, that within 4 or 5 *Minutes*, if not less, the upper part of the *Liquor*, that was *Contiguous* to the *Air*, had acquired a fine *Blew* Colour, which Descending deeper and deeper, before the End of the 10th *Minute* had diffused it self, but somewhat weakned, through the *Liquor*, whose Colour was suffered to deepen for a while longer; so that in less than a *quarter* of an *hour* from the first unstopping of the *Viol*, the *Liquor* was grown to be throughout of a rich *Ceruleous* Colour, which grew almost too opacous within a few *Minutes* longer: When carefully closing the *Viol* again with the same *Stopple* as before, we set it aside in the same place, where, the *Included Air* being denied all Commerce with the *External*, the *Liquor* began again within 2 or 3 *days* to lose of its Colour; and, to be short, afforded me the opportunity of making a 2^d Experiment, much like the former. And the like success I had, for the main, in a *Trial* or two made in another *Glass* with another portion of the same *Spirit* of *Urine*, put upon the *Filings* of *Copper*; so that the Experiment was, in all, made divers times, as well when I was not, as when I was alone: And particularly, once to be sure that the *Diurnal Air* as such had not any great Interest in the *Phenomenon*: I made the *Trial* successively about Nine a *Clock* at *Night*.

In most of these Experiments I forbore to shake the *Glass*, lest it should be suspected, that the *Agitation* of the *Liquor* might have raised some little fine powder that might have been supposed to have been *Precipitated* out of the *Tincture*, and, being thus mingled with the *Liquor* again, Restore it to its former Colour; but in truth I did not perceive any such powder to be *Precipitated*. And though to obviate the *Objection*, I forbore to shake the *Viol*, yet I justly supposed, that if, by the *Agitation* of the *Liquor*, more parts of it should be quickly exposed to the *Action* of the *Air*, the *Coloration* would be hastned, which upon *Trial* appear'd to be true.

7. We took such a *Conical Glass*, as has been lately describ'd, and covering the bottom of it with a convenient quantity of *Filings* of good *Copper*, we poured on them as much strong *Spirit* of *Sal Armoniack* as served to swim about a *Fingers* breadth above them; and, having let down such a *Mercurial Gage* as is formerly mentioned, so that it leaned upon the bottom and side of the *Glass*, we closed it very well with a *Stopple*, and set it in a quiet and well enlightn'd place, having taken good notice at what mark the *Quicksilver* rested

in the Open Leg of the *Gage*: This done, we let alone the *Menstruum* to work upon the *Filings*, which it did, as we foresaw, somewhat slowly and very calmly, without producing any *Noise* or sensible *Bubbles*, acquiring by degrees a very pleasant *Blew* Colour, and afforded us also the *Phænomenon* we chiefly lookt after; which was; that repairing from time to time to the Window to see what past, we perceived, that for 2 or 3 *days* together the *Mercury* in the *Seal'd* Leg of the *Gage* did, though very slowly, *Descend* till it appeared to be near a *quarter* of an *Inch* lower than at first; and probably the *Depression* might have been greater, if the Experiment had not been disturbed; whose *Event* yet seemed sufficiently to argue, that the *Spring* of the *Air* contained in the Cavity of the *Glass*, and communicating with that in the *Open* Leg of the *Gage* or *Syphon*, was *Weaken'd* in comparison of that in the *closed* Leg, which by the *Hermetick Seal* on one side, and the *Quicksilver* on the other, was kept from such *Communication*. And I was further careful to observe, whether the *Depression* did not continue at *Differing* Times of the *Day*, and found it to do so, as well at *Night* as at *Noon*, though at this last named time the *Sun* Shined hot upon the place and *Vessels* too.

This Experiment was made, in all 4 or 5 times, though not always with equal, yet still with some *Success*, the *Mercury* in the *Seal'd* Leg of the *Gage* being sometimes more and sometimes less, but always manifestly *Deprest*; which *Phænomenon* was confirmed, by the *Observation*, we more than once made, of the sudden *Return* of the *Quicksilver* to it's former station, upon the *Unstopping* of the *Glass*, to give free admission to the *Outward Air*.

8. A *Mercurial Gage* having been put into a *Conical Glass*, whose bottom was covered with beaten *Coral*, some *Spirit of Vinegar* was poured in, and then the *Glass Stopple*, which was very well ground, closing the *Neck* exactly, we observed, that upon the *Working* of the *Menstruum* on the *Coral* Store of *Bubbles* were for a good while produced, which successively broke in the *Cavity* of the *Vessel*; and their *Accession* so constipated the *Air*, that they comprést the *Air* imprisoned in the *closed* Leg of the *Gage* three *Marks* for *Divisions* which I guessed to amount to about the *third part* of the *Extent* it had before: But some *hours* after the *Corrosion* had ceased, the *Compression* made by this newly generated *Air*, grew manifestly fainter, and the imprisoned *Gage Air* drove down the *Mercury* again till 'twas *Deprest* within one *Division* of its first station; and thereabouts, or a little lower, continued 5 or 6 *Days*; so that in this *Operation* there seemed to have been a double *Compressive* Power exercised; the one *Transient*, by the brisk agitation of *Vapours* or *Exhalations*, and the other *Durable*, from the *Aerial* and *Springy* Particles, either *Produced* or *Extricated* by the *Action* of the *Spirit of Vinegar* upon the *Coral*.

But a pretty *Quantity* of *Spirit of Vinegar* being put upon *Minium*, it continu'd divers *days* without any sensible *Depression* of the *Mercury* in either *Leg*, nor did any *Change* appear in the *Gage*, upon the *Removal* of the *Stopple*; though 'twas evident by the great *sweetness* acquired, that it had made a *Solution* of a great portion of the *Minium*.

9. We took some *Filings* of *Copper*, and in a *Vial* capable of holding some 2 or 3 *Ounces* of *Water*, we poured on them strong *Spirit* of *Sal Armoniack* made without *Quicklime*, till the *Liquor* reached near an *Inch* above them. This was done about the 20th of *August* on the *Friday* before *Noon*, and the following *Munday* presently after *Dinner* it had acquired a deep *Blew Tincture*, and lost again so much of it, that it was *Pale* almost like common *Water*: Then to satiate a *Virtuoso*, I unstopt the *Vial*, desiring him to place his *Eye* level with the *Surface* of the *Liquor*, which in a *Minute* of an *Hour* or less appeared to his surprise and wonder, to have acquired a *Deep Blew Tincture*, that reached downwards to the thickness of the back of a *knife*, the whole *Liquor* becoming of the like *Colour* in 4 or 5 *Minutes* more, and the *Glass* being presently stopt again, and left where 'twas before, appeared not at the end of 9 *days* to have lost its *Tincture*; though now and then within that time, it seem'd manifestly *Paler* than when the *Vial* was stopt.

10. We took a round *Vial*, holding about 8 *Ounces* of *Water*, and having put into it *Filings* of *Copper* and a *Mercurial Gage*, we poured on the *Metal* strong *Spirit* of *Sal Armoniack*, till it reached to a good height in the *Vial*, which then being *Hermetically Sealed* up, was set by in a *South Window*, where it quickly acquired a deep *Blew Tincture*: There it stood about 12 *days*, before that *Tincture*, which decayed but slowly, did little by little grow so *Diluted* that the *Liquor* was *Pale* and almost like *Water*; During this stay of the *Glass* in the *Window*, the *Mercury* in the *Open Leg* appeared to be *Impell'd* up; and when after 9 a *Clock* at *Night* (which time I chose to try whether the *Nocturnal Air*, would have any thing to do with the *Phænomenon*) the *Hermetick Seal* was broken off; immediately upon which there was produced a *Noise*, and the *Mercury* in the shorter and *Closed Leg* was briskly *Impelled* up, by our guess near $\frac{3}{8}$ of an *Inch*, and though the *Orifice* at which the *Air* had *Access* was scarce wide enough to admit a middle sized *Pea*, yet within a *Minute* and *half* the *Surface* of the *Liquor* being held between the *Eye* and the *Candle*, appeared to have acquired a very *Lovely* and *Fair Colour*, which reached downwards a *quarter* of an *Inch*; so that the *Vial* seem'd to contain two very differing *Liquors* *Swimming* one on another; and the *Coloration* piercing deeper and deeper within 5 *Minutes* in all, the whole *Liquor* had attained a rich *Blew Colour*.

LXXIX. 1. To *Mingle* divers *Liquors* together by means of the *Air-Pump*, there were employed two small *Glasses*, whereof the one could enter into the other, and the least of the two was fasten'd to the *Hook* of an *Iron Wire*, and the greater put under it, and the said *Wire* was so ordered, that these two *Glasses* were a little distant one from another. The *Recipient* was of a *Cylindrical Figure*, of which one *End* is all open, to be fastned to the *Cement* of the *Pump*; the other is all closed, except a small *Hole*, having a little *Edge* or *Brim*; through which *Hole* you pass the *Hook'd Iron Wire* and tye an *Eel-skin* close about the same; and three or four *Inches* higher, the same *Skin*, is also to be tyed about the *Iron-Wire*, to keep the *External Air* from entering into the *Recipient*, and yet without taking away the *Liberty* to stir therein what you will by

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by means of the *Iron wire*, that hath a Communication Inwards and Outwards. For this purpose you must chuse that part of the *Eel-skin* that is next to the Head, the other part being pierced with many *Holes* with *Valves* that do not always shut well.

To be the more sure, that no *Air* enters by the Ligatures of the *Eel-skin*, you may apply a Tube on the *Recipient* with Cement, and pour Water into this Tube until the *Eel skin* be quite cover'd therewith. Care also must be had, that the *Hole* be exactly filled up by the *Iron-wire*; for, if it were too big, the *Eel-skin* would be thrust into it with great violence, and so hinder the Liberty of Raising and Sinking it.

When the *Recipient* was evacuated of *Air*, the lesser Glass was by the *Iron-Wire* let down into the greater, until the Liquors they contain, did *Mingle* themselves. Thus some *Aqua-fortis* was poured into the upper Glass, and *Spirit* of *Wine* into the lower, and the *Recipient* was so well *Exhausted* of *Air*, that the *Spirit* of *Wine* boyled up with great Bubbles (as usually it doth,) and the *Aqua fortis* cast some small Bubbles. After that both these Liquors were well purged of *Air*, the upper Glass was sunk into the lower, so as that the *Spirit* of *Wine* was *Mingled* with the *Aqua-fortis*; at which Instant there was yet seen a very considerable *Ebullition*.

Now to know, whether the *Aqua-fortis* gave to the *Spirit* of *Wine* some new Vigor or Force to make it Bubble; we mixed without the *Recipient* some *Aqua-fortis* with *Spirit* of *Wine*; the Quantity of the former being somewhat more than that of the latter. This Mixture being put in *Vacuo*, instead of Boyling up more strongly than the *Spirit* of *Wine*, (as 'twas thought it would have done, it only cast up some few Bubbles: Which shew'd, that the *Ebullition*, which was seen when they were *Mixed* within the *Vacuum*, is of the same Nature with all those that are made of *Acids* and *Alcalies*. For, in the very instant that they are *Mixed* they make great *Ebullitions*, but soon after they Mortifie one another, and lose the Properties they had before.

'Tis also probable, that the *Aqua fortis* and the *Spirit* of *Wine* would Boyle always when they are *Mingled*, but that the *Pressure* of the *Air* keeps this *Ebullition* from being sensible, and appears only when that *Pressure* is taken off.

When you employ *Rectified Spirit* of *Wine* instead of *Aqua-vitæ*, there is required a greater Quantity of *Aqua fortis* to Mortifie it.

It was also Experimented, that the *Solution* of *Common Salt* Boyls also with *Spirit* of *Wine*, being *Mixed in Vacuo*; and the *Solution* of *Salt Petre* yet more. The same Experiment was also made with *Common Water*, and it's *Ebullition* with *Aqua-vitæ*, purged of *Air*, was also found to be very great, when *Mixed in Vacuo*.

Further, it is somewhat remarkable, that *Common Water* doth not Mortifie *Spirit* of *Wine*, as *Aqua-fortis* doth, though they make *Ebullitions* with it almost of the same Degree. The Experiment of it is easy: For, making without the *Recipient*, a Mixture of *Common Water* and *Aqua-vitæ*, this, being put within the *Vacuum*, Bubbles up very well, though the *Common Water* be
there

there in greater Quantity than the *Aqua-vitæ*; whereas a *Mixture* of *Aqua-fortis* and *Aqua vitæ* did not there *Bubble* up at all.

After this, the *Experimenter* being desirous to see, whether these *Ebullitions* did make *new Air*; he put in the *Recipient* a *Gage* (that is a *Glass Tube* fill'd either with *Water* freed of *Air*, or with *Mercury*, serving to measure the Quantity of the *Air* in the *Recipient*) which was 4 *Inches* long, and observed, that at the Instant when the *Liquors* were mingled together, the *Water* in the *Gage* rose very *Nimbly* to the top of the *Gage*; and then drawing out this *new Air* that was made, he made the *Gage-Water* subside again by *Degrees*, in like manner as when the *Common Air* is drawn out: And by this means, it was seen, that all these kinds of *Ebullition* make an *Air* which *Expands* it self like *Common Air*. Yet it is very remarkable, that the *Air* which is made by these *Ebullitions*, is not of the same Nature; For, it hath been found *Experimentally*, that the *Air* formed by the *Mixture* of *Aqua-fortis* and *Copper* remains always *Air*, and always keeps up the *Water* in the *Glass* at that Height to which it raised it; but on the contrary, that *Air* which hath been produced by the *Mixture* of *Oyl* of *Tartar* and *Oyl* of *Vitriol*, is almost all destroyed of it self in the space of 24 *Hours*, in so much that in the *Recipient*, 24 *Hours* after the *Ebullition* had been there made, there was not found much more *Air* than there was before the same was made.

2. Mr. *Boyle* (as 'tis recorded in the *Journal Book* of the *Royal Society* Apr. 30. 1668. gave an Account to the said *Society* of the Experiments he had then made about *Generating new Air*, or *Extricating* that *Air* which was lurking before in several *Bodies*: At which time he mentioned also some ways of *Examining*, whether the Substance thus produced be *True Air* or not.

And long before that time, viz. An. 1664. the 15. of *Mar.* (Witness the same *Journal*) Mr. *Boyle* mentioned to the *R. Society*, that *Corals* or *Oyster-Shells* pounded, and put into *Distill'd Vinegar*, might prove fit Substances to produce *Air*, wholesome for *Inspiration*. At which time he also proposed, that some fit *Animal* might be put into a *Receiver* of his *Exhausting Engine*, and the *Air* pump'd out till the *Creature* grew *Sickish*, and that then some *new Air* might be produced in the *Receiver* by a *Contrivance* of making *Distill'd Vinegar* work upon the Substances before mentioned; to see whether by this means the *Animal* would recover.

About which time Sr. *Chr. Wren* also suggested, to put a *Fermenting Liquor* in a *Glass ball*, and to fit a *Stop-Cock* to it, and tye a *Bladder* about the top of the *Stop-Cock*, by which means the *Air*, to be generated by the *Fermenting Liquor*, would pass into the *Bladder*, and upon the turning of the *Stop Cock* be kept there in the form of *Air*. Mr. *Hook* also mentioned several *Liquors*, which by their working upon one another would produce an *Air*; as *Oyl* of *Tartar* and *Vitriol*; *Spirit* of *Wine* and *Turpentine*. And the same made before the *R. Society* the following Experiment: He took a *Common Glass Viol* with two *Pipes*, and some *Pounded Oyster-Shells* and *Aqua-fortis*; and as soon as the latter was by one of those *Pipes* poured upon the former, and the *Hole* stoppt with good *Cement*, the *Ebullition*, caused by the *Shells* being *Corroded*

by the *Aqua fortis*, did in a very little time blow up the Bladder, tyed on the other Pipe, so as to swell it very Plump with *Air*; which Expansion remained till the *Society* rose, after they had order'd the said Vessel to be carefully lockt up till their next Meeting, which being the Week after, the Bladder was then found somewhat thrunk. The like Experiment was made with *Bottled Ale*, supposed to yield a more wholesome *Air* for *Respiration*.

3. One Day we mingled equal parts of *Aqua-fortis* and *Aqua-vitæ*; and having put two equal Quantities of this Mixture in two small Glasses with two equal bits of *Iron*, one into each; one of the Glasses was included in *Vacuo*. Then there was seen a very great *Ebullition*, and the Liquor became *black*, whilst that which was left without the *Recipient* wrought almost nothing, but remained always *Transparent*, and rather *White* than *Black*. After these two Glasses had stood thus 12 *Hours*, that which was in *Vacuo* was taken out, and found that the *Iron* was almost all *dissolved*, whereas the other was very little diminished. This Experiment succeeds quite contrary when 'tis made with *Aqua-fortis* alone and *Copper*; for then the *Dissolution* is less within the *Vacuum*; than without it.

We made some other *Mixtures* of divers Liquors, which make no *Ebullition* at all in *Vacuo*, no more than they do in open *Air*. *Oyl* of *Olives* makes none neither with *Vinegar*, nor with *Spirit* of *Wine* at the Instant that they are *Mingled*; neither doth the said *Oyl* Mortifie the *Spirit* of *Wine*. Only this we Observed one Day, that having *Mingled* together, without the *Recipient*, some of that *Oyl* and *Vinegar* and *Spirit* of *Wine*, and put this Mixture in *Vacuo*, it did not *Boyl* up so soon as when there was no *Oyl*; but then the *Bubbles* which it made afterwards were bigger, and they began to appear again from time to time, so that some of them were seen a *Quarter* of an *Hour* after the *Recipient* had been *Evacuated*. Possibly this may come to pass, because that the *Oyl*, swimming on the *Top*, retains the more *Volatile* parts of the *Spirit* of *Wine*, which else would *Fly* away as soon as the *Air* is begun to be *Pump'd* out, and at the same time it hinders the *Surface* of the *Liquor* below from easily *Rising* up into *Bubbles*, because, to make them do so, the parts of the *Oyl*, that stick close to one another, must be separated. When therefore the *Volatile* parts are gathered together in a sufficient *Quantity*, able to surmount the *Resistance* which the *Oyl* makes to it, they issue out with much more *Violence*, than if nothing had retained them.

All these *Ebullitions*, hitherto spoken of, are greater in *Vacuo* than in the open *Air*: But with *Lime* it is not so. For, taking two equal Glasses with two equal *Quantities* of *Water*, and putting the one of them in *Vacuo*, the other in the free *Air*, there was let fall into both at the same time two equal parcels of *Lime*, one into each; and it appeared, that that which was in *Vacuo* did indeed throw up some bigg *Bubbles*, but yet fewer of them than that which was in the *Air*: and having taken it, an *Hour* after, out of the *Recipient*, and stirred the *Lime*, it was found to have only the *Consistence* of *Dirt*, whereas the other had the *Consistence* of *Sleeked Lime*. The Reason of which

which may perhaps be, that the *Volatile Salts* of the *Lime* do exhale whilst the *Recipient* is emptying.

There was also some *Plaster of Paris* flected *in Vacuo*, and the *Ebullition* of it did there appear much more than it doth in the *open Air*. When it is not Touched, the *Bubbles* that issue out leave great *Holes* in it, and then it settles very Uneven; but taking Care to stir it until the *Bubbles* be come forth, and pressing it when it begins to Settle, it becomes very smooth, and hath not so many little *Holes* as the *Common Plaster*.

I took one Day a small *Recipient*, and instead of the *Iron Wire*, I passed in to the little *Hole* a Sprig of a known Plant, which was *Baulme*, so as that the *Top* of the Plant was within the *Recipient*, and the *Roots* without. Then I closed the rest of the *Hole* with *Cement*, and when I had taken away my little *Emptied Receiver*, with the Plant, half shut up therein; I put the whole into a great *Glass* fill'd with *Water*, the *Root* being downwards; and I saw, that there were formed little *Water-Drops* upon the *Leaves* that were *in Vacuo*. I left it 10 *Days* in this Condition, and during that time there was entered about two *Spoonfulls* of *Water* into the *Receiver*, and in all appearance this *Water* had pressed through the Plant. Yet there appeared no more any *Drops* upon the *Leaves*; but that might very well come from the grosser *Excrementitious Matter* that is in the *Water*, which had stopp'd the *Conduits*.

After this, to know whether any *Air* had been form'd there, I replaced the *Receiver* upon the *Engine*, and having whelmed a bigger upon it, I saw there was but very little *Air* formed in the small one, because the great *Recipient* was almost all Empty before the *Air* included in the little one could lift it up. Yet at last it did Raise it, and I enclined the *Engine*, to the end that the little *Receiver* might not be applyed to its *Cover* when I should let the *Air* re-enter; and after this manner both the *Recipients* were filled in the same time. Then I looked upon the *Leaves* of the Plant; They were not withered, though they were not grown; only the *Leaves* had in the Middle a little changed their Colour, and had a smell somewhat Sowrish; but the next Morning the Plant was quite Spoiled. We may believe that the *Pressure* of the *Air* had made the *Water* enter into this Plant with so great a Violence, that thereby it had, as 'twere, mortified the parts, especially in the Middle where the *Leaves* were most tender; but this *Water* still kept the *Leaves* extended, and so they withered not; but, when the *Air* came to act upon them, the parts of the Plant which had so much suffered were soon corrupted by it. For 'tis very probable, as well by this Experiment, as by others hereafter to be mentioned, that the *Air* is a *Dissolvent* which corrupteth Bodies.

This being done, I made the Experiment the other way, that is, with the *Leaves* in the *Air*, and the *Roots* in a *Bottle* of *Water* that was *in Vacuo*; and immediately I saw *Air Bubbles* issuing out at the End of the Tail *in Vacuo*. After this, I put *Water* upon the *Leaves*, to see whether this *Air* came from thence, and I saw indeed soon after, that these *Bubbles* began to cease; and having taken away the *Water* wherein the *Leaves* were, I saw that the *Bubbles* began to issue out at the Tail as before: And I saw them still come out 24 *Hours*

after, but in little Quantity; and at length it quite ceased. During these 24 Hours the Roots did lengthen about four Lines, that is, one third of an Inch; which is little less than they ordinarily do in the Air.

I kept the Plant in this condition for four Days upon the Engine, and took care from time to time to draw out the Air that entered into it by the Leaves; and then it began to wither, and the Roots shot no more.

Another time I put two Twiggs of Baulme, each into a Vial full of Water and at the end of 5 Days, when I saw manifestly that they both shot Roots, I included in the Vacuum that of the two which had the longest Roots, without taking it out of its Vial. At the End of three Days, observing that it was Wither'd in Vacuo, I took it out, and changed the Vials of the Twiggs, to see, whether that which had remained in the Air, and did Thrive very well in common Water, would also Thrive in Water freed of Air; and whether that which was withered in Vacuo, would revive in the common Water and in Air. Four Days after I found the Twigg that had been in Vacuo quite Spoiled, and the other still Verdant, but not Thriving; and I observed, that it did not begin to shoot in the Water freed of Air till ten Days after it had been put in.

This Experiment drew another after it, to know whether the Water purged of Air were less fit than common Water to make Plants Vegetate. For this end I took two Vials full, the one of Water purged, the other of common Water, and having put a Twigg of Baulme in each, I left them both in the Air. I found, that the Twigg in the common Water shot at the end of 6 Days, and in Water purged shot this Time neither but ten Days after it had been put in.

I repeated this Experiment once more, and I was much surpris'd to see, that the Twig in the Water freed of Air begun this time to shoot the 3d Day, and the other in the common Water, still the 6th Day. But this was remarkable herein, that the Twigg in the Water purged shot not more but one Root, which grew very long, and on the 9th Day only it began a little to shoot another, which lengthned but one Line in two Days, whereas the Twigg in the Common Water had then 9 or 10 Roots, which were all very long, having always lengthned five Lines or more in a Day.

Although this Experiment appear'd at first contrary to the precedent, yet it still confirmed the first thought, to wit, that the Air which is mixed in common Water serves for Vegetation, considering the little Root which the Twigg shot in the Water cleansed of Air.

After this, I made some Experiments upon harder Plants. One Day I put a Green piece of Sallow wood, part in the Air and part in Vacuo, after the manner above describ'd. I put into Water that part which was in the Air, and the Water presently began to mount and to pass through the Middle of the Wood, and uncessantly formed Bubbles in the Receiver. These Bubbles continued thus for the Space of 24 Hours; and certainly it was the Water, which passing through the Wood was in part changed into Air. For, I made the same Experiment with a piece of Buffe, and the Water mounted also and passed through it, but it formed no Bubbles. Mean time, if there be Valves in Wood, they

they must needs be unable to resist the *Pressure* of the *Air*; for I have noted in *Sallow*, as well as in *Elm*, that the *Water* passes through them with the same facility what *End* soever you put in *Vacuo*.

One Day also I put the *Upper End* of a little *Elm branch* in the *Vacuum*, and the *Lower End* in the *Air*. This *lower End* I trenched in *Water*, as I had done the *Roots* of *Baulme* before: But it was a whole *Hour* before there appear'd any *Drop* of *Water* upon the *Elm leaves* in *Vacuo*, whereas upon the *Baulme leaves* the *Drops* appeared presently. The Cause of which may be the *Hardness* of the *Elm-Wood*. But I know not, why *Water* passing through *Wood* forms *Bubbles*, and in passing through *Leaves* forms nothing but *Drops*.

I made also the Experiment the other way, that is, the *Leaves* in the *Water* without the *Recipient*, and the *lower End* of the *Branch* in *Vacuo*, and I saw, that there passed nothing for *two Hours* time; insomuch that I cut a little of the *Upper End* of the *Branch* which was very *Tender*, and then indeed I saw a little *Moisture* appear at the *End* that was in *Vacuo*, but that enough only to form *one Drop*; and there appear'd no *Bubble* of *Air*. Then I Cut the *Branch* yet a little *Lower*, and then there was formed one *Drop* of *Water* at the *End* that was in *Vacuo*, but it fell not. And having Cut the *Branch* yet a little more, the *Drop* of *Water* fell down in *Vacuo*. This shews, that they were not the *Valves* of the *Plant* that hindred the *Water* from passing whilst the *Branch* was entire; but rather that it was the great *Tenderness* of the *Leaves*, suffering themselves to be compressed by the *Pressure* of the *Air*, and that so the *Water* could not insinuate it self between their parts.

Apr. 3. 1673. * I included an *Apple*, which had a little *Speck* of *Rottenness*, and some *Water* in the same *Recipient* thereby to promote the *Corruption* in case any should come to pass. But I have not found that any *Change* happen'd to it since that time.

n. 121. p. 492.
* These Experiments were
Printed at Paris,
in the Year
1674.

Jun. 7. I included in a *Receiver* two *Nosegays* of *Roses*, one suspended at the *Top*, the other having its *Tail* in a little *Vessel* full of *Water*. I also put in the same *Receiver* a *Gage* four *Inches* long, to know whether any *Air* would be there produced. *Two Days* after, I found my *Roses* a little wither'd, and the *Water* already risen to 8 or 10 *Lines* near the *Top* of my *Gage*; and after that the *Changes* of these *Flowers* became still less, so that at this present time they are not much more wither'd, and the *Water* of the *Gage* is by three or four *Lines* near the *Top*. The *Roses* which lye dipt in the *Water* are as much wither'd as the others, and as soon. Other *Roses* which I had included at the same time, but with *Air*, grew mouldy in less than 8 *Days*.

At another time I included one single *Rose-botton*, in a very little *Glass*, to learn, whether it would keep its *Scent*. At the *End* of 15 *Days* it looked a little less fresh, but was not at all wither'd; and having taken it out, I found it had still its good *Smell*; but after that it lost all both *Colour* and *Smell* in less than *two Hours*. I must also add, that its *Leaves* did not appear moist in the *Vacuum*, but they looked all moist as soon as they were in the *Air*. Which shews, that the parts of the *Leaves* had Acted as *Springs*, like as *Spunges* do, and that the *Weight* of the *Air* coming to Press upon them, did express

express the *Humidity* which had insinuated it self between the parts thus *Expanded*.

I did also include some *Gilli-flowers*, which *Changed* but very little; only they looked as if they had been *Dipped* in *Water*.

Having included some *Strawberries*, at the end of *two Days* they look'd less fresh; but after that, seeing they *Changed* no more, I took them out of the *Vacuum* after they had been there *15 Days*. They had still the *Smell* and *Taste* of *Strawberries*; but they had also contracted a very ungrateful *Taste* of the *Cement* which I then employed to close them up with.

Vid. Sup.
§. LXXIV.

At another time, I put some *Strawberries* without *Cement*, making use of a *Skin*, after the manner described formerly, and I then *Observ'd* nothing new, except that their *Taste* kept *Good*, but was a little *Sourish*, and that they yielded a little *Water*.

Jun. 24. I included some *Cherries*, to the Number of *25* or *30*, in a *Receiver* which was almost fill'd with them. They all *burst* but two. *Two Days* after they had a little *Chang'd* their *Colour*, and those two that before remained whole, were now *burst* like the rest. After that, I *Observ'd* no more *Change* in them.

Jul. 20. I included in the *Vacuum* one *Cherry* with eleven great *Corants*. The *Cherry* *burst* presently, and after that, I found it not *Changed*, only it appear'd *Turned*, as the *Corants* also did: This is a *Beginning* of *Putrefaction* which may be imputed to the *Air* that remains in the *Receivers*.

Jul. 27. I included in the *Vacuum* four *Rasberries* and three *Corants*. The latter appear'd also to be *turn'd*, and the *Rasberries* looked less fresh than they were. But 'tis now more than *5 Months* that I perceive no *Change* in them.

Hitherto I had employed none but *small Receivers*, which did just hold that little *Fruit* I put in them, and the *Red Corants* seem'd to keep well enough; so that one *Day* I fill'd a *great Glass* (of the *Figure* of *Cupping Glasses*) with them, hoping to keep that as well as the *small Receivers*. But I was surprised *five Days* after, to see that *Bubbles* were formed in the *Turpentine* which I had put about the said *great Glass* in the place where it was fastned to its *Cover*, and that these *Bubbles* were *burst* outwards; and afterwards, having seen that the *Cover* held fast to the *Bolthead* no longer, I made no doubt of the *Corants* having *produced Air* enough to lift up the said *great Glass*, and to form in the *Turpentine* the *Bubbles* I had seen. I was confirmed in this thought, when I found by the *Smell* that they had *Fermented*. They were yet *good* except some that had lost almost all their *Taste*, and all their *Acidity*.

The same thing happen'd to me with a very *small Receiver*, that could hold no more but one *Cherry* (of that kind we call *Bigarreaux*) and one *Red Corant*. These *Fruits* yielded also *Air* enough to *Lift* up their *Receiver* *7 Days* after they had been included therein: And having reiterated this *Experiment*, I found the same *Success*; only this second *Time* the *Receiver* was not *Lifted* up till the *11th Day*. This *Effect* is rather to be ascribed to the *Cherry* than the *Corant*; because I have kept *Corants* to the Number of *11*, in a *small Glass*, and they did

did not *Raise* it up. Whence it follows, that the *Bigarreaux* yield much more *Air* than *Acid Fruit*.

Another time I included some of the same kind of *Cherries*, a whole great *Glass* full, and found, that from the *Second Day* they had yielded *Air* enough to *Lift* up the *Cover*. I took away part of the *Cherries*, and included the rest again.

This *Second* time they did not *Raise* the *Glass* till the *8th Day*. The *Cherries* looked *Fair*, but they had lost much of their *Taste*, and afterwards they were spoiled in less than an *Hour*.

I did also one *Day* include three *Pears*, of that sort we call *Rouffelet*, in a like *Figur'd Glass*, which could hold no more. They *Lifted* up the *Glass* at the end of *5 Days*, and they were not *Changed*, only one of them was a little *Softer*.

Another time I put a *Peach* in such a *Glass* emptied of *Air*, with a *Gage* to it; and I found, that the first *6 Hours* the *Quicksilver* in the *Gage* was risen about an *Inch*. Yet it was not till the *13th Day* that the *Glass* was *Lifted* up; and the *Peach* appear'd to have kept very well till then; but after that, it *Rotted* in a very little *Time*.

I did once put some *Bread* with a *Gage*; but I found not that for the space of a whole *Month* it had yielded any *Air*; so that I took it out, and found it yet *good*; only it had a little *Taste* of *Mustiness*, which yet appear'd not at all to the *Eye*, and whereof the *Cause* may be ascribed to that little *Air* that might rest in the *Receiver*.

One *Day* I included a piece of *Roasted Mutton* with a *Gage*, and found, that in *4 Days* it had yielded no *Air*; but after my *Absence* of *6 Weeks* I saw the *Mercury* was *Risen* to the *Middle* of the *Gage*; and having taken out the *Meat* I found it of a very ill *Smell*.

Two Days after, I included a piece of *Raw Beef*, and a *Gage* with it, and I saw, that in *two Days* the *Quicksilver* was *Risen* an *Inch* in the *Gage*; and after *6 Weeks* *Absence*, I found, the *Mercury* was got almost to the *Top* of the *Gage*, and that this *Meat* had contracted a much worse *Smell* than that which had been *Roasted*.

I also kept for *15 Days* a piece of *Fresh Butter in Vacuo*, and I found, that it *Smelt* more *Strong* than when I first put it in: But yet it could not be still eaten upon *Bread*; whereas another piece of *Butter*, which at the same time I had kept in the *Air*, was altogether unfit to be *Eaten*.

One *Day* I covered a *Receiver*, whose *4th* part was fill'd with *Water*, and the rest all *empty*. I put it over the *Flame* of a *Candle*, and saw, that the *Water* *Boyled* very quickly, yet the *Glass* not much *Heated*; so that the *Water* *Boyled* near a *Quarter* of an *Hour* with a great *Ebullition*, and the *Glass* was no more than *Tepid*. I then took it away from the *Flame*, and saw, that the *Water* continued a very great while *Boiling*, and that it began again from time to time. I then believed, that the *Vapours* which had been *Raised* into the *Air*, were *Recondensed* by the *Cold*, and that that made the *Hot Water* *Bubble* up, as *Water* usually doth when 'tis put into the *Engine*, and the *Air* that prooves it *Exhausted*. Mean time, I have since made the *Experiment* with

a Gage, and I did not perceive, that all the *Bubbles* that issued out of the *Water*, made the *Mercury* rise to Sense.

After this, I left my *Receiver* exposed to the *Frost*, and I found that the *Ice* which was made therein was not yet quite free from *Bubbles*, though the *Water* thereof had *Boiled* in the *Vacuum*, which one would think, should have driven out all the *Air*: Yet the *Bubbles* were there far less numerous than in *Ice* made of *ordinary Water*. I perceived not, that the *Quicksilver* was much Risen in the *Gage*. Afterwards I Melted this *Ice*, and put the *Water* abroad to freeze again, still without taking it out of the *Vacuum*, and I found that this second time it was very much freer from *Bubbles*. The *Glass* did not *break*; but because it was somewhat *Conical*, we could not know, whether it remained *whole* upon the Account of it's *Figure*, or because that the *Water*, which was *Frozen* within, was freed of *Air*.

After this, I made *Spirit of Wine* Boil in *Vacuo*, in the same manner I did the *Water*; and I saw, that it *Boil'd* much sooner. It made the *Mercury* Rise about an *Inch* in the *Gage*. Then I took it from the *Fire*, and saw it continue in its *Boiling*; and even sinking the *Receiver* into *Cold Water*, it thereupon *Boiled* much more strongly. One would think, this proceeded from an *Antiperastasis*; but we have more ground to say, it came from hence, that the *Vapours* of the *Spirit* were *Condensed*, and so made the *Receiver* more *Empty*; which is sufficient to make the *Spirit of Wine* Boil, even though it were not *Hot*. The *Quicksilver* did in *two Hours* subside again, to near half a *Line* as low as it had been. Then I put the *Receiver* over the *Flame* again, and made the *Mercury* Rise more than *two Inches*; but then the *Receiver* Cracked.

One Day I took a *Tube of Plaister of Paris*, Open at one end, and Close at the other. I applyed the Open end to the *Cement* as I was wont to do *Receivers*; and I saw it was not possible thus to *Exhaust* it, because the *Air* did easily pass through the *Plaister*. I put therefore a *Tube of Iron* on the *Engine*; so as having fill'd it with *Water*, the *Tube of Plaister* was covered therewith; and then having caused the *Pump* to be Plied, I found, that the *Water* did pass as easily through the said *Plaister*. I therefore cover'd it with *Venice-Turpentine* instead of *Water*, and then I saw, that it *Evacuated* very well, and that nothing pass'd through it for the space of *two Hours*. Then I took some *Oyl* very *Hot*, and pour'd it over the *Turpentine*, which did Melt by this *Heat* and pass'd through the *Plaister*. Then I took off this *Tube* which was so pervaded by the *Turpentine*, and I saw, that that had made it *Transparent*: Which Effect is pretty like, and is to be explicated in the same manner as that of the little Stone called *Oculus Mundi*. Thus we may be assisted by the *Weight* of the *Air* to make divers sorts of *Glues* penetrate *Plaister*, *baked Earth*, *Wood*, &c. And possibly those, who shall make a good Number of such *Trials*, will find their *Labour* and *Pains* recompenced, by giving to those *Materials* such *Properties*, as they never had before.

I did also put some *Eggs* in the *Vacuum*, and one Day I saw one of them *Break*, which I had put in a small *Receiver*. It burst upon the very first *Suction*: But since that time I could never make any *break*, though I *Exhausted* as much as

I could those *Receivers* wherein I had put some. You must therefore begin to Crack them a little before you put them in the *Vacuum*, and then they do easily *Break* quite, and what is in the *Egg* riseth all into a very thick *Froth*. I also put some of these, thus ordered, over the *Fire*, where they *Boiled* very easily, not being pressed by the *Air*, but they *Boiled* there very long, before it began to appear that they were so *Boiled* as to be ready to *Eat*.

All the little *Bubbles* that appear in *Mustard*, do swell and *Break in Vacuo*, and after that, the *Mustard* is seen to be without *Bubbles*.

One Day I included a *Black Ribbon* in the *Vacuum*, and then *Burnt* it with a *Burning Glass*. Abundance of *Smoak* issued out of it, which fell by little and little, and so permitted us to see the *Ribbon* plainly; which appeared not at all *Changed*. But after I had returned the *Air* into it, and *Touched* it, I found it Turn'd to *Ashes*.

Another time I caused also some *Gunpowder* to be *Burnt* after the same manner; and I was much surprized to see, that it *Burnt* Grain by Grain, none of the *Grains* kindled, *Firing* those which *Touched*. Another time when the *Sun* had less *Force*, I could not at all *kindle* the *Powder*, but I made it only *Boil* and *Emit* store of *Smoak*. I had put a *Gage* in the same *Recipient*, by means whereof I *Observ'd*, that that *Smoak* produced no *Air*; for the *Quicksilver* did not *Rise* in the *Tube*. I noted also, that this *Smoak* falling upon the *Past-board*, on which I had put the *Powder*, appeared *Yellow*, of the Colour of *Brimstone*. After that, I took out the *Powder* that remained, being like a *Black Mass*, and having put it upon *Burning Coals*, I saw it *Burned* as doth *Salt Petre*, and so it appeared, that the *Sulphur* was almost all *Exhaled*. I was willing to reiterate this *Experiment*, and I then saw that the *Powder*, after *Boiling*, *Fuming*, and being *Kindled* Grain by Grain, (as in the first *Experiment*;) at last *Flashes* out all at once, when one hath the *Patience* to hold the *Fire* to it with a *Burning Glass*. And when the *Fumes* are grown *Clearer*, you may see *Needles* of *Salt-Petre* sticking to the sides of the *Receiver*.

Another time, I put the *Weight* of 12 or 15 *Grains* of *Powder* in a *Glass* shaped like a *Cupping Glass*, capable to hold 14 *Ounces* of *Water*, and having put *Fire* to it, I made the *Powder* *Boil* and *Smoak* as usually. Afterwards, seeing that the *Corns* began to *Crack* very near one after another; I then took away the *Burning Concave*, for fear all should be *Kindled* together: But it was already too late; for, the *Corns* did continue to *Crack* longer than a second of *Time*, and at last all *Kindled*, though there was then nothing left to *Heat* them but the *Fire* which they had kept within themselves. The *Receiver* was *Lifted* up above a *Foot* high without *Breaking*.

Another time I put the *Weight* of 18 *Grains* of *Powder*, together with a *Gage*, into a *Receiver* holding 7 *pound* of *Water*; and I saw, that the *Powder* was more difficult to be *Kindled*, than in small *Receivers*. Yet at length it was *Kindled* altogether, and made the *Quicksilver* *Rise* to the *Height* of an *Inch* and a *half* in the *Gage*; and I am very well assured, that all that *Air* was not come from without; for that part of the *Receiver*, to which the *Cover* is applied, had always been under *Water*.

From what I have been relating, it may be concluded, that there is a *Fifth* part of *Air* in *Gunpowder*; supposing, as other Experiments do shew, that *Air* is about a *thousand times* Lighter than Water. For, in this Experiment, the *Mercury* did Rise to the *18th* part of the Height where the *Air* commonly Sustains it; and consequently the Weight of *18 Grains* of *Powder* did yield *Air* enough to fill the *18th* part of a *Receiver* that contains *7 pound* of Water. Now, this *18th* part contains *49 Drachms* of Water: Wherefore the *Air*, that takes up an equal Space, being a *1000 times* Lighter, Weighs $\frac{1}{1000}$ of *49 Drachms*, which is more than $3\frac{1}{2}$ *Grains*. It follows therefore, that the Weight of *18 Grains* of *Powder* which I employed in my Experiment, contained more than $3\frac{1}{2}$ of *Air*, which is about the *Fifth* part of *18 Grains*.

It may also be Calculated, how many times this *Air* hath been *Compressed* in the *Powder*: But this Calculation is more uncertain than the former, because we know not, whether this *Air* took up more or less than the *5th* part of the Space which the *Powder* possessed. But yet 'tis certain, that, though it had even taken up *three fourths* of the whole Room of the *Powder*, and that the *14 Grains* of the other Matter had taken up no more than the one remaining *fourth* part, still this *Air* would have been *Compressed* about *three hundred times*. To Calculate this, I suppose, that the Space of a *Cubick Foot* can hold only *72 pounds* of *Gunpowder*, which do contain more than *14 pounds* of *Air*, by the foregoing *Calculus*: which Quantity of *Air* is therefore found inclosed in the *three fourths* of a *Cubick Foot*. Now, this Space doth usually contain but about *6 Drachms* of *Air*: Wherefore, to make it hold *fourteen pounds* of *Air*, which is near *three hundred times six Drachms*, it must needs be, that that *Air* be *Compressed* near *300 times*.

There is reason to believe, that, this *Compression* is much greater, because a *Cubick Foot* can hold much more than *72 pounds* of *Powder*, and because also that the *Fifth* part of the Weight must not, in appearance, possess alone the *three fourths*, and all the rest take up no more than *one fourth* of the Space possessed by all the *Powder*.

I should therefore make no difficulty to believe, that all the Effect of *Gunpowder* comes from the *Air* which is *Compressed* therein, and especially in the *Salt Petre*; for I have not yet Observed, that *Brimstone* yields *Air*. Possibly also we may find in time, that all other *Fulminations*, *Ebullitions* and *Fermentations*, that make such surprizing Motions, are nothing else but *Air Compressed* expanding it self.

One Day I included in the *Vacuum* an Insect which resembles a *Beetle*, but is a little bigger; and when I perceived it to appear *Dead*, I gave it *Air* again, and it soon after *Recovered*. Then I put it in the *Vacuum* again, and having left it there, for an *Hour*, I readmitted the *Air*, and found, that then the Insect needed much more time to *Recover*. I included it there the third time, and having left it there *two Days*, I gave it *Air* again, and saw it needed about *ten Hours* before it began to *Stir* again; yet it recovered well enough this time: But having put it in again, the fourth time, and left it there *8 Days*, it would never *Stir* again.

Intending to try the like upon a *Butterfly*, I saw, that when I readmitted *Air* to it, that the top of its *Back*, which before was much *Swelled*, did fall in more than it should, and the *Insect* would not *Recover*.

I also *Killed* in the *Vacuum* many *Animals* that *Breath*, as *Birds*, *Mice*, *Ratts*, *Rabbets*, *Cats*; and some of them I *Recovered* by quickly giving them *Air* again, before the *Engine* was quite *Exhausted*; but I never saw any of them *Revive*, that had been in a *perfect Vacuum*.

M. *Guide* did make frequent *Dissections* of such *Animals* as we had thus *Kill'd*, and *Observ'd*, amongst other things, that their *Lungs* fell to the *Bottom* in *Water*. He saith, that the *Solidity* or *Clofeness* of the *Lungs* of *Animals* that have *Died in Vacuo*, comes from hence, that the *Blood*, which is propelled into the *Lungs* by the *Vena Arteriosa*, doth so strongly press the *Bronchi* of the *Arteria Aspera*, that it expresses the *Air* out of them, and glues as 'twere their sides to one another. But for my part, I do not believe, that the *Blood* of the *Vena Arteriosa* can thus *Compress* those *Bronchi*, because that the said *Blood* is inclosed in its *Vessels*, that keep and hinder it from *Compressing* others. Yet I am not ignorant, that the things that are included in the *Oesophagus* do indeed *Compress* the *Aspera Arteria*, and that the *Aspera Arteria* by being filled *Compresses* also the *Oesophagus*, upon the account of the *Scituation* of these two *Conduits*. But it appears not at all, that the smallest *Ramifications* of those *Bronchi*, and of the *Vena Arteriosa*, are *Scituate* in the same manner; for the *Bronchi* being harder than the *Arterial Vein*, they will *Compress* it more easily, than be *Compressed* by it; and so, if you should blow them up with *Bellows*, they would *Glue* the sides of that *Vein* together, and hinder the *Circulation*: which is directly contrary to the *Experiment*; as M. *Guide* himself observeth.

It is therefore far more probable, that if the *Lungs* be *Compressed*, that *Compression* be made by the *Pleura*, which may be *Swelled* within the *Breast* as the *Skin* is *Swelled* without. But it is not necessary, that the *Lungs* be *Compressed in Vacuo*, to make them *Subside* in *Water*, for I have divers times put pieces of *Lungs* and whole *Lungs* in the *Vacuum*, and they remained there extremely *Swelled*; but as soon as the *Air* was again intromitted, they became very *Flat* and *Red*, and *Sunk* to the *Bottom* in *Water*. Which shews, that 'tis sufficient for getting the *Air* out of the *Lungs* to render them *Close* and *Red*; and I have not been able to produce this *Effect* but by means of the *Exhausting Engine*. For, I have left *Lungs* a whole *Night* between two *Plates* with a great *Weight* upon them, to endeavour to *Express* the *Air* out of them, but it would not succeed, and those *Lungs* did still *Float* upon the *Water*. I have also tried to make the *Air* re-enter into the *Lungs* after I had rendered them *Solid* in the *Engine*, and that I found very easie; for, drawing them out from the *Bottom* of the *Water*, I did *Blow* into the *Aspera Arteria*; and the *Lungs* *Swelled* again, and resumed their *Ordinary Colour*, and *Floated* on the *Water*. And this is that which befalls the *Lungs* of *Infants New-Born*.

LXXX. I *Seal'd* up a round *Glass* *Hermetically*, and covered it with a double *Bladder* very carefully, and including it in a large *Receiver*, I found, according

according to my Expectation, that after about 200 *Exhaustions* had been made, it broke all in pieces with a very great *Noise*.

LXXXI. Papers, of Less General Use, Omitted.

- n. 251. p. 144. 1. **A** List of the *French Academicians* at their New Regulation in the Year 1699. by *M. Geoffry*.
- n. 99. p. 6158. 2. An Account of some of the *Natural things*, with which the Intelligent and Inquisitive Signior *Paulo Boccone*, of *Sicily*, hath lately presented the *R. S.* and enriched their *Repository*.
- n. 246 p. 393. 3. Remarks by Mr. *Ja Petiver*, on some *Animals, Plants, &c.* sent to him from *Maryland*, by the Rev. Mr. *Hugh Jones*.
- n. 255. p. 295. 4. A Catalogue of *Shells, &c.* gathered at the *Island of Ascension*, by Mr. *Ja. Cunningham*, Chirurgeon, with what *Plants* he there Observed; Communicated to Mr. *Ja. Petiver*.
- n. 246. p. 390.
n. 247. p. 461.
n. 249. p. 44.
n. 250. p. 70. 5. An Account of a *China Cabinet*, filled with several *Instruments* and some *Natural Curiosities*, of that Country, sent to the *R. Socy* by Mr. *Buckley*, Chief Surgeon at *Fort St. George*; by *Hans Sloane M. D.*
- n. 10. p. 167. 6. A *Thermoscope* and a *Baroscope* (invented by Mr. *Rob. Boyle*) described, by Dr. *Wallis*.
- n. 13. p. 218. 7. Dr. *Hook's Wheel Barometer* (describ'd in his *Micrography*) is here something Improv'd; by Himself.
- n. 91. p. 5168. 8. *Experiments* Propos'd, to explicate the Reason of the *Suspension of Mercury* in the *Torricellian Tubes* at an unusual Height; by Dr. *Wallis*.
- n. 206. p. 998. 9. Some *Queries*, concerning the Nature of *Light* and *Diaphanous Bodies*; by Mr. *Edm. Halley*.
- n. 79. p. 3060. 10. *Queries*, concerning the different Effects of the *Sun's Heat* collected by a *Burning Concave*; and that of *Fire*, upon *Gold, &c.* by P. Fr. *Lana*.
- n. 66. p. 2020. 11. An *Experiment* concerning the Progress of *Artificial Conglaciation*, and the remarkable Accidents therein observed; by the *Florentine Philosophers*, and published in their *Saggi di Naturali Esperienze*.
- n. 23. p. 424. 12. Proposals to try the Effects of the *Pneumatical Engine* Exhausted, in *Plants, Seeds, Eggs of Silk Worms, &c.* by Mr. *Rob. Boyle*, and Dr. *Beale*.

LXXXII. Accounts and Emendations of Books, Omitted,

- n. 27. p. 501. 1. **T**HE *History* of the *Royal Society of London*, for the Advancement of *Experimental Philosophy*; by *Tho. Sprat*.
- n. 36. p. 715. 2. The Progress and Advancement of *Knowledge* since the Days of *Aristotle*; in an Account of some of the most Remarkable late *Improvements of useful Learning*; by *Jos Glanvill*. Lond, 1668 in 8°.
- n. 8. p. 145. 3. A Narration of the *Establishment* of the *Lyncei*, an *Italian Academy*, and of their *Design* and *Statutes*.
- n. 203. p. 886. 5. *Diogenes Laertius*. *Græce & Latine*; Cum *Commentariis integris Doctorum Virorum*. *Amstel.* 1692.
- n. 194. p. 535. 6. *C. Plinii Historia Naturalis*. *Notwithstanding the great Care of R. P. Hardujne*

Harduine, in this Curious Edition, yet He hath past over several Faults; 3 of which Mr. Halley hath here Corrected, viz.

1. Lib. 2. Cap. 13. Defectus [Solis & Lunæ] Ducentis Viginti Duobus Mensibus redire in suos Orbes certum est: whereas it ought to be, CCXXIII; at which Time that Period is Completed; and the Moon Returns to the Sun and to the same Node Accurately enough, to her Apogæum very near, and within a few Degrees to the same Place of the Heavens.

2. Lib. 11. Cap. 37. Jecur maxime Vetustatis Patiens Centenis durare Annis Obsidionum exempla prodidit; which Mr Halley conjectures should either be Hoc Seniorum exempla, or Hoc Sirorum exempla prodidit.

3. Lib. 20. Cap. 14. Instead of Syriation & Vomicas Vulvæ curavit illa, Mr. Halley Reads Satyriasin & Vomicas Vulvæ curavit.

7. Pinax rerum Naturalium Britannicarum, continens Vegetabilia. Animalia, & Fossilia, in hoc Insula reperta. Auth. Chr. Merret. M. D.

n. 20. p. 364.
n. 24. p. 448.

8. Museo Cospiano annesso a quello del famoso Ulisse Aldrovandi, & donato alla sua Patria dall' Illustrissimo Signore Ferdinando Cospi Patricio di Bologna & Senatore, &c. Descrizione di Lorenzo Legati Cremonese. In Bologna 1678 in Fol.

n. 140. p. 1011.

9. Musei Petiveriani Centuria Prima; Rariora Naturæ continens: viz. Animalia, Fossilia, Plantas, ex variis Mundi Plagis advecta; Ordine digesta; Nominibus propriis signata; & Iconibus Æneis eleganter illustrata. Lond. 1696. in 8°.

n. 224. p. 393.

10. 1. Saggi di Naturali Esperienze, fatte nell' *Academia del Cimento*, in Firenze; An. 1667. in Fol.

n. 33. p. 640.

2. Essays of Natural Experiments made in the *Academy del Cimento* under the Protection of the most Serene Prince Leopold of Tuscany. English'd by the Ingenious Rich Waller Esqr. Lond. 1684. in 4°.

n. 164. p. 757.

11. 1. *Miscellanea Curiosa Medico-Phylica, Academia Naturæ Curiosorum, Annus Primus.* Lipsiæ 1670 in 4°.

n. 68. p. 2077.

2. *Annus Secundus; Anni Scil. 1671.* Jenæ. 1671. in 4°.

n. 85. p. 5024.

3. *Ephemeridum Medico-Phylicarum Germaniæ Annus Tertius, &c.* Lipsiæ & Francofurti. 1673. in 4°.

n. 101. p. 15.

4. *Annus IV & V. Anni 1673 & 1674, &c. Cum Appendice.* Francofurti & Lipsiæ 1676. in 4°.

n. 129. p. 742.

12. 1. *Thomæ Bartholini Acta Medica & Philosophica Hafniensia.* An. 1671 & 1672. Hafniæ. 1673. in 4°.

n. 97. p. 6135.

2. *An 1673.* Hafniæ. 1675. in 4°.

n. 114. p. 315.

13. *Georgii Hieronymi Velschii Hecatostæ 2. Observationum Physico-Medicarum Augustæ Vindelicorum.* 1675.

n. 127. p. 673.

4. *Stephani Chauvini Lexicon Rationale, sive Thesaurus Philosophicus, &c. Rotorodami.* 1692. in Folio.

n. 199. p. 731.

A. 13

14. 1. *Collegium Experimentale sive Curiosum, in quo Primaria hujus Se-culi inventa & Experimenta Physico Mathematica, A. 1672. quibusdam Naturæ Scrutatoribus spectanda exhibuit, & ad Causas suas Naturales demonstrativâ Methodo reduxit, Jo. Christophorus Sturmius.* Norimbergæ. 1676. in 4°.

n. 121. p. 509.

2. *Pars Secunda.* Altorfi. 1685. in 4°.

n. 175. p. 1184.

15. *Esperienze intorno a diverse Cose Naturali, & particolarmente à quelle che ci son portate dall' Indie; fatte da Francesco Redi in Firenze.* 1671. in 4°.

n. 92. p. 6001.

n. 207. p. 53.

16. *Observationi Naturali, ove si contengono materie Medico Fisiche, &c.* Natural Observations, containing several *Medico Physical*, and *Botanical* matters; with diverse *Natural Productions*; several sorts of *Phosphori, subterraneous Fires* in Italy; and other Curious Subjects; in Familiar Letters, by Signior *Paul Boccone*. M. D. *Bononia*, 1684. in 12o

n. 207. p. 37.

n. 249. p. 53.

17. *Museo di Fisica, & di Esperienze, arricchito di Figure di Pianta Nove, Osservazione, Note Medicinali e Ragionamenti, secondo i Principii di Neoterici, disposto in Decade VIII.* by *S. Paolo Boccone*. Upon this Book *Mr. Ray* adds here some Remarks of his own.

n. 73. p. 2214.

18. *Philosophus Autodidactus, exhibitus in Epistola, ex Arabica in Latinam Linguam versa, ab Edvardo Pocockio*; Oxon. 1671. in 4o

n. 69. p. 2114.

19. *Prodromo Overo Saggio di alcune Inventioni nuove premeffo all' Arte Maestra, di P. Francisco Lana*. S. I. in *Brescia*, 1670. in 4o.

n. 72. p. 2179.

20. *Of the Usefulness of Experimental Natural Philosophy, the 2d Tome*; by the Honourable *Robert Boyle*, Esquire, Oxon. 1671. in 4o.

n. 103. p. 53.

21. *About the Excellency and Grounds of the Mechanical Hypothesis, some Considerations occasionally proposed to a Friend*, by *R. B. E.* Lond. 1674. in 4o

n. 181. p. 116.

22. *A Free Enquiry into the Vulgarly receiv'd Notion of Nature*; by the Hon. *R. Boyle*, Esq; Lond. 1686. in 8o

n. 40. p. 810.

23. *Ren. des Cartes Epistolæ*; Pars Prima & Secunda. Lond. 1668 in 4o.

n. 22. p. 392.

2. *Le Tome Troisieme & Dernier des Lettres de M. des Cartes.*

n. 54. p. 1094.

24. *Le System General de la Philosophie*; par *Francois Bayle*. D. M. a *Thoulouze*, 1696. in Fol.

n. 62. p. 2034.

25. *A Discourse in Vindication of des Cartes's Systeme*; by *Mr. des Fourneillis*: To which is annexed, the *System General* of the same *Cartesian* Philosophy, by *Francis Bayle*. M. D. Lond. 1670.

n. 70. p. 2137.

26. *Philosophia Veterum, è Mente Renati des Cartes breviter digesta*; ab *Antonio le Grand*, Lond. 1670. in 12o.

n. 80. p. 3094.

n. 108. p. 192.

27. *Antonii le Grand institutis Philosophiæ, secundum Principia Renati de Cartes, nova Methodo adornata, & explicata*, Lond. 1672 in 8o.

n. 94. p. 6046.

28. *Antonii le Grand Historia Naturæ*. Lond. 1673, in 8o.

n. 123. p. 570.

29. *De Consensu Vet. & Novæ Philosophiæ, Lib. 4. seu Promotæ per Experimenta Philosophiæ pars prima*: Auth. *J. B. du Hamel*. P. S. L. in 12o.

n. 65. p. 2105.

30. 1. *De Corporum Affectionibus cum Manifestis tum Occultis, Libri 2. seu Promotæ per Experimenta Philosophiæ Specimen*. Auth. *J. B. du Hamel*, Paris, 1670. in 12o. *Mr. Boyl's Discourse (in his Origine of Forms and Qualities,) concerning the Necessity of the Creator's Concourse in the Preservation of all things, being Misunderstood by Mr. du Hamel, is here Explain'd.*

Ibid. p. 2106.

n. 98. p. 6151.

2. *De Corpore Animato, Libri 4. seu Promotæ per Experimenta Philosophiæ Specimen alterum*: Auth. *Joh. Baptista du Hamel*. P. S. L. Parisiis, 1673, 12o.

n. 131. p. 790.

31. *Clavis Philosophiæ Naturalis, Aristotelica Cartesiana*; Editio secunda, aucta Opusculis Philosophicis varii Argumenti; quibus Errores Scholarum passim deteguntur, ac veritas Philosophiæ, quam Cartesianam vocant, confirmatur, Auth. *Jo. de Raei*. Amst. 1677. in 4o.

n. 65. p. 2007.

32. *Elementa Physica, sive nova Philosophiæ Principia*; ubi Cartesianorum Principiorum

Principiorum Falsitas ostenditur, ipsiusque Errores ac Paralogismi ad Oculum demonstrantur ac refutantur; a *Fran. Willhelmo* Libero Barone de Nuland, &c. *Hagæ Comitum*, 1669. in 12°.

33. *Placita Philosophica Guarini.* n. 20. p. 365.
34. *Physica*, in Decem Tractatus Distributa; Auth. *Honorato Fabri*. S. J. *Lugd. Gal.* 1669. in 4°. n. 68. p. 2082.
35. *Honorati Fabri*. S. J. Tractatus duo; quorum Prior est de *Plantis* & de *Generatione Animalium*; Posterior de *Homine*. n. 18. p. 325.
36. *Traite de Physique par Jacques Robault.* a *Paris*, 1671. in 4°. n. 70. p. 2138.
37. *Propositiones Hydrostaticæ ad Illustrand. Aristarchi Samii Systema destinatae*, & quædam *Phænomena Naturæ generalia*. Auth. *Francisco Jessop.* *Arm. Lond.* 1687. in 4°. n. 191. p. 440.
38. *Casp. Bartholini Thom. F. Specimen Philosophiæ Naturalis. Accedit de Fontium, Fluviorumque Origine Dissertatio Physica.* *Amstelodam.* 1697. in 12°. n. 237. p. 62.
39. *Thomæ Cornelii Confestini Progymnasmata Physica.* n. 30. p. 576.
40. *Les Essays Physiques du Sieur de Launay.* n. 30. p. 579.
41. *Erasmi Bartholini de Naturæ Mirabilibus Quæstiones Academicæ Hafniae*, 1674. in 40. n. 107. p. 1593.
42. *Decameron Physiologicum: Or Ten Dialogues of Natural Philosophy.* To which is added the Proportion of a *Streight Line*, equal to half the Arch of a *Quadrant*. By *Mr. Hobbs.* n. 138. p. 985.
43. *Cosmopœia Divina, seu Fabrica Mundi explicata, per Ludov. de Beaufort.* M. D. *Lugd. Batauv.* 1656. in 12°. n. 59. p. 1051.
44. *Cartesius Mosaizans;* Auth. *Job. Amerpoel* *Leowardiæ* 1659. in 120. Ibid. p. 1053.
45. *The Divine History of the Genesis of the World*, explicated and illustrated, *Lond.* 1670. in 40. n. 60. p. 1083.
46. *A Treatise of the Bulk and Selvage of of the World, &c.* by *Nath. Fairfax.* M. D. *Lond.* 1673. n. 99. [p. 6172]
47. *Telluris Theoria sacra.* Authore *T. Burnetio.* *Lond.* 1681. in 40. Ph. Col. 3. p. 75.
48. *Archeologiæ Philosophicæ, sive Doctrina Antiqua de Rerum Originibus;* Libri duo Auth. *Tho. Burnet.* *Lond.* 1692. n. 201. p. 796.
49. *Considerations on a Book Entitled, the Theory of the Earth: Published some Years since by the Learned Dr. Tho. Burnet. Written by Jo. Burnet,* Jun. *Gent.* n. 203. p. 888.
50. *The Wisdom of God manifested in the Works of the Creation;* in 2 Parts. by *Mr. J. Ray.* *Lond.* 1692. in 8°. n. 196. p. 611.
51. *Three Physico Theological Discourses, concerning, 1. The Primitive Chaos, and Creation of the World. 2. The General Deluge, its Causes and Effects. 3. The Dissolution of the World;* by *Mr. J. Ray.* *Lond.* 1693, in 8°. Ib. p. 615.
52. *The Prodromus of a Dissertation concerning a Solid contained in a Solid;* by *Nicolaus Steno.* *English'd out of Latin.* *Lond.* 1671. in 8°. n. 72. p. 2186.
53. *An Essay toward a Natural History of the Earth, and Terrestrial Bodies, especially Minerals: As also of the Sea, Rivers and Springs. With an Account of the Universal Deluge, and of the Effects it had upon the Earth.* By *J. Woodward;* M. D. *Lond.* 1695. in 8°. n. 217. p. 115.

- n. 219. p. 181.
199.
54. *La Vana Speculatione disingannata dal senso: Lettera Risponsiva circa i Corpi Marini, che Petrificati li travano in varii Luoghi Terrestri. Di Agostino Scilla Pittore Academico della Fucina, in Napoli, 1670. in 4^o. This Book is here Abridg'd, some short Notes added, and some of the Author's Figures annexed and explained, by two of the Fellows of the Royal Society.*
- n. 8. p. 145.
n. 11. p. 191.
55. 1. *The Origin of Forms and Qualities, illustrated by Considerations and Experiments; by the Hon. Robert Boyle, Esq.*
- n. 66. p. 2034.
2. *The same in Latin. Oxon. 1669. in 12^o.*
- n. 28. p. 532.
56. *Free Considerations about Subordinate Forms; by the Hon. Rob. Boyle.*
- n. 63. p. 2057.
57. *Tracts written by the Hon. Rob. Boyle, about the Cosmical Qualities of things; the Temperature of the Subterranean and Submarine Regions; and the Bottom of the Sea; together with an Introduction to the History of Particular Qualities. Oxon. 1670. in 8^o.*
- n. 127. 669.
58. *Experiments, Notes, &c. about the Mechanical Origin of diverse Particular Qualities: Among which is inserted a Discourse of the Imperfection of the Chymists Doctrine of Qualities; together with some Reflections upon the Hypothesis of Alkali and Acidum: By the Hon. Rob. Boyle Esq. Lond. 1675. in 8^o.*
- n. 130. p. 766.
59. *Roberti Boyle Nobilissimi Angli & Soc. Regiæ dignissimi Socii, Opera Varia Geneva. 1677. in 4^o. This Edition and Translation is here complained of for several Reasons.*
- n. 53. p. 1069.
60. *Certain Philosophical Essays, and other Tracts; by the Hon. Rob. Boyle.*
- n. 162. p. 702.
61. *Experiments and Considerations about the Porosity of Bodies, in two Essays; by the Hon. Robert Boyle Esq. Lond. 1684. in 8^o.*
- n. 96. p. 6101.
62. *Several Tracts written by the Hon. Rob. Boyle; of the strange Subtlety, Efficacy, and determinate Nature of Effluvioms; of new Experiments to make the Parts of Fire and Flame Stable and Ponderable; together with some Additional Experiments about Arresting and Weighing of Igneous Corpuscles; as also a Discovery of the Perviousness of Glass to Ponderable parts of Flame, with some Reflections on it by way of Corollary.*
- n. 170. p. 982.
63. *An Essay of the great Effects of even Languid and Unbeeded Motions. Lond. 1685.*
- n. 1. p. 8. n. 3.
p. 46.
64. *New Observations and Experiments in order to an Experimental History of Cold. by the Hon. Rob. Boyle. Esqr.*
- n. 78. p. 3043.
65. *Dissertations sur la Nature du Froid & du Chaud; par le Sieur Petit. Avec un Discours sur la Construction & l'Usage d'un Cylindre Arithmetique, invente par le même Auteur. a Paris. 1671.*
- n. 267. p. 724.
66. *Thaumantiadis Thaumasia, sub Præsidio Dom Cbr. Sturmii. Noriburgæ. 1699.*
- n. 42. p. 845.
67. *A Continuation of new Experiments Physico Mechanical, touching the Spring and Weight of the Air, and their Effects; the I, Part, &c. by the Hon. Rob. Boyle. F. R. S. Ox. 1668. in 4^o.*
- n. 50. p. 1017.
68. *Georgii Sinclari Ars Nova & Magna Gravitationis & Levitatis. Roterodami. 1669. in 4^o.*
- n. 92. p. 5199.
- Some Complaints and Suggestions by that Author, (in his Preface) are here Answer'd;*

69. Dimostrazione Fisico-Matematica Delle sette Propositioni, che promesse n. 65. p. 2013.
Donato Rosetti. In Firenze 1668. in 4°.
70. Observations touching the *Torricellian Experiment*, and the various Solu- n. 104. p. 78.
 tions of the same, especially touching the *Weight and Elasticity of the Air.*
Lond. 1674. in 8°.
71. Tracts written by the Hon. *Rob. Boyle*, of a Discovery of the admira- n. 67. p. 2052:
 ble *Rarefaction* of the *Air* (even without *Heat*;) New Observations about the
Duration of the *Spring* of the *Air*; New Experiments touching the *Condensa-*
tion of the *Air* by meer *Cold*; and its *Compression* without *Mechanical Engines*:
 And the admirably Differing *Extension* of the same Quantity of *Air* *Karified*
 and *Compressed.* *Lond. 1670. in 4°.*
72. Tracts, written by the Hon. *Rob. Boyle*, containing new Experiments n. 92. p. 5197.
 touching the *Relation* betwixt *Flame* and *Air*, and about *Explosions*: An Hy-
 drostatical Discourse, occasion'd by some Objections of *Dr. Hen. More*, &c.
 To which is annext an *Hydrostatical* Letter, about a way of *Weighing Water*
 in *Water*: New Experiments of the *Positive* or *Relative Levity* of Bodies
under Water; of the *Air's Spring* on Bodies *under Water*; and about the dif-
 fering *Pressure* of Heavy *Solids* and *Fluids.* *Lond. 1672. in 8°.*
73. Tracts, consisting of Observations about the *Saltness* of the *Sea*: An n. 97. p. 6127.
 Account of a *Statical Hygroscope* and its Uses; together with an Appendix a-
 bout the Force of the *Air's Moisture*: And a Fragment about the *Natural* and
Preternatural State of Bodies by the Hon. *Rob. Boyle*. To all which is premised, a
Sceptical Dialogue about the *Positive* or *Privative Nature* of *Cold*: By a Mem-
 ber of the *R. Society.* *Lond. 1673. in 8°.*
74. Tracts, containing. 1. *Suspitions* about some *Hidden Qualities* of the n. 110. p. 226.
Air, with an Appendix touching *Celestial Magnets*, and some other Particulars
 2. *Animadversions* upon *Mr. Hobb's Problemata de Vacuo.* 3. A Discourse of
 the Cause of *Attraction* by *Suction*: By the Hon. *Rob. Boyle. Esqr.* *Lond. 1674.*
in 8°.
75. A Discourse concerning the Origin and Properties of *Wind, &c.* by *R.* n. 90. p. 5147.
Bobun. Oxon. 1671. in 8°.
76. *Aero-Chalinos*, or a *Register* for the *Air, &c.* by *Nath. Henshaw. M. D.* n. 133. p. 834.
Lond. 1677. in 12°.

C H A P. II.

Hydrology.

I. TAKE a Globe of Firr or Maple, or other light Wood, as *A.* let it be well secured by Varnish, Pitch, or otherwise, from Imbibing Water; then take a piece of Lead, or Stone, *D.* considerably Heavier than will Sink the Globe: Let there be a long Wire Staple *B.* in the Ball *A.* and a Springing Wire *C.* with a bended end *E.* and into the said Staple, press in with your Fingers the Springing Wire on the bended end: And on it hang the Weight *D.*

To Sound the
 Depth of the Sea
 without a Line;
 by Dr. Hook.
 n. 9. p. 147.
 n. 24 p. 439.

Fig. 45.

by its Hook *E*, and so let Globe and all sink gently into the Water, in the posture represented in the *Figure*, to the bottom, where the Weight *D*, touching first is thereby stopt; but the Ball, being by the Impetus it acquired in Descending carried downwards a little after the Weight is stopt, suffers the springing Wire to fly back, and thereby sets it self at Liberty to Re-ascend. And by observing the time of the Balls stay under Water (which may be done by a Watch, having, Minutes and $2ds$; or by a good Minute Glass; or best of all by a Pendulum, Vibrating seconds; the which must be three Foot, three Inches, and one fifth of an inch long, *viz.* between the middle of the Bullet, and the upper end of the Thread, where it is fastened; or held when it Vibrates,) You may, with the help of some Tables, come to know any *Depth* of the *Sea*.

Note, That care must be had of proportioning the Weight and Shape of the Lead, to the Bulk, Weight, and Figure, of the Globe; after such a manner, as upon Experience shall be found most convenient.

In some of the Trials already made with this *Instrument*, the Globe being of Maple-wood, well covered with Pitch, to hinder soaking in, was $5\frac{1}{2}$ Inches in Diameter, and Weighed $2\frac{1}{2}$ pounds; the Lead, of $4\frac{1}{2}$ pound Weight, was of a *Conical*, (but is now used of a *Globous*) Figure 11 Inches long, with the sharper end downwards, $1\frac{2}{3}$ at the bottom in Diameter. And in those Experiments made in the *Thames*, in the Depth of 19 foot Water, there passed between the Immersion and Emerision of the Globe, 6 Seconds of an hour; and in the Depth of 10 Foot Water, there passed $3\frac{1}{2}$ Seconds, or thereabouts.

In the same Trials it was also found; that there was no difference in time, between the Submersions of the Ball at the greatest Depth, when it rose two Wherry's length from the place where it was let fall, being carried by the Current of the Tide) and when it rose only a Yard, or so, from the same place where it was let down: And that it must be so in great Depths and Stronger Currents, is as certain, as easy to be Demonstrated.

And if it be alleged, that it must be known, when a Light Body Ascends from the bottom of the Water to the Top, in what proportion of Time it Rises; it may be considered, that in this Experiment the Times of the Descent and Ascent are both taken and computed together; so that, for this purpose, there needs not the nicety which is alleged.

Of other Experiments of this way of *Sounding* without a *Line*, made by the Noble Lord Viscount *Brounker*, Sir *Robert Moray* Knight, and Mr. *Hook*, in the Channel at *Sheerness*; the following Account was given; *vid.*

	Ounce.	Grains.
A Wooden Ball A weighed	$32\frac{2}{3}$	00
Another Wooden Ball B,	30	22
A Lead A	30	00
Another Lead B,	$30\frac{1}{4}$	00

The *Ball B*, and the *Lead B*, were let down at 16 *Fathom*; and the *Ball* returned in 48 single *stroaks* of a *Pendulum*, held in the *Hand*, *Vibrating* 58 single *stroaks* in a *Minute*.

A Second time repeated with the same success; therefore the Motion was 4 *Foot* every *second*.

Again, the *Ball A*, and the *Lead B*, whose *Nail* was bended into a sharper *Angle*; the *Ball* returned in 39 *stroaks*. A second time repeated with the same success at the same *depth*.

Ball B, *Lead B*, in which *Trial* the *Line*, not being clear, stopped a little the *Motion*; the *Ball* returned in 47 at the same *depth*.

Ball A, *Lead A*, at 8 *Fathom* and 1 *Foot*, returned at 20; repeated at 8 *Fathom*, returned at 19.

Tried the third time at 10 *Fathom* and 4 *Foot*, returned at 28.

A fourth *Trial*, at the same *depth*, just the same.

At a fifth, at 10 *Fathom* 5 *Foot*, returned in 27.

A sixth *Trial* just the same.

A seventh at 12 *Fathom* 5 *Foot*, returned in 37.

An 8th *Trial*, just the same.

Another *Day* near the same *place*.

Note, That the *Pendulum* was this *Day* adjusted, and made a little shorter, there having been but 58 *Vibrations* in a *Minute* the other *Day*.

Ball A, *Lead B*, at 14 *Fathom*, returned in $32\frac{1}{2}$.

A Second *Trial*, a little after, in the same *place*, returned in 33. In the making of which *Trial*, the *Vibrations* were told aloud, and the *Lead* having been let down by a *Line*, was found to touch the bottom in just half the time the *Ball* staid under *Water*. By a second *Trial*, the *Ascending* and *Descending* was found to be in equal *Times*. And by a third *Trial*, with another *Lead*, the very same found, *vid.* $16\frac{1}{2}$ *descending*, and $16\frac{1}{2}$ *ascending*. This *Lead* and *Ball* let down without a *Line*, the *Ball* returned in 13 *Vibrations*; a *Sign* it went not to the bottom.

A *Trial* made with a *Lead*, whose *Iron Crook* was fastned at the top of it, succeeded very well, and the *Ball* returned in $34\frac{1}{2}$: But by reason of the *Current*, the *Experimentors* could not perceive, when the *Lead* touched the bottom. This *Lead* being let down without a *Line*, the *Ball* returned in $32\frac{1}{2}$. The *depth* of *Water* was now found by the *Ships Lead*, to be 14 *Fathom*.

Fig. 46.

Another *Trial* was made with a *Line*, bowing the *Point* of the *Lead*, and the *Ball* returned in 34. The same let down without a *Line*, the *Ball* returned in 6 or 7 *Vibrations*; a *Sign* again it went not to the bottom. In a *Trial* with another *Lead*, the *Ball* returned in 34. Repeated again with the same success.

Fig. 47.

In a *Trial* with a *Lead*, whose *Nail* was set awry, the *Ball* returned in 34. After which *Trial* the *Depth* was found to be just 14 *Fathom*: The last *Lead* and *Ball* being let down without a *Line*, the *Ball* returned at 35. In another *Trial* with a *Lead* that never failed, the *Ball* returned in 34, and the *Lead* touch'd the *Bottom* at 17.

Fig. 48.

By a Tryal with another Lead, the same Time was found exactly.

By a 3^d Tryal with this last, the very same.

These Trials were made near about High water, at the depth of 14 *Fathom* just, by Measure; and in them, the Motions seem to be 5 *Foot* every *Second*.

In all these Trials, the greatest difficulty was, in the use of *Conical* Figures, with Iron Crooks, to bend the Iron that it might be sure to carry down the Ball with it to the bottom, and when come thither, to let it go: for almost every one of these Leads failed in one of these requisites, till by several Trials they had been adjusted.

It is not to be Omitted, That the last Trials being made near High-Water, the Ball was found to Rise (by the Boat being permitted to drive) far off upon one side, out of the way, That any light thing, suffered to swim on the Water, wou'd be carried; which seemed to argue a motion of the Under-parts of the Water, differing from that of the Upper (a thing which is said to be at certain Times of the Tides, both at the Mouth of the *Sound*, and of the *Streights*; which deserves to be further enquired into.) The Angle made by these different motions, seemed to be about 4^o *gr*.

To fetch up Water from any Depth; by Dr. Hook. n. 9. p. 149. n. 24. p. 447. Fig. 49.

II. Let there be made a Square *Wooden Bucket* C, whose Bottoms EE, are so contriv'd, that as the Weight A sinks the Iron B, (to which the Bucket C, is fastened by two Handles DD, on the end of which are the moveable Bottoms, or Valves EE, and thereby draws down the Bucket; the resistance of the Water keeps up the Bucket in the Posture C, whereby the Water hath, all the while it is descending, a clear passage through; whereas, as soon as the Bucket is pulled upwards by the Line F, the resistance of the Water to that Motion, beats the *Bucket* downward, and keeps it in the posture G, whereby the Included Water is kept from getting out, and the Ambient Water kept from getting in.

By the advantage of this Vessel; you may come to know the Constitution of the Sea-Water in several Depths; and whether it be *Salter* at and towards the *Bottom*, than at or near the *Top*: Likewise whether in some places of the Sea, any *sweet Water* is to be found at the *bottom*.

Directions for observing Tides; by Sir Rob. Moray. n. 17. p. 298.

III. 1. To observe in what Proportion the *Increases* of the *Tides* from the *Neap* to the *Spring Tides*, and their *Decreases*, and the *Risings* and *Fallings* of the *Ebbs*, happen to be in regard of one another. It is supposed upon some Observations made by Sir *Rob. Moray* (though not throughly and exactly performed,) that these *Increases* are in the Proportion of *Sines*; the first Increase exceeding the lowest in a small proportion; the next in a greater; the 3^d greater than that; and so on to the midmost, whereof the Excess is greatest, diminishing again from that, to the highest *Spring Tide*; so as the proportions before and after the Middle, do greatly answer to one another, or seem to do so.

2. To observe, the Increase and Decrease of the *Velocity* of the *Current*; which is also supposed to be according to the Proportion of *Sines*.

3. The

3. The exact measures of the *Heights* of every utmost *High-Water* and *Low-Water* from one *Spring-Tide* to another.

4. The exact *Heights* of *Spring-Tides* and *Spring-Ebbs*.

In order to all which this following *Apparatus* is proposed to be made use of. In some convenient place upon a Wall, Rock, or Bridge, &c. Let there be an Observatory standing as near as may be to the Brink of the Sea, or upon some Wall; and if it cannot be well placed just where the *Low-Water* is, there may be a Channel cut from the *Low-Water* to the bottom of the Wall, Rock, &c. The Observatory is to be raised above the *High-Water* 18 or 20 Foot; and a Pump of any reasonable Dimension, placed perpendicularly by the Wall, reaching above the *High-Water* as high as conveniently may be. Upon the top of the Pump a Pulley is to be fastned, for letting down into the Pump a piece of floating Wood, which as the Water comes in may Rise and Fall with it. And because the *Rising* and *Falling* of the Water amounts to 60 or 70 Foot, the Counterpoise of the Weight, that goes into the Pump, is to hang upon as many Pulleys, as may serve to make it Rise and Fall within the space by which the Height of the Pump exceeds the Height of the Water. And because by this means the Counterpoise will Rise and Fall slower, and consequently by less proportions, than the Weight it self, the first Pulley may have upon it a Wheel or two, to turn Indexes at any proportion required, so as to give the *minute parts* of the Motion, and *Degrees* of Risings and Fallings. And because if the *Hole*, by which the Water is let into the Pump be as large as the *Bore* of the Pump it self, the Weight that is Raised by the Water, will Rise and Fall with an Undulation according to the Inequality of the Sea's Surface, 'twill therefore be fit, that the *Hole*, by which the Water enters, be less than half as bigg as the *Bore* of the Pump; any Inconvenience that may fall thereupon, as to the Periods and Stations of the *Floud* and *Ebb*, not being considerable.

5. To observe the Position and Strength of the *Wind*; the state of the *Weather*; The Heights of the *Barometer*, *Thermometer*, *Hygroscope*; and the *Moon's Age*, and *Place* in all respects.

IV. 1. The true Time of the *Tides* at all times of the *Moon*, is very rudely and slightly reckoned up by most Seamen and Astronomers; most of them reckoning, as if the *Moon* being upon such a set *Point* of the *Compass* (as the Seaman calls it) or so many *hours* past the *Meridian* (as the Almanack-Makers reckon) it were *High-Tide* in such and such a Port at all Times of the *Moon*. And thus they reckon the *Tides* every Day to differ constantly 48 min. As for Instance; a *South-West Moon* makes a *Full Tide* at *London*, that must be understood that it is *High-Tide* at *London*; when the *Moon* is 3 *hours* past the *Meridian*. Now this is true indeed at the *New* and *Full Moon*, but not at other Times of the *Moon*, which few take any notice of: Only Mr. Booker had wont to give this *Caveat*, that about the *first* and *last Quarters* of the *Moon*, the *Neap-Tides* did not flow so long as the *Spring-Tides* by one *Point* of the *Compass*; but he gives no Rule to proportion the difference.

Tides observed at London; by Mr. Hen. Phillips. n. 34. p. 656.

But

But observing this more narrowly, I find, that at *London* the *Tides* fall out at the least *two Points*, that is, one *hour* and a *half* sooner, in the *Quarters* than in the *New* and *Full Moon*. I have also found by many *Trials*, that the true *Time* of the *Tides* might be found out to be somewhat shorter and shorter, from the *New* and *Full Moon*, unto the *Quarters*; yet not in an *Equal* manner, neither gradually *Decreasing* from the *New* and *Full Moon* until the *Quarters*; but rather, that there was some little difference of *Alteration* both at the *New* and *Full Moons*, and also at the *Quarters*; and that the greatest difference fell out in the midst between them, agreeing very well to a *Circular Proportion* after this manner.

Fig. 50.

1. Divide a *Circle* into 12 *Equal* parts or *hours*, according to the *Moon's* Motion or distance from the *Sun*, from the *New Moon* to the *Full*.
2. Let the *Diameter* of the *Circle* be divided into 90 parts or *Min.* that is, according to the *Time* of the *Difference* of *Tides* between the *New* or *Full Moon*, and the *Quarters*; which is one *hour* and an *half*.
3. Make *Perpendicular Lines* cross the *Diameter* of the *Circle* from *hour* to *hour*.
4. Reckon the *Time* of the *Moon's* coming to the *South* in the *Circumference* of the *Circle*, and observe the *Perpendicular Line*, that falls from that point upon the *Diameter*; and the proportional *Min.* cut thereby, will shew how many *Hours* or *Min.* are to be *Subtracted* from the time of *High Tides* at the *New* and *Full Moon*, that so you may have the *True Time* of the *Tides* that present day.

For *Example*; At *London*, on the day of *New* and *Full Moon* it is *High-Tide* at 3 of the *Clock*, that is, when the *Moon* is 3 *hours* past the *Meridian*; and so by the common *Rule*, the *Moon* being about 4 days old, it will be *South* about 3 of the *Clock*, and it will be *High-Tide* three *hours* afterwards, that is, at 6 of the *Clock*. But now by this *Rule*, if you count this time of the *Moon's* coming to the *South* in the *Circumference*, the *Perpendicular Line*, which comes from 3 to 9, cuts the *Diameter* at 45 *min.* which shews, that so much is to be abated from the time of *High Tide* in the *New* and *Full Moons*; So that it is *High-Tide* 45 *min.* before 6 of the *Clock*; that is, at 5 *hours* 45 *min.* and not at 6 of the *Clock*, according to the common *Rule*.

The like you may do for any other *Port* or place, knowing the *Time* of *High-Water* at the *New* and *Full Moon* in that place: And you may do it the more readily, if you set down the *Time* of *High-Water* at the *New* and *Full Moon* under the *Diameter*, as I have done for *London*, where it is *High-Tide* at III of the *Clock*. So that when the *Moon* is *South* at III of the *Clock*, the *Perpendicular* cuts the *Diameter* at II *hours* 15 *m.* and so when the *Moon* is *South* at IX. of the *Clock*, by adding *Two hours* 15 *min.* you may have the *Time* of *High-Water*, which is XI of the *Clock* and 5 *Min.*

And thus you may easily make a *Table*, which by the *Southing* of the *Moon* shall readily tell you the time of *High-Tide* at any time of the *Moon*, as I have done here for *London*: to which all other places may be reduced to correspond

On the Quarter Days.

High-Water on the *Bar*, at 5 a Clock.

At *Rings-End*, at a *Quarter* past 5.

At the *Custom-House*, half an *Hour* past 5.

A *Southerly Wind* between *S. S. E.* and *S. S. W.*, blowing fresh makes it *flow* near half an *Hour* longer than its usual *Course*.

N. B. That this *Observation* makes the *Tides*, upon the *Quarter Moons*, come in *Later*, in respect of the *Moon's Southing*, than upon *New* and *Full Moons*, by half an *hour*; whereas in the *River of Thames*, as high as *London*, the *Quarter Moons* make *High-Water* above an *Hour* and *Quarter* sooner, in that respect, than the *New* and *Full*; as may be seen by the accurate *Tide-Tables* of *Mr. Flamsteed*; but it is from hence evident, that the same *Tables* are not applicable to the *Sea-Ports*; where there is not the same *Reason* for the *Anticipation* of the *Neap Tides* upon the *Quarter Moons*.

The *Cause* of this *Phænomenon* seems to be, that the *Impulse* of the *Ocean* in the *Quarter Moons* is not so vigorous as in the *New* and *Full*; nor the *Motion* of the *Waters* so quick, (as is evident by daily experience :) Whence it comes to pass that in the *Open Sea*, and in *Ports* upon the *Sea-Coast*, as this of *Dublin*, the *High-Water-Time* falls out *Later* than when the *Motion* is more *Rapid* in the *New* and *Full*; but on the contrary, in *Rivers*, at any considerable distance from the *Sea*, the resistance of the *Weight* of the *Fresh Water*, which is kept suspended during the time of the *Flood*, is longer overcome by the more potent *Impetus* in the *New* and *Full* than by the weaker in the *Quadratures*: and from hence this difference should be still more and more considerable as the *Port* is farther *Removed* from the *Sea*.

4. Our *Diurnal Tides* from about the latter end of *March*, till the latter end of *September*, are about a *foot* higher (perpendicular; which is always to be understood) in the *Evening* than in the *Morning*, that is, in every *Tide* that happens after 12 in the *Day*, before 12 at *Night*. On the contrary, the *Morning Tides* from *Michaelmas*' till our *Lady Day* in *March* again, are constantly *Higher* by about a *Foot*, than those that happen in the *Evening*. And this *Proportion* holds in both, after the gradual *Increase* of the *Tides* *Rising* from the *Neap* to the *Highest Spring*; and the like *decrease* of its *Height* 'till *Neap* again is deducted.

The *Highest Mensrual Spring-Tide* is always the *Third Tide* after the *New* or *Full Moon*, if a cross *Wind* do not keep the *Water* out, as the *N. E.* or *N. W.* usually doth; whose contrary *Winds*, if strong, commonly make those to be *High Tides* upon our *Southern Coasts*, which otherwise would be but low.

The *Highest Springs* make the *Lowest Ebbs*: (Though I am informed by an expert *Water-man*, that it sometimes happens, that there may be a very *low Ebb*, though no *High Spring*, which they term an *Out let*, or *Gurges* of the *Sea*; as when a great *Storm* chances off at *Sea*, and not on the *Land*.)

The *Water* neither *Flows* nor *Ebbs* alike in respect of equal *Degrees*; but its *velocity* increaseth with the *Tide* till just at *Mid-Water*, that is *Half flown*, or at *Half Flood*, at which time the *Velocity* is strongest, and so decreaseth proportionably,

proportionably till *High-Water* or *Full Sea*. As may be guessed at by the following *Scheme*, collected by Observations made at several Times and Places. And although it be restrain'd to *Plymouth-Haven*, or the like, where the Water Riseth about 16 Foot (I say usually, because it may vary in this Port from the *lowest Neap* to the *Highest Annual Spring* above 7 or 8 Foot) yet it may indifferently serve for other places, where it may Rise as many *Fathom*, or not so High, by a proportional *Addition* or *Subtraction*.

	Time.		Height	
	b.	' f. inch.		
Flowing	1	01	6	
	2	02	6	
	3	04	0	
	4	04	0	
	5	02	6	
	6	01	6	

	Time.		Height.	
	b.	' f. inch		
Ebbing.	1	01	6	
	2	02	6	
	3	04	0	
	4	04	0	
	5	02	6	
	6	01	6	

The usual Number of Tides, or Times of *High Water* from *New Moon* to *New Moon*, or from *Full Moon* to *Full Moon*, is 59.

In Hong-road,
4 Miles from
Bristol; by Cap.
Sam. Sturmy,
n. 41. p. 813.

5. 1. I have observed, That our *Annual Spring Tides* do happen in *March* and *September*, either at the *Tide* next before the *Sun's* Ingress into the *Equinoctial* Points of *Aries* and *Libra*, or the next *Tide* after, according as the *Moon* is near her *Full* or *Change*, when the *Sun* thus enters into the said *Signs*: And then it flows in height about 45 Foot; the lowest *Neap Tides* flowing in height 25 Foot.

Signs.

2. That the *Lowest Neap* makes the *highest Spring*, if the *N. E.* Winds hinder not, by blowing hard, and so keep back the *Tides*; as usually they do when they blow: Whose contrary Winds, *S. W.* if they blow hard, make here the *Highest Tides*.

3. That from about the latter end of *September*, they are about 1 Foot and 3 Inches higher, perpendicularly in the *Evening* than in the *Morning*; that is, if *High Water* happen after the *Sun* is past the *Meridian*, or in the *Tides* betwixt *Noon* and *Midnight*. But from *Michaelmas* to our *Lady-day*, we find the contrary, the *Day Tides* being, in that Season, higher by 15 Inches than the *Night Tides*, or the *Tides* between *Midnight* and *Noon*. And this proportion holds in both, after the Gradual Increase of the *Tides* rising from the *Neap* to the highest *Spring*, and the like Decrease of their Height till *Neap* again.

4 That the *Highest Menstrual Spring-Tide* is always the third after the *Full Moon* or *Change-day*, if it be not kept back by *N. E.* Winds.

5. That it flows here on the *Change-day*, when the *Moon* is *E. S. E.* the *Tide* flowing in for the space of 5 Hours, and *Ebbing* 7 Hours. But in *Neap-Tides* it does not flow here by two Points of the *Compass* so long.

6. That the Water flows nor Ebbs equal Spaces in equal Times, but its Velocity is strongest at the first, both of the Flood and Ebb, and so gradually Decreaseth until Full Sea, or Low Water. This is observed in Spring Tides only, as you may see by the following Table, which I have made from my Observations of our Tides here. And I have farther Observed, that it hath Flow'd or Ebb'd at the first of the Tide one Foot in 6 Minutes, or that then the Tide Ran out a Foot in 6 Minutes, or did Rise so much in Height.

	Time		Height.	
	h.	'	f.	Inch.
Flowing.	0	15	2	7½
	0	30	2	6
	0	45	2	6
	1	00	2	6
	0	15	2	6
	0	30	2	5½
	0	45	2	5
	2	00	2	5
	0	15	2	3
	0	30	2	3
	0	45	2	3
	3	00	2	3
	0	15	2	2
	0	30	2	1
	0	45	2	1
4	00	2	1	
0	15	1	9	
0	30	1	8	
0	45	1	8	
5	00	1	8	
		5		44

	Time		Height.		
	h.	'	F.	In	
Ebbing.	0	15	2	7½	
	0	30	2	6	
	0	45	2	6	
	1	00	2	6	
	2	00	9	0	
	3	00	8	0	
	4	00	6	9	
	5	00	5	0	
	6	00	4	0	
	7	00	3	0	
			7		00
			44		10½

7. The Usual Number of Tydes from New Moon to New Moon, or from Full to Full, is 59.

8. In the River of Severn, 20 Miles above Bristol near Newnham, 160 Miles from the River's Mouth (Lundy) the Head of the Flood at its coming in in Spring Tides, ariseth in height like a Wall near 9 Foot high, and so runs for many Miles together, covering at once all the Shoales which were dry before; at which time all Vessels, that lie in the way of the said Head Tides, or (as it is vulgarly called) Boar, are commonly Overset, or carried upon the Banks, and the Head of the Tide being past, such Vessels are left dry again, It flows there but two Hours and 18 Foot in height, and it Ebbs ten Hours. The Reason of the said Boar is doubtless the straightning and shoaling of the River in that Place,

Place, it being there but half a Mile broad; as it is but twenty Pearches over, three Miles higher; running Tapering to Gloucester.

6. We have been informed by a curious Gentleman, that the Annual highest Tides about Cheapstow Bridge, were at St. David's and Michaelmas Stream; that is the one a little before the Vernal, and the other somewhat after the Autumnal Equinox, which agrees also with the Conjecture of a very Intelligent Mathematician, who is withal of Opinion, that because both are not far from the Equinoxes, (though the one before, the other after) it might well give Occasion to think it was depending on the Equinox.

At Cheapstow, by ---- Ibid. p. 816.

7. Our great Bay Mr. Camden calls Washes, whereas they are only two small Arms of the Sea, running into it, viz. Fosdike and Cross-keys; 'tis full of Sands, making two Channels to Lyn, and as many to Boston. It may be useful to Travellers to have a Table when to pass over the said Washes, tho' without a Guide, I would not advise them, especially after great Freshes, which make the Sands shift, and consequently Quick, and Horses many times stick fast, the way to get them out is, by several Peoples trampling round them at a Distance, which by degrees Raiseth them.

A Table of the Washes in Lincolnshire; by Mr. Chr. Meritt. n. 223. p. 352. n. 224. p. 392.

Moon's Age.	Fosdike Begins.	Ends.	Full Sea.	Moon's Age.	Fosdike begins.	Ends.	Full Sea.
1	16	10	4	09	24	11	24
2	17	10	5	10	25	11	12
3	18	11	6	11	26	12	00
4	19	12	7	12	27	1	48
5	20	1	8	13	28	2	36
6	21	2	9	14	29	3	24
7	22	3	10	15	30	4	12
8	23	4	11			5	

Cross-Keys begins to be fordable fifteen Minutes after Fosdike. and Ends an Hour sooner.

8. It is High Water upon the Day of the New and Full Moon.

On the Coast of Gascony and Guienne.

At 3h. at the Mouth of Garonne, and the Isle of Ree.

At 3½h. at St. John de Luz, at Bayonne, and Memissan.

At 3¾h. at Royan, Brouage and Rochelle.

At 3h. on the Coast of Poitou.

At 3¼h. at Ollonne and Beauvoir.

The Tides in France, by ---- n. 185. p. 220.

On the Coast of Britany.

At 1½h. at Bell Isle.

At 3h. at the Mouth of the Loyre, at Garande, Morbihan, Blavet, and Concarneau.

At $3\frac{3}{4}$ h. at *Apenars, Vannes, and Auray.*

At $2\frac{1}{4}$ h. at *Apenmark, Audierne, the Race of Fontenay, and Le Conquet.*

At $2\frac{3}{4}$ h. at *Brest, and at Cape de Four.*

At 4 h. at *St. Paul de Leon.*

At $4\frac{1}{2}$ h. at *Port Blanc.*

At 6 h. at *St. Malo and Cancale.*

On the Coast of Normandy.

At 7 h. at *Granville, and Barneville.*

At 8 h. at *Cherbourg and Barfleur.*

At 9 h. at *Caen and Honfleur, at the Mouth of the Seine, and at Haver de Grace.*

At $9\frac{3}{4}$ h. at *Fescan and St. Valeri.*

At $10\frac{1}{2}$ h. at *Rouen, Dieppe, and Treport.*

On the Coast of Picardie.

At 11 h. at the Mouth of the *Somme, at Estaple, Boulogne, and Ambletense.*

At 11 h. at *Calais.*

At 12 h. at *Dunkirk, Newport, and Ostend.*

At Bermudas,
by Mr. Rich.
Norwood. n. 30.
p. 565.

9. 1. I have only taken a general notice; of the *Tides* as, that it is *high Water* about 7 of the Clock on the *Change-Day* (in some Creeks an hour or two later.) The Water *Riseth* but little, as about 4 Foot at High Water; but at *Spring-Tides* it may be a Foot more. The *Tides* without, are very various in their *Setting*; Sometimes the *Tide* of *Flood* sets to the *Eastward*, sometimes to the *Westward*: But in fair, Calm, and settled Weather, the said *Tide* sets from the *South-East* toward the *North-west*, as they say.

By Mr. Rich.
Stafford. n. 40.
p. 792.

2. The Water about our Island (*Bermudas*) does not *Flow*, by any Mans *Observation*, above 5 Foot; and that but at one Season of the Year, between *Michaelmas* and *Christmas*; at other times not above 3 Foot. It is *High-Water* when the *Moon* is about an hour High; and the like after her going down. It *Flows* in from the *North-West* and runs to the *South-East* nearest, and in that part of the Land which lies most to the *North-West* there it is *High Water* soonest: But the *Tide* does not always *Ebb* and *Flow* directly that Course round about our Coast; but I suppose, the Reason is that some points of Land, or *Sholes*, may turn its *North-West* and *South East* Course.

At Cabo Cors
Castle on the
Coast of Gui-
ney; by Mr.
Heathcot.
n. 158. p. 578.

10. The Sea Runs here along the Shore continually to the *Eastward*, at a very great Rate, except at *Full* and *Change*, for then it runs to *Westward*, or at least makes a great Abate. Nov. 24. 1683. I took the time of the *High-Water* at the Castle (as near as I could) at 3 h. 30'. p. m. It *Flowed* about 6 Foot.

An Hypothesis
about the Flux
and Reflux of
Sea; by Dr.
Wallis. n. 16.
p. 263.

V. 1. The *Sea's Ebbing* and *Flowing*, hath so great a *Connexion* with the *Moon's Motion*, that in a manner all *Philosophers* (whatever other Causes they have

have joyned with it) have attributed much of it's Cause to the *Moon*; which either by some *Occult Quality*, or particular Influence, which it hath on moist Bodies, or by some *Magnetick Vertue* drawing the Water towards it, (which should therefore make the Water there *Highest*, where the *Moon* is *Vertical*) or by its *Gravity* and Pressure downwards upon the *Terraqueous Globe* (which should make it *Lowest* where the *Moon* is *Vertical*) or by whatever other means (according to the several Conjectures of Inquisitive Persons) hath so great an Influence on, or at least Connexion with, the *Sea's Flux* and *Reflux*, that it would seem very unreasonable to seclude the consideration of the *Moon's* motion from that of the *Sea*: The *Periods* of *Tides* (to say nothing of the greatness of them near the *New-Moon* and *Full Moon*) so constantly waiting on the *Moon's* motion, that it may be well presumed, that either the one is Governed by the other; or at least both from some Common Cause.

The first that I know of, who took in the consideration of the *Earth's* Motion, (*Diurnal* and *Annual*) was *Galilæo*: Who in his *Systeme of the World*, hath a particular and very rational discourse on this Subject. But that discourse is to be look'd upon only as an *Essay* of the *General Hypothesis*; which as to Particulars, was to be afterwards adjusted from a good *General History of Tides*; which it's manifest enough, that he had not; and which is yet in a great measure Wanting.

And what I say of *Galilæo*, I must in like manner desire to be understood of what I am now ready to say to you. For I do not profess to be so well skill'd in the *History of Tides*, as that I will undertake presently to accommodate my *General Hypothesis* to the *Particular Cases*; or that I will indeed undertake for the certainty of it, but only as an *Essay* propose it to further Consideration, to stand or fall, as it shall be found to answer Matter of Fact.

I consider therefore that in the *Tides*, or the *Flux* and *Reflux* of the *Sea*, besides extraordinary Extravagances, or Irregularities, whence great Inundations or strangely *High Tides* do follow, (which yet perhaps may prove not to be so merely Accidental as they have been thought to be, but might from the Regular Laws of Motion, if well considered, be both well accounted for, and even foretold; there are these 3 notorious Observations made of the *Reciprocation of Tides*. First the *Diurnal Reciprocation*, whereby twice in somewhat more than 24 hours, we have a *Flood* and an *Ebb*; or a *High Water* and *Low-Water*. Secondly, the *Menstrual*; whereby in one *Synodical Period* of the *Moon*, suppose from *Full Moon* to *Full Moon*, the Time of those *Diurnal Vicissitudes* doth move round through the whole Compass of the Νυχθημερον , or *Natural Day* of 24 hours: As for Instance, if at the *Full Moon*, the *Full Sea* be at such or such a place just at *Noon*, it shall be the next day (at the same place) somewhat before *One* of the *Clock*; the day following, between *One* and *Two*; and so onward, till at the *New Moon* it shall be at *Midnight*; (the other *Tide*, which in the *Full Moon* was at *Midnight*, now the *New Moon* coming to be at *Noon*), and so forward till at the next *Full Moon*, the *Full Sea* shall (at the same place) come to be at *Noon* again. Again, That of the *Spring Tides* and *Neap Tides* (as they are call'd); about the *Full Moon* and *New Moon* the *Tides* are at the *Highest*, at the *Quadratures* the *Tides* are at the *Lowest*: and at the times Intermediate,

mediate, proportionably. Thirdly, the *Annual*; whereby it is observed; that at sometimes of the Year, the *Spring-Tides* are yet much Higher than the *Spring-Tides* at other times of the Year: Which Times are usually taken to be at the *Spring* and *Autumn*; or the two *Equinoxes*; but I have reason to believe (as well from my own Observations for many Years, as of others who have been much concerned to heed it whereof more will be said by and by;) that we should rather assign the beginnings of *February* and *November*, than the two *Equinoxes*.

I. Now in order to give an account of these three *Periods*, according to the *Laws* of Motion and Mechanick Principles; we shall first take for granted, what is now a days pretty commonly entertained by those who treat of such matters; That a Body in *Motion* is apt to *Continue* in its *Motion*, and that in the same degrees of *Celerity*, unless hinder'd by some contrary *Impediment*: (like as a Body at *Rest*, to continue so, unless by some sufficient *Mover*, put into *motion*;) And accordingly (which daily Experience Testifies) if on a Board or Table, some Loose Incumbent Weight be for some time *Moved*, and have thereby contracted an *Impetus* to *Motion* at such a *Rate*; if that Board or Table chance by some external obstacle, or otherwise, to be stopped, or considerably retarded in its *Motion*, the incumbent loose Body will shoot forward upon it: And contrary wise, in case that Board or Table chance to be Accelerated or put forward with a considerably greater speed than before, the loose incumbent Body, (not having yet obtained an equal *Impetus* with it) will be left behind, or seem to fly backward upon it. Or, (which is *Galilæo's* Instance) if a broad Vessel of Water, for some time evenly carried forward with the Water in it, chance to meet with a Stop, or to slack its motion, the Water will Dash forward and Rise Higher at the fore part of the Vessel: And contrary wise, if the Vessel be suddenly put forward Faster than before, the Water will Dash backwards, and Rise at the hinder part of the Vessel. So that an Acceleration or Retardation of the Vessel which carries it, will cause a Rising of the Water in one part, and a Falling in another: (which yet by its own Weight, will again be reduced to a Level as before.) And consequently, supposing the *Sea* to be but as a Loose Body carried about with the *Earth*, but not so United to it as necessarily to receive the same degree of *Impetus* with it, as its fixed parts do, The *Acceleration* or *Retardation* in the Motion of this or that part of the *Earth*, will cause (more or less, according to the proportion of it) such a Dashing of the Water, or *Rising* at one part, with a *Falling* at another, as is that which we call the *Flux* and *Reflux* of the *Sea*.

Now this premised, we are next, with him, to suppose the *Earth* carried about with a *Double motion*; the one *Annual* in *B E C*, the *Great Orb*, in which the *Center* of the *Earth* *B*, is supposed to move about the *Sun* *A*. The other *Diurnal*, whereby the whole moves upon its own *Axis*, and each point in its Surface describes a Circle, as *D E F G*.

It is then manifest that if we suppose, that the *Earth* Moved but by any one of these Motions, and that regularly, (with an equal Swiftnes;) the *Water*, having once attained an equal *Impetus* thereunto, would still hold equal pace with it, there being no occasion, from the Quickning or Slackning of the *Earth's motion*, (in that part where the *Water* lieth) for the *Water* thereon either to be

cast Forward or Backward, and thereby to *Accumulate* on the other parts of the *Water*: But the True *Motion* of each part of the Earth's Surface being compounded of those Two *Motions*, the *Annual* and *Diurnal*; (the *Annual* in *B E C*, being, as *Galilæo* there supposeth, about three times as fast as a *Diurnal motion* in a great Circle, as *D E F*;) while a point in the *Earth's* Surface moves about its Center *B*, from *G*, to *D*, and *E*, and at the same time its Center *B*, be carried forwards to *C*; the True *Motion* of that Point forwards; is made up of both those *Motions*; to wit of *B*, to *C*, and of *G*, to *E*; but while *G*, Moves by *D*, to *E*, *E* moves backward by *F*, to *G*, contrary to the motion of *B*, to *C*; so that the true motion of *E*, is but the difference of *B C*; and *E G*: (for, besides the motion of *B*, above the Center; *G*, is also put forward as much as from *G* to *E*; and *E*, put backward as much as from *E*, to *G*;) so that the *Diurnal motion*, in that part of the *Earth*, which is next the *Sun*, as *E F G*, doth abate the progress of the *Annual*, and most of all at *F*; and in the other part, which is from the *Sun*, as *G D E*, it doth Increase it, and most of all at *D*, that is in the Day time there is abated, in the Night time is added, to the *Annual Motion*, about as much as is *G E*, the Earth's Diameter. Which would afford us a Cause of two *Tides* in 24 hours; the One upon the greatest *Acceleration* of *Motion*, the Other upon its greatest *Retardation*.

2. And thus far *Galilæo's* Discourse holds well enough; But then in this it comes short; that as it gives an Account of *Two Tides*, so those *Two Tides* are always to be at *F*, and *D*; that is at *Noon* and at *Midnight*: Whereas Experience tells us, that the time of *Tides*, moves in a *Months* space through all the 24 hours; of which he gives us no account. For though he do take notice of a *Menstrual Period*; yet he doth it only as to the Quantity of the *Tides*, greater or less; not as to the Time of the *Tide*, sooner or later.

To help this *J. Bapt. Balianus* makes the *Earth* to be but a *Secondary Planet*, and to move not directly about the *Sun*, but about the *Moon*; the *Moon* mean while moving about the *Sun*; in like manner as we suppose the *Earth* to move about the *Sun*, and the *Moon* about it. But though this might furnish us with the Foundation of a *menstrual Period* of *Accelerations* and *Retardations* in the Compound Motion of several parts of the *Earth's* Surface; yet there is not good reasons to admit of this *Hypothesis*.

Instead of this, that *Surmise* of mine, (for I dare not yet, with confidence, give it any better name,) of what I have spoken to you heretofore, (and which hath occasioned this present account which I am now giving you,) is to this Purpose.

The *Earth* and *Moon* being known to be Bodies of so great Connexion, as that the *Motion* of One follows that of the *Other*, may well enough be looked upon as one Body, or rather one Aggregate of Bodies, which have one common Center of *Gravity*; which Center of *Gravity* according to the known Laws of *Statics* is in a straight Line Connecting their respective Centers, so divided as that its parts be in Reciprocal Proportion to the *Gravities* of the Two Bodies. As for Example; Suppose the *Magnitude* (and therefore, probably, the *Gravity*) of the *Moon* to be about a *One and fortieth* part of that of the *Earth*; And the Distance of the *Moon's* Center from the Center of the *Earth*, to be about 56 *Semidiameters* of the *Earth*, the distance of the *Common Center* of *Gravity* of the two Bodies, will be from that

Riccioli. *Alm.*
Nov. Tom. 1. l.
4. c. 10. n.
111. p. 256. 2.

of the *Earth* about $\frac{1}{42}$ of 56 *Semi-diameters*, that is about $\frac{1}{3}$ of a *Semidiameter* of the *Earth*, above its *Surface*, in the *Air*, directly between the *Earth* and *Moon*.

Now supposing the *Earth* and *Moon*, jointly as One Body, carried about by the *Sun*, in the *Great Orb* of the *Annual Motion*; this Motion is to be estimated, (according to the *Laws of Statics* in other Cases) by the Motion of the *Common Center of Gravity* of both Bodies. For we use in *Statics* to estimate a Body, or Aggregate of Bodies, to be Moved upwards, downwards, or otherwise, so much as its *Common Center of Gravity* is so Moved, howsoever the Parts may change places amongst themselves.

And accordingly the Line of the *Annual Motion* will be described, not by the *Center* of the *Earth* (as we commonly estimate it,) but by the *Common Center of Gravity* of the Bodies, *Earth* and *Moon*, as one Aggregate.

Fig. 52.

Now supposing *ABCDE*, to be a part of the *Great Orb* of *Annual Motion*, described by the *Common Center of Gravity*, in so long time as from a *Full Moon* at *A*, to the next *New Moon* at *E*; the *Center* of the *Earth* at *T*, and that of the *Moon* at *L*, must each of them, (supposing their *Common Center of Gravity* to keep the Line *AE*,) be supposed to describe a *Periphery* about that *Common Center*, as the *Moon* describes her *Line of Menstrual Motion*. And in like manner, *EFGHI*, from that *New Moon* at *E*, to the next *Full Moon* at *I*.

Fig. 53.

From *A* to *E*, (from *Full Moon* to *New Moon*) *T* moves (in its own *Epicyle*) upwards from the *Sun*: And from *E* to *I*, (from *New Moon* to *Full Moon*) it moves downwards, towards the *Sun*. Again, from *C* to *G*, (from *Last Quarter* to the following *First Quarter*,) it moves forward according to the *Annual Motion*; but from *G* forwards to *C*, (from the *First Quarter* to the ensuing *Last Quarter*) it moves contrary to the *Annual Motion*.

It is manifest therefore, according to this *Hypothesis*, that from the *Last Quarter* to the *First Quarter* (from *C* to *G*, while *T* is above the *Line* of the *Annual motion*) its *Menstrual motion* in its *Epicyle* adds somewhat of *Acceleration* to the *Annual motion*; and most of all at *E*, the *New Moon*: And from the *First* to the *Last Quarter* (from *G* forward to *C*, while *T* is below the *Line* of the *Annual motion*,) it abates of the *Annual motion*; and most of all at *I*, or *A* the *Full Moon*.

So that in pursuance of *Gallileo's* Notion, the *Menstrual* Adding to, or Subtracting from the *Annual motion*, should either leave behind, or cast forward the loose Waters incumbent on the *Earth*, and thereby cause a *Tide*, (or Accumulation of Waters,) and most of all at the *Full Moon* and *New Moon*, where those *Accelerations* or *Retardations* are greatest.

Now this *Menstrual Motion*, if nothing else were superadded to the *Annual*, would give us two *Tides* in a *Month*; and no more; (the one upon the *Acceleration*, and the other on the *Retardation*;) at *New Moon* and *Full Moon*; and two *Eobs* at the *Two Quarters*; and in the *Intervals*, *Rising* and *Falling Water*.

But the *Diurnal motion* superadded, doth the same to this *Menstrual*, which *Gallileo* supposeth it to do to the *Annual*; - that is, doth Add to, or Subtract from

from the *Menstrual* Acceleration or Retardation; and so gives us *Tide upon Tide*.

For in whatsoever part of its *Epicycle* we suppose *T* to be; yet because, while by its *Menstrual* motion, the Center moves in the Circle *LIN*; each Point in its Surface, by its *Diurnal* motion moves in the Circle *LMN*: Whatever Effect (Accelerative or Retardative) the *Menstrual* would give, that Effect by the *Diurnal* is Encreased in the Parts *LMN*, (or rather *LMn*, the Semicircle) and most of all at *M*; but diminished in the Parts *NO L* (or rather *n Ol*) and most of all at *O*. So that at *M* and *O*, (that is when the Moon is in the *Meridian* below or above the *Horizon*;) we are to have the *Diurnal Tide* or *High-Water*, occasion'd by the greatest Acceleration or Retardation, which the *Diurnal Arch* gives to that of the *Menstrual*; which seems to be the true cause of the *Daily Tides*, and withal gives an Account, not only why it should be every Day, but likewise why at such a time of the Day; and why this time should in a Month run through the whole 24 Hours, *viz.* because the Moon's coming to the *Meridian* above and below the *Horizon*, (or as the Sea men call it, the Moon's *Southing* and *Northing*) doth so: As likewise of the *Spring Tides* and *Neap Tides*. For, when it so happens, that the *Menstrual* and *Diurnal* Accelerations or Retardations, be coincident, (as at the *New Moons* and *Full Moons* they are) the Effect must needs be the greater. And although (which is not to be dissembled) this happen but to One of the *Two Tides*; that is, the *Night-Tide* at the *New Moon* (when both motions do most of all Accelerate) and the *Day Tide* at *Full Moon* (when both do most Retard the *Annual* motion;) yet, this *Tide* being thus raised by two concurrent causes; tho' the next *Tide* have not the same cause also, the *impetus* contracted, will have influence upon the next *Tide*; upon a like Reason, as a *Pendulum* let fall from a higher Arch, will (tho' there be no new Cause to occasion it) make the *Vibration* on the other side (beyond the *Perpendicular*) to be also greater: Or, of *Water* in a broad *Vessel*, if it be so jogged, as to be cast forward to a good height above its *Level*, will upon its *Recoiling*, by its own *Gravity*, (without any additional Cause) mount so much the higher on the hinder part.

Fig. 54

But here also, we are to take notice, that though all parts of the *Earth* by its *Diurnal* motion, do turn about its *Axis*, and describe *Parallel Circles*; yet not equal *Circles*; but greater near the *Aequinoctial*, and lesser near the *Poles*, which may be a Cause why the *Tides* in some parts may be much greater than in others. But this belongs to the particular Considerations, (of which we are not now giving an Account) not to the *General Hypothesis*.

3. The *Annual High Tides* having been observed (grossly) to happen about the *Spring* and *Autumn*; they are generally referred to the two *Aequinoxes*. But the *Inhabitants* of *Rumney-marsh* in *Kent*, where the *Sea* being kept out with great *Earthen Walls*, that it doth not at *High Water* overflow the *Level*; are generally agreed by their *Observations*, (and *Experience* dearly bought) that their *Times of Danger* are about the beginning of *February* and of *November*: That is, at those *Spring Tides* which happen near those *Times*; to which they give the Names of *Candlemas Stream*, and *Allhallond Stream*: And if they escape those *Spring Tides*, they apprehend themselves out of *Danger*

ger for the rest of the Year. And as for *March* and *September* (the two *Æquinoxes*) they are as little solicitous of them, as of any other part of the Year. And I have my self very frequently observed (both at *London*, and elsewhere) that in those Months of *February* and *November*, (especially *November*) the Tides have run much higher than at other times; Particularly in *November* 1660. I found the Water so High in *King-street Westminster*, that it came up not only into the Boots, but into the Body of the Coach; and the *Pallace-yard* (all, save a little place near the *West End*) over-flowed; as likewise the *Market Place*; and many other places; and their Cellars generally filled up with Water. And in *November* 1665. it may be well remembered what very High Tides there were, not only on the Coasts of *England* (where much hurt was done by it) but much more in *Holland*, where, by reason of those Inundations, many Villages and Towns were overflowed.

'Tis true, there does not happen any single Signal Accident, which might cast it on these times, yet there is a Compound of Two that may do it: Which is the *Inequality* of the *Natural Day*, (well known to *Astronomers*) arising from a double Cause. *First*, Because the Sun, by reason of its *Apo-gæum* and *Perigæum*, doth not at all times of the Year dispatch, in one Day, an equal Arch of the *Ecliptick*: *Secondly*, Equal Arches of the *Ecliptick* do not in all parts of the *Zodiack* answer to equal Arches of the *Æquinoctial*, by which we are to Estimate Time.

According to the *First* of these Causes, we should have the *Longest* Natural Days in *December*, and the *Shortest* in *June*, which if it did operate alone, would give us at those times *Two Annual High Waters*. According to the *Second* Cause, if operating singly, we should have the *longest* Days in the *Two Solstices* in *June* and *December*, and the *Two shortest* at the *Equinoxes*, in *March* and *September*; which would at those times give occasion of *Four Annual High Waters*.

But the *True Inequality* of the *Natural Days*, arising from a Complication of those Two Causes; sometimes Crossing, and sometimes Promoting each other, though we should find some Increases or Decreases of the *Natural Days*, at all those Seasons answerable to the respective Causes, (and perhaps of *Tides*, proportionably thereunto: Yet the *longest* and *shortest* *Natural Days* absolutely of the whole Year (arising from this Complication of Causes) are about those times of *Allballontide* and *Candlemas*; (or not far from them) about which those *Annual High Tides* are found to be: As will appear by the *Tables of Equation of Natural Days*. And therefore, I think, we may with very good Reason, cast this *Annual Period* upon that cause, or rather Complication of Causes. For (as we before shewed in the *Menstrual* and *Diurnal*) there will, by this *Inequality* of *Natural Days*, arise a *Physical Acceleration* and *Retardation* of the Earth's Mean Motion, and accordingly a casting of the Waters Backward or Forward; either of which will cause an *Accumulation* or *High Water*.

I must here add, (that I be not mistaken) that whereas I cast the Time of the *Daily Tides* to be at all Places, when the Moon is there in the *Meridian*; it must be understood of *open Seas*, where the Water hath such free Scope for
its

its Motion, as if the whole Globe of Earth were equally covered with Water: Well knowing, that in *Bays* and *Inland Channels*, the position of the Banks and other like Causes must needs make the times to be much different from what we suppose in the *Open Seas*: And likewise, that even in the *Open Seas*, *Islands*, and *Currents*, *Gulfs* and *Shallows*, may have some Influence, though not comparable to that of *Bays*, and *Channels*. And moreover, though I think that Sea-men do commonly reckon the time of *High Water* in the *Open Seas*, to be then, when the Moon is there in the Meridian (as this *Hypothesis* would cast it:) Yet I do not take my self to be so well furnished with a *History* of *Tides*, as to assure my self of it; much less to Accomodate it to particular Places and Cafes.

It may be thought perhaps, that if the Earth should thus describe an *Epicyle* about the *Common Center of Gravity*, it would (by this its change of place) disturb the *Celestial Motions*, and make the apparent Places of the Planets, especially some of them, different from what they would otherwise be. For though so small a removal of the Earth, as the *Epicyle* would Cause, (especially if its Semi-diameter shou'd not be above $1\frac{1}{2}$ of the Earth's Semi-diameter) would scarce be sensible, if at all, to the remoter Planets; yet as to the nearer it might.

To this my Answer is, That such difference hath been observ'd, and hath very much Puzzl'd *Astronomers* to give an Account of. Mr. *Horrocks* was fain to have recourse to somewhat like *Kepler's Amicable Fibres* (which he had no affection to at all) to give Account of the Inequalities of the Moon's Motion. And other *Astronomers* have introduced (some upon one Supposition, some upon another) some kind of *Menstrual Equation*, to solve the Inequalities of the Moon's Motion, according to her *Synodical Revolution*, or different Aspects (of *New Moon*, *Full Moon*, &c.) besides what concerns her own *Periodical Motion*. For which, this Consideration of the *Common Center of Gravity* of the *Earth* and *Moon*, is so proper a Remedy (especially if it shall be found precisely to answer those *Phænomena*, which I have not Examined, but am very apt to believe) that it is so far from being, with me an Objection against it, that it is one of the Reasons, which make me Inclineable to Introduce it.

The like Consideration may reasonably be had of *Jupiter* and *Saturn*, and their *Satellites*, which yet, because of their smallness, may chance to be so little, as that at this distance, the Change of their Apparent Places may not be discernable. For all these *Satellites* are to their *Principals*, as so many *Moons* to the *Earth*. And Mr. *Horrocks* expresseth some such little Inequalities in *Saturn's* Motion, of which he could not imagine what Account to give: Which, for ought I know, might have been accounted for, if at that time the *Satellites* of *Saturn* had been discovered; and that Mr. *Horrocks* had thought of such a Notion as the *Common Center of Gravity* of *Saturn* and his *Companions*, to be considerable, as to the guiding of his Motion.

Some Objections
Answered; by
Dr. Wallis. ib.
p. 281.

2. 1. To the first Objection, *That it appears not how two Bodies, that have no Tye, can have one common Center of Gravity*: That is (for so I understand the Intendment of the Objection) can Act or be Acted in the same manner, as if they were Connected; I shall only Answer, that it is harder to shew How they have, than that they have it. That the Load-stone and Iron have somewhat Equivalent to a Tye though we see it not, yet by the Effects we know. And it would be easie to shew that two Loadstones, at once applied, in different positions, to the same Needle, at some convenient distance, will draw it not to Point directly to either of them, but to some Point between both; which Point is, as to those two, the *common Center of Attraction*; and it is the same as if some one Loadstone were in that Point. Yet have these two Load-stones no Connexion or Tye, though a *Common Center of Virtue*, according to which they joyntly Act. And that there is somewhat that doth Connect the Earth and Moon, (as much as what Connects the Loadstone, and the Iron which it draws,) is past doubt to those, who allow them to be carried about by the Sun, as one Aggregate or Body, whose parts keep a respective Position to one another: like as *Jupiter* with his *four Satellites*, and *Saturn* with his *One*.

2. To the Second Objection; *That at Chatham and in the Thames, the Annual Spring Tides, happen about the Æquinoxes; not (as this Hypothesis doth Suppose elsewhere to have been Observed) about the beginning of February and November*. If their meaning be, that *Annual High Tides*, do then happen, and then only, If this prove true, it will ease me of half my work: For it is then easily Answered, that it depends upon the *Obliquity* of the *Zodiack*, the parts of the *Æquinoctial* answering to equal parts of the *Zodiack*, being near the *Solstitial* points greatest, and near the *Æquinoctial* points least of all. But besides, this *Annual Vicissitude* of the *Æquinoxes*, not to say of the *four Cardinal Points* (which my *Hypothesis* doth allow and assert;) I believe it will be found, that there is another *Annual Vicissitude* answering to the *Sun's Apogæum* and *Perigæum*. And that the greatest Tides of all will be found to be upon a Result of these two Causes cooperating. And to what is said to be observed at *Chatham*, and in the *Thames*, contrary to that I alledge as observed in *Rumney Marsh*; I must at present ἀπέχεσθαι, and refer to a *melius inquirendum*. For a good Diary of the Height and Time both of *High-Water* and *Low-Water*, for a Year or two together, even at *Chatham*, or *Greenwich*; but rather at some place in the Open Sea, or at the *Land's End* in *Cornwal*, or on the West Parts of *Ireland*; or at *St Helen's* or the *Bermudas*; &c. would do more to the resolving of this Point, than any Verbal Discourse without it.

3. To the third Objection, *That supposing the Earth and Moon to move about a Common Center of Gravity; if that the Highest Tides, be at the New-Moon when the Moon being nearest to the Sun the Earth is farthest from it, and it's Compound Motion at the Swiftest; and that the Tides Abate as the Earth approacheth nearer, till it comes into the supposed Circle of her Annual Motion: It may be demanded, why do they not still Abate as the Earth comes yet nearer to the Sun and the Swiftness of its Compound Motion, still Slackens? And so, why have we not Spring-Tides at the New-Moon (when the motion is Swiftest), and Neap Tides at Full Moon (when the Motion is Slowest): But Spring-Tides*
at

at both? The Answer (if observed) is already given in my *Hypothesis* it self. Because the Effect is indifferently to follow, either upon a Suddain *Acceleration*, or a suddain *Retardation*. Now both of these happening, the One at the *New Moon* the other at the *Full-Moon*, do cause *High Tides* at both.

4. To the 4th Objection, *That the Highest Tides are not at all places, about the New-Moon and Full Moon; and particularly, that in some places of the East Indies, the Highest Tides are at the Quadratures:* I Answer in general; That as to the particular *Varieties of Tides* in several Parts of the World, I cannot pretend to give a Satisfactory account, for want of a competent *History of Tides, &c.* Because (as is intimated in what I wrote in the general) the Various Positions of *Channels, Bays, Promontories, Gulfs, Shallows, Currents, Trade Winds, &c.* Must needs make an innumerable Variety of Accidents in particular places, of which no satisfactory account is to be given from the general *Hypothesis* (though never so true) without a due consideration of all those. Which is a Task too great for me to undertake, being so ill furnished with Materials for it.

5. To the 5th Objection, *That, the Spring-Tides happen not, with us just at the Full and Change, but two or three days after:* I should with the more confidence attempt an Answer, were I certain, whether it be so in the *Open Seas*, or only in our *Channels*. For the Answers will not be the same in both Cases. If only in our *Channels*, where the *Tides* find a large indraught; but not in the *Open Seas*: We must then seek a Reason of it from the particular Position of these places. But if it be so generally in the wide *Open Seas*: We must then seek a Reason of it from the general *Hypothesis*. And, till I know the matter of Fact, I know not well which to offer at. I know that Mariners use to speak of *Spring Tides* at the *New* and *Full* of the *Moon*; though I have still had a suspicion that it might be some Days after, as well in the *Open Seas*, as in our narrower *Channels*. And therefore I have chosen to say, in my Papers, *About the New* and the *Full*, rather than *at the New* and *Full*; and even when I do say *At*, I intend it in that laxer sence in which I suppose the Mariners are to be understood, for *Near* that Time. The truth is, the *Flux* and *Reflux* of Water in a Vessel by reason of the jogging of it; though it follow thereupon; yet is, for the most part, discernable some time after. For there must, upon that Jog, be some time for Motion, before the Accumulation can have made a *Tide*. And so I do not know but that we must Allow it in all the *Periods*: But in my *Conjectural Hypothesis* (while it is yet but a Candidate) I did not think my self Oblig'd to speak more nicely.

But now, (after all) the Clearest Evidence for this *Hypothesis* (if it can be had) will be from *Celestial Observations*. As for instance; Supposing the *Sun* at *S*, the *Earth's* Place in its *Annual Orb*, at *T*; and *Mars* (in Opposition to the *Sun* or near it) at *M*: From whence *Mars* should appear in the *Zodiack* at γ , and will at *Full Moon* be seen there to be, the *Moon* being at *C*, and the *Earth* at *C*; (and the like at the *New-Moon*.) But if the *Moon* be in the *First Quarter* at *A*, and the *Earth* at *a*; *Mars* will be seen, not at γ , but at α ; too *Slow*: And when the *Moon* is at *B*, and the *Earth* at *b*, *Mars* will be seen at β ; yet

Fig. 55.

too Slow: Till at the *Full-Moon*, the *Moon* at *C*, the *Earth* at *c*, *Mars* will be seen at γ , its true Place, as if the *Earth* were at *T*. But then after the *Full*, the *Moon* at *D* the *Earth* at *d*; *Mars* will be seen, not at γ , but at δ ; too *Forward*; and yet more when the *Moon* (at the *Last Quarter*) is at *E*, the *Earth* at *e*, and *Mars* seen at ϵ . If therefore *Mars* (when in *Opposition* to the *Sun*) be found (all other allowance being made) somewhat too *Backward* before the *Full Moon*, and somewhat too *Forward* after the *Full Moon*, (and most of all, at the *Quadratures*) it will be the best confirmation of the *Hypothesis*. The like may be fitted to *Mars* in other Positions, *mutatis mutandis*; and so for the other *Planets*.

But this Proof, is of like Nature as that of the *Parallax* of the *Earth's Annual Orb* to prove the *Copernican Hypothesis*. If it can be Observed, it proves the *Affirmative*; but if it cannot be observed, it doth not convince the *Negative*, but only proves that the *Semidiameter* of the *Earth's Epicycle* is so small as not to make any discernable *Parallax*. And indeed I doubt that will be the Issue. For the *Semidiameter* of this *Epicycle*, being little more than the *Semidiameter* of the *Earth* it self, or about $1\frac{1}{3}$ thereof (as is conjectured, in the *Hypothesis*, from the *Magnitudes* and *Distances* of the *Earth* and *Moon* compared;) and there having not as yet been observed any *Discernable Parallax* of *Mars*, even in his nearest Position to the *Earth*, it is very suspicious, that here it may prove so too.

The Variety of the Annual-Tides, in several places of England, Considered; by Dr. Wallis. n. 34. p. 652.

3. In my *Hypothesis* for *Tides*, I cast the *Annual High Tides* for the Coast of *Kent*, (and consequently the *Rivers* of *Thames* and *Medway*) about the beginning of *November* and *February*: Which agrees with Observations on those Coasts, and particularly with that of yours [Mr. Oldenburgh's] of Feb. 5. 1667.

The last year [1667] when I was present in the *R. S.* I remember an account was brought us of the *Annual High Tides* on the *Severn*, and at *Chepstow bridge*, to be about the beginning of *March*, and the end of *September*. Which though they agree not with the particular times on the Coast of *Kent*, yet in the general they agree thus far, That the one is about as much before the one *Equinox*, as the other is after the other *Equinox*. You now acquaint me with the *High-Tides* about *February 22*, about the Coast of *Plymouth*, which is later than that of the Coast of *Kent*, but sooner than that on the *Severn*. And I doubt not but that in other parts of the World will be found other *Varieties*.

The Reasons of these *Varieties* are (as I have formerly signified) to be attributed to the particular Position of those Parts rather than to the General *Hypothesis*.

Of which this, in brief, may serve for some account at present. The General *Hypothesis* of the *Earth's Diurnal Motion* from West to East, would cast that of the Waters, not following so fast from East to West; which causeth the *Constant Current* within the *Tropicks*; where the *Circles* are greatest, Westward from the Coast of *Africa* to that of *America*, (which is also the Cause of the constant *Eastern Breeze* blowing in those parts.) But the Sea thus beating on the Coast of *America*, is cast back as with an *Eddy* on either hand, and consequently

sequently returns from the *American* Shore East-ward towards the Coast of *Europe*; where, the Parallel Circles to the *Aequator* being less, and consequently the Diurnal Motion slower, doth not cast the Waters so strongly Westwards, as between the *Tropicks*; and so not strong enough to overcome the *Eddy*, which it meets with from the other Motion, which gives the Sea a North Easterly Motion (on these Coasts) as to its usual Course. The *Current* therefore of our Seas being North Easterly, we are next to consider, at what time it runs more to the North, and at what more to the East. When it runs most Northerly, it runs up the *Irish Sea*, and so up the *Severn*: When most Easterly, it runs straight up the *Channel*, and so to the Coast of *Kent*: When between these, it beats against *Devonshire* and *Cornwall*, and those parts. We are therefore to consider (as to the *Annual Periods*) that the *Annual Motion* of the *Earth* in the *Zodiack*, and the *Diurnal* in the *Aequator*, are not precisely in the same direction, but make an Angle of $23\frac{1}{2}$ *Deg.* at the *Aequinoxes*; but run, as it were, Parallel at the *Solstices*: And as they be nearer or farther from these Points, so is the *Inclination Varied*. Which several Directions of Motion, do cause the Compound Motion of both to *Vary* from the East and West more or less, according as the Sun's position is farther or nearer the *Solstices*. And therefore nearer to the *Aequinoxes* this Inclination doth cast the constant *Current* of our Seas more to the North and South; and further from it, more to the East and West. Which is the reason why the *Current* up the *Irish-Sea* is nearer to the *Aequinoxes* (at the beginning of *March* and end of *September*) and up the *Channel* or *narrow Seas*, farther from it (at the Beginning of *February* and of *November*;) and against the Coasts of *Devonshire* and thereabout, at some Intermediate Time.

4. I fear *Dr. Wallis* may be mistaken about the *Annual Vicissitudes* of the *Tides*, which he contendeth to be about *Allballontide* and *Candlemas*; For

1. Our *English Seamen* (who are more to be trusted than the Inhabitants of *Rumney Marsh*) use to say, that the *Highest Tides* in the Year seem to happen rather about the *Aequinoxes*, than those two other assigned times, when the *Natural days* are longest and Shortest.

2. If that which he Supposeth should be the Cause of the *High-Tides*, he mentions at *London* in *Nov.* 1660 and 1665, the like might be expected every *November*; and as frequently in *February*; of which he gives not one Instance. But those *High-Tides* in the *Thames* in *November*, if we dare credit the *London Watermen*, are caused by the coming down of the *Land Waters* after a very great *Rain*, which being encountered by the *Tide of Flood* from the Mouth of the *Thames*, cannot but Swell to an unusual Height. To induce us to believe which, we need only consider, that the latter end of *October*, and the beginning of *November* (or rather both those whole Months) are generally the *Rainiest* part of the whole Year. Now if the great *Rains* fall so, that the *Land-Waters* come down to the flowing part of the *Thames*, just upon the *Full* or *Change*, when the *Spring-Tides* happen, as they did (for Example) *Septem.* 30. 1555. and *October* the 22. 1629. (*Stow* and *Howes* are my Authors,) those *Spring-Tides* must be the Higher, as proceeding from a Double Cause.

Animadversions upon Dr. Wallis's Hypothesis; by Mr. Jos. Childrey. n. 64. p. 2061.

3. There

3. There is another thing notoriously known by all Sea-men, to be a Cause of *high* or *low Tides*, namely the sitting of the Wind at such or such a Point of Compass, and Blowing hard. It is the constant saying of all Sea-men in *Kent*, that ever I met with, that the North West Winds make the *Highest Tides* in the *Thames*, *Medway*, and all the Coasts about the *South* and *North Forelands*; and likewise on the Coast of *Holland* and *Flanders*. And the Reason they alledge for it is, because (say they) that Wind doth with equal Force Blow in the *Tide* of *Flood* at both Ends of this *Island* of *Britain*, that is, from the Northward between the Coasts of *Scotland*, *Norway*, and *Futland*; and also from the Westward by the Coasts of *Cornwal*, *Devonshire*, *Dorsetshire*, &c. up along the *Sleeve*; and for the same reason they say (and I think truly) that a South East Wind Deads and Hinders the *Tides* there. Agreeably to this I very well remember, when I was a Boy and lived at *Rochester*, that when the *Tides* were, unusually *High*, the Wind was always North West, and the *Moon* near the *Full* or *Change*. And the Inhabitants about *Chatham*, the Hundred of *Hoo*, and the Isle of *Graine*, will with one Voice say, that they never fear their Low Marshes being overflowed by the *Tide*, but when the Wind is at North West or thereabout, upon the *Spring Tides*. Here at *Weymouth* those Able and Antient Sea-men, I have talked with, tell me, that a S. S. E. Wind makes the *greatest Tides*, and that according to the degree of the Wind, *cæteris paribus*, the *Tides* rise more or less notably, but that they never observe any extraordinary Swelling *Tides* about *Allhallontide* or *Candlemass*, unless the Wind be about S. S. E. And the Reason they give for that Wind's Raising the *Tides* there, is, (in my opinion) very convincing, if we consider the lying of the Haven in the Map. And for the same Reason, I suppose, the Wind from the same Point may make the *Highest Tides* at *Southampton*; a Westerly Wind at *Bristol* and *Severne*; an Easterly Wind at *Hull*; a North-East Wind at *Wifbych* and *Lyn*; a Southerly Wind upon the opposite Coasts of *England* and *Ireland*, &c. And I am confident if more particular Enquiry be made in *Rumney Marsh*, it will be found, that *Dimchurch-Wall* is never in danger of being Overflowed or broken by the *Tides*, but upon very stormy and Tempestuous Weather; especially when the Wind either blows right on upon the Shore, or when it sits in that Point, that Raiseth the *Tides* Highest there. And if we do but consider, that *Allhallontide* and *Candlemass* are no more famous for the longest and shortest Natural Days, than they are generally infamous for Stormy Weather; especially the former Season, (*Wet* and *Windy* Weather being most concomitant,) we have good ground to Attribute *High Tides*, at those times of the Year, to another Cause than the Author suppoeth; and make a more than probable Conjecture at the occasion of the Mistake. It is true, *March* is very often more stormy than *February*, (though seldom so stormy as *October* and *November*) which possibly might occasion that Opinion, which some hold, (of which number, *Pliny* is one) that the *Highest Tides* are about the *Æquinoxes*. And if the thing were found to hit pretty frequently in *March*, Men might not be careful to observe the other *Æquinox*; though yet it cannot be deny'd, that we have Blustering Weather many times before *Michaelmass*. In Confirmation of all this that I have said, concerning the Influence of
the

the *Winds* being considerable on the *Tides*, I shall add these following Collections of my own out of *Histories, Chronicles, &c*

1250. *Octob. 1.* (Saith *Holinshead*) upon the *Change* of the *Moon*, was a most dreadful *Inundation* of the *Sea*, that did exceeding much hurt to *Holland* beyond *Sea*, *Holland* in *Lincolnshire*, and the *Marsh-Ground* in *Flanders*, and drowned *Winchelsea*. But he tells us withal, that an unheard of *Tempest* of *Wind* accompanied it.

1555. *Sept. 30.* (Saith *Stow*) was a *Notable Inundation* of the *Thames*; but he saith withal, that it was by occasion of a great *Wind*, and *Rain* that had fallen; the *Moon* was in *Perigæo*.

1569. *March 10.* I find this *Manuscript Note* in *Latine* in an *Ephemerides* for that *Year*, over against the *Day*; *Septentrionis maxima Sævitia: Nivis flocci magni, ingens frigus. Maxime Tumescibat æstus Maris die & nocte; nam excurrerat in Agros late.*

1592, *Sept. 6 Wednesday*, (saith *Stow*) the *Wind* being *West* and by *South*, as it had been for two *Days* before very *Boisterous*, the *Thames* was made so *void* of *Water*, by forcing out the *Fresh*, and keeping back the *Salt*; that *Men* in diverse places might go 200 *Paces* over, and then fling a *Stone* to *Land*, &c.

1600. *Decemb. 8.* I find this *Note* written in another *Ephemerides* for that *Year*, over against the *Day*, by an unknown *Person*, who, as it seems, was then at *Venice* (where a *South East Wind* makes the *Highest Tides*) *Inundatio Venetiis 6. ped temp. Sirocco.*

1601. (Saith *Grimston* in his *Netherland History*) the *Sea* being forced in by a strong *NW Wind*, did some mischief to *Ostend*.

1601. *Octob. 25. St. n.* a great *Tempest* (saith the same *Author*) and the *Wind* *West North West*, and the *Tide* much *Higher* than usual at *Ostend*.

1602. *Feb. 23, 24, st. n.* Blew a *Terrible North West Wind*, which made the *Water* rise higher than usual at *Ostend. Idem.*

1604. *March. 1. n. st.* The *Wind* was very *Great* at *West*, and *North West*, with a furious *Tempest*, the *Tide* at *Ostend* Rising so *High*, as it had not done in forty *Years* before. *Idem.*

The *Perigæosis* of the *Moon* also seems to have (at least) some *Influence* on the *Tides*, and to make them swell higher than else they would do. For I have found by observing the *Tides* (as often as I had leisure) several *High Tides* and *Inundations* (though I must not say all,) to happen upon the *Moon's* being in, or very near, her *Perigæum*. For Example,

That famous *Inundation* mentioned before out of *Holinshead*, 1250, *Octob. 1.* Was when the *Moon* was in *Perigæo*, as appears by *Calculation*.

1530. *November 5.* That *Inundation* on which was made the *Distick*.

Anno ter deno post sesquimille, *Novembris,*
Quintâ, stat salsis *Zelandia* tota sub *Undis*;

Was, when the *Moon* was in *Perigæo*.

Jan. 13. 155 $\frac{1}{2}$. The Sea, (saith *Michell* in his *Chronicle*) brake in at *Sandwich*, and overflowed all the *Marshes* thereabout, and drowned much *Cattle*; the *Moon* in *Perigæo*.

1570. *Novemb.* 1. Was a dreadful *Flood* at *Antwerp*, and on all the *Coasts* of *Holland*, that made infinite *Spoil*; the *Moon* in *Perigæo*.

1600. *Decemb.* 8. Above mentioned; the *Moon* in *Perigæo*.

160 $\frac{6}{7}$. Jan. 20. Was a great *Inundation* in *Severne*, mentioned in *How's* *Chronicle*; that did much hurt in *Somersetshire* and *Glocestershire*, &c. the *Moon* in *Perigæo*.

1643. Jan. 23. *l. n.* (saith a little *Low Dutch Chronicle* that I have) was a terrible *High Water-Flood* in *Friesland*, &c. whereby much hurt was done to the *Dykes*; and at *Gaes* by *Haerlingen*, the *Dead Bodies* streamed out of the *Earth*; the *Moon* in *Perigæo*.

1651. Feb. 23. *st. n.* (saith the same *Chronicle*) was *St. Peter's High Flood*, whereby much hurt was done to the *Dykes* in *Friesland*, *Embderland*, and elsewhere, and not far from *Dockum* by *Oudt-woudumer Zuil*, is a *Breach* of 42 *Roods* long, broken in the *Dyke*: The *Moon* in *Perigæo*.

Aug. 2. 1657 *st. v.* At *Feversham* (where I then lived) was a very high *Spring Tide*; and yet the *Wind* was at *South East*, which deads the *Tides* there; the *Moon* in *Perigæo*.

Aug. 22. 1658. *st. v.* At *Feversham* was a very *High Tide* in the *Afternoon*, though the *Wind* was *Southerly*, and blew very stiff, which the *Seamen* there wondred at; the *Moon* in *Perigæo*.

1661. Upon *Michaelmas Day*, was a great *Overflowing* of the *Severn*, that it drowned the lower *Ground* lying by it; I lived then in *Glocestershire*, and immediately as soon as I heard of it, I noted it down in my *Memorandums*; the *Moon* in *Perigæo*.

The *Scheme* of the *Weather* printed in the *History of the R. S.* tells us, that *May 24.* 1663. was a very great *Tide* at *London*. But it tells us withal that the same day the *Moon* was in *Perigæo*.

Sept. 1. 1669. Here at *Weymouth*, I observed my self a very *High-Tide*; and so did several *Seamen* in that *Town*, who wondered at it, the *Weather* being very *Calm*, and that little *Wind* that was being at *North East*, which uses to contribute nothing at all to the *Tides* in that *Haven*; the *Moon* in *Perigæo*.

Further, that which inclines me to believe, that the *Perigæosis* of the *Moon* is of some concernment in this matter, is, because it is a *Maxim* amongst our *Kentish Seamen*, that they never have two *Running Spring Tides* (as they call them) together, but that the next *Spring Tide*, after a *High Running Spring*, is proportionably weak and slack; which, if true, is very correspondent to my opinion, because if the *Moon* be in *Perigæo* at this *Spring-Tide*, she will be in *Apogæo* at the next. Accordingly I have received this account at *Weymouth*, that this present *Feb.* 16 $\frac{69}{70}$ the *Spring-Tides* ran very *High* after the *Change*, though the *Weather* was pretty *Calm*, and that *Wind* that was not very favourable

vourable to the *Tides*, and that the Spring Tides after the *Full*, were very *Low*, and weak, which is exactly according to my Conjecture.

But I conceive that the best Touch-stone to prove the Soundness of my Opinion (which I confess I never had the opportunity to do yet,) is to have it observ'd, whether those *Neap-Tides* be not apparently Higher (*consideratis considerandis*) that happen at the *Moon's* being in *Perigæo* either at the *First* or *Last Quarter*: Because it is a received and demonstrable Truth in *Astronomy*, that the *Moon* being in *Perigæo* at either *Quarter*, comes then nearer the Earth, than when it is in *Perigæo* at the *Change* or *Full*.

5. That the *Winds* have a great Influence on the *Tides* of particular Coasts and Havens, I do not at all question; and the like I say of *Land-Waters* which are as to Inland Rivers, very considerable; especially as to Inundations upon Rising of the Water: For that the *Tide* and *Land-floud* should joyntly make a greater Inundation, than either singly would have done, is not to be doubted. But in my Essay I take no notice of these, because my business was to give a Statical account of *Stated Periods* (*Diurnal, Menstrual, Annual*) arising from Regular Motions; not of Accidental Extravagances, such as these are.

Answer'd by Dr.
Wallis. ib.
p. 2068.

The *Moon's Perigæosis* also is far from being contrary to my *Hypothesis*: But for as much as it doth not still fall out at the same time of the *Day, Month, or Year*, I could not make it a Component of any of those noted Periods, *Diurnal, Menstrual, or Annual*; (and of more Periods than these, I did not know that there hath been any general notice taken, of which I might think my self obliged to give an account.) But it may very well influence any or all those, according as it falls out advantageous or disadvantageous for them.

And as I do so readily concur with him in all the particulars by him suggested; so I think he will not be difficult in assenting to all the Materials of my *Hypothesis*. The account which I give of the *Diurnal* and *Menstrual* Periods (from the *Common Center* of *Gravity* of the *Earth* and *Moon*;) he doth allow as very Rational: And consequently (which is the Foundation of it,) that any *Acceleration* or *Retardation* of the Compound Motion of the particular parts in the *Earth's* Surface, is to give such an *Accumulation* of Waters as causeth a *Tide*; and the Complication of such *Accelerations* and *Retardations* concurring or interfering one with another, doth occasion the perplex *Varieties* in them.

If therefore there be no other Periods of *Tides* but these, or no other remarkable, my work is done, and I need not be further solicitous: For, then there will seem to be either no other inequality of motions, or none considerable. But, if there be also observable an *Annual* Period, (as perhaps there may be) then are we to seek for the Cause thereof in somewhat of Inequality, which doth (for the *Annual* Period) Annually recur; or (for any other Period,) which doth recur in such a time as that other Period doth require.

'Tis true I have not insisted on the *Moon's Apogæum* and *Perigæum* (with the Inequality of Motion depending on it; or the Obliquity of its Orb (which causeth another Inequality both in the Motion of Longitude and Right Ascension,) because I did not know of any Periodical Vicissitude of *Tides* consonant thereunto

thereunto. When any such shall be discovered, we have here a Foundation ready for the Salving of it. And I the rather think they may be considerable, because the *Earth* and *Moon's* *Appropinquation* and *Elongation*, doth really alter the Distance of the *Common Center of Gravity* (of the *Earth* and *Moon*) from the *Earth* (rendering the *Earth's* *Epycicle* *Elliptical*;) and much favours what *Mr. Childrey* observes of the *Moon* in *Perigæo*. But as to any *Annual Vicissitude*, it is not of use, because it doth not *Annually* recur.

But if the *Annual High-Tides* be at the *Æquinoxes*, not at the times I have assign'd, then so much of the *Hypothesis* as concerns the *Excentricity* may be spared, (or allowed to be so little as not to be remarkable;) and that of the *Obliquity* alone will give a sufficient account of it. Or if (to which he seems rather to incline) there be no such *Annual Vicissitudes* at all; then may that of the *Obliquity* be spared also, and yet the *Hypothesis* be perfect without it. And, till some such be observed, and acknowledged, it will be sufficient to say, That, though both the *Excentricity* and *Obliquity* do cause some *Inequality* in the Motion; yet so little, as that in the *Tides* it is not remarkable, they falling just as if the three Motions, (*Annual, Menstrual, Diurnal,*) were all exactly *Circular*, and on *Parallel Axes*.

But as to matter of Fact in *Rumney Marsh* I say, that (according to the best account I can there get, and the unanimous consent as well of *Fisher-men* and other *Water-men*, as of other *Inhabitants*;) it is constant; hardly missing (or very seldom) any one Year (be the *Weather* fair or foul;) and as well about *Candlemass*, as about *Allballontide*, every year, though not then so High: Of which (though they do not pretend to give any reason of it,) I think a Cause may be very *Rationally* assigned. For if you consult the *Tables of the Inequality of Natural Days* (which *Parallel* I make use of for the *Explication* of this) you will find, that about one of the *Extreams* (in *January*) the *Increase* and *Decrease* of the *Natural Days* *Fluctuates* very much; sometime *Increasing*, sometime *Decreasing*, according as this or that of the two Causes, thwarting one another, doth prevail: But about the other *Extream* (in *October*) it is much otherwise; the *Increasing*s and *Decreasing*s going on in a continual course for a long time together. And the same Causes, applyed to the business of *Tides*, may very *rationally* be supposed to produce as *Unequal Effects*. And though the *Seamen* at *Weymouth* have not observed any such signal Effects about *Allballontide* and *Candlemass*: Yet those about *Chepstow* observe the like to happen about the *Beginning of March* and *End of September*, (the one as much before the *Vernal*, as the other is after the *Autumnal Æquinox*, like as in our case it happens) which they call by the Name of *St. David's Stream* and *Michaelmas Stream*; as we do those in *Kent*, *Candlemass Stream*, and *Allballon Stream*: Of these different Seasons at *Chepstow* bridge from those of *Rumney Marsh*, I have already given my remarks. But since it is not yet (it seems) agreed, Whether such an *Annual Phænomenon* happen; or, if so, not at that time; (so that, for ought yet appears, it may be at the Seasons I design, that is, between the *Winter-Solstice* and the two *Æquinoxes* on either side of it, though, on several Coasts, severally Remote,) I think it best to let this part of the *Hypothesis* stand as it is unrevoked, as that which, when it shall be

be discovered, and agreed on, stands ready enough to give a Rational Account of it, and, in the mean time, does no hurt. And in such a Complication of Causes so Abstruse, scarce any thing but *Observation* will determine, which of the Causes, and in what Degree, is to be judged predominant.

VI. The sole Principle upon which Mr. *Newton* proceeds to Explain most of the great and surprizing Appearances of Nature, is no other than that of *Gravity*, whereby in the Earth all Bodies have a *Tendency* towards it's Center; and there is the like *Gravitation* towards the Center of the Sun, Moon, and all the Planets.

Mr. Newton's
Theory of the
Tides Ex-
plain'd; by Mr.
Halley. n. 226.
p. 445.

Now this Force of *Descent* Decreases, as the Square of the *Distance* of the Heavy Body from the Center Increases.

There is also Room to suspect, that the Force of *Gravity* is, in the *Cælestial* Globes, proportional to the *Quantity* of *Matter* in each of them.

From these Principles it is evident, that if the *Earth* were alone, that is to say, not affected by the Actions of the *Sun* and *Moon*, the Ocean being equally pressed by the Force of *Gravity* towards the Center, would continue in a perfect *Stagnation*, always at the same Height, without either *Ebbing* or *Flowing*; But the *Sun* and *Moon* having a like Principle of *Gravitation* towards their Centers, and the *Earth* being within the *Activity* of their *Attractions*, it will plainly follow, that the Equality of the Pressure of *Gravity* towards the Center will thereby be Disturbed; and though the smallness of these Forces, in respect of the *Gravitation* towards the *Earth's* Center, renders them altogether imperceptible by any Experiments we can devise, yet the Ocean being Fluid and yielding to the least Force, by its *Rising* shews where it is less Press'd, and where it is most Press'd by it's *Sinking*.

p. 445.

Now if we suppose the Force of the *Moon's* *Attraction* to Decrease, as the Square of the *Distance* from its Center Increases (as in the *Earth* and other *Cælestial* Bodies) we shall find, that where the *Moon* is perpendicularly either above or below the *Horizon*, either in *Zenith* or *Nadir*, there the Force of *Gravity* is most of all Diminished, and consequently that there the Ocean must necessarily *Swell* by the coming in of the Water from those parts where the pressure is greatest, viz. in those places where the *Moon* is near the *Horizon*. Thus let *M* be the *Moon*, *E* the *Earth*, *C* it's Center, and *Z* the place where the *Moon* is in the *Zenith*, *N* where in the *Nadir*. Then by the *Hypothesis* it is evident, that the Water in *Z*, being nearer, is more Drawn by the *Moon*, than the Center of the *Earth* *C*, and that again more than the Water in *N*, wherefore the Water in *Z*, has a *Tendency* towards the *Moon*, contrary to that of *Gravity*, being equal to the Excess of the *Gravitation* in *Z*, above that in *C*: And in the other Case, the Water in *N*, tending less towards the *Moon* than the Center *C*, will be less Press'd, by as much as is the Difference of the *Gravitations* towards the *Moon* in *C* and *N*. This rightly understood, it follows plainly, that the *Sea*, which otherwise would be *Spherical*, upon the Pressure of the *Moon*, must form it self into a *Spheroidal* or *Oval* Figure, whose longest Diameter is where the *Moon* is *Vertical*, and shortest where she is in the *Horizon*; and that the *Moon* shifting her Position as she turns round the

Fig. 56.

the Earth once a Day, this *Oval* of Water shifts with her, occasioning thereby the *two Floods* and *Ebbs* Observable in each *25 Hours*.

And this may suffice, as to the general Cause of the *Tides*; it remains now to shew how naturally this Motion accounts for all the Particulars that has been Observ'd about them; so that there can be no Room left to doubt, but that this is the True Cause thereof.

The *Spring-Tides* upon the *New* and *Full Moons*, and *Neap-Tides* on the *Quarters*, are occasioned by the attractive Force of the *Sun* in the *New* and *Full*, Conspiring with the Attraction of the *Moon*, and producing a *Tide* by their United Forces: Whereas in the *Quarters*, the *Sun* Raises the Water where the *Moon* Depresses it, and the contrary; so as the *Tides* are made only by the Difference of their Attractions. That the Force of the *Sun* is no greater in this Case, proceeds from the very small Proportion the Semidiameter of the *Earth* bears to the vast Distance of the *Sun*.

It is also Observed, that *cæteris paribus*, the *Æquinoctial Spring-Tides* in *March* and *Sept.* or near them, are the *Highest*, and the *Neap-Tides* the *Lowest*; which proceeds from the greater Agitation of the Waters, when the Fluid *Spheroid* revolves about a *Great Circle* of the *Earth*, than when it turns about in a *Lesser Circle*; it being plain, that if the *Moon* were constituted in the *Pole* and there stood, that the *Spheroid* would have a fixt Position, and that it would be always *High-Water* under the *Poles*, and *Low-Water* every where under the *Æquinoctial*: And therefore the nearer the *Moon* approaches the *Poles*, the less is the Agitation of the Ocean, which is of all the Greatest, when the *Moon* is in the *Æquinoctial*, or farthest distant from the *Poles*. Whence the *Sun* and *Moon*, being either Conjoyned or Opposite in the *Æquinoctial*, produce the greatest *Spring Tides*; and the subsequent *Neap-Tides*, being produced by the *Tropical Moon* in the *Quarters*, are always the least *Tides*; whereas in *June* and *Decem.* the *Spring-Tides* are made by the *Tropical Sun* and *Moon*, and therefore less Vigorous; and the *Neap-Tides* by the *Æquinoctial Moon* which therefore are the Stronger. Hence it happens, that the Difference between the *Spring* and *Neap-Tides* in these Months is much less considerable, than in *March* and *September*. And the Reason why the very *Highest Spring Tides* are found to be rather before the *Vernal* and after the *Autumnal Æquinox*, *viz.* in *Feb.* and *Oct.* than precisely upon them, is, because the *Sun* is nearer the *Earth* in the *Winter Months*, and so comes to have a Greater Effect in producing the *Tides*.

Hitherto we have considered such Affections of the *Tides* as are Universal, without Relation to particular Cases; what follows from the Differing Latitudes of Places, will be easily understood by the following *Figure*.

Fig. 57.

Let *ApEP*, be the *Earth*, cover'd over with very deep Waters; *C*, its Center; *P, p*, its *Poles*; *AE*, the *Æquinoctial*; *Ff*, the *Parallel* of Latitude of a Place; *Dd*, another *Parallel* at equal Distance on the other side of the *Æquinoctial*; *Hh*, the two Points where the *Moon* is *Vertical*; and let *Kk*, be the *Great Circle* wherein the *Moon* appears *Horizontal*. It is evident, that a *Spheroid* described upon *Hh*, and *Kk* shall nearly Represent the Figure of the *Sea*; and *Cf*, *CD*, *CF*, *Cd*, shall be the *Heights* of the *Sea* in the places, *f*, *D*,

D, F, d, in all which it is *High-Water*: And seeing that in 12 Hours time by the *Diurnal* Rotation of the *Earth*, the Point *F*, is transferred to *f*; and *d*, to *D*: The Height of the Sea *C F*, will be that of the *High-Water* when the *Moon* is Present, and *C F*, that of the other *High Water*, when the *Moon* is Under the *Earth*: Which in the Case of this Figure is less than the former *C F*.

And in the Opposite Parallel *D d*, the contrary happens. The *Rising* of the Water being always alternately Greater and Less in each place, when it is produced by the *Moon* Declining sensibly from the *Equinoctial*: that being the greatest of the two *High-Waters* in each *Diurnal* Revolution of the *Moon*, wherein she approaches nearest either to the *Zenith* or *Nadir* of the Place: Whence it is, that the *Moon* in the Northern Signs, in this part of the World, makes the *Greatest Tides* when Above the *Earth*, and in the Southern Signs, when Under the *Earth*; the Effect being always the greatest where the *Moon* is Farthest from the *Horizon*, either Above or Below it. And this alternate Increase and Decrease of the *Tides* has been Observ'd to hold true on the Coast of *England*, at *Bristol* by Capt. *Sturmy*, and at *Plymouth* by Mr. *Coleprests*.

But the Motions hitherto mentioned are somewhat altered by the Libration of the Water, whereby though the Action of the *Luminaries* should cease, the *Flux* and *Reflux* of the Sea would for some time continue. This Conservation of the Impressed Motion diminishes the Differences that otherwise would be between two Consequent *Tides*, and is the Reason why the *Highest Spring Tides* are not precisely on the *New* and *Full Moons*, nor the *Neaps* on the *Quarters*; but generally they are the *Third Tides*, after them, and sometimes later.

All these things would regularly come to pass, if the whole *Earth* were covered with Sea very Deep: but by Reason of the Shoalness of some places, and the Narrowness of the Streights, by which the *Tides* are in many Cases Propagated, there Arises a great diversity in the Effect, and not to be accounted for, without an Exact Knowledge of all the Circumstances of the Places, as of the Position of the Land, and the Breadth and Depth of the Channels by which the *Tide* flows; for a very Slow and Imperceptible Motion of the whole Body of the Water, where it is (for Example) 2 Miles deep, will suffice to Raise its Surface 10 or 12 Feet in a *Tides* time; whereas, if the same Quantity of Water were to be conveyed upon a Channel of 40 Fathoms deep, it would require a very great Stream to effect it, in so large Inlets as are the Channel of *England* and the *German Ocean*; whence the *Tide* is found to set strongest in those places where the Sea grows narrowest; the same Quantity of Water being to pass through a smaller Passage: This is most evident in the Streights, between *Portland* and *Cape de Hague* in *Normandy*, where the *Tide* runs like a Sluce; and would be yet more between *Dover* and *Calis*, if the *Tide* coming about the Island from the North did not Check it. And this Force being once Impressed upon the Water, continues to carry it above the *Level* of the ordinary Height in the *Ocean*, particularly where the Water meets a Direct Obstacle, as it is at *St. Malo's*; and where it enters into a long Channel, which running far
into

into the Land, grows very streight at its Extremity, as it is in the *Severn Sea* at *Chepstow* and *Bristol*.

This Shoalness of the Sea, and the Intercurrent Continents are the Reason, that in the Open *Ocean* the time of *High Water* is not at the *Moon's* Appulse to the Meridian, but always some Hours after it ; as it is observed upon all the *West Coast* of *Europe* and *Africa*, from *Ireland* to the *Cape of Good Hope* : In all which, a *S.W.* Moon makes *High Water*, and the same is reported to be on the *West side* of *America*. But it would be endless to account all the particular Situations, which are easie *Corollaries* of this *Hypothesis* ; as why the *Lakes*, such as the *Caspian Sea*, and *Mediterranean Seas*, such as the *Black Sea*, the *Streights*, and *Baltick*, have no sensible *Tides* : For *Lakes* having no communication with the *Ocean*, can neither Increase or Diminish their Water, whereby to Rise and Fall ; and *Seas* that communicate by such Narrow Inlets, and are of so immense an extent, cannot in a few Hours time receive or empty Water enough to Raise or Sink their Surface any thing sensibly.

Vid. inf.
§. XI.

Lastly, The Cause of those *Extraordinary Tides* in the Port of *Tunkin* in *China*, is proposed by Mr. *Newton* to be from the Concurrence of Two *Tides* ; the one propagated in six Hours, out of the great *South-Sea*, along the Coast of *China* ; the other out of the *Indian Sea*, from between the Islands in 12 Hours, along the Coast of *Malacca* and *Cambodia*. The one of these *Tides* being produced in North Latitude, is, as has been said, Greater, when the *Moon* being to the North of the *Aequator*, is above the Earth, and less when she is under the *Earth* ; the other of them, which is propagated from the *Indian Sea*, being raised in South Latitude, is greater when the *Moon*, declining to the South, is above the *Earth*, and less when she is under the *Earth*. So that of these *Tides* alternately Greater and Lesser, there comes always successively two of the Greater, and two of the Lesser together every Day ; and the *High Water* falls always between the times of the arrival of the two greater Floods ; and the *Low Water* between the Arrival of the two lesser Floods. And the *Moon* coming to the *Aequinoctial*, and the alternate Floods becoming Equal, the *Tide* Ceases, and the Water Stagnates : But when she has passed to the other side of the *Aequator*, those Floods which in the former Order were the Least, now becoming the Greatest, that that before was the time of *High Water* now becomes the *Low Water*, and the *Converse*. So that the whole Appearance of these *strange Tides*, is without any forcing Naturally deduced from these Principles.

Under Currents in the Dawns, at the Streights-Mouth, and in the Baltick ; by Dr. Tho. Smith. n. 158. p. 564.

VII. 1. In the Offing between the *Northforeland* and *Southforeland*, it run *Tide* and *Half Tide*, that is, it is either Ebbing Water or Flood upon the *Shore*, in that part of the *Downs*, three Hours, (which is, grossly speaking, the time of *half a Tide*) before it is so off at Sea. And it is a most certain Observation, that where it flows *Tide* and *half Tide*, tho' the *Tide* of Flood runs aloft, yet the *Tide* of Ebb runs *under-Foot*, that is, close by the Ground ; and so at the *Tide* of Ebb, it will flow *under Foot*.

There is a vast Draught of Water poured continually out of the *Atlantick* into the *Mediterranean*, the Mouth or entrance of which between *Cape Spartel*

or

or *Sprat*, as the Sea-men call it, and *Cape Trafalgar*, may be near 7 Leagues wide, the *Current* setting strong into it, and not losing its force till it runs as far as *Malaga*, which is about 20 Leagues within the *Streights*. By the benefit of this *Current*, tho' the Wind be contrary, if it does not overflow, Ships easily turn into the *Gutt*, as they term the Narrow Passage, which is about 20 Miles in length. At the end of which are two Towns, *Gibraltar* on the Coast of *Spain*, which gives denomination to the *Streights*, and *Ceuta* on the *Barbary Coast*: At which places *Hercules* is supposed to have set up his *Pillars*. What becomes of this great quantity of Water poured in this way, and of that, which runs from the *Euxine* into the *Bosphorus* and *Propontis*, and is carried at last through the *Hellespont* into the *Ægean* or *Archipelago*, is a curious Speculation, and has exercised the Wit and Understanding of Philosophers and Navigators. For there is no sensible Rising of the Water all along the *Barbary Coast* even down to *Alexandria*, the Land beyond *Tripoli*, and that of *Egypt* lying very low, and easily overflowable. They observe indeed that the Water rises 3 Feet, or 3 Feet and half, in the *Gulf of Venice*, and as much, or very near as much, all along the *Riviera of Genoua*, as far as the River *Arno*: But this rather adds to the Wonder.

My Conjecture is, that there is an *Under-Current*, whereby as great a quantity of Water is carried out, as comes flowing in. To confirm which, besides what I have said above about the difference of Tides in the *Offing*, and at the *Shore* in the *Downs*, which necessarily supposes an *Under-Current*, I shall present you with an Instance of the like Nature in the *Baltick Sound*, as I received it from an able Sea-man, who was at the making of the Trial.

3. He told me, that being there in one of the *King's Frigats*, they went with their Pinnace into the middle Stream, and were carried violently by the *Current*: That soon after they sunk a Bucket with a large Cannon Bullet to a certain depth of Water, which gave check to the Boat's Motion; and sinking it still lower and lower, the Boat was driven a Head to the Windward against the upper *Current*; the *Current aloft*, as he added, not being above 4 or 5 Fathom deep, and that the lower the Bucket was let fall, they found the *Under Current* the stronger.

VIII. The *Euripus* is a Streight of the *Ægean Sea*, so narrow that a Galley can scarce pass through it under a Bridge, built between the *Cittadel* and the *Donjon* of *Negropont*. But not only this place, where the Bridge is, is call'd the *Euripus*, but also 10 or 12 Leagues on each side of it, where the Channel being more large, the inconstant Course is not so sensible, as at the Foot of the *Castle*. For 3 or 4 Leagues on each side there are found 6 or 7 Gulfs, wherein this Water shuts it self up, to issue from thence as often as it enters there; and the Situation of these Gulfs contributes to the oddness of this *Flux and Reflux*; of which the *Moon* seems to be the Principal Cause.

There are 20 Days of each *Moon* in which the Course of the *Euripus* is *Regular*, and 10 in which it is *Irregular*; that is to say, 5 Days before and 5 Days after the *New and Full Moon*, the Course of it is *Regular* and Strong; And then you see there the like Phænomena with those of the *Ocean* at *Bour-*

The Irregular Flux and Reflux of the Euripus, by F. Jacq. Paul. Babin. n. 71. p. 2153.

deaux. The Sea hath 2 *Fluxes* and *Refluxes* in 24 Hours, and every Day it Retardeth almost an Hour. But there are 9 or 10 *Changes* of the Course of the Water during the remaining 10 Days of *Inequality*; unless it blow hard, for then the Course changeth not above 6 or 7 times. I once stay'd on the Mill (which is under the Bridge) $1\frac{1}{2}$ Hour, and I saw the Course of the Water *Change Thrice*, though the Wind was pretty High; and the Wheels of the Mill turned as often diverse ways. *M. de la Hogue*, a *Parisian Gentleman*, being curious, stayed there almost a whole Day with a *Janissary*; and the *Moon* being near the *Full*, he observed the same thing that happens in the *Ocean*. But though he designed to stay there full 24 Hours during the *Irregular Days*, he was dissuaded from it for fear of the *Turks*, that might take him for a *Spy*, and do him some mischief.

The Water Riseth not much above a Foot; and when it Riseth it Runs into the Sea, and when it Sinks, it flows into the Channel going towards *Constantinople*.

The small *Gulfs*, that are on the left side of the Port of *Negropont*, are fill'd when the Water Riseth; and Emptied, running towards *Theffalonica* or *Constantinople*, when it Descends. *F. Vabois* took notice of the same at *Constantinople*, viz. That the Waters of the *Black Sea*, that come from *Constantinople*, drive the *Euripus* in its Rising towards the *Main Sea*, and that thereafter the Waters retire themselves towards the same place again from whence they came. The same Person also observed, That that swelling of the *Euripus* which is *Irregular*, lasted not above a good quarter of an Hour, and the Sinking thereof, three good Quarters, tho' then the Water ran with more rapidity, and seem'd to us to come away in thrice as great plenty, than when he saw it rise. I know not whether this proceeded from the Wind, not being able to assure you, that this effect is ordinary.

Between the Ascent and Descent there is a little Interval, wherein the Water seems to be at Rest and Stagnating, so that if there be no Wind stirring it, bits of Wood and Straw lie still upon the Water without Motion.

From what I have said, 'tis not difficult to reconcile the Authors that have written so differently of the *Euripus*. For those that have said, that there is nothing in it but what is seen in the *Ocean*, that is, two *Fluxes* and *Refluxes* in 24 Hours, have only observed it in those 20 Days of its *Regularity*. And the Ancients have not delivered a falshood, when they say that there are 7 *Reciprocations* in one Day, because that happens when the Winds trouble and retard the Course of the Water: And I do assure, by often reiterated Observations, that when 'tis still Weather, the *Flux* and *Reflux* is made even to 9 or 10 times in a Natural Day.

Extraordinary
Tides about the
Orkney's; Com-
municated by
Sir Rob. Moray.
p. 98. p. 6139.

IX. In *Fairay-Sound* (betwixt the Isles of *Fairay* and *Aetha* in *Orkney*) the Sea runneth North East, for the space only of 3 Hours in *Flowing*, and 9 Hours South West in *Ebbing*. This is the Course of the *Tide* only in the middle of the *Sound*, which is but one Mile broad.

Whilst the Sea runneth from West to East in *Flowing* through *Westra Firth* (which is 8 Miles in breadth) there are no greater *Surges*, than in any other place

place of the Sea; and in a Calm Day it is as smooth as any Lake, though there is constantly a great *Current*, in the *Flux* and *Reflux* of the Sea. Yet at the South East End of a little Island, on the S. E. side of *Westra*, and about a Mile from it, the Sea no sooner begins to run Westward in *Ebbing*, but there beginneth a *Surge* to appear, which continually Encreaseth until the *Ebb* be half spent, and afterwards it decreaseth until it be *Low Water*; at which time there appeareth no such thing. East and West from this *great Surge*, there are some few *lesser Surges* seen, which are *gradually less* toward the East and West. I having occasion to pass that way, in a little Boat, when we had passed over the *Eastmost Surges*, and were beginning to ascend the biggest, upon the 10th of *April*, at one of the Clock in the Afternoon, the *Surge* before us was so high, that it intercepted the sight of the Sun, and some *deg.* of the Firmament above it. The *Surge* is about a quarter of a Mile in length. When there is any Wind, which occasioneth the Breaking of the Tops of the *Surges*, there is no passing that way. The *Current* of the *Tide* is so strong there, that there is no need of Sails or Oars, save only to direct the Boat as doth the Helm.

X. In that Tract of Isles, on the *West* of *Scotland*, called by the Inhabitants the *Long-Island*, as being about 100 Miles long from North to South, there is a multitude of small Islands, situated in a Fretum or *Firth*, that passes between the Island of *Eust* and the *Herris*; amongst which there is one called *Berneray*, some three Miles long and more than a Mile broad, the length running from East to West, as the *Firth* lies. At the East end of this Island, where I staid some 16 or 17 Days, I observed a very strange Reciprocation of the *Flux* and *Reflux* of the Sea, and heard of another no less remarkable.

*Extraordinary
Tides in the
West Isles of
Scotland; by Sir
Rob. Moray.
n. 4. P 53.*

Upon the West side of the *Long Island*, the *Tides* which came from the South West, run along the Coast Northward; so that during the *ordinary Course* of the *Tides*, the *Flood* runs East in the *Firth*, where *Berneray* lies, and the *Ebb* West. And thus the Sea *Ebbs* and *Flows* orderly, some 4 Days before the *Full Moon*, and *Change*, and as long after (the *ordinary Spring Tides* Rising some 14 or 15 Foot upright, and all the rest proportionably, as in other places) But afterwards, some four Days before the *Quarter Moons*, and as long after, there is constantly a great and singular *Variation*. For then, (a *Southerly Moon* making there the *Full Sea*) the Course of the *Tide* being Eastward when it begins to *flow*, which is about $9\frac{1}{2}$ of the Clock, not only continues so till about $3\frac{1}{2}$ in the Afternoon, that it be *High-water*, but after it begins to *Ebb*, the *Current* Runs on still *Eastward*, during the whole *Ebb*; so that it runs *Eastward* 12 Hours together, that is, all Day long, from about $9\frac{1}{2}$ in the Morning, till about $9\frac{1}{2}$ at Night. But then, when the *Night Tide* begins to *Flow*, the *Current* Turns and runs *Westward* all Night, during both *Flood* and *Ebb*, for some 12 Hours more, as it did Eastward the Day before. And thus the *Reciprocations* continue, one *Flood* and *Ebb*, running 12 Hours *Eastward*, and other 12 Hours *Westward*, till four Days before the *New* and *Full Moon*; and then they resume their ordinary *Regular Course* as before, Running East, during the 6 Hours of *Flood*; and West, during the 6 of *Ebb*. And this I ob-

served curiously, during my abode upon the place, which was in the Month of *August*, as I remember.

But the Gentleman, to whom the Island belongs at present, and diverse of his Brothers and Friends, knowing and discreet Persons; and expert in all such parts of Sea-matters, did assure me, that whereas between the *Vernal* and *Autumnal Equinoxes*, that is, for 6 Months together, the Course of *Irregular Tides* about the *Quarter Moons*, is to run all Day, that is 12 Hours, as from about $9\frac{1}{2}$ to $9\frac{1}{2}$, $10\frac{1}{4}$ to $10\frac{1}{4}$, &c. *Eastward*, and all Night, that is 12 hours more, *Westward*; during the other 6 Months, from the *Autumnal* to the *Vernal Equinox*, the *Current* runs all Day *Westward*, and all night *Eastward*.

At Tunqueen;
by Mr. Fr. Dav-
enport. n. 162.
p. 677.

XI. 1. During my stay at *Batsha* having (without intermission) Observ'd the *Daily Course* of the *Tides*, my Advice is, that upon the several following days of the *Moon's Age* in every particular Month of the Year, no *English* Commander should upon any occasion whatsoever adventure over this *Bar*, unless he have a *Pilot* from the Shoar, who undertakes to bring him in; or that he hath only charge of some small Bark or Junk, that draws no more than 8 or 9 foot Water.

In the $\left. \begin{matrix} 1 \\ 7 \end{matrix} \right\}$ *Moons*, from the $\left\{ \begin{matrix} 3 \\ 17 \end{matrix} \right.$ to the $\left. \begin{matrix} 7 \\ 21 \end{matrix} \right\}$ days of the *Moon's Age* Exclusively.

In the $\left. \begin{matrix} 2 \\ 8 \end{matrix} \right\}$ *Moons*, from the $\left\{ \begin{matrix} 1 \\ 14 \end{matrix} \right.$ to the $\left. \begin{matrix} 5 \\ 18 \end{matrix} \right\}$ days of the *Moon's age* Exclusively,

and from the 27 to the 1st of the $\left. \begin{matrix} 3 \\ 9 \end{matrix} \right\}$ *Moon's* Exclusively.

In the $\left. \begin{matrix} 3 \\ 9 \end{matrix} \right\}$ *Moons*, from the $\left\{ \begin{matrix} 11 \\ 25 \end{matrix} \right.$ to the $\left. \begin{matrix} 15 \\ 29 \end{matrix} \right\}$ days of the *Moon's Age* Exclusively.

In the $\left. \begin{matrix} 4 \\ 10 \end{matrix} \right\}$ *Moons*, from the $\left\{ \begin{matrix} 9 \\ 23 \end{matrix} \right.$ to the $\left. \begin{matrix} 13 \\ 27 \end{matrix} \right\}$ days of the *Moon's Age* Exclusively.

In the $\left. \begin{matrix} 5 \\ 11 \end{matrix} \right\}$ *Moons*, from the $\left\{ \begin{matrix} 7 \\ 21 \end{matrix} \right.$ to the $\left. \begin{matrix} 11 \\ 25 \end{matrix} \right\}$ days of the *Moon's Age* Exclusively.

In the $\left. \begin{matrix} 6 \\ 12 \end{matrix} \right\}$ *Moons*, from the $\left\{ \begin{matrix} 5 \\ 19 \end{matrix} \right.$ to the $\left. \begin{matrix} 9 \\ 23 \end{matrix} \right\}$ days of the *Moon's Age* Exclusively.

And excepting on these 6 days above mentioned in every respective *Moon*, he may safely adventure over the *Bar* any day, provided always that he mistake not the time of the *Tide*, but come over at *Half Flood* or better, though he may take notice that the best *Tides* will be about 6 or 7 days after the Water's first beginning to *Increase*, and the First days of the Water's *Increase* are,

In the	$\left. \begin{matrix} 1 \\ 7 \end{matrix} \right\}$	Moons,	on the	$\left. \begin{matrix} 5 \\ 19 \end{matrix} \right\}$	days	} of the Moon's Age.
In the	$\left. \begin{matrix} 2 \\ 8 \end{matrix} \right\}$	Moons,	on the	$\left. \begin{matrix} 3 \\ 16 \end{matrix} \right\}$	days	
In the	$\left. \begin{matrix} 3 \\ 9 \end{matrix} \right\}$	Moons,	on the	$\left. \begin{matrix} 13 \\ 27 \end{matrix} \right\}$	days	
In the	$\left. \begin{matrix} 4 \\ 10 \end{matrix} \right\}$	Moons,	on the	$\left. \begin{matrix} 11 \\ 25 \end{matrix} \right\}$	days	
In the	$\left. \begin{matrix} 5 \\ 11 \end{matrix} \right\}$	Moons,	on the	$\left. \begin{matrix} 9 \\ 23 \end{matrix} \right\}$	days	
In the	$\left. \begin{matrix} 6 \\ 12 \end{matrix} \right\}$	Moons,	on the	$\left. \begin{matrix} 7 \\ 21 \end{matrix} \right\}$	days	

The *Bar* it self being about a mile and a half in Length, and no where, except in it's first entrance, exceeding half a mile in Breadth, is very even, but yet affords considerably differing *Soundings* in the same Age and Time of the *Tides*, according to the season of the Year, and, which seems to be somewhat strange, hath the *Highest Tides* in the *Northerly Monsoon*, as I have been informed by those who are seemingly best able to give an account thereof; and I must needs say, that the Trial I made on the *Bar* in *July 1678* did accord with what I understood from several of the Fisher men, and others as to that *Month*, which induced me to enter this Information, that coming over at *half Flood* (except on the days aforementioned as Dangerous to come over in) there will be found according to the Age of the *Tides*,

In the	$\left. \begin{matrix} 3 \\ 4 \end{matrix} \right\}$	Moons,	from 16 to 21 feet Water.
	$\left. \begin{matrix} 5 \\ 6 \end{matrix} \right\}$		
In the	$\left. \begin{matrix} 7 \\ 8 \end{matrix} \right\}$	Moons,	from 19 to 24 feet.
	$\left. \begin{matrix} 9 \\ 10 \end{matrix} \right\}$		
In the	$\left. \begin{matrix} 11 \\ 12 \end{matrix} \right\}$	Moons,	from 21 to 27 feet;
	$\left. \begin{matrix} 1 \\ 2 \end{matrix} \right\}$		
In the	$\left. \begin{matrix} 1 \\ 2 \end{matrix} \right\}$	Moons,	from 17 to 22 feet.

Always the *Higher* the *Flood* the *Lower* the *Ebb*, so that according to the Strength of the *Tides* at *Low-Water* the *Soundings* are from 6 to 13 feet.

On the *first* and *second* days of the *Water's Increase* the *Influxes* are very small and uncertain, but afterwards the *Tides* for 13 days are Constant in their Course, one *Flood* and one *Ebbing* being compleated in 24 hours time, equally sharing the space of a *Lunar Circuition* of the Earth between them, and every *Flood* beginning nearest $\frac{1}{2}$ of an hour later than the *Precedent Flood*, and also

also considerably Increasing in the Height of the *Tide* every day from the *Third* unto the *6th* and *7th* days of the *Waters Age*, on which two days the *Flood* runs very High: But on the *8th* day (which may be accounted the last of the *Spring Tides*) the *Waters* begin gradually to *Decrease* again, retaining the same orderly difference of time in each *Tide*, until the next following *First* day of the *Water's Increase*, when during two days unsettledness, there is a *Shifting* of the *Tides* in respect of the beginning of the *Flood* and *Ebb*, after which said *Shifting*, a *Constancy* in their *Inverted Course*, is again retained in the above mentioned order for 13 days following; as for Example,

On the 25 and 26 days of the 4th *Moon* (4th and 5th of *June* 1678, Δ in the latter end of *Aries*) being the *First* days of the *Waters Increase*, the *Influxes* were very small, (there happening on the 26 a falling back of the *Tides* about 13 hours): But from the 27th (*June* 6. which was the *Third* day of the *Water's Increase* after the *Last Quarter*, unto the 9 day of the 5th *Moon's Age* (*June* 18. 1678. Δ in ≈ 20 .) I noted a very *Constant Course* in the *Tides*, every *Flood* Beginning with the *Rising* of the *Moon* and Ending at its *Setting* the following *Ebb* in like manner continuing during the time of the *Moon's* Absence from this *Hemisphere*. But on the said 9th day of the 5th *Moon's Age* (*June* 18. 1678) being the *First* day of the *Water's Increase*, their motion was scarcely perceptible; on the 10 day there was another falling back of the *Tides* nearest 13 hours, and on the 11th day, (which was the 3d day of the *Water's Increase*, after the *First Quarter* of the *Moon's Age*) the *Flood* having as I said) shifted the preceeding day, took its turn to Begin at the *Moon's Setting* and End at its *Rising*, and accordingly the *Tides* successively following assumed and kept a constant *Regularity*, the *Tides* being at *Highest* the 16th of the *Moon*, (1678. *June* 24. \odot in middle of Ψ) which was the 7th of the *Water's Age*, until the 23 of the said *Moon's Age* (*July* 1. 1678.) on which (being the *First* day of the *Water's Increase*) the *Influx* was again scarcely discernable for its smallness.

N. B. This *Bar of Tunking* is about 110 Deg. of *Longitude* to the East of *London*, and in the *Lat.* 20°. 50'.

On the 24th Day the *Tides* fall back (as I had found it twice before to have done on the same days of the *Water's Age*,) nearest 13 hours, by which means the *Flood* on the 25th day (which was the 3d day of the *Water's Increase* after the *Last Quarter* of the *Moon*) now again commenced with the *Rising Moon*, whereby it hath fallen out always to be *High Water* between Noon and the following *Midnight* every day during my stay here. (\odot *Last Quarter* 22 days, \odot *First Quarter* 8 days)

So that it may pass into a *Corollary*, viz. In the 4th 5th and 6th *Changes* of the *Moon* from the 3d day of the *Water's Age* after the *Last Quarter*, to the 3d day of the *Water's Age* after the *First Quarter* of the following *Moon*, the *Water* begins to *Flow* when the *Moon Riseth*, and to *Ebb* again when it *Setteth* in the *Horizon*, and the contrary to the third day of their *Age* after the *Last Quarter*, excluding always their *Motion* on the two *First* days of the *Waters Increase*, because of its smallness and *Uncertainty*.

I am informed by the Inhabitants hereabouts, that this may hold for a Rule from the 2^d to the end of the 7th Moon, and that the Converse thereof holds true in the other 6 Months of the Year, viz. from the 8th to the end of the First Moon: According to which the Tides will fall out to be at the Highest in the Evening for 6 Months successively, and the other half Year in the Morning; that is to say between Midnight and the following Noons. And though I cannot aver the truth of it, yet I find that the Tide last Year in the 11th Moon, which occasionally upon the Ship *Eagle's* departure hence I took some notice of, did fall out not disagreeing with what they affirm: And I am yet the rather induced to believe that in every Annual Revolution, there may be such a constancy in this different motion of the Tide appropriated to each Moiety of the Year, because that during my ——— days stay at *Batsha*, I have found the Predictions of the Natives Confirmed by my own Observations of the Tides falling out to be High Water always between Noon and the succeeding Midnight, occasioned by the aforesaid Falling-back at the end of 15 days; so that on every Third day of the Water's Increase, the Flood Begins at the hour whereon the day before it Ended.

To prevent mistakes in the accompt of the Moons, it may be sufficient to inform those who use this Port, that the First Change of the Moon after the 15th day of *January Old stile*, is reckoned for the Beginning of the Year, and that Moon being accompted the First, the rest follow in order until the Expiration of the 12th which compleats their Year, except only in their Leap Years, and then they have 13 Moons, taking in one extraordinary to make up the deficiency of the Moon's Epact in their accompt, in which Years the First day of their New Years Moon falls out before the said 15 day of *January*, as it did this Year 1678 upon the 12 being Leap Year with them; so that they reckoned Two Months for One this Year, (that is to say the 2^d and 3^d Moons, after their New Years Day) they called 2^d Moons, for otherways this present Moon which Changed in *July* (the 8th) would have been the 7th, whereas now they Count it but the 6th Moon, and accordingly do the Tides fall out. But this Leap Year being past, the First Moon in the Year must be reckoned to begin on the Change next following the 15th of *January*, and all the other Changes counted successively as before said until the Intervention of another Leap-Year.

2. The Effect of the Moon upon the Waters, in the production of the Tides in this Port of *Tunking*, is the more wonderful and surprising, in that it seems different in all its circumstances from the General Rule, whereby the Motion of the Sea is regulated in all other parts of the World I have yet heard of. For first, each Flux is of about 12 hours Duration, and its correspondent Reflux, as long; so that there is but one High Water in 24 hours. Then there are in each Month, two Intermissions of the Tides, about 14 days asunder, when there is no sensible Flood or Rising of the Waters to be observed; but the Sea is in a manner Stagnant. Thirdly, that the Increase of the Water has its 14 days Period, between the aforesaid Intermissions: And that at 7 days end makes the Highest Tides, from which time the Water again gradually Abates, and the Flood is Weaker till it comes to a Stagnation; both Increase and Decrease observing

A Theory of the Tides at Ton-queen; by Mr. Edm. Halley. ib. p. 685.

ving the same Rule, in being exceeding Slow in their Beginning and End, and Swift in the Middle. Lastly, (and which is most Odd) the *Rising Moon* in the one half of each Month, makes *High Water*, and the *Setting Moon* in the other half. Those particulars consider'd together with the *Tables*, shewing the Days of the *Water's stagnation* in each *Month*, gave me a Light into the Secret of this strange Appearance, so as to be able to bring the hitherto Unaccountable Irregularity of these *Tides* to a Certain Rule.

And First it appears by the Latter of the two *Tables*, that the *Intermissions* of the *Tides* happen nearly upon those Days, that the *Moon* enters the Signs of *Aries* and *Libra*; or passes the *Equinoctial*; which divides the *Moon's* Course nearly into two equal parts, as well as the *Sun's*, and from hence it follows that the *Tropical Moons* in \odot and \oslash , are those which occasion the Greatest *Flux* and *Reflux*; and for the Rule of the Change of the Time of *High Water*, which Mr. *Darvenport* calls a *Falling Back* of the *Tides*, the Example he hath given us, let us know that the \cap in *Northern Signs* brings in the *Flood*, whilst she is above the *Horizon*, so as to make *High Water* at her *Setting*; and on the contrary, that whilst she is in *Southern Signs*, it flows all the Time the *Moon* is below the *Horizon*, and so make *High Water* at her *Rising*. But it is to be observed that though the *Moon* pass swiftly from *South* to *North*, when she is in or near \vee , and from *North* to *South* in or near *Libra*, yet the Motion of the *Sea* which is the Cause of this *Tide*, is scarce discernable for 3 or 4 Days, when the *Moon* passes the said *Equinoctial Points*; whence it appears that though the *Declination* of \cap , or her distance from the *Equinoctial*, be that whereby these *Tides* are Regulated, yet the *Increase* and *Decrease* of the *Water* is by no means proportionable to that of the *Declination* of \cap ; that changing swiftly where the *Increase* of the *Water* is observed to be most slow. It seems therefore, and I propose it as a probable Conjecture, that the *Increase* of the *Waters* should be always proportionate to the *Versed Sines* of the double Distances of the *Moon* from the *Equinoctial Points*; Upon which *Hypothesis*, *Fig. 58.* will give an elegant Synopsis of the whole Matter. Let *AB*, be the bottom of the *Bar* of *Tunking*; *CD*, a perpendicular thereto, whereon to measure the several *Depths* of the *Water*; *CV*, *C \simeq* , the mean *Depth*, which is that whereat the *Water* is stagnant upon the *Moon's* being upon the *Equinoctial Points*; being commonly about 15 Feet: *C \odot* *Occid.* the *High Water Mark*, when the *Moon* is in \odot or \oslash , being about 24 Foot. *C \oslash* , *occid.* the Height of the *Low Water Mark* when the *Moon* is in \odot or \oslash , being about 6 Foot; so that the greatest Rise of the *Water* on the *Tropical Moons* will be about 18 Foot; then dividing *V \odot* , and *\simeq \oslash* , into two equal parts in *E*, *F*, on those two points, as Centers, describe the two Circles, each of whose Radii are four Feet and a half, which being kept between the Compasses, naturally divide the said Circles in the Points γ , π , δ , ρ , &c. through the which Points if you draw Lines parallel to the Base *AB*, they shall cut the Perpendicular *CD*, in the Heights of the *High* and *Low Water Marks*, which will be at the entrance of the *Moon* into the said Signs. So the greatest *Depth* of the *High Water*, when the *Moon* enters γ , π , ρ , κ , is but $17\frac{1}{4}$ Feet, and the least at *Low Water* $12\frac{3}{4}$ Feet: But when she enters π , δ , τ , ω , the *High*

Water depth is $21\frac{3}{4}$ Feet, the *Low Water* is $8\frac{1}{4}$ Feet; as appears by the *Figure*. And this *Hypothesis* not only agrees with all that *Mr. Davenport* hath observed himself, or collected from the *Natives*, but hath been found to hold true since in the Year 1682, by the Ingenious Captain *Knox*, in his Voyage to this *Port*; so that there is no room to doubt of the Truth thereof. 1. By this Method may the *Time* and *Height* of the *Tides* be with sufficient Certainty computed: But to Philosophize thereon, and to attempt to assign a Reason, why the *Moon* should in so particular a manner Influence the Waters in this One Place, is a Task too hard for my undertaking, especially when I consider how little we have been able to establish a Genuine and Satisfactory *Theory* of the *Tides*, found upon our own *Coasts*, of which we have had so long Experience.

XII. *Mr. Boyle* having recommended this matter, among others, to a learned Physitian that was sailing into *America*, and furnished him with a small *Hydrostatical Instrument*, to observe from time to time the differences of *Gravity* he might meet with, This Account was returned him, that he found by the *Glass*, the *Sea-water* to Increase in Weight the nearer he came to the *Line*, till he arrived at a certain *Degree of Latitude*; as he remembers, it was about the 30th, after which the Water seemed to retain the same *specifick Gravity*, till he came to the *Barbadoes*, or *Jamaica*.

The differing Gravities of Sea-water according to the Climates, by ----- n. 18. p. 315.

XIII. *M. Hauton* hath now declared his Secret of making *Sea-Water sweet*. It consists first in *Precipitation* made with the *Oil of Tartar*, which he knows to draw with small Charges. Next, he *Distills* the *Sea Water*; in which the Furnace taketh up but little room, and is so made, that with a very little Wood or Coal he can *Distill* 24 (*French*) *Pots* of Water in a Day; for the Cooling of which he hath this new *Invention*, that instead of making the *Worm* pass through a Vessel full of Water (as is the ordinary Practice) he maketh it pass through one Hole, made on purpose out of the Ship, and to enter in again through another: So that the Water of the Sea performeth the *Cooling* part; by which means he saveth the Room, which the common *Refrigerium* would take up; as also the Labour of Changing the Water when the *Worm* hath Heated it. But then *Thirdly*, he joins to the two precedent Operations *Filtration*, thereby perfectly to Correct the Malignity of the Water. This *Filtration* is made by means of a peculiar Earth, which he mixeth and stirs with the *Distilled Water*, and at length suffers to settle at the bottom.

A way to make Sea-Water sweet; by M. Hauton. n. 67. p. 2048, 2050.

He maintains, that his *Distilled Sea-water* is altogether salubrious. He proveth it first from Experience, it having been given to Men and Beasts, without any ill effect at all upon them. Secondly, From Reason, grounded on this, that that peculiar Earth being mixed with the *Distill'd Water*, blunts the Points of the *Volatile Spirits* of the *Salt*, and serveth them for Sheaths, if I may so speak, taking away their force and *Maligne sharpness*.

XIV. It seems Probable to me, that the *Sea-water* was the only Element Created at the *Beginning*, before any *Animal* or *Vegetable* was Created, or the *Sun* it self. But upon the Creation of these, the *Fresh Water* had its Rise Accidentally

Sea Water made Fresh; by Dr. Marr. Lister. n. 156. p. 493. De Font. Med. Angl.

dentally, because it owes its being in great part (as I have elsewhere shewn) to the *Vapours* of *Plants*, and the *Breath* of *Animals*; and the *Exhalations* raised by the *Sun*. Now that the *Sea-Water* is made *Fresh* by the *Breath* of *Plants* growing in it, I thus demonstrated: I took a long *Glass Body*, and having fill'd it pretty full with *Sea Water*, taken up at *Scarborough*, I put therein common *Sea Weed* (*Alga Marina*) fresh and new gathered, some with the *Roots* Naked, and some growing on and adhering to *Stones*: The *Glass Body* being full, I put thereon a *Head* with a *Beck*, and adapted a *Receiver* thereto, all without any *Lute* or closing the *Joints*; from these *Plants* did *distil* daily (though in a small *Quantity*) a *Fresh*, very *Sweet*, and *Potable Water*, which hath no *Empyreuma*, or unpleasant *Tast*, as all those *Distill'd* by *Fire* necessarily have

This I take to be the most *Natural*, most *Easie*, and most *safe* way of having *sweet Water* from the *Sea*, and which may be of great *Use*, even to supply the *Necessity* of *Navigators*. And I do not doubt but there may be found other *Plants* growing in or near the *Sea*, which would yield *Fresh Water* in much greater *Quantities*.

Wells of Fresh Water near the Sea at Bermudas; by Mr. Rich. Norwood. n. 30. p. 566.

XV. We digg *Wells* of *Fresh Water* sometimes within 20 *Yards* of the *Sea*, or less, which *Rise* and *Fall* upon the *Flood* and *Ebb*, as the *Sea* doth; and so do most of the *Wells* in the *Country*, though further up (as I am inform'd): Wheresoever they digg *Wells* here, they dig till they come almost to a *Level* with the *Superficies* of the *Sea*, and then they find either *Fresh Water* or *Salt*. If it be *Fresh*, yet if they dig two or three *Foot* deeper, or often less, they come to *Salt Water*. If it be a *Sandy Ground*, or a *Sandy Crumbling Stone*, that the *Water* soaks gently through, they find usually *Fresh Water*; but if they be hard *Limestone* *Rocks*, which the *Water* cannot *soak* through, but passeth in *Chinks* or *Clefts* between them, the *Water* is *Salt* or *Brackish*.

To Examine the Freshness of Water; by Mr. Boyle. n. 197. p. 627.

XVI. I When I remembred and consider'd, that (as I have found by various *Trials*) diverse *Metalline*, and other *Mineral Solutions*, could be readily *Precipitated*, not only by the *Spirit* of *Salt*, but by *Crude Salt*, whether *Dry* or *Dissolved* in *Water*, 'twas no very difficult *Matter* for me to think, that by a heedful application of the *Precipitating* *Quality* of *Common Salt*, one might discover whether any *Particles* of it, (at least in a number any way considerable) lay concealed in *Distill'd Water*, or any other propos'd to be *Examin'd*. To this End I employ'd several *Drugs*, and those not all prepar'd by one *Menstruum*. And tho' two or three of my other *Trials* had *Successes*, that I disliked not when I made them, yet that which at length I pitched upon as the most certain and which therefore I meant, when I had the *Honour* to be sent for by his *Majesty* about the *Patentees Water*, was that which I think may be best understood, as well as recommended, by this short *Narrative*.

I took some *Common Water* *Distill'd* in *Glass Vessels*, that it might leave its *Corporeal Salt*, if it had any, behind it, and put into a *Thousand Grains* of it one *Grain* of *Common Dry Salt*: Into a convenient *Quantity*, for Example, two or three *Spoonfuls*, of this thus *Impregnated Liquor*, I let fall a fit proportion, for Instance 4 or 5 *drops* of a very strong and well *Filtrated Solution* of

well

well-refined *Silver*, Dissolved in clean *Aqua Fortis*; [for a Shift, common or *Sterling Silver* will serve the turn:] And I made the Experiment succeed with *Spirit of Nitre*, instead of *Aqua Fortis*; upon which there immediately appeared a *Whitish Cloud*, which, though but slowly, Descended to the bottom, and settled there in a *White Precipitate*. And to make the Experiment rather severely, than at all favourably, there was usually taken somewhat more than a *thousand parts* of *Water* to one of *Salt*.

But I Observed, that having let fall a *few Drops* of our *Metalline Solution*, into the *Liquor* obtain'd from *Sea Water* by the *Patentees* way of *Sweetning* it, there did not presently ensue any white *Cloud* or *Precipitate*, much less such an one as had been newly afforded by the *Water* that was *Impregnated* with less than a *thousandth* part of *Salt*. And if after some time there happened to appear (for 'tis not absolutely necessary it should) a little *Cloudiness* in this *Facitious Liquor*, it was both slower produced, and much less, than that which appeared in the *Impregnated Water*.

Perhaps it may be proper, that I here observe (what is not wont to be taken notice of) That divers *Solutions* of *Mineral Bodies* may be *Precipitated* by *Dilution*; that is, (to explain this Expression) when the *Solution* has time enough allowed to diffuse it self through a great *Quantity* of *Water*, the *Saline* parts are thereby so *Diluted* and *Weakened* that they are no Longer able to sustain the *Mineral Corpuscles*, they kept swimming before, but make with them, and the *Water*, a confused and *Subsiding Mixture*; usually of a *Whitish Colour*. This may appear when the *Butter* of *Antimony*, being put into *Common Water*, is thereby quickly and plentifully *Precipitated* in the form of that *White Powder*, that *Chymists* (not over-deservedly) call *Mercurius Vitæ*. To which I may add, that I have also produc'd a *Powder* of that *Colour*, by pouring into *common Water* a strong *Solution* of *Tin Glass* made in *Aqua fortis*. And by the same way we have *Precipitated* the *Tincture* (or *Solutions* of the finer parts) of *Falap*, *Benjamin*, true *Labdanum*, *Antimonial Sulphur*, and divers other *Bodies*, made in *Vinous Spirits*. If it were not for this *Power*, that *Water* has to weaken most *Solutions* of *Bodies*, I could have employed instead of that *Silver*, either *Quick-silver* Dissolved in *Aqua Fortis*, or *Lead Crude* or *Calcin'd*, in the same *Liquor*, or (which is more convenient) in strong *Spirit of Vinegar*; since these, and some others, are found to be *Precipitable* by *Salt Water* into *Whitish Powders*. But tho' a very heedful *Observer* may for a Shift, make use of these *Metalline Solutions*, to guess at the *Quality* of *Water*, as to *Freshness* and *Saltiness*; yet the *Precipitation* that is made by *Dilution*, is not difficult to be Distinguish'd from that which is perform'd by a true and proper *Precipitant*, (as in our case by the *Common Salt*, that is harbour'd in the *Pores* of the *Water*) both by the *Quickness* of the *Effect*, and the *Copiousness* of the white *Substance* produc'd, and on both those *Accounts* is very much inferior to it; as may evidently appear in the very different *Effects* that our *Solution* of — had upon the *Patentees Water*, compar'd with those it had upon *Water Impregnated* with a *thousandth* part of *Salt*, and upon divers *Common Undistilled Waters*.

But to return; The Usefulness of this Experiment is not to be Estimated only by the *Examen* it helps us to make of *Dulcify'd Sea-Water*, but much more by the Estimate, that by its means may be made of *natural Fresh Waters*, whether of *Springs, Rivers, Clouds, Lakes, Wells, &c.* For it being generally granted, that those Water's, *cæteris paribus*, are the best, as well for the Wholesomeness, as divers Oeconomical Uses, as *Washing, Brewing &c.* that are free from *Saltiness*, which is an Adventitious, and in most cases, a hurtful Quality in Waters; by our way of *Examining* these Liquors, a heedful Eye may in a trice discover, whether there be any latent *Saltiness* in them (as most Waters Imbibe from the Soyle they have Travers'd or do Stagnate in) and may enable one, especially by the help of a little Practice, to give a near guess, how much one Water is *Fresher* than another, as I have purposely try'd with pleasure in differing Waters, that are ordinarily Drunk, even by considerable Persons. And if once you have attentively marked, what change 4 or 5 drops, for instance, of our Discovering Liquor will make in *two or three*, or some other small determinate Number, of *Spoonfulls* (or rather of *half Ounces*) of *Water*, 'twill not be difficult for a heedful Observer, keeping the same proportion between the two Liquors, to make a near Estimate, whether any natural Water proposed to him, have a Greater, an Equal, or a Lesser degree of *Freshness* or *Saltiness*, than that Water that he has chosen for his *Standard*; and How Much in case there be a difference, the propos'd Liquor is Less or More free from *Saltiness* than the other.

And that (to add this upon the by) such a Difference in a Liquor of such frequent inward Use as Water (which is the *Basis* of *Beer, Ale, Mead* and some other Common Drinks) may have considerable Effects upon Human Bodies in reference to *Health*, may be probably argued from the differing Effects that Waters more or less Impregnated with *Salt*, have upon divers other Bodies. Since most *Pump-Waters*, for instance, will not Boil Peas and Beef, and some other Aliments, near so well as *Spring-Water* or *Rain-Water*, which are usually Softer, and more free from the *Saltiness* we speak of. 'Tis commonly known to Barbers and Laundresses, that the same *Pump-Water* will not so well and uniformly, or without little Curdlings, Dissolve Wash Balls and Soap, as *Rain Water*, and some *Running Waters* usually will: Nay, when I was curious of *Tempering Steel*, I remember 'twas confess'd by the Skillfullest Artists I made use of, that some Tools (as *Gravers, &c.*) made of that Hardest of *Metals*, would receive a differing *Temper* if they were quenched in *Pump-Water*, from that which the like Extinction in *Spring-Water*, or *River-Water* would give them.

I might add on this occasion, That, whereas Experience has informed several Persons, who have consulted it, that divers *Medicinal Waters*, that are presumed to own their Virtues to the participation either of *Metalline*, or of other *Mineral Bodies*, do upon Trial appear to leave sometimes little, and sometimes nothing behind them, except a kind of *Common Salt*; our Precipitant may much assist Men to discover, whether a *Mineral Water* propos'd to be examin'd, do, or do not contain, such a *Salt*, and if it do, whether it contain it copiously

copiously or no. This I have tried upon more than one of our *English Mineral Waters*, and thereby found in a trice, that one that is reputed of another Nature, contained pretty store of *Saline* matter; and that another (which is still for ought I have learned, of an unexamined and unknown Nature) is *Impregnated* with a surprising Plenty of *Saltish* Substance. But how and with what Cautions our *Precipitant*, may be most usefully employ'd, about the *Examen* of *Medicinal* and other *Mineral Waters*, belongs not to this Place. Upon which account I forbear to declare the Use I have sometimes made of our *Precipitant*, in Examining the *Fresh Urine* of *Men*, the *Serum* of *Human Blood*, and other Bodies belonging to what the *Chymists* call the *Animal Kingdom*.

I have not, for certain Reasons, ascribed to our Method of *Examining Waters* a greater Nicety than to be able to discover *one* part of *Salt* in a *thousand* of *Water*, that Proportion being great enough to recommend it, and express'd by a round Number easie to be retained in ones Memory: Yet I would not have it thought but that, if it were requisite, our Method may make more nice Discoveries. For having sometimes for Curiosities sake, put *one Grain* of *Salt* into no less than *fifteen hundred* of *Distill'd Water*, we could manifestly, (tho' not quite so conspicuously as before) make it appear by our way, that even this so Lightly Impregnated Liquor was not devoid of *Salt*, but had more of that in it, than some of the *Patentees water* that I kept by me had; nay, I once found, that a *Grain* of dry *Salt*, being dispersed through *2000*, and another time that being *Dissolved* in *3000* times its Weight of the same kind of Liquor, so inconsiderable a proportion of *Salt* was plainly discoverable by our *Precipitant*.

It may be Objected, That whereas the Experiments hitherto mentioned, have been try'd only upon *Waters* Impregnated with gross or corporeal *Sea Salt*, this perhaps may not hinder, but that they may be Imbued with the *Spirits* of *Marine Salt*, which by reason of their Activity, may be as unhealthful to the Drinker, as the *Grosser Salt* it self. But tho' to this Surmise I might answer, that a very small Proportion of *Spirit of Salt*, may in many Cases make the *Water* Season'd with it, rather *Medicinal* than Unwholesome; yet I shall answer more directly to the Objection, by saying, that to manifest its not being well grounded, I took above *1000 Grains* of *Distill'd Water*, and, instead of *Corporeal Salt*, put to it *one single Drop* of moderately strong *Spirit of Salt*, (for I had much stronger by me, that I purposely declin'd to employ) and having shaken it into the *Water*, I let fall into a Portion of this unequally composed Mixture, some *drops* of our *Solution* of *Silver*, which presently began to *Precipitate* in a Whitish Form; insomuch that, for ought appeared to the Eye, this Trial succeeded better, than if the *Water* had been Impregnated with but *1000th part* of *Corporeal Salt*. The like Experiment was made with the *Patentees water* instead of the other. And to pursue this Trial a great way further, I had the Curiosity to Diffuse *one Drop* of *Spirit of Salt* into *2000 Grains* of *Distill'd Rain water*; and upon letting fall some *Drops* of our *Precipitant* into it, I found that the Success well answer'd my Expectation.

And then, to urge the Trial yet further, I added as much of the same *Distill'd Rain water*, as by a modest Conjecture made it amount to at least *half* as much.

much more. So that *one Grain* of *Spirit of Salt* had a manifest Operation though not quite so conspicuous as the former, upon above 3000 *Grains* of *Water*, whose immunity from *Common Salt* we tryed apart. And that a *Drop* of the *Saline Spirit* we made use of, did not equal in Weight a *Grain* of dry *Salt*, I found by this, that having let fall into a Counterpois'd piece of Glass *ten drops* of that *Spirit*, I found them to want near half a *Grain* of 9 *Grains* Weight.

The like Trial I made by substituting above 1000 *Grains* of *Rain water*, in the Room of the like Quantity of *Distill'd water*.

It is the Opinion of some *Seamen*, and of a Person, for whom I have a profound respect, that *Water* ought to have a little *Saltishness* to preserve it; if this be really a desirable Quality in our *Artificial water*, it may in a trice be supplied with as much *Saltness*, whether *Corporeal* or *Spirituous*, as shall be required, and consequently as will bring it to be equal in that quality to the *Common Water* of *Rivers* or of *Springs*. And perhaps 'twill not be impertinent to add on this occasion, that in some places, especially lying in *Hot Climates*, it may sometimes be of good use to know, whether on the account of the *Sun's Heat*, or that of the *Subterranean Regions* of the *Earth*, the *Rain-Water* is impregnated with *Volatile* (not *Acid*) *Spirits* like those that are *Distill'd* from *Urine*, and which I have for Curiosities sake obtain'd from a *Mineral Body*, *Native Sal-Armoniack*; upon which account I made a Trial that inform'd me, that if 5 or 6 *Drops* of *Strong Spirit of Urine* (whose drops I observ'd to be but small) were shaken into 1000 *Grains* at Least of *Distill'd* or *Rain-water*, impregnated but with *one* of *Salt*, our *Precipitant* would make a Discovery of some *Saltishness* in the *Liquor*. And it were neither to be admired nor censured, if the *Patentees water* should sometimes shew a Change, when our *Precipitant* is plentifully put or long kept in it, especially that Change being a more *Light* one, than that I came from speaking of. Since, for ought I have yet observed, not only such *Undistill'd Waters* are generally allow'd to be freely *Potable*, but even those that Nature herself *Distills* are not always quite devoid of *Saltness*.

For I have found *Rain Water*, that I caus'd carefully to be sav'd after the Houle tops had newly been well wash'd with former *Rain*, to grow a little troubled, if any store of our *Precipitant* were kept for some competent time in it. And being gently *Distill'd* off, it left a *Residence*, which with a little of our *Solution* afforded a far more suddenly made and copious *Precipitate*, than had been produc'd with the like quantity even of *Pump-Water* it self. And, tho' I have met with *Rain Water* that was more free from *Salt* than any *Spring* or *River Water* that I remember I have examin'd, yet, having for Curiosity sake made Trial of *Snow-Water*, (which if the Weather had been somewhat Milder, would have been *Rain*) this *Liquor* I say, which is thought to afford the *Lightest* *Water* of all *Natural* ones, I manifestly found by our way of *Examining* it, not to be devoid of *Saltness*.

It has been surmised by some, that even a moderate Action of the *Fire* upon *Water*, will make it *Brackish* and *Putrifie*. But that the *Patentees Water* is not *Brackish*, appears by the foregoing Trials; and that it is more free from *Saltness*, than most of the *Waters* Men do without scruple Drink: And that it

may keep sweet longer than is necessary in a Ship, that can from time to time, within a few Days, supply it self with *Fresh* out of the *Sea*, may be gathered from these two things; The *First* is, That I caus'd a Pint of it to be *Hermetically seal'd* in a *Vial*, whereof I left, by guess, about a third part empty, and having about *six Weeks* after, held this *Vessel* against the *Light*, I found the *Water* to be *Clear* and *Limpid*; tho' I did not judge it had deposited so much as the tenth part of a *Grain* of *Feculency*. And having opened the *Seal*, and taken out a little of the *Liquor*, I did not find it *Alter'd*, either as to *Smell* or *Taste*. The *Second* is, that I have kept a *Bottle* of it in the same unstopt *Vessel* near *8 Months*, and yet it continues *Sweet* and well *Condition'd*. And if that which is call'd *Crudity* in *Water* does consist, (as probably it oftentimes does) in certain gross *Particles* that are mingled with the purely *Aqueous* ones, it is likely, that the *Action* of the *Fire* may *Divide* and *Dissipate* these into *Minuter Particles*, and thereby destroy the *Texture* that makes them hurtful; and by caul'g innumerable *Tumblings* and *Rovings* amongst the more *Earthy Particles*, give them opportunity to make little *Coalitions*, whose *Weight* *Precipitating* them to the bottom, frees the pure *Water* from them.

And because 'tis but too *Probable*, that the *unwholsomeness* of diverse *Waters*, proceed, not only, or perhaps not so much, from bare *Crudity* as from a great quantity of grosser *Particles*, that are not easie to be rais'd, because of their being combin'd with *Fixt* and *Earthy* ones, that swim up and down in the *Water* they impregnate, as *Silver* or *Mercury* does in a *Solution* made with *Aqua Fortis*, or rather as the *Particles* of *Salt* do in *Pump Water*, and many other *Common Waters*: On this Account, I say, the *Patentees* *Invention* may very much *Correct* such *Waters*, since by their way of *Sweetning* those *Liquors*, the truly *Aqueous* Parts are not only freed from the *Saline* ones, but from the *Mineral*, and other gross and *Hurtful Corpuscles* that may have lain conceal'd in the *Liquor*. As may be argued from hence, that having purposely in the gentle *Fire* of a *Digestive Furnace*, slowly *Distill'd* off a *Pound* of the *Patentees water*, it left us in the *Cucurbit* so light and thin a *Feculency*, that the bottom of the *Glass* seem'd to be rather *Sullied* than *Cover'd* by it; and I did not judge that the whole *Feculency*, if we could have got it out, would have amounted to so much as *two Grains*.

Perhaps it was upon some such *Reasons*, that the last *Great D.* of *Tuscany*, when he drank *Water*, preferr'd for *wholsomeness*, that which was *Distill'd* to that which was not; and if herein that *Learned Prince*, and those of the same *Opinion*, were not mistaken, it will highly recommend the *Usefulness* of the *Patentees* *Invention* to *Mankind*. For there are *Multitudes* of *Waters* that are not considerably *Brackish* to the *Taste*, that yet, by reason of some unheeded *saltiness*, as in most *Pump waters*, more frequently by reason of *Crudity*, are not only unfit, or (at best) less fit for divers *Oeconomical Uses*, as *Washing*, *Boiling* of some *Meats*, &c. But are very *Unwholsome*; sometime to a *Degree*, that makes them *Mischievous* to whole *Communities*, and perhaps *Nations*. I remember I have seen a notable *Instance* of this in those huge and unsightly *Tumors* about the *Throat*, which are observed by *Travellers* to be exceeding common, among those that inhabit the lower *Tracts* of *Ground* that lie between

the *Rhetian*, *Helvetian* and some other neighbouring *Mountains*; which monstrous *swellings* are generally imputed to the *Snow-waters* that flow from the *Mountains*, and make the usual *Drink* of the meaner sort of *People*; whence 'tis observ'd that *Persons* of better *Condition*, who drink *Wine* more than *Water*, are either not at all, or far less troubled with these *Disfiguring Goitres*, (as they call them.) But much more notable *Instances* to our present purpose are afforded me, by that *Great* (and yet living) *Traveller*, *Monsieur Tavernier* (*Baron of Aubonne*) who speaking of a *Nation* of *Cafres* or *Negroes*, that comes sometimes to *Trade* with the *Portuguese* from a remote part of *Africk*, informs us, "That the *Water* of their *Country* is very *Bad*, which is (says he) the Reason that their *Thighs* do *swell*, and it is a *Wonder* to see any of them free. Nay, which is far more, where he speaks of the *African Kingdom* (or *Empire*) of *Monomotapa*, he has this memorable *Passage*: "The *Natives* never live long, by reason of the *Badness* of the *Waters* in the *Country*: For at the *Age* of 25 they begin to be *Dropsical*, so that 'tis a great wonder if any among them Live above 40 Years.

These *People* might (probably) be much *Reliev'd*, and be brought to live as long as other *Nations*, if they had so compendious a way as that of the *Parentees*, to provide themselves plentifully with *Waters* whose *Crudity* is corrected; its grosser and heavier parts separated, and its *Brackishness* destroy'd by the *Fire*, as its *Action* is regulated and help'd by their *Invention*.

The *Experiment* mention'd in this *Paper* was try'd at a *Meeting* of the *R. S.* Feb. 17. 169 $\frac{1}{2}$. by *Dr. Sloane*, with a *Success* answerable to the *Assertions* of the *Honourable Author*, and that a *Drop* or *two* of *Spirit* of *Salt* mixed with *Common Water*, would be by the same *Method* discovered.

By *Dr. Hook.*
ib. p. 639.

2. At a *Meeting* of the *R. S.* March 2. 169 $\frac{1}{2}$, *Dr. Hook* read a *Lecture* concerning a *Method* of his own for the discovering the smallest quantity of *Salt* contained in *Water*, from a *Principle* of *Hydrostaticks*; and after his *Discourse* thereof, he produced the *Apparatus* which he had prepared to *Exhibit* the same before the *Persons* then present.

The *Method* of doing which *Operation* was by means of a large *Poise* of *Glass*, somewhat of the shape of a *Bolt-head*, the *Ball* of which, *B*, was about 3 *Inches* Diameter, but the *Stem* or *Neck* thereof, *CC*, was not above $\frac{1}{4}$ of an *Inch*. This was so poised by *Red Lead* put into it, as to make it but a little *Heavier* than fair or *fresh Water*. Then this *Poise* was suspended by the small *Stem* to the end of a slender *Beam*, *A*, which was very *Tender*, and being not overcharg'd with *Weight*, would turn with a small part of a *Grain*. This *Beam* was hung on a steady *Frame*, and the *Poise* hanging at one end of the same, covered with the *Water* to a certain *Mark* or *Division* made on the small *Neck*, at *D*, it was so counterpoised by some small *Weights* put into the opposite *Scale* of the *Ballance*, *F*. Then the weight of the *Water* contained in the *Cistern* or *Vessel*, *EE*, into which the *Poise* was *Immersed* (being first known) a 2000th part of its *Weight*, was taken of *Common Salt*, weighed out and put into the whole 2000 parts of the *Water*, which by being stirred, soon *Dissolved*. Then the *Poise* suspended as before, was viewed and *Examined* by many then present, and they manifestly saw, that near half an *Inch* more of the
Neck

Neck Emerged out of the Water so Seasoned, than did before the 2000th part of Salt was Dissolved therein.

This was only one Use of this Method of discovering very small Alterations in the Constitutions of Bodies, the same Author having long since, namely October 25. 1677. Shewn to the same Society a Method of discovering diverse Alterations much more curious, namely to the 176000th part of its Weight.

XVII. There is an Odd Spring in the Diocesis of Paderborn in Westphalia, which loses it self twice in 24 Hours; coming always after 6 Hours back again with a great Noise, and so forcibly as to drive 3 Mills not far from its Source. The Inhabitants call it the Bolderborn, as if you should say the Boysterous Spring.

An Ebbing Well in Westphalia; by..... n. 7. p. 127.

XVIII. Lay-Well (near Torbay) is about 6 Foot long, and 5 Foot broad, and near 6 Inches deep, which Ebbs and Flows very often every Hour, visibly enough. I am informed, 'tis most constant Winter and Summer, tho' I am apt to think, it moves faster in Winter, when the Well is Fuller than in Summer: Because when I observed it first, (in July 1693.) I think it flowed somewhat quicker than I found it did on my second Observation, toward the End of August following; for the Water was then considerably shrunk in the Well, notwithstanding we had for about a Fortnight much Rain: And tho' when once it began to flow, it performed its Flux and Reflux in little more then a Minutes time, yet I observed it would stand at its lowest Ebb sometimes two or three Minutes; so that it Ebbed and Flowed by my Watch about sixteen times in an Hour, and some times I have been told, 20. As soon as the Water in the Well began to Rise, I saw a great many Bubbles Ascend from the bottom, but when the Water began to Fall, the Bubbling immediately ceased. I measured its High and Low-Water Marks and found them between 5 and 6 Inches distant; not of Perpendicular Depth, but as it spread it self on a broad Stone, as the Sea does on a Beach or Shoar. Tho' I am apt to think its Perpendicular Height would be as much or more in that time, were its cut-let Damm'd up to try an Experiment: For as it Rises it runs out with a small Stream, which is greater or less, according as the Water in the Well Rises and Falls.

An Ebbing Well near Torbay; by Dr. Will. O-liver. n. 204. p. 909, 910.

That it has any Communication with the Sea is not manifest, nor is the Water Brackish at all. The whole Country adjacent is very Hilly all along the Coast, in so much that from Brixam to the top of the Hill is about a Mile and half; and the Well is about half way up the Hill, (which hereabout is somewhat uneven and interrupted) and comes out at a small Descent, yet considerably Higher than the Surface of the Sea.

I tryed it with an Oaken Leaf as soon as I saw it the first time, but could not find it Change Colour. I drank of it, 'tis very Soft and pleasant, has no manner of Roughness in it, and serves for all manner of Uses to the Country People in their Houses; they also use it in Fevers as their ordinary Diet-drink which succeeds mighty well.

The Zirchnitzer
Sea in Carniola
described; by Dr.
Brown. n. 54.
p. 1083. n. 109.
p. 194.

XIX. 1. Having cross'd the River *Dravus*, and pass'd Mount *Luibel* in the *Carnick Alpes*, by that noble Passage cut through the Rocks, and Vaulted like that of *Pausilype* near *Naples*, I went to *Brounizza*, two Leagues from whence, and beyond the Hills, is the *Zirchnitzer Sea*, receiving that Name from *Zirchnitz*, a Town of about 300 Houses.

This *Lake* is near two German Miles long, and one broad. On the South side thereof lies a great Forrest, and on the North side the Country is flat; but the whole Valley is encompassed with High Hills, at some little distance from it. But I saw no *Snow* upon them, tho' upon other Mountains in the Country, I observed *Snow* in *June*. Upon Hills on the side of Great Lakes, the *Snow* lies not so long as upon Hills more distant.

This *Lake* is well fill'd with Water for the greatest part of the Year; but in the Month of *June* it sinketh under ground, not only by percolation or falling through the Pores of the Earth, but retireth under ground through many great *Holes* at the bottom of it; the little, if any, that remains in the Hilly or Rocky part, is Evaporated: And in the Month of *September* it Returns by the same, and in a short time covers the Tract of Earth again, but I cannot determine the space of time to a Day. This *Return* and *Ascent* is so speedy, and it mounteth at the *Holes* with such violence, that it springs out of the Ground to the height of a Pike. The Water that *spouts* seems somewhat Clear in the Air, but being spread about, looks as formerly in the *Lake*.

The *Holes* generally are stony, not in soft or loose Earth; yet in one or two places the Earth hath been known to sink, and fall in, particularly near a Village call'd *Sea-dorf*. They are of different largeness and Figure; some Perpendicular, at the beginning; and then Oblique; others oblique at first; scarce two exactly alike. Such *Holes* I have seen in other parts of *Carniola* and in other Countries also. We have a Hole called *Elden hole*, not made by Art, but naturally, in the Mountains in the *Peak Country* of *Derbyshire*, above 80 *Fathoms* deep. The great *Holes* are the same every Year; but possibly part of the Water may sometimes find or make new Passages through the Crevices and Cribrous parts of the Field.

When the Water goeth first away, they see it in these *Holes* for a while, but afterwards it descends lower out of their sight.

This piece of ground in the time of the *Retirement* and Absence of the *Water*, is not Unfruitful, but by a speedy and plentiful production of *Grass*, yieldeth not only a present Sustenance for the Beasts of the Field, but a good Provision of Hay for the Cattle in Winter.

The *Lake* is not only thus filled with *Water*, but every year well stored with *Fish*. The Prince of *Eckenberg* is Lord of it, and of much Country thereabout: But upon the *Retiring* of the *Water* all have liberty to *fish*; and the *Fishermen*, standing up to the waste at the *Holes* before mentioned, intercept the passage of the *Fish*, and take a very great number of them, which otherwise would be secure for some Months under the Earth, and not fail to return in *September*. But at that time the Prince will not permit them to make any such attempt.

The *Fish* of this *Lake* have a closer Habitation than those of any other I know; for they pass some Months under the *Earth*, and a good part of the Winter under *Ice*. I could not learn that there were any *Otters* in this *Lake*,
(which

which otherwise must probably have taken the same course with the *Fish*;) not that there were any remarkable Extraneous substances, any Vegetables, or unknown Fishes brought up by the Water, but those which come up are of the same kind with those which Descend.

The Bottom of the *Lake* is not even, nor near about the same Depth, but sometimes two foot, and then suddenly twenty yards deep. And because the *Fish* haunt the deep places more then the Shallows; they have given Names to the seven chiefest Cavities or Valleys in the *Lake*.

The Water is not always at the same Height, but somewhat differing according unto Rains, Snows, or Drought; and they are sensible of its height by the tops of the Hills in it, and its spreading towards *Zirchnitz*; but it alters not very much till it begins to go away.

No *River* enters it, but only inconsiderable *Rivolets* on the South and East-side; nor hath it any other discharge known, but by the *Holes*.

There are also diverse *Caverns* and deep places in the Country of *Carniola* even where there is no Water.

Between *Sea-dorf* and *Nider-dorf*, the Ground sometimes *sinks* in several places upon the sudden Retiring of the *Lake*; and the aforesaid Prince of *Eckenberg* was once so curious, as to descend into one *Hole*, through which he passed under a Hill, and came out on the other side; as I was informed by *M. Andreas Wiser*, the present Judge of *Zirchnitz*, and also by *Johannes Wiser*, who hath formerly held the same place.

The Country is High about the *Lake*, but the *Lake* is not High in respect of the Country near it, but low.

The *Snow* falls not till after the *Lake* is Return'd.

This *Lake* probably may hold dependance of, and communication with some subterraneous great *Lake*, or Magazine of Water belonging to these *Hilly Regions*, which when full, and running over, may vent it self with Force and Plenty into this Field, and when scant of Water, Absorb and Drink in the same again; the Water of the *Lake* returning but from whence it came, having no *River* running out of it, whereby to be discharged.

I went also to a noted Stone, commonly called the *Fishers-Stone*, which hath somewhat of the use of the *Nilescope-Pillar* at *Grand Cairo*. It is a large Stone upon one of the Hills, or elevated parts of the Field, which whensoever it appears above Water, the Fisher-men being upon the *Lake*, take notice of it, and know thereby, that in a few Days the Water will *Retire* under ground. For after the *filling* of the *Lake* in *September*, the Water never Decreaseth so low again, as to let the *Fisherstone* appear, till it begins to *Retire* under ground.

2. This *Lake* was by the Antients call'd *Lugea Palus*, by the Moderns *Lacus Lugeus*, tho' at present its Latin Name be *Lacus Cirknicensis*, in High-dutch *Zirchnisersee*, and in our *Carniolan Tongue* *Zirknisco Jeseero*. Why it was so called of old, is unknown or very uncertain; but the Original of the present Name is more sure, it being derived from the adjacent Town of *Cirknits*; and that had its Name from a Chappel of the *Virgin Mary*, which at first stood alone, but now the Town is built round it. This Chappel was no great Edifice at first, and therefore was called the *little Chappel*, which in the Language

By M. J. Weichard Valvafor:
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of the Country is *Zirkviza*; whence the Lake was named *Zirkvisko Jefero*, or the *Chappel-Lake*, but now by abuse *u* being changed into *n* *Zirknisko Jefero*.

It is distant from the Capital City of the Province *Labac*, six German Miles; it is a good German Mile long, or better than 4000 Geometrical Paces, and is about half as much in Breadth. Its ordinary Depth is 10 Cubits, its least 5 or 6, rarely 3, but its greatest is 16 Cubits. It is every where surrounded with Woody Mountains, which on the South and West side are very High, and 3 Miles broad, running far in length into the *Turkish* Country, and afford nothing but Horrid Stony Desarts, overgrown with Trees. On the North and East side, there is between the Mountains and the *Lake*, a small Territory, which tho' narrow, is nevertheless Pleasant, and is inhabited by one Town, 3 Castles, and 9 Villages, and adorned with twenty Churches; as may be seen in the *Map*, which was drawn by my self upon the place, with all possible care.

Fig. 60.

In the Mountain call'd *Favornik*, standing near the *Lake*, there are two Holes, or exceeding deep Precipices, in which many thousand wild *Pidgeons* roost all the Winter; entring in *Autumn*, and coming out with the first of the *Spring*: What they live upon in these Caverns is unknown, but I take it to be the *Nitrous* Sand. In another Hole call'd *Slivenza*, 'tis the Belief of the Country People, that the *Witches* hold their Assemblies, because that several times Lights like *Ignes fatui* are observed there. On the top of this Hill is a Hole of an unknown Depth, out of which there often breath out noxious *Steams*, supposed to occasion Tempests of *Thunder*, and *Lightning* and *Hail*; and for this Reason the Priest of *Zirknits* every *Whitson-Monday* goes to the Hole in *Procession*, and uses over it a certain form of *Exorcisme*.

There run into this *Lake* continually 8 *Rivulets*. The two least are call'd *Bellebrech* and *Tresenz*; the 3^d is the Fountain *Oberch*, out of which abundance of Water gushes with great force; the 4th 5th and 6th call'd *Steberziza*, *Lipsinziza* and *Seronschiza*, may for their bigness deserve the Name of *Rivers*, the 7th *Martinschiza* breaks out at a Cleft in the Rock: The last call'd *Cirknizer bach* is a pretty large River.

Now this *Lake* being every where surrounded with Mountains, and nowhere running over, Nature has given it two Visible Channels or Stony Caverns, call'd *Velka Karlouza* and *Mala-Karlouza*, by which the Water runs under the Mountain; and a 3^d concealed subterraneous Passage, which without doubt communicates with the other two under ground (as I shall hereafter prove). These having run half a German Mile, come out at the other side of the Mountain, near the *Chappel* of *St. Cantian* (as I have faithfully drawn it) in a Desert place; at a *Stony Cave A*; and become the River called by the Inhabitants *Jefero*, that is the *Lake*. This River *Jefero* marked *B*, is reasonably bigg, and having run half a quarter of a mile enters a wide *Stony Cavern I*, running slowly under the Hill for the space of a good Musquet-shot; then coming out again on the other side, after it has run thro' a small Platt *m m*; it Enters a 3^d *Cavern* or *Grotto C*; wherein having passed 50 paces, one may say *Siste Viator, ne plus ultra*, for it runs no longer peaceably as before, but with

Fig. 61.

great

great Noise and Roaring falls down a very much inclined Channel of Stone, so that neither I nor any else durst follow it farther. In June 1678. I went my self in a small Fisher-boat under the Mountain, through the *Cave I*, and entred the *Grotto C*, till I came to the aforesaid *Falls*, without any danger or trouble, the passage being wide enough.

It must be noted, that the Valley wherein this River *Jesero* runs, is exceeding steep, but the Plat of Ground *mm*, is plain and stony, of an Oval Form, and is surrounded with (as it were) a very High Rampart *KKK*, so steep that it would be impossible for a Cat to climb out of it, unless at one place, where-at a Man may make a Shift to go up and down, tho' not without peril of his Life; the Way being in some places not above three or four inches, and nowhere above 6 inches wide. In the Year 1684, I went down here in Company with a *French Gentleman*, but the Water being up and we wanting a Boat, we could not go under the Hill, nor enter the *Grotto C*; so we returned, and with great difficulty descended by a Steep and narrow Passage at *D*, and came to a *Cave* bigger than any Church, through which the River *Jesero* runs. Here we found several *Figures* of Stone, the Workmanship of Nature, and strange *Holes* and *Caverns* in the Earth; but by reason the River was then up, we could go no farther. At other times when the Water is down, one may go with lighted *Torches* a great Way under ground; and it is said there are here very odd *Figures* formed by the Petrified Water: Among the rest one resembling a *Weaver* at Work, of which the Country People want not their Superstitious Traditions.

But to return to our *Lake*; I say that about the Feast of *St. James's-Tide* and sometimes not till *August*, the Water runs away and it is *Dry*: But it *Fills* again and most commonly in *October* or *November*, yet so as not to observe any certain time; for some times it has been *Dry* twice or thrice in a Year: As in the Year 1685, it was *Dry* in *January*. Again the Water began to Draw off, on the 15 of *August*. *St. N.* and it was quite Clear by the 8th of *September*; and this present Year 1687, it has been thrice *Empty*, which makes the *Fishing* very poor and inconsiderable. Sometimes again, tho' but seldom, it has happened to be three or four Years together *Full* of Water, and then is the best of the *Fishing*. But it never yet was observed that this *Lake* was *Dry* for a whole Year together.

The Right of *Fishing* in this *Lake*, upon certain Terms agreed on, does at this time belong to the *Lordships* or *Castles* following, 1. to *Haasberg*, 2. *Steegberg*, 3. *Laas*, 4. *Schneeperg*. 5. *Avesperg*, 6. to *Sitticium*, which is a *Monastery* of *Cistercian Monks*.

There are 3 *Islands* in this *Lake*, viz. *Mala-Goriza* and *Velka Goriza*, which are uninhabited; The 3d is a very pretty *Island* called *Vornek*, that is reasonably big, having upon it a *Village* of 4 houses called *Ottock*; above this *Town* upon a little *Eminence* stands a *Church*, which is no small *Ornament*. Those that live on it have *Fields*, *Meadows*, *Pastures*, *Wood*, *Gardens* and *Orchards*, and all things necessary for *Life*.

There is also a very fine *Peninsula* all covered with *Wood*, called *Dorvassek*. When the *Lake* is up, and one comes in a *Boat* between the *Island Vornek* and
this

this *Peninsula*, the farther part of the *Lake*, lying under the Mountain, very well resembles a curious Port for Shipping. At the farther end when the Water Draws off, there appears Rows of Stakes, a Signe that there hath been formerly a *Bridge*, and therefore it is at this day called the *Old Bridge*.

In this *Lake* there are many *Pitts* in the shape of Basons or Cauldrons, which are not all of the same depth or breadth; the breadth of them being from 20 to 60 Cubits more or less, and the depth from 8 to 20 Cubits. In the bottom of *Pitts* are several *Holes*, at which the Water and Fishes enter, when the *Lake Ebbs* away.

Fig. 60.

The principal *Pitts* in which they *Fish*, are 18; situated and named as is represented in the Map. They are called *Maljoberch*, *Velkjoberch*, *Kamine*, *Sueiuskajamma*, *Vodonos*, *Louretschka*, *Kralouduor*, *Rescheto*, *Ribeskajamma*, *Rethje*, *Sittarza*, *Lipanza*, *Gebno*, *Kotcu*, *Ainz*, *Zeslenza*, *Pounigk*, and *Lewishe*. Besides these there are several other lesser *Pitts* of no Note, because there is no such *Fishing* in them as in those but now mentioned.

In the Months of *June*, *July* and *August*, when this *Lake* begins to Draw off, it grows quite *Dry* in 25 days, if no great Rains Intervene. And the aforesaid 18 *Pitts* are all Emptied the one after the other, in a certain and never failing Order of Time.

When the *Lake* begins to Sink, which appears by a certain *Stone*, which they observe, the Inhabitants of the Town called *Oberdorff* or *Seedorf*, give notice thereof to all the Neighbouring Fishermen, that are appointed by the several *Lords* having Right in this *Fishing*. The People of this Town have Orders not only to watch the Falling away of the Water; but likewise to take care that no Body presume to *Fish* in the *Lake* when it is Full of Water; that being forbidden: So that these are, as it were the *Keepers* of the *Lake*.

1. The first *Pitt* called *Maljoberch*, is not properly a *Pitt* like a Cauldron, but only a Depression of the Bottom without any *Holes* in it: But there grows much Grass and Weeds, and many *Fish* are Caught therein: Three days after the Water begins to *Ebb*, this *Pitt* is Emptied: Then the Parish Clark of *Seedorf* gives notice thereof by Tolling a Bell, and all the Inhabitants of the Town, Old and Young, Men and Women, lay aside all other Business and go to *Fishing*, stark Naked as ever they were born, without any regard to Modesty or Shame.

The *Fish* they Catch they divide in halves, one part they give to the Prince of *Eggenberg*, as the Lord of the *Mannour*, the other half is their own.

2. The *Pitt* *Velkjoberch* is emptied the 3d day after *Maljoberch*, the manner and Right of *Fishing* as in that.

3. Four hours after this, the *Pitt* *Kamine* begins to empty; here they generally *Fish* with a Trawle, as in several other *Pitts* of lesser Note, having first purchased leave of the aforesaid Lord of the *Mannour*. Here, as likewise in the *Pit*.

4. *Sueiuskajamma* (which sinks one hour after *Kamine*) is much *Fish* caught, and abundance of large *Crabs*, but they are lean and of no good Taste.

5. The fifth *Pitt* *Vodonos*, dries 5 days after *Kamine*. In this and the other *Pitts* which follow they *Fish* with a long Net or *Sayne*. Herein they can have

no more than 5 or 6 *Hawl's*, by reason of the great *Swiftness* wherewith the Water runs away at the *Holes* in the bottom, (which is such that a Horse can hardly keep pace with it) and carries away the *Fish* with great Violence under the Earth. Sometimes when Fishermen are not nimble, they can scarce get two *Hawl's* before the Water be gone; to prevent which they have a Mark near this Pitt, *viz.* the *Stone Ribeskekamen*, that is the *Fisher's Stone*, which as soon as it begins to appear upon the *Recess* of the Water, gives notice that it's time to begin the *Fishing*.

6. The Pitt *Louretschka* is evacuated a day and a half after *Vodonos*, the *Fishing* is after the same manner, and the same Caution necessary, because of the *suddain Recess* of the Water.

7. The Water leaves the Pitt *Kraloudour* 12 hours after *Louretschka*; and 3 days after that,

8. The Pitt *Rescheto*. In this latter, in the Year 1685, after the *Lake* had been some *Years* without being *Dry*, there were taken at the first *Hawl*, 21 *Carts* of *Fish*, at the 2^{d.} 17, and at the 3^{d.} 9, as I have been credibly informed by those that were present.

9. The Pit *Ribeskajamma* falls *Dry* at the same time with *Rescheto*, which is that next to it. In this *Pit* they *Fish* under ground, which is a Curiosity not unpleasant, and differing from all the rest. For there is in the bottom a great *Hole* in the *Stone*, by which Men may easily go down with *Lighted Torches*, as into a deep *Cistern*; and there is under a large *Cavern* like a *Vault*, the Bottom or *Pavement* whereof is as it were a *Sieve* full of *little Holes*, whereby the Water runs away leaving the *Fish* *Dry*, where they are Caught.

10. The Pit *Rethje* is empty two Hours after *Ribeskajamma*, and is of no great Consequence for *Fish*: An Hour after this, the Pitt 11 *Sittarza*, and in 5 or 6 Hours more 12. *Lipanza* falls *Dry*.

13. The 3^{d.} day after *Rescheto* the Pitt *Gebno* is Evacuated; in this they rarely *Fish* with *Nets*, but let fall *Dry*, and the *Holes* in the Bottom being so small, that they exceed not the size of a Man's Arm, all the great *Fish* are left behind in the Pit.

14. Two days after *Gebno* the Pit *Koteu* becomes *Dry*: In this they sometimes take the *Fish* as in the former, but the *Holes* being greater let bigger *Fishes* pass.

15. The Pit *Ainz* empties 4 or 5 Hours after *Koteu*: In this they seldom (unless they cannot help it) let the Water run away without using their *Nets*, as in *Gebno*; because of one great *Hole* in the Bottom whereby many great *Fishes* may escape.

16. The Pit *Zestenza* sinks three Hours after *Ainz*; in this they always *Fish* with *Nets*. As in

17. *Pounigk*, which is emptied the next Day after *Koteu*.

18. The last Pitt called *Leuische* is Evacuated the third Day after *Pounigk*, that is the 25th Day from the beginning of the *Recess* of the Water of the *Lake*, so that in 25 Days the *Fishing* of this *Lake* is over. In this last Pit about 17 Years since, I am certainly informed, that there fell a *Flash* of *Lightning* about the time of *fishing*, which stunned a great Multitude of large *Fishes*,
so

so as that they filled 28 *Carts* with them: (By a *Cart* is meant as much as one Horse can draw). These *Fish* are not properly *Thunderstruck*, but only *stunned* with the Violence and Sulfureous Vapour of the *Lightning*, which makes them Rise and Swim as Dead upon the Top of the Water; but if they be taken up and put in *Fresh Water*, they soon recover, otherwise they Die. This is no uncommon Accident in this *Lake*.

The *Fishing* being thus ended, a Sign is given by tolling the Bell in the *Chappel* of *St. John Baptist*, near the Town of *Cirknitz*. Upon which all the Inhabitants of the Neighbouring Villages and of *Cirknitz*, without regard either to Age or Sex, go for the most part stark *Naked*, into the *Lake*, and look for *Fish* among the Weeds and Sedge, and in the smaller *Pitts*. And many creep into the Subterraneous *Caverns* and Passages, and find store of large *Fishes* there. They having full Liberty to search all over the *Lake*, excepting in the *Pitts Pianze, Narte, and Velkjoberch*. This Barbarous and Immodest Custom of going *Naked*, has been often attempted to be reclaimed by the *Carthusian Monks*, but all in vain, for so prevalent is a Habit of vicious Practices over good Precepts, that they have not yet been able to perswade them so much as to cover their Secrets.

There are besides these some other *Pitts* in the *Lake*, as *Skednenza, Mala* and *Velkabobnarza*, in which they *fish* likewise, as also in *Mala karlouza* and *Velka-karlouza*: In both these they go far under ground with lighted *Torches*, and find *Fish*, but these *Pitts* are of no great value. In *Velka-bobnarza* one may go in at great *Holes*, and descend many Fathoms under ground. These two Names *Velka* and *Mala-bobnarza*, signifie in the *Carniolan Tongue*, the *Greater* and *Lesser Drummer*; nor is it without Reason that these *Pitts* are so called; for when it *Thunders* and *Lightens*, there is heard in these two *Pitts*, as it were, the Sound of many *Drums* beating, which *Anno 1685*, I heard with my own Ears; it *Thundring* 3 times successively, and the Sound of *Drums* answering accordingly.

The two *Pitts Narte* and *Pianze*, are never emptied, but always remain *Fenny*, when the rest of the *Lake* is quite *Dry*. It is believed that in these *Pitts* the *Fish* lay their *Spawn*, and therefore it is prohibited to *Fish* in them. In them is an incredible Number of *Horseleeches*, which according to the vulgar Opinion, understand certain Words; for that upon repeating them, they will come in great Parties towards him that repeats them, whereas if he be silent, very few of them will touch him. These *Horse leeches* often stick upon the People in the *fishing* time, (some of them being dispersed all over the *Lake*) and the Method they take to get them off, is to get some other Person to piss upon the *Leech*, which makes it let go its hold; and this without any respect to Modesty, is practised as well upon the *Women* as *Men*.

There are in the Mountain nigh the *Lake*, but something Higher than it, two great and Terrible stony *Caves*, the one called *Urainajamma*, the other *Sekadulze*, which tho' far distant one from the other, have yet the same effect, *viz.* When it *Thunders* and *Lightens*, these two *Caves* do *Emit Water* with a wonderful and incredible force, and with it sometimes a great quantity of *Ducks*, with some *Fish*, which I my self observed in *October 1685*, not without

but great danger of my Life. I took my Horse and rid cross the *Lake* as far as the Island *Vornek*, in company with two old experienced Fisher-men; when suddenly the *Cavern* in the Mountain *Slivenza* began to breath forth misty Vapours, forming a Cloud. Upon which my Fisher-men advised me to make haste, for without doubt those Clouds would produce a Tempest. They had scarce said so, when it began to *Lighten* and *Thunder* dreadfully; and I had difficulty to perswade them to accompany me as far as the Pitt *Velkabobnarza*, being desirous to examine what is said of it, that when it *Thunders* the Sound of many *Drummers* is heard in it. This I found three times to succeed as reported, and then with all the speed we could, we hasted to the Island *Velkagoriza*, not being able to go farther, because the Water was in many Places grown out of our depth, where two Hours before we had passed dry. Here we got one of the little Fisher Boats, which when the *Lake* is dry, lie dispersed here and there on the bottom; and having got in my Horse, we began our Voyage, but had the ill luck to overset our Boat, and so were obliged to swim for't, and with much to do arriv'd safe on the other Shore. Then we could see from the other side that the Water gushed with great Impetus out of the Cave *Sekadulze*, being cast three or four Fathoms, as if it were forced by a *Fire-Engine*, and several *blind Ducks* were thrown out by the Water. It is not to be wondred that the *Lake* fills so fast, for considering the Violence wherewith the Water rushes, it is as much as a great River; this Cave *Sekadulze*, being a Fathom wide, and higher than a Man. It is look'd upon as a dangerous thing to enter into this *Cave*, because the Water comes so all on a sudden, that if it should chance to come it is impossible to escape it.

When it *Rains* moderately, the Water *Spouts* with great Violence two or three Fathoms perpendicularly, out of the Pitts, *Koteu* and *Zeslenza*. It comes likewise forceably out of the Spring *Tresenz*, as likewise out of *Velkioberch*, bringing with it at this latter abundance of *Fish*, and some *Ducks*. But when it *Rains* very hard and long together, especially with *Thunder*, then the Water breaks out with very great Force, not only from all the aforesaid Pitts, *Holes* and *Caves*, but likewise at several thousand other little *Holes* (which are all over the bottom of the *Lake*, and which when the *Lake* is *drie*, drink up the Waters of the 8 *Rivulets* that run into it) *spirting* several Fathoms high, from some perpendicularly, from others obliquely, so that there is not a pleasanter sight than this. And out of the Pitts, *Vodonos*, *Rescheto*, and some others, having great *Holes* at the bottom, there comes with the Water a great quantity of *Fish*. In case of great *Rains*, the 8 *Rivulets* are likewise much encreas'd, so that all things concurring, this *Lake* in 24 Hours time, will from quite *Dry* be *Full* of Water, and sometimes in 18 Hours; tho' at other times it has been known to be three Weeks in *filling*. But it is a constant Observation, that *Thunder* and *Lightning* help much to *fill* it speedily.

This *Lake* being thus by turns *wet* and *dry*, serves the Inhabitants for many purposes. For *First*, while it is *full* of Water, it draws to it several sorts of *Wild-Geese* and *Ducks*, and other *Water-Fowl*, as *Hérons*, *Swans*, and the like, which may be shot, and are very good Meat.

Next, as soon as the *Lake* is *Emptied*, they pluck up the *Rushes* and *Weeds*, which make excellent Litter for Cattle. 3. Twenty days after it is fully *dry*, they do cut a great quantity of *Hay* upon it. 4. After the *Hay* is in, they *Plow* it and sow *Millet*, which sometimes by the too sudden coming of the *Water* is destroyed: But it generally comes to Maturity. 5. While the *Millet* is on the *Ground*, they catch a great Number of *Quails*. 6. The *Millet* being in, there is good *Pasture* for Cattle. 7. When the *Lake* is *dry*, there is great Variety of *Hunting*; there coming out of Neighbouring Woods and Mountains, plenty of *Hares*, *Foxes*, *Deer*, *Swine*, *Bears*, &c. so soon as the *Water* is gone. 8. When it is full one may *fish* in it. 9. In Winter time it will be so firmly *Frozen*, as to bear all sorts of Carriages, and is a great convenience to the People to fetch their *Wood* and other *Necessaries*. *Lastly*, At the time when the *Water* goes away, it yields great abundance of *Fish*, as has been already said. And that which is most *Wonderful* is, That all this comes to pass in the same place, and the same Year, *Viz.* If the *Lake* be early *Dry*, and it fill not too soon; but it is to be noted, that the the *Hay* does not grow, nor is the *Millet* sown all over the *Lake*, but only in the more fertile places

There are only these sorts of *Fish* taken in this *Lake*, which are very well tasted. They are the *Mustela Fluviatilis* or *Eel-pout*, some of them weighing two or three Pounds; 2. *Tench*, some of them weighing six or seven Pounds; and *Thirdly*, *Pikes* in very great plenty, of ten, twenty, thirty, and some of forty Pound Weight; in the Bellies of these it is common to find whole *Ducks*; *Crabbs* are found no where but in the *Pitts Kamine* and *Sueinskajamma*: They are large but ill tasted

The *Cause* or rather *Modus* of all these wonderful *Phænomena* in the *Lake* of *Zirchnitz* is, according to my *Opinion* and *Speculations*, as followeth; there is under the Bottom of the *Lake*, another subterraneous one, with which it communicates by the several *Holes* described. There are also one or more *Lakes* under the Mountain *Javornik*, but whose *Surface* is higher than that of the *Lake* of *Zirchnitz*. This upper *Lake* is possibly fed by some of those many *Rivers*, which in this *Country* bury themselves under *Ground*, and has a *Passage* sufficient to carry the *Waters* they ordinarily bring unto it: But when it *Rains*, especially in *Thunder Showers*, which are the most hasty, the *Water* is precipitated with great *Violence* down the steep *Valleys*, in which are the *Channels* of these *Rivulets*; so that the *Water* in this *Lake* being encreased by the sudden coming in of the *Fains*, faster than it can empty, *swells* presently; and finding several *Holes* or *Caverns* in the Mountain Higher than its ordinary *Surface*, it runs over by them both into the *Subterraneous Lake* under that of *Circhnitz*, (into which the *Water* comes up by the several *Holes* or *Pitts* in the Bottom thereof) as likewise by visible *Passages* above *Ground*, such as *Urainajamma*, *Sekadulze*, and *Tresenz*.

That some of these *Passages* bring *Fish*, some *Ducks* and *Fish*, others only *Water*, seems to depend on the position of the *Inward Mouths* of these *Subterraneous Channels*; for if they be so constituted, as to draw off the *Water* from the *Surface* of the *Upper Lake* on which the *Ducks* swim, they must needs be

be drawn away by the Stream into these *Caverns*, and come out with the Water: But if so that the Channels open into the *Upper Lake*, under the Surface of the Water, and from thence ascend Obliquely for some space, before they come to descend, then the Water they carry is drawn from below the Surface, and consequently can bring with it no *Ducks*, but only *Fish*. Those *Pitts* which yield only *Water*, may well be supposed to be fed by Passages too narrow to let the *Fish* pass, tho' their multitude may make the Quantity of Water they emit to be very considerable.

The Manner of the *falling away* of the *Water* or *Emptying* of the *Lake*, I thus explain. After a long *Drought* or want of *Rain*, all the Springs that feed the *Upper Lake* under *Javornik* are much diminished; so that wanting fresh Supplies, it ceases to run over by the several Channels but now mention'd: Hence the *Lake* of *Zirknitz*, and that under it, are fed only by the Eight *Rivulets* that always fall into them, and then the Water draws off faster than it comes in, both by the Channels of *Mala* and *Velka-karlonza*, as also by a concealed Subterraneous Passage out of the *Under Lake*, which latter alone is able to transmit more Water than the said 8 *Rivulets* afford. Consequently the *Lake* must *Sink*, and that in a certain proportion of time, depending on the quantity of Water to be Evacuated, compared with the Excess of that that Runs out above that that Enters it, in the same time. 1. Those *Pitts* that are Higher are soonest *Dry*, the Lower latest, and so come to be Emptied in the Order above described, and when the *Lake* is all *Dry*, then the said *Rivulets* soak by several little *Holes* in the bottom, into the *Under Lake*, and all their Water is carried away by the aforesaid *Subterraneous Passage*.

That there is such a Passage is very Evident, and that it Communicates under Ground with the Channels of *Mala* and *Velka-Karlonza*, coming out with them as has been already said, near *St. Cantian* at a *Rocky Cave*, and making the River *Jesero*: For when the *Lake* of *Zirknitz* is very full, and Runs out of both *Velka* and *Mala-Karlonza*, the River *Jesero* at *St. Cantian* Overflows, and Runs with great Violence; when it only Runs out at *Mala-Karlonza* (which is somewhat lower than the other) then the Water of *Jesero* is much less rapid; but when the *Lake* is so fallen, that it runs out at neither of the two, the River *Jesero* is still less, but runs with a considerable Stream, till two Days after the *Lake* has been *Dry*; after which, the said River becomes little, voiding no more Water than the *Lake* receives from the 8 Rivers that Run into it: By which it is clearly proved, that this *Subterraneous Passage* does meet with the Channels of *Velka* and *Mala-Karlonza*, and needs no farther Illustration.

Hence it appears, why this *Lake* sometimes is twice or thrice *Dry* in a Year, at other times continues full for three or four Years together, but was never known to be *Dry* for a whole Years time; for it falls *Dry* at any time when there falls but little *Rain* in a long space of time; and in *Rainy Years* it continues always full; but it never happens in this Country, that there is a *Drought* for a whole Year together.

The *Ducks* I have so often mention'd, and which are cast out with the Water, are generated in the *Lake* under the Mountain *Favornick*; when they first come out, they *Swim* well; but are stark blind, and have no *Feathers* on them, or but few, and therefore are easily caught; but in 14 Days time they get *Feathers*, and recover their *Sight* yet sooner, and afterwards *fly* away in Flocks. They are Black, only white on the Fore-head, their Bodies not big, resembling ordinary *Wild-Ducks*, and are of a good Taste, but too Fat, having near as much Fat as Lean.

I kill'd some of them as soon as they had been cast out at *Sekadulze*, and opening their Bodies, I found in them much *Sand*; and in some few, small *Fishes*; in others green stuff like *Grass* or *Herbs*; which was the more strange, because I never found any green thing growing in any of our *Subterraneous Grottoes* or *Lakes* in *Carniola*; I tryed also to procure some of the *Fish* at the time of their being cast out, to open them and see what they live upon, but notwithstanding all my endeavour, I could not get any of them to satisfy my Curiosity withal.

Almost every Year, at a *Hole* in the Mountain called *Storseg*, about half a German Mile from the *Lake* of *Zirknitz*, near the Town of *Laas*, whenever there happen great Floods of Rain, this sort of *Ducks* is cast out in great abundance, by the Water Gushing out with much force. I conceive that this Cavern *Storseg* is another Passage out of the same *Lake* under *Favernick*, that overflows and fills up our *Lake* of *Zirknitz*; but this being somewhat Higher, it never runs out unless the said *Lake* be more than ordinary swelled by the violence of the *Rains*. The casting out of great Numbers of *Ducks* here, is so common, that it is lookt upon as no Rarity.

It may seem strange and hard to believe, that there should be such *Subterraneous Lakes* and *Channels* as we here suppose; but besides that, without them it would be impossible to account for all these several Effects which are most true, and which I my self have observed: There is a most Notable Instance of the like things, found in the *Subterranean Cavern* called the *Grotto Podpetschio*.

Fig. 3.

This *Grotto* is in *Carniola* in the Parish of *Guetenfeld*, distant four German Miles from the City *Labac*. *a*, is a *Hole* or Entrance into the Rocky Mountain; *b*, is a great *Cavern* in the Mountain, capable to hold above a Hundred Horse-men; *c, k*, is a Channel big enough for a Man to pass by, as far as the *Lake o*, out of which Lake the Inhabitants hereabouts draw all their Water, (having none nearer) and fetch it with lighted *Torches*. Into this *Lake o*, the Water runs with a great Stream by the Channel *l*, and out of this *Lake* it falls down a *Precipice* into a great *Cavern*, with so much noise, that the discharge of a *Pistol* would not be heard here. There is likewise another Channel *m*, which tends upwards obliquely, and leads to the great *Lake n*, whose length and breadth are hitherto undiscovered; I look'd about it with many Lights, and could see nothing but Water, and throwing Stones several ways as far as I could, I heard them all fall in the Water: And I found the depth of it near the Bank to be ten Cubits, and doubt not but it is much deeper in the Middle.

The Country People told me, that this Channel *l*, affords always an equal quantity of Water, or else is quite Dry; and that sometimes it will cease to run in a Moment, and continue Dry for some Weeks, and then on a suddain it will run again with great force, so as the Noise thereof frequently frights the People as they come for Water.

Out of the Cave *b*, there is another Channel *c*, which is divided into three others *d*, *e*, *f*. This Channel *f*, tends obliquely downwards, till it comes to a running Water in *g*, from whence one may go on to *b*, where looking thro' a little Hole, one may see another little Lake.

All the Channels I have mentioned, are formed in a very hard Rock, and are smooth or polished, as if cut by Mens Hands; These may be seen by any one that will go with lighted Torches; and there are many such in which I have not been.

If any one would carry a Boat to the Lake *n*, and would row upon it, I doubt not but he might find several curious things. I believe this *Subterraneous Lake* to be a German Mile long: For from this *Grotto Podpetschio*, at a Miles distance, there is a Village called *Kumpale*, whose Inhabitants have no other Water, than what they fetch out of a Hole in the Rock, going with lighted Torches, by a large Channel, to a great Lake under ground. I measured with good Geometrical Instruments, such as Miners use, the Level of these two Lakes of *Podpetschio* and *Kumpale*, and found them to be in one *Horizon*; and this I did twice, both when the Channel *l*, at *Podpetschio* Run, and when it did not Run. When it began to Run, I found that the Lake *n*, was two Cubits Higher than it had been before; when it ceased to Run I came again on purpose to observe it, and found that then also, the other Lake at *Kumpale* was in the same Level; from whence it is most certain, that these two, are only one continued *Subterranean Lake*.

XX. The Lake of Geneva, which is one of the most pleasant Places of the World, lies like a *Croissant* of Water, one Extremity whereof is 18 Leagues distant from the other, and the Banks of which are gently raised to some Heights, then to Collines, at length to stupendious Mountains; which yet are not so linked to one another, but that they leave betwixt them Interstices of 15 or 20 Leagues Prospects, checkered by Meadows, Corn-Fields, Orchards, Vines, Forrests of Firr-Trees, Snow lying on the sides of the Rocks. All those Objects, which at a Distance are confounded, and seem to make but one, have near Hand their several Beauties. That Point where Geneva stands, is somewhat longer and more extended than the other. This *Croissant* where 'tis largest, which is from *Morges* to *Thonon*, is about 5 good Leagues over.

The Lake of Geneva; by
n. 86. p. 504.

The Water of this Lake is very good to drink, and ever so Limpid, that even in the rolling of the Waves, which sometimes go high enough, the Water is not troubled but along the Banks. And if one do attentively look down from the Castle of *Chilon*, or from any of the Neighbouring Heights, into the Bottom of the Lake, he may see high Mountains under the Water. And the Water is so Deep before *Vevray*, that the Sounding Line at the end of 400 Fathoms, seems, because it will not stay, to touch upon something Slippery.

Slippery. 'Tis held to be 500 *Fathoms* deep before *Roole*; and 'tis affirm'd, that near this great *Depth* there may be seen a kind of *Isle* under *Water*.

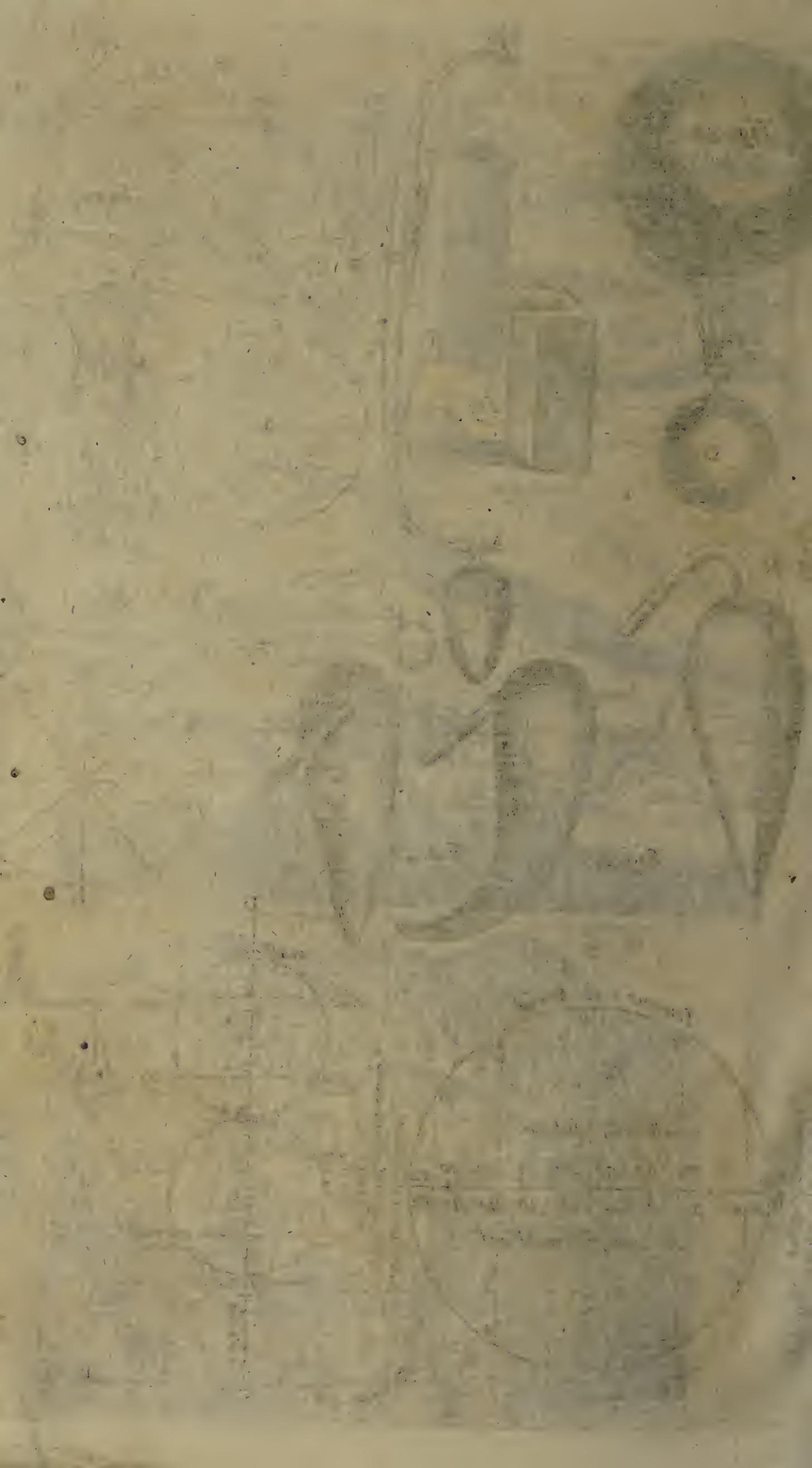
The *Rhone* enters at one of the *Points* of the *Croissant* into the *Lake*, and issueth out at the other; but with this *Difference*, that whereas he comes in *Dirty* and *Miry*, he ever goes out so *Pure* and *Clear*, that under the *Bridge* of *Geneva*, where the *Water* is deep 25 *Feet* in *Summer*, you may well discern the smallest *Stones* at the *Bottom*. And the same *Water*, which in this *Place* appears of a *Saphyrine Blew* in the *Shade* of the *Houses*, appears altogether *Green*, nor is so *Transparent*, when the *Sun* *Shines* on it.

Having heard the *Sentiments* of the *Curious* of *Lausanne* and *Geneva*, and the *Opinions* of the most knowing *Fishermen*, that are there in great *Number*, and especially at *Coupet*, I believe with the *Latter*, that although the *Rhone* entering into the *Lake* loseth its *Violence*, yet doth he still keep some sensible *Motion* in some *Places*, and every where *Observable*, and that no *Trouts* are taken any where in this *Lake* but in this *Current* of the *Rhone*.

The *Water* of this *Lake* commonly begins to *Encrease* about the end of *January*, or the *Beginning* of *February*, and continues to do so unto the 20th. of *July*, and often unto the very *Month* of *August*; and then it insensibly *Decreaseth*, so that the *Water* is less high in *Winter* than *Summer*, by 12 or 15 *Feet*. About this *Increase* of the *Water* there are different *Opinions*; 'Tis true, they all believe in general, that the principal *Cause* of the *Increase* of the *Water* is the *melting* of the *Snow*, and of the *Mountainous Ice*, that is in the *Winter* formed of the *Waters* of the *Springs*, and *Torrents* which the *Frost* fixeth. This is so true, that when there is much *Snow* in *Winter*, the *Waters* are very *High* the ensuing *Summer*. But when great *Rains* chance to fall in *January*, then the *Snow*, not yet being well *hardned*, Melterh on a sudden altogether: And when this *Melting* is not so violent, all the *Snow*, that will melt, melts at the end of *May* or at the *Beginning* of *June*; so that, there remaining but the *Stock* of *Ice* for entertaining the *Increase* of the *Water* unto the *Month* of *August*, some have thence been induced to assign other *Causes*.

At the *Issuing* out of the *Bars*, that form *Geneva* on the side of the *Lake*, are seen in the *Water* two or three huge *Flints* standing out of the *Water*, the chief of which they call *Niton*: And the *Tradition* is, that it formerly was an *Altar* consecrated to *Neptune*, there being also a place cut out in the middle, which they take to have been the place for the *Sacrifice*. On this *Flint* 7 or 8 *Persons* can sit; and sometimes, when the *Waters* are very low, there are found about it *Knives*, and *Needles*, as thick as *Bodkins* of *Tweeses*, and much longer; both of *Brass*, well enough made, and esteemed for to have served for the *Sacrifices*.

This *Lake* in *Serene* and *Calm* *Weather* appears sometimes, and that even before *Sun* *Rising*, as if it were made of divers pieces *Differently Coloured*; part of it being *Browner* than the rest: Which seems to be caused by a *Breath* of *Wind* passing thorow the *Water*, coming either from the *Bottom* of the *Lake* or from above; though others think this gentle *Agitation* to proceed from some *Springs*



Springs that are at the Bottom, making the Water Shiver above. But that part of the Water, that is not moved, appears as Even and Smooth as a Looking-Glass, or like Water traced by a Ship. And as for the Colours, they are in my Opinion, an Effect of the Neighbouring Mountains, the different Images of which, being confounded in the Water, make an appearance of very Pale Colours.

After that the *Rhone* is entered into the *Lake*, he retakes not his impetuous Course before a Quarter of a Miles distance from its coming forth again, that is, above *Geneva*. And the nearer he comes to that Town, the more his Bed becomes narrow, and consequently his Course more Rapid. Yet this Rapidness hath been in our times once Surmounted by *Wind*, and once by *Water*.

In the Winter of the Year 1645. there arose in the Morning about 9 a Clock so furious a *Wind*, that not only it uncovered the Houses, but also laid dry the Bed of the *Rhone* above the Bridges, so that many, in the view of all the Town, crossed quite over it (to the little Island) dry Foot, and one of the Sons of M. D' *Aubigny* took up some Medals, which he found in his Way. This passage was free during an Hours time; at the end of which the River retook its Course. At that Season the Water being very Low, and a West wind, to arrive at *Geneva*, being pressed by the high Mountains, that bring it upon the Town as by the Nose of a Pair of Bellows, it came to pass, that that Wind did Violently bear upon the Water near the Bars, keeping suspended the Water that was beyond, and those Waters that were beneath running away downwards by a Declivity, and under the Shelter of the Houses. Whilst I was Scrupling at this Relation, they brought me *Gallasius* his Commentary upon *Exodus*, Printed 1560; where 'tis recorded, that the like Accident had fallen out at *Geneva* at the time when that Minister Lived there, a South-West Wind having made the *Rhone* to Recoil into the *Lake*, and many People having thereupon passed over Dry for an Hours time.

Concerning the other Accident; you may remember that the River *Arve*, which is a kind of Torrent, falls into the *Rhone*, about 1000 paces beneath *Geneva*. In the Month of *December* in the Year 1652. the said *Arve* did so extraordinarily Swell, that not only it over-run its Banks with Impetuosity, but also interrupted the Course of the *Rhone*, and forced it to re-enter into the *Lake* for the Space of 14 Hours.

This *Lake* doth very much abound with *Fish*, which have as 'twere Cantonniz'd themselves, and divided the *Lake* amongst them. The *Trouts* are not to be found there, but, as hath been already mentioned, in the Current of the *Rhone*; the *Carps* have taken up their Quarter towards *Veuvey*; the *Pikes* and *Pearches* have also their Habitations a part: But some other *Fish* that are but Passengers, not living constantly in the *Lake*, spread themselves almost every where indifferently. The great *Trouts* pass out of the *Lake* for 4 Months of the Summer, and are taken in Autumn when they are returning thither. The *Fishing* is farmed out at *Geneva*; and there are Conservatories, where many of these big *Trouts* are kept, among which there are some that weigh fifty Pounds. Some-

Sometimes they catch *Pikes* there of 80 *Pounds* Weight; and a *Pound* Weight at *Geneva* you know to be 18 *Ounces*.

In the Months of *July* and *August* they Fish for the Fry of *Pearches*, at a time when they are no bigger than the smallest taggs. These are a very Delicious Dish there called *Mille Cantons*.

The Lake Aver-
nus; by Dr.
Tancred Ro-
binson. n. 172.
p. 1038.

XXI. I have seen many *Water-Fowl* Feeding upon and Flying over the *Lake Avernus*, reported by many of our own, as well as forreign Writers, to Kill Birds at a distance. I observed several *Land Fowl* also to Fly over that *Lake*, without the least Disturbance, from all sides, and ends. But peradventure the *Poysonous Steams* (if there are any peculiar to that *Lake*,) sometimes Vanish, and Return again; or else may be alter'd by new *Effluvioms* intermingled with them.

The Lake of
Mexico; by ...
n. 130. p. 758.

XXII. The *Lake of Mexico* hath this of extraordinary, and perhaps peculiar, that part of its Water is *Sweet*, and the other part *Salt*; which make it believed to be derived from two Sources, whereof the one holds *Sweet Water*, the other comes from some Mineral and *Saline Earth* found in the Hills through which this Water passeth, and is Impregnated with the *Salt* which is dissolved in its Course: Or if it have no peculiar Source, it must be, that that which makes part of the *Lake Salt*, is the Bottom or the Earth under the Water, being in that place full of *Salt*; which is confirmed by Experience, much *Salt* being made of it every Day, of which that City drives a great Trade with remote Parts, even the *Philippines* themselves, whither it is Transported in considerable Quantities. That part of the *Lake* which is *Sweet*, is Still and Quiet; the *Salt* part is Agitated and moved according as the Winds blow. The *Sweet Water* is very good and Wholesome, breeding plenty of little Fishes; that which is Moved is *Bitter-Salt*, breeding no Fish at all. The *Sweet Water* is Higher than the other, and falls into it. The Water of the *Salt* part is 7 Leagues Long, and as many Leagues Broad, and hath above 22 Leagues in Compass; that of the *Sweet Water* is near as bigg; and the whole *Lake* contains about 50 Leagues in Compass.

An Inland Sea
near Dantzick,
Fielding in Sum-
mer a Poisonous
substance; by
M.Kirk' y.n.83.
p. 4069.

XXIII. Near a small Village call'd *Tuckum*, $2\frac{1}{2}$ *German Miles* distant from *Dantzick* Westward, there is an *Inland-Sea* (made by the meeting of 3 Rivulets, some Springs from the adjoining Hillocks, and the Descending Rain and Snow-water,) of about half a *German Mile* long and an eighth part of such a *Mile* broad. The *Soil* of the ground round about seems to be Sand mixt with Clay. Its Shore generally Sandy, as is its Bottom also. Its Depth where Deepest, four Fathoms; but for the most part but one, or one Fathom and a half. 'Tis stored with Wholesome and Delicate Fish, as *Pearch*, *Roch*, *Eels*, &c. and Famed for a small Fish much esteemed here, and not much unlike a *Pearch*, only not so party-Coloured, and having a larger Head proportionable to its Body, called the *Cole-pearch*. The Water *Sweet* and *Wholesome*; but only in the three Summer Months, *June*, *July*, and *August*, it becomes every Year,

Year, during the dry Weather, Green in the middle with an *Hairy Efflorescence*; which *Green Substance*, being by some violent Wind forced ashore, and with the Water drunk by any Cattle, Dog, or Poultry, causeth Certain and *Sudden Death*; whereas at the same time, that a knowing and Ingenious Person (who first acquainted me with it,) saw three Dogs Killed with it, the Horses that were ridden into the Water beyond the place, where this *Green Substance* Floated, drunk without any Hurt; and that also, during the same Season, the Water in the Streams, that Flow from it, are *Wholesome*.

XXIV. 1. There is a little *Lake* in *Straberrick* on the Lord *Lovel's* Lands, which never *Freezes* all over (even in the most vehement *Frosts*) before *February*; but one Night's *Frost* thereafter will *Freeze* it all over, and two Nights then will make the *Ice* of a very considerable thickness. I have heard of two others *Lakes*, one of which, is on Lands belonging to my self, called *Loch Monar*, of a pretty Largeness, which steddily keeps the same Method. There is another little *Lake* in *Straglash* at *Glencanich* on Lands belonging to one *Chissolm*; the *Lake* lies in a bottom 'twixt the Tops of a very High Hill, so that the bottom it self is very High. This *Lake* never wants *Ice* on it in the middle, even in the Hottest Summer, though it *Thaws* near the Edges: And this *Ice* is found on it, though the Sun, by the reason of the Reflexion from the Hills, in that Country is very Hot, and *Lakes* lying as High in the Neighbourhood have no such Phænomenon. 'Tis observable also, that about the Borders of this *Lake* the *Grass* keeps a continual *Verdure*, as if it were in a constant Spring, and Feeds and Fattens Beasts more in a Week than any other *Grass* doth in a Fortnight.

Our famous *Lake Ness* never *Freezes*; but on the contrary in the Violentest *Frosts*, the greater Clouds of *Steams* do arise from it. And I remember, that at two several times, I being at *Inverness*, walking in the Evenings along the Bridge over the River *Ness*, a *Mist* of those *Steams* coming from the *Lake* and falling down to us over the River (for there was no *Mist* in any place thereabout but on this *Lake* and River only,) our Hair became all White, like the Whiteness of a hoar Frost, but it was Soft and Warm; and this was in the midst of Summer and in Warm Evenings. Dr. *George Mackenzy* (who lives at *Inverness*) told me, that he Observes *Rosemary*, though uncovered, to continue in the Gardens about that *Lake's* side, notwithstanding the last Winter's long and Violent *Frosts*; whereas a far less Violent Winter ordinarily kills all the *Rosemary* which is in Gardens that lie in Warmer places, and at the Sea-side: And though I live near it, and in a better Soil and warmer Situation, yet any *Winter*, more than ordinary Cold, Kills my *Rosemary*, though covered over with Straw and Litter. This he attributes (and, I think on good ground) to the Warmth occasioned by those *Steams* that frequently arise from that *Lake*.

In *Glevely* at a place called *Achigniglium*, there is a little Rivulet, which so turns *Holly* into a *Greenish Stone*, that they ordinarily make Moulds of it for casting of Balls for Fuses; and Tinkers that work in Brass make both their Moulds and Melting Potts of it; and Women their round *Wharls* for Spinning. May it not be, that by the long Infusion in *Water*, descending from Hills, which

perhaps abound in Marle, capable to be resolved into small particles by the constant washing of the Water, may it not be, I say, that these little Particles do Intrude into the Cleansed Pores of the *Holly*, and so make up that *Soft Stone*? And any thing Ligneous remaining of the very hard Timber, being all Incrustated with this Marle, may it not thereby be guarded from the *Action* of the *Fire*?

By Mr. Ja. Fraser. n. 254. p. 230.

2. The *Lake Ness*, according to Highland Tradition and Bards, has its Name from one *Nysus* an *Irish Hero* that fix'd a Colony in *Stratharig*, with *Dornadillo* his Wife. The Promontory, upon which he had his Residence, is to this Day call'd *Down Dearnill*; and he being the first that ever offered to set out Boat or Barges upon this Lake, it is after him called *Loch-Ness*. It is 24 Miles in Length, and in most places two in Breadth. One *George Scot*, tried 500 *Fathoms*, and *Capt. Orton* a whole Barrel of Plum-line, but found no Bottom. The Banks of this *Lake* ascend high and Mountainous, with Woods. The *Lake* never Freezes, which is imputed to the many great Springs and Fountains in it; the only Fish in it is *Salmon*. This *Lake Ness* discharges itself in a River of the same Name, six Miles in Length, which runs slowly yet never Freezes, but still *Smoaks* with *Frost*: And from this *Smoak* is spread a Fog over all the adjacent Country.

On the side of *Loch Ness* stands the famous Castle of *Urquhart* upon a Rock; the great Ditch round it was for the most part cut out of the Rock, and received the Water of the *Lake*. This Castle consisted of 7 great Towers, and 'tis said was built by the *Cuminees*, but had its Overthrow by King *Edward* the first of *England*; and nothing remains now but one Tower to the East.

To the Westward of this Castle about 4 Miles, upon the side of *Loch Ness*, stands that great Mountain *Meal fuor vouny*, of a round, neat, high Shape; it will be two Miles of Perpendicular Height from the *Lake*. Upon the very Top of this Hill there is a *Lake* of Cold *Fresh Water*, about 30 Fathom in Length and six broad, no Course or Stream running to it or from it. I plum'd with 100 *Fathom* of small Line but could find no Bottom. It is always Equally Full, and never Freezes.

About 23 Miles West from the End of the River of *Ness*, there is a Forrest called *Affaruck*, in which there is a Mountain call'd *Glenin-Tea*; and on the North side, under the Shade of a great sloping Rock, stands a *Lake* of *Fresh Water*, call'd *Lochan Wyn*, or *Green Lake*, 18 Foot in Diameter, about a Fathom Deep. This *Lake* is always cover'd with *Ice*, Summer and Winter.

Lough Neagh in Ireland; by Mr. Will. Molyneux. n. 158. p. 552.

XXV. 1. It is generally agreed by all the Inhabitants thereabouts, that *Lough Neagh* has a *Petrifying* Quality: But that no Wood will *Petrify* in it, except *Holly*. It is also asserted with some probability, that the *Earth* about the *Lough* has this *Petrifying* Quality: For I am certainly informed, that a Gentleman of the Country about this *Lough*, a little before the Rebellion, cut down some Timber for building, and amongst others cut down a large *Holly Tree*, but

but being diverted by the Rebellion from building, his Timber lay on the Ground in the place where it was fell'd, upon the Banks of the *Lough*, all the Miserable time of the War, till at last the Kingdom being settl'd, the Gentleman went to look for his Timber, and found the other Timber overgrown with Moss, and the *Holly Petrify'd*, tho' the Water of the *Lough* had never reach'd it.

And perhaps the *Holly* it self, that grows upon the Banks of this *Lough*, may be more apt to be *Petrify'd*, than the same Wood growing other where; and brought thither, and put into the *Lough*, for certainly if the *Ground* has this Quality, this is very likely to follow.

That what we call *Lough Neagh Stone* was once *Wood*, is most probable on these accounts *First*, It will not stir with *Acids*. 2. It will *Burn* and *Flame*; and the *Smoak* of it smells like the *Smoak* of *Wood*. 3. When *Burnt* it betrays the very *Grain* of *Wood*, with the other Vessels belonging to *Vegetables*. 4. I have many of them of various degrees of *Petrification*; some that have clearly lost the *Colour* of *Wood*, and are become perfectly *Black*, and very *Hard*; others that are not so *Black* nor *Hard*; but one more especially was sent me about a Year ago, which is a Parallelepiped, of about 4 Inches long, and an Inch thick, cut, I suppose, whilst *Wood* in that shape purposely, whose *outward Coat* is very *Black*, and smooth, but this is meerly superficial, for being cleft longwise through the middle, (which it suffered far more easily than that which is more throughly *Petrify'd*) I there discovered the whole *Body* perfectly of the *Colour* and *Grain* of *Holly*, for I can scrape it with my Nail; but what was most surprizing in it was, the discovery of the *Pith*, as plainly and as perfectly distinct in *Colour* and *Texture* from the rest (but it also was *Petrify'd*) as it could possibly have been seen in the *Natural Wood*.

I never have seen nor could hear of any part of the *Stone* in the least resembling *Iron*.

I have used some endeavours to procure a piece of this *Lough Neagh Stone* to which the *Wood* was yet fastened, but I never could attain it, tho' some assert they have seen pieces two or three Foot long, with about eight or ten Inches of *Stone* and the rest *Wood*. Tho' I am apt to believe this may be stretching the matter too far, for I conceive that that Humour that *Petrifies* one part, when it begins to operate, Insinuates it self soon throughout the whole *Body*.

'Tis observed that this *Petrifying Quality* is not equally Diffused throughout the Whole *Lough* (which is about 15 or 16 Miles long, and 8 or 9 Miles broad in all places) but is most strong about that part where the *Black Water* (a River so called) empties it self into this *Lough*, that is about the South West Corner; as likewise it is said to be more strong about the Edges of the *Lough*, than further into the Water.

I have found upon Trial, that this *Stone* is not *Magnetical*, for it will not stir a *Needle*, or *Steel-filings*, neither will it apply to the *Magnet*, in *Power* or *Calced*. n. 166. p. 820.

Upon further Trial I find, that though it will not apply to the *Magnet Crude*,

yet being *Calcined* it applies most briskly: The occasion of my former Error being, that I did not *Calcine* it long enough.

By Mr. Edward
Smith. n. 174.
p. 1108.

2. No Experiment, or Observation yet made, (that I can hear of) can prove that this *Lough* has really the Quality of *Petrifying Wood*; or that the *Water* does any way help or promote the *Petrification*. On the Contrary a Neighbouring Gentleman of good Credit and Worth, about 19 Years ago, stuck two *Holly Stakes* (a Wood which all agree will soonest *Petrifie* in this *Lough*) in two several Places of the *Lough*, near that place where the upper *Band* enters into it; and that part of the *Stake*, which for so long time has been washed by the *Water*, remains there without any Alteration, or the least Advance towards *Petrification*. It is reported indeed that the *Water* has this Virtue, especially about those Places, where the *Black Water* discharges it self into the *Lake*: But it seems evident from the very Nature of Liquid Bodies, that any Vertue received in one part must necessarily be Diffused through the whole, at least in some Degree; and therefore there is good Reason to believe, that the *Water* is wholly *destitute* of this *Petrifying Quality*.

But that this Vertue is Certainly, if not Only, in the *Ground* or *Soil* I judge for these Reasons; that there are many *Stones* turned up daily, especially at their breaking up new *Ground*, which we cannot in any Probability think were brought thither: They are often found at two Miles Distance from the *Lough*, seldom further, in great Numbers, and very Deep in the *Ground*; and a Gentleman (on whose Credit I receiv'd the Information) saw a Stump of a *Tree* digged out of the *Ground* at a small distance from the *Lough*, which by handling of it he found to be *Petrify'd*: He assured me the *Roots* and all were *Stone*, and altogether like those *Stones* that are ordinarily found, and go by the Name of *Lough-Neagh-Stones*. This Gentleman was of Opinion these were *Lapides sui Generis*, till this Observation convinced Him. And that these *Stones* were once *Wood* is, I think, very certain, for they shew the plain *Vestigia* of *Wood*; they likewise *Burn*; *Cleave*; *Filings* of this *Stone* thrown into the *Fire* emit a *Fragrant Smell*; and they cut kindly with a *Knife*, though not so easily as other *Wood*.

That not only *Holly*, but also other *Wood* has been *Petrify'd* about this *Lough*, and in the *Soil* adjacent, I have sufficient Grounds to conjecture on this Account; because some *Fishermen*, being *Tenants* of a Gentleman from whom I had this Relation, told him, they had found buried in the *Mud* of this *Lough* great *Trees*, with all their *Roots* and *Branches Petrify'd*; and some of that bigness, that they believed they could scarcely be drawn by a *Team* of *Oxen*. They broke off several *Branches* as bigg as a *Man's Leg*, and many bigger, but could not move the great *Trunk*. By this Bulk of it, I guess it to be *Oak*, no *Trees* in that Country, these excepted, growing to that prodigious bigness; at least 'tis certain that *Holly* never grows to that Bigness.

Two Gentlemen of the North told me, that they themselves had seen the same Body partly *Wood* and partly *Stone*: But the only Reason for thinking so, being the Diversity of Colours, which might well enough proceed from several Degrees of *Petrification*, we may probably think them deceived;

ceived; for they made no Experiments on that part which they Reputed *Wood*.

The *Bark* is never found *Petrify'd*, as I am informed by a diligent Inquirer, but often something Rotten about the *Stone* answerable to the *Bark*.

XXVI. A Gentleman tells me, That he hath met with a place in *England*, where, though there be no *Petrifying Spring* (for that I particularly asked) *Wood* is turned into *Stone* in the *Sandy Earth* it self, after a better manner than by any *Water* I have yet seen. I find it to be a very odd Substance; wonderfully *Hard* and *Fix'd*. Here is a certain *Stone*, that is thought to be *Petrified Bone*, being in shape like a *Bone*, with the marrow taken out; but with a fit *Menstruum*, I found that I could easily *Dissolve* it, like other Soft *Stones*. And possibly it may prove as fit as *Osteocola*, for the same Medicinal Uses.

Petrifications;
by Mr. Rob.
Boyle. n. 6.
p. 101.

XXVII. From the But of a growing *Elm* near *Wadley* (a mile from *Farington* in *Berks*) one of the spreading Claws having been formerly cutt off with an *Axe*, that part of the But, from whence the same was severed, being about $1\frac{1}{2}$ foot above ground, and inward within the Trunk of the Tree, hath contracted a *Petrified Crust*, about the thickness of a Shilling all over the *Woody part* within the *Bark*; the marks of the *Axe* also remaining very conspicuous with this *Petrify'd Crust* upon it.

By Mr. Phi.
Packer. n. 19.
p. 329.

XXVIII. We have some *Waters* in *Scotland* that *Petrify*. Upon the North side of the *Firth of Forth*, some 8 Miles from the City, there is a Cove close upon the Sea, the Roof of which is covered with a *Stalagmites* a Foot deep, like the Fringe of a Bed; the upper Coat is of a Sea-Colour, the Juice is as white as the *Sal Prunellæ*; the *Water* which Droppeth from it, if it touch the Skin, maketh it *Smart*. Near to this same Cove, is a piece of an hollow Rock, which within, from the Top to the Bottom, is full of so many Orders of *Columns*, resembling the Pipes of a Church Organ, and some of different Figures; I broke a small one and found it somewhat *Hollow* in the middle. All the *Ground* in this place is full of *Lime stone*.

Petrifying Waters in Scotland;
by Sr. Rob. Sibbald. n. 222.
p. 321.

XXIX. As I Travell'd over *Stanemoore* in *Yorkshire*, I observ'd the River *Greatah* (a River about half as big as *Charwell* at *Oxford*) Run under Ground for about a Mile, so that we pass'd over it dry foot. The Passage under Ground is but Narrow; so that in *Winter* when the Streams are High, it keeps the Channel above Ground.

The River Greatah Running under Ground; by Mr. Hugh Todd. n. 163.
p. 729.

XXX. At some Leagues Distance from *Gottenburgh* in *Sweden* that River Rushes down from a Prodigious high *Precipice* into a deep *Pit* with a Terrible Noise, and such a mighty Force that the *Masts* (which are floated down this River to *Gottenburg*) usually turn Topsy-turvy in their Fall, and do often Fly to pieces when dashed against the Surface of the *Water* in the *Pit*. This occurs if the *Mast* fall Sideways upon the *Water*; But if they fall Endways, they Dive so far under *Water* that (according to my Information) they Rise not again

A Cataract in Gottenburg River; by Mr. Gourdon. n. 266. p. 691.

again for $\frac{1}{4}$ Hour; others $\frac{1}{2}$ Hour; several $\frac{3}{4}$ of an Hour; and some a whole Hour and upwards. The *Lake* or *Pit* into which they Fall, has been often Sounded with a Line of some *Hundred Fathoms* Long, but never could they find any *Ground*.

River-Water
Recover'd after
Stinking; by ...
... n. 127.
p. 652.

XXXI. Though it be commonly reputed Peculiar to the *Thames-Water* alone, upon *Stinking* to be recoverable or *Potable* again; I can affirm upon my own knowledge, that *Water* taken aboard at *New-London* in *New-England*, though in 8 days time it *Stunk* intolerably, yet when we came to *Virginia*, it *Recovered* so perfectly, that I made no *Scruple* to *Drink* of it in *Harbour*, even when we had *Fresh Water* newly brought from *Shore*; nor could I easily perceive, it had any *Relicks* of its late *Corruption*.

Inundations in
Gascoyne, by
M. Pl. Col.
... 1. p. 9.

XXXII. 1. In the Beginning of *July* 1678. after some gentle *Rainy Days*, which had not Swelled the *Waters* of the *Garonne* more than usual, one *Night* this *River Swelled* all at once so mightily, that all the *Bridges* and *Mills* above *Toulouse* were carried away by it. In the *Plains* which were below this *Town*, the *Inhabitants*, who had built in places which by long *Experience* they had found safe enough from any former *Inundations*, were by this *Surprised*; some were *Drowned* together with their *Cattle*; others had not saved themselves but by *Climbing* of *Trees*, and getting to the *Tops* of *Houses*; and some others who were looking after their *Cattle* in the *Field*, warned by the *Noise* which this *Horrible* and *Furious Torrent* of *Water* (*Rowling* towards them with a *Swiftnes*s like that of the *Sea*) [*in Britaigne* he means] made at a *Distance*, could not scape without being *Overtaken*, though they fled with much *Precipitation*: This nevertheless did not last many *Hours* with this *Violence*.

At the same time exactly, the two *Rivers* only of *Adour* and *Gaue*, which fall from the *Pyrænean Hills*, as well as the *Garonne*, and some other little *Rivers* of *Gascoyne*, which have their *Source* in the *Plain*, as the *Gimone*, the *Saue*, and the *Rat*, Overflowed after the same manner, and caused the same *Devastations*. But this *Accident* happen'd not at all to the *Aude*, the *Ariege*, or the *Arise*, which come from the *Mountains* of *Foix*, only that they had more of the same than those of the *Conserunt*, the *Comminge*, and the *Bigorre*.

M. Martell (by the order of *M. Foucault*) hath searched after the *Cause* of this *Deluge*, being assur'd that it must have had one very *Extraordinary*: For all who had seen the *Circumstances* agreed, that it had *Rain'd* indeed, but that the *Rain* was neither so great, nor lasted so long, as to swell the *Rivers* to that *Excess*, or to *Melt* the *Snows* of the *Mountains*.

But the *Nature* of these *Waters*, and the manner of their *Flowing* from the *Mountains*, confirm'd him perfectly in his *Sentiments*. For, 1. The *Inhabitants* of the *Lower Pyræneans* observ'd, that the *Water* flowed with *Violence* from the *Entrails* of the *Mountains*, about which there were open'd several *Channels*, which forming so many *furious Torrents* tore up the *Trees*, the *Earth*, and great *Rocks*, in such narrow places where they found not a *passage* large enough.

nough. The Water also which Spouted from all the sides of the Mountain in innumerable Jets, which lasted all the time of the greatest Over-flowing, had the Taste of Minerals.

2. In some of the Passages, the Waters were Stinking (as when one Stirs the Mud at the Bottom of the Mineral Water) in such sort that the Cattle refused to Drink of it, which was more particularly taken notice of at Lomber, in the Overflowing of the Saue (which is one of the Rivers) where the Horses were 8 Hours Thirsty before they would endure to Drink it.

3. The Bishop of Lombes having a desire to cleanse his Gardens, which the Saue passing thorow by many Channels by this Overflowing, had fill'd with Sand and Mud; those which entered them felt an Itching, like to that which one feels when one Baths in Salt Water, or Washes ones self with some strong Lixivial. This Itching could not be produc'd by either Rain or Snow Water, but by some Mineral Juice, either Vitriolick or Aluminous, which the Waters had Dissolved in the Bowels of the Mountains, and had carried along with it in passing out through those numerous Crannies.

For these Reasons M. Martel Believes the true Cause of this Overflowing to be nothing else but Subterraneous Waters. And to explain the Means of this Irruption, he supposes that there is in the Earth a great Number of Basons, Cavities, or great Receptacles of a vast Extent full of Water, from which by divers issues into lower passages there gets and runs out Water enough to furnish that which runs above the Earth, during the Seasons that it Rains little or nothing.

One cannot well doubt of the Truth of this Supposition if he considers.

1. That in Mines as well as in Pits, the more one diggs the more abundance of Water is met with.
2. That there are Rivers that the Earth Swallows, as that of Guadalquivir in Spain, and others that Gush out of it compleat Rivers.
3. That there are Gulphs in divers parts of the Sea.
4. That there are Lakes without Bottoms, consonant to what P. Kircher remarks in his *Mundus Subterraneus*, which Diminish not at all, and yet receive little or nothing of Water from above. Such as are in the same Pyrenean Mountains the Lake of Berwale, of Barboiau, and St. Pé.
5. And to Conclude, That there are found in Caves vast Subterraneous Lakes; as amongst others, that in a Cave near Grenoble, of which Francis the first had the Curiosity to desire to know the Extent, having caused a Boat to be made for this Purpose. Hence we must conclude, that the Inner parts of the Earth are like a Sponge Dipped in Water, and soaked on every side; or like our Body filled with differing Vessels which are the Canals, through which the Blood is communicated to the whole Body.

This being so, 'tis not at all difficult to understand how the Earth thus constituted may suffer, in process of Time, great Changes within its Bowels, as well as on its Superficies, where the parts of Mountains and vastly great Rocks Separating and Tumbling down, Crush sometimes whole Towns, as it happen'd in the Year 1618. to the Town of Pleurs, in the Valtoles, by the fall of a Rock which hung over that Town. This Matter is more easily to be done in the Bowels of the Earth, because the Waters or Subterraneous Rivers do soak,

and

and by Degrees undermine the parts of the Earth which uphold the heaviest Mountains: Whence it must necessarily follow, that these same Mountains must Sink down in Proportion to the Mass they have lost. And 'tis certain, that somewhat like this happened in these *Mountains*: For the People which inhabited those parts, have seen the Earth Cleft in divers places. And have observed also, that in some Places there have happen'd *Foundering*s of the *Earth* for a very considerable Extent, one part of the Mountain being Separated, Sunk down, which appeared by the profound Clefts many Feet deep, but of little Breadth. So this Mass of the Mountain in its Settling all at once upon the Water of the Gulphs or *Subterraneous Lakes*, which are under the highest *Pyrenean* Mounts, in all the extent they take up from *Le Foix* even to *Bern*, do force the Water to *Gush* out all together with great Violence to the same Quantity with the Bulk of that part of the Mountain which is Settled in the *Subterraneous Lakes*, which is the Cause of this Prodigious Overflowing.

But that which will not suffer me to doubt at all but that there was some such *Subterraneous* Tumbling down, is this, that three Months after this furious *Inundation*, that is to say, about the end of *September*, there happen'd a *Second Overflowing* in some Places near to those where the first happen'd, which made also great Spoil, particularly that which came from the River of *Arriège*. And 'twas then Remarkable, That a Fountain that runs from a Rock upon the *Lot*, near the *Cahors*, considerable for the Abundance of it's Water which turns three Mills at its very Source, became all *Red*, which was never seen before in the Memory of Man.

Some Effects of
Vitriolate Wa-
ters; by Mr. J.
Beaumont. Ph.
Col. n. 2. p. 6.

2. One *Will. Dally*, an able Miner, being employed at *Week* in *Glocestershire*, about 2 Miles from *Kenysham*, to renew an *Old Work* which was about 6 Fathom deep, and was more than half full of Water, he drew what he could out with a Bucket, and then he went down into the *Mine* to clear out the remainder. Having stood in the Water some Days his Legs began to *Itch* extremely, and *Swell'd* very much, and at length broke out into *Sores*. I enquired of him how the *Ore* lay in it's *Mine*, and he told me the *Vein* of *Ore* grew in the middle of a *Vein* of *Sulphur* (as he call'd it) that is, *Marchasites*, which was about a Yard wide; from this I easily gathered, that the *Waters* in the *Mine*, having stood a long time on that large Bed of *Marchasites*, was strongly impregnated with the *Vitriolate Salts*, which abound in them, and was the Cause of the *Itching* and *Swelling* of his Legs.

An Inundation
in Ireland; by
Dr. Hook. Ph.
Col. n. 2. p. 1.

XXXIII. *Jun. 26 1680*. An *Inundation* happen'd not far from *Londonderry* in *Ireland*, more Monstrous than that in *Gascoyne*. 'Tis suspected that both proceeded from some extraordinary Change in the *Subterraneous Caverns* of those Hills from whence the Water gushed, very few Mountains being without them.

Inundations in
Yorkshire; by
Mr. R. P.
n. 245. p. 382.

XXXIV. 1. The Inhabitants of *Kettlewell* and *Starbottan*, in *Craven* in the County of *York*, suffer'd a very great Loss in *June 1686*. by a suddain *Overflow* of *Water*. The Towns are situate under a great *Hill* on the East and West; the Countrey is very *Mountainous* and *Rocky*. The Descent of *Rain* was

was after a Thunder-Clap, for about the continuance of an Hour, and half with extraordinary Violence, and by several Eye-Witnesses the *Rock* on the East side Opened Visibly, and Water they beheld thence into the Air the height of an ordinary Church-Steeple; so that the *Current* of Water came down the Hill into the respective Towns, as in one entire Body, and with a *Breast* as if it would have Drowned the whole Towns, Several Houses were quite Demolished, and not a Stone left; others Gravell'd to the Chamber-Windows; some Inhabitants driven, until this Day, from their Habitations, the Current of the Water running through their Houses; mighty Rocks Descended from the Mountains into the Valley, and there lie immoveable; many fair Meadows covered with Sand and Stones, that the Worth of the Soil will not Regain the same; Household Goods taken away into the great River of *Wharfe*, and so lost, besides many Quick Goods. The Loss reputed to be many Thousand Pounds; many Families quite Ruined, others in part only.

There have been *two* other *Floods* since the *first*, though not so great and dangerous. The *Becks*, or *Currents* of *Water*, which run through these Towns were so Gravell'd up by the *first Flood*, that the Passage is much altered, and cannot be *Regain'd*; though there have been many Hundreds of Men set to do it.

2. *Mar. 22. 1696* At half an Hour after 12 a Clock, being Calm but a little *Rainy* Weather, the River which passeth by the plain Ground of *Noordwyck*, did in the space of a Quarter of an Hour *Swell* to that Height, that the Sugar-Mill, the Sugar-Work, and almost all the said Ground was thereby Ruined, the most part of the Sugar Canes being rooted or torn out of the Ground by the Violence of the *Torrent*. We cannot Imagine whence so sudden a *Swelling* of this River has been caused, while the *Rain* not being very hard, could not be of that Effect; for in such Case it should have continued longer; for about 12 a Clock, when the Company's Servants assembled for their Dinner, the Water of the River was at it's ordinary Height, and before they had half Dined all the Country was *Overflown* by the Water, *viz.* one Foot higher than 2 Years ago by Reason of the *Hurricane*, when we had so Violent a Storm as ever was heard of. And at one a Clock all the extraordinary Water was Gone, and the River again at it's Ordinary Height. There has been no *Earthquake* that could Cause it, neither was there any such thing in other *Rivers*.

*In Mauricius
Iland; by M.
Roel of Dic-dati.
n. 242. p. 268.*

XXXV. In order to compare the Quantity of *Rain* with the Quantity of Water running away in *Springs* and *Rivers*, it is necessary to measure these two sorts of *Water*. Those that make Profession of governing and conveying *Spring-Waters*, say that a Cubick Inch of Water yields in 24 Hours 144 *Muids*, (the name of a *French* Measure, holding 280 *French Pints*;) others say, it yields but 70 of that Measure.

*The Origine of
Fountains and
Rivers; by
M..... n. 119.
p. 447.*

But I have Reason to believe, that it yields 83 of this Measure, and follow those that say, that a Vessel of twoFoot deep, long, and broad, holds one *Muid* of Water.

And therefore if a *Conservatory* should hold 3378 *Muids* of *Water*, it would furnish for a whole Year a sufficient Quantity to make an *Inch* of *Water* run constantly. As for the Measure of *Rain Water*, I have found by Observations that from *Oct.* 1668 to *Oct.* 1669, there had fallen so much of it as mounted to the *Height* of 18 *Inches* 7 *Lines*; and from the same Month 1670 to the same Month 1671, there happen'd only so much as came to the *Height* of 8½ *Inches*; and from *Jan.* 1673 to *Jan.* 1674 to the *Height* of 27½ *Inches*. Of which, taking the Medium, we have 19 *Inches* and 2½ *Lines*.

This suppos'd, let us Estimate some *River*, as it runs from it's very Source to a Place where some *Rivolet* enters into it, and see, whether the *Rain Water* that falls about the Course thereof, if it were put into a *Conservatory*, would be sufficient to make it Run a whole Year. In order to this I have considered the *Seine* which from its Source to *Ainay le Duc* is about 3 Leagues long, and the sides of it's Course extend themselves on the Right Hand and the Left about 2 Leagues on each side, where there are other little *Rivers* that run another way: And, since that those *Rivolets* need *Water* to maintain them as well as the *Seine*, I will count but half that space of the sides, and say, that the Place where the *Seine* passes, hath from its Source to *Ainay le Duc* three Miles long and two Miles large. Whereupon I say further, if a *Conservatory* were made for this bigness, it would be 6 square Leagues in Surface, which being reduced to Fathoms, would make 31245144 Fathoms in Surface. In this *Conservatory* Imagine that during a whole Year there has fallen *Rain* to the *Height* of 19 *Inches* 2½ *Lines*, as was said before. This *Height* of 19 *Inches* and 2½ *Lines* gives 280899942 *Muids* of *Water*, or there about, according to the Measure suppos'd.

All this *Water* thus Collected is that Stock which is to serve to make this *River* run for a whole Year, from its Source to the Place before Named, and which must also serve to supply other Occasions and Losses, such as are the Feeding of *Trees*, *Herbs*, *Vapours*, and extraordinary Swellings of the *River* whilst it *Rains*, and *Deviations* of the *Water* running another Way.

Concerning the Measure or Estimate of the *Water* of this *River*, it would be difficult to find it just and precise, and to determine what Quantity it furnishes. Yet so far as I was able to judge, it can have no more than 1000 or 1200 *Inches* of *Water* always running, compensating the lesser Quantity it hath at its Source with the greater it hath towards *Ainay le Duc*: The which I so judge by the Comparison I make of these *Waters* with those of the *River* of the *Gobelins*, in the Condition wherein it is towards *Versailles*, where it hath 50 *Inches* of *Water*, according to the Measure taken of it. So that I esteem, it will be enough to allow twenty four or twenty five times as much to our *River*. For the Channel of it is to be 4 or 5 Fathoms large, and for Depth it is but Shallow; it Carries no Boats, and serves only to Float down some loose Billets.

These Particulars being thus suppos'd, I say, that 1200 *Inches* of *Water* do furnish in 24 Hours 99600 *Muids* of *Water* after the Rate of 83 *Muids* to an *Inch*, that is 36453600 for a whole Year. And therefore taking this Quantity

ty of $36\frac{1}{2}$ Millions from the 280 Millions that falls into the *Conservatory* above described, there will remain yet above 188 Millions of *Muids*, which amounts to almost 5 times as much, and which serves to furnish for the *Losses Diminutions*, and other *Wastes*, above taken notice of. So that there needs but the 6th part of the *Rain* and *Snow-water* that falls in a Year, to run continually through the whole Year.

Now if these *Rain Waters* are sufficient to make one *River* run, they may also suffice for all the rest in Proportion; considering especially, *first*, what remains for *Waste*, which is superabundant; and *Secondly*, what little space I allow to both sides of the *River's Course*, which is but of one League on each side. For *Rivers* are not commonly two Leagues near one another.

It may be Objected, that there are Countries where it *Rains but Seldom*, and somewhere it *Rains not at all*, and yet there are *considerable Rivers*. But I answer, that the *Rivers* of those Countries, where it *Rains but Seldom*, do not run continually, being only big in Winter, but in Summer almost quite dried up. The Reason of both which Effects is, that they being nigh some high Mountains whence they come, the *Snow* that falls in Abundance on those Hills, and is *Melted* afterwards, is able, as long as that Water lasts, to make them run abundantly in Winter, leaving them Dry when it ceases in Summer.

As for the Countries where it *Rains not at all*, there are but few of them in the World. The *Torrid Zone* (where that may be more true than any where else) is a Climate abundantly Moistened with *Rains* twice a Year, and it may be more than these Northern Countries, at least in greater Plenty at certain Seasons. But if there should be any Countries where *no Rain at all* should Fall, that will not hinder the Running of *Rivers* there, because they may have their Sources in other Countries where it *Rains*, as the *Nile* in *Ægypt* where it *Rains not*.

XXXVI. 1. About 2 Leagues from *Paderborn*, is a Treble Spring call'd *Metborn*, which has 3 Streams, two whereof are not above one Foot and an half distant from one another, and yet of so differing qualities, that whereas one of them is Limpid, Blewish, Lukewarm, Bubling and holding *Sal Armoniack*, *Ochra*, *Iron*, *Vitriol*, *Allum*, *Sulphur*, *Nitre*, *Orpiment*, used against *Epilepsies*, bad *Spleens*, and the *Worms*; the other is Ice Cold, Turbid and Whitish, much Stronger in *Tast*, and Heavier than the former, holding much *Orpiment*, *Salt*, *Iron*, *Nitre*, and some *Sal Armoniack*, *Allum* and *Vitriol*; of this all Birds observed to Drink of it do *Dye*; which I have also privately Experimented by taking some of it home, and giving it to Hens, after I had given them Oats, Barly, and Bread Crums: For, soon after they had Drunk of it, they became Giddy, Reeled and Tumbled upon their Backs, with Convulsion Fitts, and so Dyed with a great extension of their Leggs. Giving them common *Salt* immediately after they had Drunk they Dyed not so soon; giving them *Vinegar* they Dyed not at all, but 7 or 8 days after were troubled with the *Pipp*. Those that Dyed being opened, their *Lungs* were found quite Shrivelled together. Yet some Men that are troubled with *Worms*, taking a little Quantity

Mineral Springs,
about Paderborn
in Germany; by
.... n. 7. p. 133.

tity of it, and diluting it in common Water, have been observed by this means to kill the *Worms* in their *Bellies*, so that a great Number of *Worms* came from them; whereupon though they are Sick, yet they Dye not. As to the 3^d Stream that lies lower than the other two, about 20 paces distant from them, it is of a Greenish Colour, very Clear, and of a Sour Sweet Taste, Pleasing enough. It hath about a middle *Weight* between the other two, whence we guess, that it is mixed of them both, meeting there together; to confirm which we have mixed equal Quantities of these two, with an addition of a little common Well-water, and have found that they, being stirr'd together and permitted to Settle, made a Water just of the same Colour and Taste of the 3^d Stream.

At Basel; by ...
ib. p. 134.

2. At *Basel*, the Spring running in the *Gerbergasse* (or *Tanners Street*) from *St. Leonard's Hill*, is of a Blewish Colour, and somewhat Troubled, holding *Copper*, *Bitumen*, and *Antimony*, about 3 parts of the first, one of the 2^d and two of the Last; as have been examined by Skillful Persons. Our *Tanners* do water their *Skins* in it; and being a well Tasted and Wholesome Water, it is both much *Drunk* and used to *Bath* in.

There are two others, called *Randulphs Well*, and *Brun Zam Brunnen*, very Observable: The former of them having a *Camphory* and *Drying* Quality, and used against *Hydropical* Distempers; the latter containing some *Sulphur*, *Salt Peter* and *Gold*, and being an excellent Water to *Drink*.

Near Yeoville
in Somerset-
shire; by Dr.
J. Beal. n. 18.
p. 323. n. 20.
p. 359.

3. Mr. *Philips* of *Montague* has in his Pastures of *Socke*, about 3 Miles from *Yeovill*, a large Pool to which *Pigeons* resort, but the *Cattle* will not Drink of it, no not in extream want of Water. To the Taste it is not only *Brackish*, but hath other Loathsome Tastes. In a Venice Glass it looked Greenish and Clear, just like the most Greenish Cyder as soon as it is perfectly Clarified. I boil'd a Pint of it in a Posnet of Bell Metall, and suddenly it yielded a thick Froth, having somewhat of a *Vitriolate Taste*. Suffering the Water to be Boyled all away, it left much of the same on the sides and bottom of the Posnet.

On Malvern
Hill in Here-
fordshire; by
Dr. J. Beal.
n. 20. p. 358.
p. 57. p. 1161.

4. There is a Spring near the Top of *Malvern Hill*, having a long and old Fame for *Healing* of *Eyes*: And about a Furlong lower is another *Healing Spring*. When I was for some Years molested with *Tetters* on the back of one and sometimes of both my Hands, notwithstanding all endeavours of my very friendly and Skilfull Physicians, I had speedy Healing from a Neighbouring *Spring* of far less Fame. Yet this Spring healed very old and Ulcerous Sores on the Legs of a poor Fellow, which had been Poisoned by Irons in the Goal, after other Chirurgery had been hopeless. And by many Trials upon my Hands and the *Tetters*, I was perswaded, that in long *Drougths* and lasting *Dry Frosts*, those Waters were more effectually and more speedily *Healing*, than at other times. I held this Water in my Mouth till it was warm, and perchance somewhat intermingled with *Fasting Spittle*, and so dropping it upon the *Tetter*, I there could see it immediately gather a very thin *Skin* upon the *Raw Flesh*, not unlike that which is seen to gather upon Milk over a Gentle Fire. This *Skin* would have small Holes in it, through which a Moisture did issue
in

in small Drops, which being Wiped away, and the Water continued to be Dropp'd warm out of the Mouth, the Holes would diminish, and at last be all quite Healed up.

For the *Eye Waters*, I conceived them more strongly *Tersive*, and Clearing the *Eyes*; and they had a Rough Smartness, as if they carried Sand or Gravel into the *Eye*.

5. I think the Waters we call *Chalybeate*, and particularly this at *Farrington*, to be impregnated principally from the *Vitriol*, or *Salt of Iron*, which is very Volatile; so that little of it can be found by Evaporation of a great quantity, or from the Precipitated Sediment. I put 4 Ounces of ordinary clear Water into a Glass, and impregnated it with a known proportion of *Gall*: Then by degrees I let fall into it the *Salt of Iron*, until I found it thereby as deeply Tinged Red, as the same quantity of *Farrington-Waters* would be by the same proportion of *Gall*: The quantity of the *Salt of Iron* that performed this, was near two Grains. This Water, so Tinged, Tasted and Smelled just as the natural Water from the Spring with *Gall* did: If I added a greater proportion of *Salt*, it would make it Nauseous and *Emetical*.

At *Farrington* in *Dorsetshire*; by *Dr. Highmore*. n. 56. p. 1130.

It begins to be in high Esteem for extraordinary Cures of the *Scorbute*, *Asthma*, &c. It hath [as I have found upon Trial] a larger proportion of the *Mineralls*, than *Astrap-water*; but the force holds not, if *Removed* from the *Spring-head*.

n. 51. p. 1039.

6. About a Mile and half out of *Durham*, on the North-East-side near *Butterby*, is lately discovered a *Medicinal Spring*, which is this Year much frequented, and may be of great benefit to the Country. It was found out by Workmen that dug in that place for Coal. When they were 12 Fathom and an half deep, they discovered this Treasure of *Natural Physick*. They then tryed the Rock about 100 Yards off; where they lost themselves much about the same Depth; and instead of Coal discovered a *Spring* of excellent clear Water, which issues out at the Hole which their Instruments made.

In the *Bishoprick of Durham*; by *Mr. Hugh Todd*. n. 163. p. 727.

7 At *Lancarim* in *Glamorganshire* is a *Medicated Spring*, much frequented from several Counties, time out of Mind, for the *King's Evil*. There is a Rill of about an Ell broad between two Collines, covered with Wood; about 12 Yards from this *Spring*, the Rill falls from a Rock 8 or 9 Foot high, which makes a grateful Noise; the *Spring* (which is exceeding Clear) comes out of a pure *White Marle*; tho' I thought there had been no *White Marle* in *Wales*, for the Earth is Red. A *Graduate Doctor* hereabout imputes the Virtue of this *Spring* to the *Lime Stone*, and says one of the chief Ingredients of the Doctors for the *King's Evil*, is *Lime water*.

In *Glamorganshire*; by *Mr. Aubry*. n. 233. p. 727.

8 I had a *Mineral Water* sent me, not long since, by *Mr. Duncan* (a Surgeon) from *Eglingham* in *Northumberland*. I found it turned almost quite Black with Galls, though it had been brought at least 30 Miles by Land-Carriage. After I had slowly, in a Glass, Evaporated more than one half of this Water, it still retained the same *Atramentous Quality*, and struck yet as Deep with Galls as ever; and at last it yielded me a Real and Genuine *Vitriol*. I say nothing of the *Ocre* which this Water let fall in very great Plenty, that being a thing common to all *Atramentous Waters*.

At *Eglingham* in *Northumberland*; by *Dr. Cay*. n. 245. p. 365.

I was surprized at this Phænomenon: For I could not bring my self to think it possible, that the *Pyrites*, lying constantly under *Water*, should ever yield *Vitriol*; and I knew of nothing else (at least in *England*) that I could expect it from. But having lately an Opportunity to visit this *Notable Well*, I found our mighty Rarity, our *Vitriol-Water*, to be only on old *Drift* made for the Draining of a Row of old-wrought *Coal Pits* a little above, and I inform'd my self from some old Men, that had formerly wrought in these *Pits*, that there was Plenty of the *Pyrites* there, by them call'd, *Brass Lumps*; and that this *Drift* was sometimes Dry, and sometimes ran with a plentiful Stream; which is as fair and full an Account how this *Water* comes to have *Vitriol* in it, as any one need to desire.

At St. Amand
near Tournay;
by M. Geoffry.
n. 247. p. 430.

9. There has been found a *Mineral Water*, call'd *St. Amand's Water*, which has been very much in use the last Summer and Autumn, in all sorts of Sicknesses, rather for it's Novelty, than for its great and extraordinary Properties. It is call'd *St. Amand's Water*, because its *Spring* is in the Land depending on the *Abby* of the same Name, of the Order of *St. Benedict*, in the Diocese of *Tournay* in *Flanders*; but the *Fountain* is call'd particularly, *La Fontaine du Bouillon*, for the impetuous *Boyling* of that Springing *Water*.

This *Fountain* is situated in a Shallow and Marshy Ground; the *Bason* of the *Spring* is 450 Foot square, there is in the Bottom of that *Bason* the *Mud* of 20 Foot deep; beyond that they find the *Sand*, which sometimes is very moving and at some other times is very firm. Very often this *Fountain* casts up a great Quantity of *Sand*: And last Year in a little Time it cast up more than 16 Cart Loads of it, by the which all the *Bason* was border'd.

There is to be found 3 sorts of *Earth*; the first and Superficial is *black*, and Burns as *Turf*, with the same Smell; the second is *White*; and the 3d has the same Colour as the *Slate*. These two last sorts of *Earth* do give, by *Lixivium*, a *Salt* like *Sal Gemmæ*.

This *St. Amand's Water* in its *Spring* is Clear and *Luke Warm*, and appears much Hotter at Night and in the Morning, than the rest of the Day. It has the *Smell* and *Taste* like Standing *Water*. If it is exposed to the *Air* it loses its *Smell* and *Taste* in a short time. By that Facility to lose its *Taste* and *Smell*, one may judge that it has a *Sulphur* very *Volatile*; and for that great *Volatility* and *Subtility* it is almost impossible to make any Experiments upon it.

This *Mineral Water* has the same *Weight* as the *Seine River Water*. It altered not the Colour of the *Sirrup* of *Violets*, nor the *Tincture* of *Turne Sol*, *Lime Water*, the *Oyl* of *Tartar*, the *Volatile Spirit* of *Sal Armoniack* and *Hart's Horn* have *Whited* that *Water*, and have made in it a light *Coagulum*.

This *Water*, mixt with the *Dissolution* of *Armoniack Salt*, has not given any *Smell*. It has not alter'd the *Infusion* of *Galls*. Mingled with the *Solution* of *Vitriol*, has troubled it a little, and has given a *Greenish Colour*, and at length it *Precipitated* a *Yellow Powder*.

Acid Spirits have not *Fermented* at first with that *Water*, but afterward it has made some little *Bubbles*, which remained to the side of the *Glasses* wherein were contained the *Liquors*.

I have *Distilled* 5 *Pints* of that *Water*; the *Distill'd Water* has not had any *Taste* nor *Smell*, and it has not *Changed* the *Tincture* of *Turne Sol*, neither the *Lime Water*. There remained from that 5 *Pints* (or 160 *Ounces*) 70 *Gr.* of *Residue*; the which, by *Lixivium* has given to me 55 *Gr.* of *Grey Earth*, and 15 *Grains* of *white Salt*, almost like *Sal Gemmae*.

The *Residue* of the *Evaporated Water* put upon the *Burning Coals*, has not cast any *Smoak*, neither has made any *Detonation*; the *Spirit of Nitre* poured upon it, has very much *Fermented*; the *Spirit of Wine* has not extracted any *Tincture* from that *Residue*.

One may conclude by all these *Experiments*, that this *Water* has not any *Acidity*, it participates not of *Vitriol*, nor of *Alum*; and there is in it but a little *Quantity* of the *White Earth*, and less also of *Salt* very like *Sea Salt*.

They are the *Parts* of *Earth* and *Salt*, which shew themselves in the *Mixture* of the *Lime-Water*, &c. of *Fix'd* or *Volatile Alcalis*.

They are the same *Parts* which begin that light *Fermentation* in the *Mixture* of *Acid Spirits*; but that *Fermentation* is imperfect because of the little *Quantity* of the *Earth*, which is *Drown'd* in so great a *Quantity* of *Liquor*; in Effect when the *Water* is *Evaporated*, the *Acid Spirits* do *Ferment* very much with the *Residue*.

It appears by the *Smell* of that *Water*, that it contains a *Sulphur* very *Subtile*, which dissipates it self very easily, and which is not sensible in the *Experiments*. 'Tis nevertheless to be attributed to that *Sulphur*, the principal *Effects* which they do attribute to that *Mineral Water*, as of helping in the *Palsy*, &c. in other sorts of *Distempers* where the *Nervous Gender* is attack'd; in *Short-Breath*, and in all *Affections* of the *Lungs*; and of *Remedying* many other *Infirmities* which are caused by the *Sharp Ferments*, the which are sweetened by that *Water*. For the other *Properties* of it, as of *Purging*, of taking away *Obstructions*, of *Tempering* the *Hot Intrals*, &c. it may have the same *Effects* with common *Water* being drunk abundantly.

One may *Drink* many *Glasses* of this *Water* beginning by 4, 6 or 8 every *Morning*, and augmenting till 12, 18, 20 or more, according as the *Stomack* is able to support it. This *Water Passes* readily by *Urine*, and many *Persons* are *Purged* by it. Sometimes one may mix with it some *Diuretick Salt*, to make it *Pass* more freely, and for rendring it more *De-obstructive*. At other times one may put some *Manna* or other things for making it more *Purgative*. One may *Wash* also in the *Mud* of that *Fountain*, according to *Necessity*.

XXXVII. I have observed a *Spring*, that in all the *Extream Frosts*, that have been these 10 *Years*, hath yielded a small *Stream*, which running over a large *Tract* of *Pasture*, keeps all the *Banks* and *Borders Green*, and free from

A Spring that is never Frozen; by Dr. J. Beale. n. 56. p. 119.

from *Freezing*, Dissolving the *Snow*, and *Smoking* all the way where it runs.

The Baths in Somersetshire; by Mr. Jos. Glanvill: n. 49. p. 977.

XXXVIII. 1. The Country round *Bath* is very Hilly and Uneven; but the Hills lye in order; they are generally Rocky and Steep from South-West and by West, to North-East and by North: The whole Tract of the Country, within 5 and 7 *Miles*, abounds with *Coal-mines*, more or less. But there are no other considerable *Mines* that I can hear of, nearer than *Mendip*, which is 10 *Miles* hence, excepting some of *Lead* at *Berry* in *Glocestershire*, which lyes upon the North of this place, about 4 or 5 *Miles* distant.

2. The Hills for the most part afford a *Free-stone*; and on the North West of *Lansdown* (which hath that Situation to the Town, and is just above it) the Stones digged there, are a sort of Hard stone, commonly call'd a *Lyas*, blue and white, Polishable.

3. The *Town* and *Baths* are of very great *Antiquity*. Besides what I find in very ancient *Chronicles* to that purpose, one of our great *Antiquaries* (Mr. P.) asserts, that these *Baths* were 800 Years before *Christ*: Which if so would give occasion to enquire, how consistent with it that *Hypothesis*, concerning the Cause of the *Heat* of these *Waters*, may be, which makes it to be the *Fermentation* of Minerals *in fieri*; and whether it be likely, that the Minerals through which these *Waters* pass, should be in that state of *Imperfection* so many Hundred Years. But this other *Opinion* seems to me very Probable which supposeth the Cause of the *Heat* to be, that two Streams having Run through and Imbibed certain sorts of Different Minerals, Meet at last and Mingle their Liquors, from which *Commixture* arises a Great *Fermentation* that Causes *Heat*; like as we see it is in *Vitriol* and *Tartar*, which when Mingled beget an *Intense Heat* and *Ebullition*.

4. It is affirmed here, that the *Town* for the most part is built upon a *Quagmire*, though the places all about it are very Firm ground. Some Workmen, that have been employed in digging, have found a *Mire* 10 foot deep: Without the North gate, the highest place of the Town, at *Seaven*. The Earth between is a kind of *Rubbish*; sometimes they find *pitching* a man's length underground, and passages for the Water to pass 7 or 8 foot down they have met with *Oyster-shells*.

5. The *Town* and Country circumjacent, generally abound with *Cold Springs*: And in some places the *Hot* and *Cold* arise very near each other; in one place, within two Yards, and in others, within 8 or 9 of the Main *Baths*.

6. The *Guides* of the *Cross-Bath* inform me, that when there is a great West Wind abroad, standing by the *Springs* they feel a Cold Air arising from beneath: If the Wind be at East and the Morning close with a little misting Rain, the *Cross Bath* is so Hot as scarce to be endured, when the *King's* and *Hot Baths*, are Colder than usual. In other Winds let the Weather be how it will, this *Bath* is Temperate. The *Springs* that *Bubble* most are Coldest. The *Cross-Bath* fills in 16 hours, both in Winter and Summer, without any difference

difference from Heat or Cold, Flouds or Drought; That of the *Kings* in 12 or 14 hours.

7. A Man may better (ordinarily) endure 4 hours Bathing in the *Cross Bath*, than $1\frac{1}{2}$ in the others. In the *Queen's Bath* (which hath no *Springs* of its own; but comes all out of the *King's*) they have found under a flat stone, which upon occasion was taken up, a Tunnel, and a Yielding *Mud* in and under it, into which they thrust a Pike, but could feel no bottom. In the *Kings Bath* there is a Spring so *Hot*, that it is scarce Sufferable, so that they are fain to turn much of it away, for fear of inflaming the *Bath*. The *Hottest Spring* will not harden an *Edge*.

8. The *Bath Water* does not pass through the Body like other *Mineral Waters*; but if you put in *Salt* it *Purgeth* presently. Upon *Settlement* it affords a *black Mudd*, useful in *Aches*, applyed by way of *Cataplasm*; to some more successful than the very *Waters*. The like it *Deposits* upon *Distillation*, and no other. Nor hath any more been discovered upon all the *Chymical Examinations*, that have come to our knowledge. One *Dr. Astendoff* found, that the Colour of the *Salt*, drawn from the *King's* and *Hot-Bath*, was *Yellow*; that which was extracted from the *Cross-Bath*, *White*. This *Dr.* Concluded, that the *Cross Bath* had more of *Allum* and *Niter*, than the *Hottter Baths*, which abound more with *Sulphur*. And yet that *Bath* loosens *Sbrunk Sinews*, by which it should seem it abounds not much with *Allum*. It is Harsher to the *Tast* than the other *Baths*, and Soaks the *Hands* more.

9. A Man cannot *Drink* half the quantity of Strong Drinks in the *Bath*, that he can *out* of it; but if he hath *Drunk* before to excess, it allays much, and is a great refreshment to the Body. The *Bath* provoketh *Urine*.

10. They are very useful in *Diseases* of the *Head*, as *Palsies*, *Epilepsies*, and *Convulsions*; In *Cuticular Diseases*, *Leprosies*, *Itches* and *Scabbs*; in all *Obstructions* of the *Bowels*, as *Spleen*, *Liver*, and *Mesentery*, and the *Schirrosity* and *Hardness* of those parts; in most *Diseases* of *Women*; in the *Scurvy* and *Stone*: As to which last while I am Writing, an *Alderman* of the *City* assures me, that his *Wife*, who had been exceedingly troubled with the *Stone*, went into the *Cross-Bath* for it, and *Voided* there several *Stones* as bigg as those of *Olives*, and was never troubled with that distemper after. The *Bath* is also good in *Cold Gouts*, as they call them.

The same *Alderman* tells me, that it gives him present *Ease*, when he is troubled with the *Fits* of it. He uses to go in, as soon as the fit takes him; which then goes off presently, and returns not in a considerable time after: He puts his *Feet* upon the *Hottest Springs* in the *King's Bath*.

But it hath a contrary *Effect* in *Hot Gouts*; and some who are troubled with that *Distemper* tell me, that the *Bath* puts them into a *Fit* if they go into it without *Preparation*; or if they have the *Fit* before, it inflames it more, and sends it about the Body, and disables the *Joynt* so, that there is no *Treading* on it for the present. Further, the *Bath* is effectual in the *Diseases* of *Children*, particularly the *Rickets*, removing the *Humours* that proceed from it without fail. 'Tis also good for *Women* that are apt to *Miscarry*, if us'd moderately.

The *Bath-guides* go in, when they are ready to *Lye down*; and other *Women* of the Town use it ordinarily throughout their Time, and are never observed to *Miscarry*. It facilitates *Deliverance*. Besides is very effectual for the Streightning of *Broken Bones*, and good in all *Cold* and *Moist Distempers* and *Weakness* of *Nerves*, *Stupefactions*, *Relaxations*, and *Violent Pains*: In all which it gives Ease, except the *Lues Venerea*, for in that (except the Malignity be overcome by the Methods of Physick) it Exasperates the *Pain* more. 'Tis an excellent Remedy to remove the remaining *Weakness* in *Gouts*, as hath been remarkably exemplified in Old Men, even to the Age of 83. Years.

11. There is no instance of *Cures* performed by it in Former Times, but we have the experience of it in Ours; yea and in some others, as in *Dropsies*, *Cachexies*, *Spleen*, &c. In which Cases they were Shy heretofore of using the *Bath*, for fear of Confirming those *Obstructions*, whereas 'tis now found, that their Cure is Facilitated by it.

12. The *Bath guides* live to a very great Age, sometime to near 100 Years; ordinarily, if they are Temperate to 70. There are two at this time above 80, a Man and his Wife.

13. In the *Cross-Bath* the *Guides* have observed a certain *black Fly* with *Sealed Wings*, in the form of a *Lady Cow*, but somewhat bigger. They say, it shoots quick in the Water, and sometimes Bites. It lives under the Water, and is never found but in very *Hot Weather*: They suppose it comes up with the *Springs*. It is not to be seen elsewhere,

14. The *Cross Bath* Eats out *Silver* exceedingly; and I am told that a Shilling in a Weeks time hath been so Eaten by it, that it might be wound about one's Finger. The *Baths* agree (as the Vulgar speak) with *Brass*, but not with *Iron*: For they will Eat out a Ring of this Metal in 7 Years, when *Brass* Rings seem to Receive no prejudice at all from it.

15. When *Women* have washt their Hair with the mixture of Beaten Eggs and Oatmeal, this will Poison the *Bath* so, as to beget a moist noisome *Smell* casting a *Sea-Green* on the Water, which otherwise is very Pure and Limpid. This will Taint the very Walls, and there is no Cleansing of it, but by Drawing the *Bath*.

16. In Summer the *Baths* purge up a *green Scum* on the Top, but in Winter never; but then leave a *Tallow* on the Walls.

17. The Walls that keep in the *Hot Springs* are very Deep set, and Large; 10 Foot thick, and 14 deep from the Level of the Street. The *Cement* of the Wall is *Tallow*, *Clay*, *Lime* and *beaten Bricks*. In the Year 1659. the *Hot Bath* (a *Bath* particularly so call'd, of equal Heat with the *King's Bath*) was much Impaired by the breaking out of a *Spring*, which the Workmen at last found again, and Restored. In Digging they came to a firm Foundation of *Factionous* Matter, which had Holes in it like a *Pumice Stone*, through which the Water played; so that 'tis like the *Springs* are brought together by *Art*: Which probably was the *Necromancy*, the People of ancient times believed and reported to have contrived and made these *Baths*; as in a very ancient *Manuscript Chronicle* I find these Words: *When Lud Hidirafs was Dead, Bladud his Son, a great*

great Nygromancer (so 'tis there writ) was made King, and he Made the Wonder of the Hot-Bath by his Nygromancy; and he Reign'd 21 Years, and after he Died and Lies at the New Troy. And in another old Chronicle 'tis said, that King, Bladud sent for the Necromancers to Athens to Effect this great business; who 'tis like were no other than cunning Artificers, well Skill'd in Architecture and Mechanicks.

18. It hath been observed, that Leaves, like those of Olives, come sometimes out of the Pump of the Hot Bath.

2. These Waters have been long Famous for the Cure of Palsy's and Barrenness: An Instance of Both in one Person, I shall now give you, A Gentlewoman of about 30 or 32 Years of Age, having been Married about 10 or 12 Years, and never with Child, was suddenly seiz'd with a Palsy on the Left side, for which (after 8 or 10 Months Trial of other Means to little Purpose,) she was brought to the Bath, where (after usual Preparations, and some internal Means,) she continued that Season, about 6 Weeks; the Winter coming on she was forced to desist; but (by the Advantage she received, was Encouraged to come very early the next Year, and did continue with us the whole Summer, and recovered, in great Measure, the use of her Arm and Hand, Leg, and Tongue; and not only so, but, in a few Weeks after, she returned to her Husband,) Conceived with Child, and had (at about a Year and halfs Distance between them,) 5 Children, following. She shew'd me 4 of them Lusty and Strong and well grown for their Age, the 5th Dyed. She her self hath no return of a Palsy but is Infirm, I think Consumptive; she is now about 51 Years Old.

By Dr. Pierce
n. 169. p. 944.

XXXIX. At Baden a little City in Austria, 4 German Miles Southward from Vienna, seated on a Plain but nigh unto a Ridge of Hills, which are the Excursions of Mount Cetius, are convenient Baths; two within the Town, five without the Wall, and two beyond a Rivulet called Swechet.

Baths in Austria
and Hungary;
by Dr. E.A.
Brown n. 59.
p. 1044.

The Duke's Bath is the largest, about 20 feet square, in the middle of an House of the same Figure, built over it. The Vapour passes through a Tunnel of Wood, at the Top: And the Water is conveyed into the bottom of the Bath, at one Corner, through wooden Pipes and Trees, under the Town-Wall, from the Spring-head, which Riseth at a little distance Westward. The Springs of the rest of the Baths Rise under them, and are let in through Holes of the Plancher, for all the Baths are Wainscotted, the Seats, Sides and Bottoms being made of Fir. The Water for the most part is Clear and Transparent, yet somewhat Blewish, and maketh the Skin appear Pale in it, as doth the Smoak of Brimstone. It coloureth Metals (except Gold, whose Colour it also Heightens) turning them Black in a few Minutes. The Coyne of this Country, mixt of Copper and Silver, (having $\frac{7}{15}$ of Silver, and $\frac{8}{15}$ of Copper) is in a Minutes time turned from a White into a dark Yellow, and soon after becomes Black. To the Moss and Plants which it Washeth, it gives a fine Green Colour, and leaves often a Scum upon them of a Purple mixt with White. As it runs from the Spring-head, it somewhat resembles the Sulphur River in the

way from *Tivoli* to *Rome*, but is not so strong or *Stinking*, nor doth it In-
crustate its Banks.

I pass'd to the *Spring head* (which Riseth under a Rocky Hill) about the
length of 40 Yards, through an Arched passage cut in the Rock, which is
also a *natural-Stove*, (as that of *Tritola* and *Bajæ*) made by the *Hot Bath-Wa-*
ter running under it. Most part of this Cave is Incrustated with a white sub-
stance, by them called *Salt peter*. At the Mouth of the Cave it becomes Har-
der and Stony.

I caus'd some of the Pipes, through which the *Bath Water* runs, to be o-
pened, and from the upper part of the Pipe, I took some quantity of *Fine*
Sulphur in Powder, somewhat like *Flowers of Brimstone*; this being as it were
Sublimed from the Water, and not *Depos'd*, being found in the upper
part of the Pipe. *Oleum Sulph. per Campanam* dropped into this Water, is re-
ceived into it quietly. *Oleum Tart. per Deliquium*, causeth an *Ebullition*, as in
the making of *Tartarum Vitriolatum*.

The *Second Bath* within the Wall is that of our *Lady*, about 12 foot broad,
and 24 long. One end of it is under a Church of the same Name. This is fuller
of *Sulphur* than the rest, and more Blue, and leaveth a *Yellow Flower* upon the
boards as the others do a white.

The 3^d is the *New Bath*, out of the Town nigh the Gate.

The 4th the *Jew's Bath*, which hath a partition in the middle to seperate the
Men from the *Women*.

The 5th, *St. John's Bath*, of a Triangular Form.

The 6th, the *Beggars Bath*, always Shallow, so as they lye down in
it.

The 7th, the *Bath* of the *Holy-Cross*, about 2 Fathoms Square, chiefly for
the *Clergy*.

The 8th, *St. Peters Bath*, *Greener* than the rest.

The 9th, the *Sower Bath*, set about with Stone-balastres, and covered with
a Cupola and Lanthorn. The Water is very *Clear*: In the *Steam* of this *Bath*
I have often coloured *Money Black* without touching the Water; and staying
only in the room where the *Bath* is, the Buttons of my Cloaths, and what
else of Silver the Vapour could come at, were coloured *Yellow* or *gilded*: And
yet the Water it self, once *Cold*, changeth not the Colour of Metals, though
Boiled in it.

The *Hottest* of these *Baths* have not the *Heat* of the *Queen's Bath* at *Bath*
in *England*. They use no *Guides*, as with us, but direct themselves with a
short turn'd Staff.

Manners-dorff, seated under an Hill on the East side of the River *Leyta*
hath only one *Bath*. It Riseth under a Church, built over the Spring-
head.

The Water of it is *Luke-warm*, and therefore they boyle it in great Cop-
pers, when they desire it *Hotter*, and *Bath* in Tubbs fill'd with this boyling
Water. From the Substance, which sticks to the Coppers in boyling, it is
collected, that it is Impregnated with *Sulphur*, *Salt-peter* and *Chalk*. This
Water

Water Coloureth the Stones in it of a fair green like a *Turkois*; and the Steam of it, which sticks to the Moss under the Church, turns into Drops of Gold or Amber.

Dotis, 2 Hungarian Miles from *Comora* in Hungary hath also Sulphureous Baths, said to be Warm in Winter. In March and October, I found their Warmth very Remiss, scarce perceivable. In Colour they are Blueish, and to Taste Acid. The Queen's Bath and the Great Bath Rise in a Marsh, Northward of the Castle.

There is another Bath in the Governour's Garden within the Town. They are used as those of *Manners-dorff*.

At *Banka*, two Hungarian Miles from *Freistat*, in a Meadow, I took notice of 15 Baths: And there have been more, but the River *Waag* eateth away the Banks, and swallows up the Baths, and into 3 of these 15 it hath also broke in. The Water of these is like to that of *Baden* in *Austria*; it leaves a White Sediment upon the Moss and places it Washeth, and Tinctureth Metals Black. I stuck some Money into the ground over which the Water passeth, that part which was in the ground retained its own Colour, and the other part in the Bath-Water acquired a Coal Black. These Baths are Open, and very Hot.

The Baths of *Boinitz* nigh the River *Nitra* in Hungary, are of a moderate gentle Heat, much beautified by Count *Palsi* Palatine of Hungary: And all of them covered under one large roof. The first is the Noblemen's Bath, built of Stone, descended into on all sides by Stone stayres. Four more there are of Wood, but very handsomely and well Built.

At *Stub'n*, 3 Hungarian Miles from *Newsol*, and 2 from *Ckremnitz*, near to a Rivolet, are divers Baths of great Esteem. The Water whereof is Clear, and Smells of Sulphur; the Sediment Green. It colours the Wood over it Green and Black, but does not change the Colour of Metals so soon as most others. I left Money in it a whole Night, which was yet but faintly Coloured. The Springs arise underneath, and pass through the Holes in the Plancher of the Baths. The Heat thereof is answerable to the King's Bath in England. These Baths are 7.

The first, is the Noblemen's Bath; the 2d, the Gentlemen's Bath; the 3d, the Countryman's; the 4th, the Countrywoman's; the 5th, the Beggar's Bath; the 6th, for such as are infected with the *Lues Venerea*; the 7th, the Bath of the Gypsies: Of whom there are many in those parts. These Baths are in a Plain, encompassed on all sides with Hills; the highest unto them are towards the East; and it is the same Ridge of Hills, which on the other side are so rich in Metals.

Glass Hitten, an Hungarian Mile or about 7 English Miles from *Schemnitz*, hath 5 Baths; two of which are Large. It deposes a Red Sediment, and Incrustates the Wood and Seates of the Bath under Water with a Stony substance; and it Guildeth Silver. But the most remarkable of these Baths is that which is called the Sweating Bath, whose Hot Springs drain through an Hill, and fall into a Bath, built to receive them; at one end of which, by Ascending I went into a Cave, which is made a noble Stove by the Heat
of

of these *Thermæ*, and so ordered with Seats, that every one who sits in it, either by chusing a higher or lower Seat, may regulate his *Sweating*, or enjoy what Degree of *Heat* he desireth. This *Cave* as also the sides of the *Bath*, are covered by the continual Dropping of those *Hot Springs* with a Red, White, and Green substance: The Red and Green make the best shew, but the White is used against the *Stone*, and cureth *Ulcers* and sore backs of *Horses*.

Eisen-bach about 4 *English Miles* from *Glas Hitten*, and 5 or 6 from *Schemnitz*, hath also *Hot-Baths*. I have seen great *Trees*, placed at the Top or Superficies of the Water in these *Baths*, which have suffered *Petrification*. Here are two convenient *Baths*, much frequented; and a 3^d which is made by the Water let out of the Former, called the *Snake's Bath*, from the Number of *Snakes* coming into and delighting in it, when 'tis filled with these Warm Waters.

The *Natural Baths* of *Buda* are esteemed the Noblest of *Europe*, not only in respect of the large and *Hot Springs*, but the Magnificence of their Buildings.

For the *Turks Bath* very much, and, though little curious in most of their private Houses, yet are they very Sumptuous in their Publick Buildings, as their *Chans* or *Caravansara's*, *Mosches*, *Bridges* and *Baths* declare.

There are 8 *Baths* whereof I had opportunity to take notice, during my stay at *Buda*; 3 towards the East and South East part of the City, in the way leading towards *Constantinople*, and 5 towards the West end of the Town in the way towards *Old Offen*, and *Strigonium*.

The first is a large open *Bath* at the foot of an high rocky Hill, formerly called *Purgatorium*, whereof the People have some odd and scrupulous Apprehensions.

The 2^d is covered with a *Cupola*, and stands nigh the same Hill, but more into the Town, and near a place where they use *Tanning*.

The 3^d is call'd the *Bath* of the *Green Pillars*, though at present they be of a *Red Colour*; and it stands over against the *Caravansara*. The Water is *Hot*, but Tolerable without addition of Cold Water. It is Impregnated with a *Petrifying* juice, which discovers it self on the sides of the *Bath* upon the Spout and other places, and maketh a *Grey Stone*: And the Exhalation from the *Bath*, Reverberated by the *Cupola*, by the Irons extended from one Column to another, and by the Capitals of the Pillars, formeth long *Stones* like Ice-icles, which hang to all the said places; such as may be observed in many *Subterraneous Grotto's*, and particularly in *England* in *Okey hole* in *Somersetshire* and *Pooles-hole* in *Darbyshire*.

The Water is let out at Night when the *Women* have done *Bathing*, who often stay late. The *Bath* is Round, set about with large Pillars supporting a *Cupola*, which hath openings to let out the Steam thereof; and yet the whole room continues to be a *Hot Stove*.

The *Baths* of the West end of the Town are.

1. *Tactalli*, or the *Bath* of the *Table*; a small *Bath* Covered: The Water white and of a *Sulphureous Smell*.

They

They *Drink* of this as well as *Bath* in it. What they *Drink*, they receive from a Spout bringing the Water into this place. I delivered a *five Sols* piece to a Turk Bathing in it, to *Guild* for me, which he did in about a Minute by rubbing it between his Fingers, while the Hot Water fell from the Spout upon it.

2. *Barut Degrime*, or the *Bath* of the *Powder-Mill*. It rises in an open Pond near the high way, and mixeth with the *Fresh Springs*, so that the Pond is of a Whitish colour in one part, and Clear in the other, as also Cold and Hot in several parts. This, conveyed cross the high way into a *Powder mill*, becomes useful in making of *Gun powder*. They conceive here that this *Bath* communicates with the *Sulphureous Springs* at *Dotis* many Miles distant.

3. *Cuzzoculige*, the little *Bath* or the *Bath* of the *Saint*; for which name the *Turks* give a Superstitious reason. 'Tis kept by *Turkisk Monks*. The *Bath* where the Springs arise, is so *Hot* as scarce to be endured; but being let out into another Bathing place at some distance, it becomes Tolerable and fit for use. This Water hath neither *Colour*, *Smell*, nor *Tast*, different from *Common Water*, and deposeth a *Sediment*; only the sides of the Bath are *Green* and have a *Fungous* substance all over.

4. *Kaplib*, a very Noble Bath, but part of the Buildings were consumed this Year (1669) by a great Fire which happen'd in *Buda*; but is by this time repaired by the *Turks*. The Water is very *Hot*, not without a *Petrifying* juice in it. The Buildings about it are Eight Square with a Noble *Bath* in the middle: With a Circle or Trench of Water about it for the better Ornament. On every Side it has a *Nichio* wherein is a Fountain. In the middle of the Antichamber (where they leave their Cloaths) there is also a fair Stone Basin and a Fountain.

5. The *Bath* of *Velibey*; which hath a strong *Sulphureous Smell*, and a *Petrifying* juyce in it; and is so *Hot*, that to make it Tolerable it requires the addition of Cold Water. This is the Noblest Bath of any. The Antichamber very large, the Bath-room capacious, and high Arched and adorned with 5 *Cupola's*: One a very Fair one, over the great Round Bath in the middle; and one Lesser, over each of the 4 Corners; where are either Baths or Bath-stoves for more private Use: In these the *Turks* take off the *Hair* of their Bodies by a *Psilotbrum* mixt with *Soap*; it being not their custom, to have any *Hair*, except on their *Beards*, and a Lock on the *Crown* of their *Heads*. Twelve Pillars support the Great *Cupola*, between 8 whereof are Fountains of the *Hot Water*, and between the other are places to sit down, where the Barbers and Bathmen attend. And each of these places have two Cisterns of Free stone, into which are let in Hot Bath water and also Cold Water, to be mixed and tempered as every one pleaseth.

Men Bathe in the Morning, and *Women* in the Afternoon. When any *Man* intends to Bathe, having entred the first room he finds there divers Servants attending, and furnishing him with a Cloth and Apron. Then he puts off his apparel and having put on the Apron he entereth the 2^d room, wherein the great Bath is, and Sits on the side of the Bath, or between the Pillars nigh a Fountain; where

where the Barber strongly rubbs him with his Hand opened, stretching out his Arms, and lifting them up; after which the Party Batheth. Then if he be a Subject of the Grand Signior's, or it be the custom of his Country, he hath his Head shaved, and if a young Man, his Beard, except the Upper Lip. Next the Barber rubs his Breast, Back, Arms and Legs, with an Hair Cloath, while he either sitteth or lieth with his Face downward; then washes his Head with Soap, and after throws Cold Water upon him all over his Body; and so the Party Walks about in the *Steam* of the *Bath* for a time.

These *Baths* are made use of two ways, either by entring into the *Water*, or fitting about the Bath in the *Steam*. For the *Vapour* of the Bath makes the whole Room a *Stove*; and most sweat as long as they stay in it; and some enter not the *Water* at all, but have it Poured upon them, or else only continue in the *steam* of the *Bath*, which sufficiently provoketh *Sweat*.

XL. Five Miles from *Padua* are the *Waters*, called *Aponensia*, from a Town call'd *Aponum*. They are actually very *Hot* and *stinking*, and yield a great deal of very *fine Salt*; of which the Natives serve themselves in their Ordinary occasions. The *Salt* is gathered after this manner: The Natives, after Sun-set, stir pieces of *Wood* in the *Water*, and presently the *Salt* sticks to them, and comes off in small Flakes, exceeding *White*, and very *Salt*; This never loseth its *Savour*. The People there, with the same *Water* used to wash their Walls, to render them *Whiter* than ordinary; which it doth even *whiter* than *Lime*. Such Walls conserve their *Saltiness* some few days only, and then become insipid, even tho' they sweat forth a white Excrecence in thin and light Flakes like *Nitre*, many Years after. But that *Salt*, that is collected from the *Stones*, *Gravel*, and *Earth*, by which the Rivulets descending from those Baths, do run, is without any Taste of *Salt*; though there be no difference in the *Forms* or *Colour* from that which is Gathered with the *Wooden Instruments*.

XLI. In *Jamaica* there is a very *hot Spring* of *Mineral Water*, but the Distance and Trouble of getting to it has kept People from trying it till this last Month (*viz. March 169 $\frac{1}{2}$*) when two Persons, the one very much Macerated with the *Belly ach*, and another with the *Pox*, as is supposed, went to it, carry'd Cloaths, built a Hut to keep them from the Rain and Sun, and both presently by *Drinking* and *Bathing*, found such ease, that in about 10 Days they returned perfectly Cur'd. It comes out of a Rock in a fresh Current, near to a fine Rivulet of good cool *Water*; but is so *Hot*, they all affirm it soon boils *Eggs*; some say *Craw-fish*, *Chickens*, and even a *Turkey*; but perhaps this last wants good Confirmation. However it's certain, that near where it comes forth, there is no enduring any part of the Body but it takes off the *Skin*; it Cures *Ulcers*, and *Contracted Nerves* and *Sinews*; in a few days to a *Miracle*. Collonel *Beckford* who was given over by the Physicians, with *Pains* in his *Bowels* very *Acute*, that had worn him out, and another for the *Venerical Disease*, and one for the *Belly-Ach*, went up since Collonel *Beckford* is finely recovered, and the other almost cured of his *Ulcers*; so that the *Water* is beyond doubt, and many are resorting to it.

At Aponum
near Padua; by
Mr. Dodington.
n. 83. p. 4067.

Hot Springs and
other Mineral
Waters in Ja-
maica; by Sir
Will. Beefton.
n. 220. p. 226.

It has been try'd with *Galls* in my sight, and it makes the Water in 24 Hours look only like *Canary*, or *Old Heck*. But we have a fine large River runs by the sides of this Town, which serves all the People for Drinking and other Uses, and was by the *Spaniards* call'd *Rio Cobre*, or the *Copper River*; this now our Curiosity has led us to try with *Galls*, and in one Night the Water turns to a deep Green, more enclining to Black, deeper Colour'd than any *Emerauld* I ever saw, which makes me doubt the *Copper Mines* in it are not enough Digested, and that it's unwholsome, but were the *Copper* more Refined and Excellent, it would be a *salubrious* Water. I have also tryed several Water Springs and Rivers hereabouts, and find them all Ting'd with some *Metal* or other.

2. We have lately discovered two *Hot Springs* in *Jamaica*; one to Windward, which seems *sulphurous*: The other to Leeward, is very *salt*, but as I am told, does not partake of *Brimstone*; and both very much magnified for the *Endemick Diseases* of these Parts, the *Dry Belly-ach*, *Pains* of the *Nerves*, and *Yaws*.

By Mr. Robert Tredway. n. 212. p. 712.

XLII. Though the Particles of Water are so minute, that we cannot discern them with our *Eyes*, yet by *Feeling*, we may distinguish the Acute and vigorous Particles of *Healing Waters*, from the Languid and hurtful Particles of common Waters. The *Healing* Water will intermingle with their Asperity's such an agreeable Titillation, as will invite us to Rub in, or Press on the cleansing and Tersive Water; and will, all along, recompence the pain of searching the Wound by their Active Frictions, with such speedy Reparations, and such indulgent Degrees of *Sanation*, as mitigates the Torment with store and variety of Pleasures. Other common Waters, even those of some of the Purest and most Cristalline Fountains, are almost poisonous, encreasing *Tetters*, and fomenting *Ulcers*, with an inward and sullen painfulness. This dextrous Water, by a most favourable Chyrurgery, searches to the bottom of Old and *Cancerous Ulcers*; sweeps or shaves away the Roots of *Tetters* and *Cancers*, and appeaseth the unnatural Rage; and some of these *Healing Waters* are benigne, whether we apply them Outwardly, or trust them inwardly, for the relief of our *Entrails* and *Vitals*. And by these remarkable *Indications*, and the Effects I have seen succeeding, I have been confirmed of the real Virtue of some of the (so call'd) *Holy Wells* of oldest reputation in *England*; and have discovered other *Healing Springs*, whose Vertues were not much known, or noted before.

Observations concerning Healing Springs; by Dr. J. Beale. n. 57. p. 1155.

Our *Eyes* also may be, in some Sense, good Witnesses of peculiar *Figures* in the Particles of those *Spring Waters*, which are proper for the *Eyes*. They seem to scoure the *Eyes*, as it were, with sharp, but very fine Gravel. And by this *Indication* I have tryed and found the Springs which are extraordinary for the *Eyes*, and perhaps to Cleanse *Optick Glasses*. About 30 Years ago, in a very Hot and Droughty Summer, there was an *Epidemical* Distemper of Mens *Eyes* and *Eye-lids*; I found it so at *London* and *Westminster*, and almost in every House where I came, as I travelled Westward on both sides *Severn*. *Verjuice*, or the Juice of *Crabs* was found the best Remedy; and where they knew it not, I gave notice of it; and all that try'd it, confessed that it was not a very unpleasant ap-

plication. Their *Eyes* had a fretting Itch; and *Verjuice* proved more agreeable than *Vinegar*, or *White wine*, or any other liquor or Mixture. Some such Tickling Pleasure, but yet more delicate and tender; there is in some *Spring Waters*, which are for the *Eyes* peculiar.

The *Springiness* of *Wool* more than of *Linnen*, offers another Visible and Tangible Demonstration, how the stronger and quicker *Springs* of some Water more than of other, may conduce more or less to *Healing*; or may be more or less Noxious, either inwardly taken or outwardly applied.

I knew one who was shot in his Heel with an Arrow, which carried with it a very small ragg of the *Woolen Stocken*: This Ragg not being found by the Chirurgions, though they were then of the best Note, the Wound became for a Year or two incurable; and the Pain was so intollerable, that it was thought necessary to cut off his Foot. At last by chance the Rag was found, and taken away, and then the *Cure* was soon Perfected. *Woolen* and *Linnen* may have their Turns and Seasons; the one as a Mechanical Operation for *Heating* by a close and permanent *Friction*; the other as a quiet *Lenitive*. Our tender Skin can hardly bear the incessant *springiness* of *Wool*; in a deep Wound we can less endure it. But the *Springs* of some *Waters* may be lined with a softer Liquor than the Hairy and curled Filaments of *Wool*: And hence we may perceive, how some Waters may by their Rolling Particles be the greatest *Probes*, and yet the surest Searchers, *Cleansers* and *Healers*. And hence also, on the contrary, we may see, how some Waters, which Cure *Ulcers* and *Cancers* by *Outward* application, may be too busily Corrosive and Dangerous, if taken *Inwardly*.

I think I may note, that generally all the Springs in *England* that are of very Ancient Esteem for *Healing*, and were commonly call'd *Holy Wells*; such as *St. Winefrid's Well* in *Flintshire* (of which I never made Trial, but it carries the greatest Fame) are all very *Pure*, and yield no kind of *Sediment*. In this our *Hot Baths*, and perhaps some few *Mineral Springs* are to be excepted. I must yet be more particular.

I know a *Spring*, which the Old People there call their *Holy Well*, on the side of a *Low Hill* in an Arable Field, which (besides the *Healing Qualities*) hath an extraordinary efficacy in clearing the Skin from *Sun-burnings* and *Freckles*; and addeth as much lustre, as agrees with the finer Art of *Concealing Art*, and with *Modesty*; and after washing two or three Mornings it makes the Skin as *smooth* as *Glass*. It passeth through a Vein of *Light Sand*, if I may call it *Sand*; 'tis more like to some kind of *Blewish crisped Marble*; 'tis so *Light* and *Hollow*, as if it were freshly working by some *Ferment*; and 'tis full of very small and thin *Laminae*, seeming to be *Metalline* and bright like the purest *Silver*, but the Refiners could not find it to be of any value. I was inquisitive to search it out, whether this Water had the *Beautifying* property from the *Silver-like Lamina*, or rather gave those *Veins* of *Earth* that *Tinture* and *Ferment*. Only two things I can affirm: 1. I saw many *Springs* opened in the *Lower Grounds*, which seemed in all appearance to run from the same Head, and had also the same very bright *Ferment* in their Passages, where they were opened, but these had nothing of the same Property for *Heal-*

ing, or for *Beautifying*; as I found by many Trials, more than daily for some Years together. 2. The common Fields adjoining, had on their Clods and Fallows, somewhat of the same Glittering much Faded, but enough to Dazle their Eyes that Fixed them on it in a bright Sun Shining. May not some *Subterranean Steam* give the *Tincture*, both to that Vein of Earth through which it passed more freely; and also more forcibly to that *Spring*, by a greater resort, or by some advantage it got by the *Ascent* of the Ground? (And we commonly find these *Healing Springs*, either near the Top, or on the Side, or near the Foot of some Hill, or Running from the Hill:) And thus the *Streams* Reverberated and dashed down by the Motion of the Air, and by the Weight of the Atmosphere, may beget the same *Metalline Tincture* in the adjacent Fields. This was far enough from yielding *Sediment*; and it had a Pleasing *Smoothness*; and was very inoffensive to the *Stomach*; but it searched the *Eyes* somewhat Smartly, and Cleared them speedily, and was generally commended for many *Healings*, both Inwardly and Outwardly; and was every way much more Pleasing than Tormenting.

Within two Miles of the same, is another of their old *Holy-Wells*, on the Brow of such another Hill in an Arable Field, within half a Mile of the Lofty *Malvern Hill*: This is very kind for the *Eyes*, and hath also done many Cures upon *Putrid* and *Fætid Ulcers*, which were many years deplored for Incurable, as I can affirm upon my own knowledge I have seen it Tryed often, and always to good Effect; sometimes considerably Wonderful.

Vid. Sup. §.
XXXVI. 4.

Many drink of it, and much extol it for Healings: And I never could hear of any that complained of hurt done by it. It was somewhat asperous, but pleasing in malignant Ulcers.

But much greater is the Reputation of the *Holly-Wells*, as they call them, on the side of *Malvern Hills*, which Hills divide *Worcestershire*, from *Herefordshire*. The Higher Spring is peculiar for the *Eyes*: About a Furlong lower is the *Healing Spring*; This cureth many Maladies and *Cancers*, if applyed before the Strength of Nature be overthrown. I have read in the Monuments belonging to the *Hospital* at *Ledbury*, a Town in the way from *Hereford* to those *Springs*, that a Bishop, some Ages past, endowed that *Hospital* with Revenues, for the entertainment of Distressed Passengers that Travelled to those *Springs* for Relief. 'Tis above 50 Years since I heard a Panick Story spread all over the City and Country of *Worcester*, the Physicians had Poisoned those Wells. I am perswaded, that the ground of this Fable was only this; After more than ordinary Rain for one, two, or three, Years together (as it falls sometimes in *England*) some *Common Waters*, by a part of the same or some other Channel, do drive to the same Aperture and Drown the excellency of the *Healing Water*. In this Droughty Year (1669.) we find, that many excellent Springs have lost more than half, and some more than 4 parts of five of the Waters which they did usually afford in the same Seasons of the other Moister Years; and the remaining Waters have the Stronger Efficacy. Of this Expectation from long *Droughts* I formerly advertis'd you, And 'tis now Remarkable, that the better Springs, which are on the *Side* of *Hills*, and on the *Higher* ground, do maintain their *Current* much better, than those which

are in the *Lower Vale*. 'Tis so in many places about us here; when the Better Springs had lost 4 parts of their Current, many of the Lower Springs were quite Dried up. All these Waters are purely *Limpid*, Free from all *Sediment*, very *Terfive* and searching, most Effectual at the *Spring head*.

I omit many other *Healing Waters*, that I may give you a brief touch of such *Mineral*, *Saline*, and *Medical Waters*, as I have found, or heard of in our Neighbourhood; Namely about *Yeavil* in *Somersetshire*. I lately heard of two more *Metalline Springs* in *Dorsetshire*, besides that of *Farrington*; Perhaps their Virtues and their Fame are encreased by this *Drought*. The *Saline Spring* mentioned by *Dr. Highmore* to be at *East-Chenock*, is about 3 Miles hence Westward. In a very *Droughty* Summer I found it *Strong Brine*. But there is a *Salt Spring* of far greater worth at *Everich*, about 12 Miles hence towards *Shepton Mallet*. The Pool, which yieldeth *Vitriolate Salt*, is in *Sock-Denis*, 3 or 4 Miles from hence Westward. 'Tis not a great Pool, nor above 10 foot Square. Whether the *Salt* proceedeth from a *Spring*, or from a *Vein* of *Vitriolate Earth*, I cannot yet determine; but the Mud and Earth about it is as *blew* as any *Roman Vitriol*. In a long lasting and hard *Frost*, I sent for a Quart Bottle of the Water, and found it very Thick, and Blackish, and it Scented intolerably strong, not much unlike *Gunpowder* newly Inflamed. Close adjoining into this Town of *Yeavil*, were two *Springs* kind for the *Eyes*; the one in a Pasture; the other within a Bolt-shoot in a Field.

Vid. inf. §.
XLIV. 2.

Vid. Sup. §.
XXX. 3.

The Old People prefer that in the Pasture before the other, as they have it from Elder Tradition, and their pretended Experience: And at this time, the more commended Spring, which is in the Pasture, and on the side of a Rising ground, runs freely; the other is newly Dried up. 'Tis not every slight *Gravelling* of the *Eyes* that sufficiently *Indicates* an extraordinary *Eye-Water*: Many good Springs have a Degree of *Terseveness*; but that which is extraordinary, hath a *Friction* somewhat permanent, and is in the end *Gratifying*. We have also, close by our Town, a Spring called *Rusty well*. Where it breaks out, and where it first falls, it Tingeth the Stones of the Colour of *Rusty Iron*, and it hath the *Smell* strongly, (and seemeth to *Tast*) of *Rusty-Iron*. Yet 'tis as Clear as any Water, and I tryed it for a Month or more in my Study, putting *Cornish slate* and Pebbles to it in a Glass; and it gave no *Tincture* at all to the Stones, nor any *Sediment*; so that I suspect the *Tincture* to proceed from some *Effluvium* mingled with the Water at first Opening: But I confide not much in the single and short Trial I made. Some old Men boast of many great Cures it hath done.

Our Fore-Fathers and very old Men, scarce heard of the Name of the *Scorbute*; 'Tis a seasonable Providence, if, since that Disease is become so *Epidemical*, the Remedy should be so Obvious and Vulgar, as is pretended to be by such *Ferruginous Springs*.

This breaks out near the Foot of a Lofty Hill, which continues, with some lesser falls, about 3 Miles Westward to *Hamden Quarre*, where they dig a hard Freestone of a dark yellow Colour. At *West Camel*, 5 Miles hence Northward, is a very Fœtid Black Spring, which Tingeth Silver Black immediately; and I am told, that about 10 Miles hence, more Eastward, near

Wine-Caunton, not many years ago, they Digged for *Cole*, where the *Cole* men were endangered by a *Fœtid Damp*; And when they assayed the *Cole* in the Fire it proved very *Noysom*, so that they forsook those *Cole-mines*. Perhaps it may be serviceable to them that know not how to make an honest use of *Arsenic* and other *Poysons*.

Here again, with some Timorousness, I propose the Inquiry, whether *Subterraneous Steams* might not give the *Dark-Yellow Tincture* to the *Hamden Quarre*, and the property to this Water of *Rusty well* for the *Fulvous Coloration*: It cannot be expected, that Materials, differing so much as Stones seem to differ from Water, when perfectly Petrified, should retain the very same Colour, though both received it from the very same *Steams*. The same I propose for the Blackness and Fœtidness of the *Spring* in *West-Camel*, and of the *Cole* near *Wine-Caunton*, that both may receive the same *Tincture*, and *Odour* from *Subterranean Steames*, which may perhaps be of so many kinds, and mixtures, as to cause much of the great diversities of *Metals*, *Minerals*, *Earths*, and *Soyles*; and of some minute Differences in the *Colour*, *Tast*, *Odour*, and *Dress* of *Vegetables*; Yea and of the *Furres*, *Haires*, *Wool*, and other little varieties in *Animals* (particularly in *Sheep*) in several places; more immediately in *Vegetables*, and of *Animals* by Remoter circumstances; I will not except the *Ethiopick-Hue*, and *Humours* of Men in *Distant Climates*, though *Vegetables* and *Animals* do (for the most part) retain their *Seminal Properties* in *Distant Climates* for many Generations. And perhaps from these *Terrestrial Steames* the *Vegetables* do imperceptibly draw some of their *Salts*, and much of their *Nutriment*.

For these *Overtures* I will at present instance no more than thus. The illustrious Mr. *Boyle* hath, methinks, evinced, that the most Solid Bodies we know, have their *Atmospheres* of *Steams* and *Exhalations*: And whatever the Materials be, which are under our *Terrene Crust* towards the Center, whether Fluid, Flaming, or gross Substances, they must needs hold an Intercourse of *Transpirations*, and mutually operate by their perpetual Agitations, and Whirlings about: And by the *Vulcano's*, frequent in *Japan*, and in several other places, and by the *Heats* in Deepest *Mines*, and by many other manifest Arguments, it appears, that there are always strong *Steams* Ascending towards the *Surface* of the *Earth*: And, if their *Generative Power*, and other Efficacies were duly examined, and prosecuted to the best purposes, we might perhaps in time find them to have a greater Virtue, and more useful for us, than many of the *Constellations* and *Celestial Influences*, which make no small Noise amongst *Astrologers*.

XLIII. Visiting the Famous *Boyling Fountain* at *Peroul*, not far from *Montpelier*, I found the Water to *Heave*, and *Boyle* up very furiously in small *Bubbles*; which manifestly proceeded from a *Vapour* breaking out of the *Earth*; for upon Digging any where near the *Ditch*, and pouring other Water upon the Dry place newly Dugg, I observed in it immediately the same *Boyling*, as the Exquisite Naturalist Mr. *Ray* has related in his *Travels*. The like *Bubbling* of Water is also found round about *Peroul*, upon the Sea shore; and in the E-

*Observations on
Boyling Foun-
tains and Sub-
terraneous
Steams; by Dr.
Tancred Ro-
binson. n. 169.
p. 922. n. 172.
p. 1038.*

tang it self. But when I had taken some of the Sand and Earth out of the Fountain and Ditch, and put it into Vessels, pouring the same Water upon it, there did not appear the least *Perturbation*, or Alteration thereupon; the Superficies of the Water continuing very smooth, Equal and Quiet. And for further satisfaction, I sought out, and discovered in several Dry places of the Ground thereabouts, many little *Ventiducts*, Passages or Clefs, where the *Steam* issued forth; at the Mouths of these Channels or Pipes, placing some light Bodies, as *Feathers*, small thin pieces of *Straws*, *Leaves*, &c. I found them soon Removed away. This *Vapour*, upon the Application of a lighted Candle, or Torch, did not *Flame*, or catch the least Fire; as the Fumes running through

n. 172. p. 1038: a *Boiling Spring* near *Wigan* in *Lancashire* do, with which those *Burning Fountains* near *Grenoble* in *Dauphine*, near *Cibinium* or *Hermanstadt* in *Transylvania*, near *Chermay* a Village in *Switzerland*, in the Canton of *Friburg*, and that

n. 169. p. 9. 23. not far from *Cracovia* in *Poland*, do agree in many particulars. Many *Hissing Springs* *Bubbling* at the Top, I have found in *Switzerland*, (the best watered Country that ever I saw) and in many places near the *Rhine*. The like is related by *Varenius* near *Culma*, and by *Dr. Plot* in *England*. There are other *Boiling Waters* of a quite contrary Temper, being actually *Hot* to several Degrees, so as to *boil Eggs*, and many other Things put into them; as those near the *Solfatara*, not far from *Naples*; as also upon the top of *Mount Zebio* in the Duke of *Modena's* Territories, not far from his *Villa* near *Sassolo*; in the Source of the *Emperour's Bath* at *Aken*, in the Country of *Fuliers*; and in *Japponia*, mentioned by *Varenius*.

From the foregoing History, we may take occasion to reflect a little upon the manifold variety of *Exhalations* prepared in, and flying out from the vast *Magazines*, and several *Reconditories* below, as to their *Qualities* and *Effects*; some being *Cold* and *Dry*, resembling *Air* or *Wind*, as those near *Peroul*, and in the *Caverns* of *Mountains*, especially those of *Æolus* and other *Hills* of *Italy*; as also in *Mines* upon the meeting of *Water*. Others are *Inflamable*, and of a *Bituminous* Nature, though not actually *Warm*, as those near *Wigan* in *Lancashire*. There are also many *Steams* very *Hot*, *Sulphurous*, and *Saline*; more especially those in the natural *Stoves*, *Sweating-Vaults*, *Grotts*, *Baths*, and the *Vulcano's* near *Naples*, *Bajæ*, *Cuma*, and *Puzzuolo*, as also in some of the *Subterraneous Works* at *Rome*. Others there are of an *Arsenical*, and such like venomous *Qualities*, as in the *Grotto del Cano*, on the Bank of the *Lago Agrano*; in many *Mines*, in *Poysonous Springs* and *Lakes*.

Now these various *Steams* meeting with, and running through *Waters*, must cause a great variety of *Phænomena* and *Effects* in them. Whether this great Diversity proceeds from the various *Breaths* of the *Pyrites*, and the *Lapis Calcarius*, whilst under their different States, and Changes, or from other sorts of *Effluvioms*, I dare not determine: But I am apt to believe that there may be

n. 172. p. 1039. Veins of the *Pyrites* near those Places, the *Inflammability* of which *Mineral*

Mid. Inf. Cap. III. hath already been discoursed of, and made very clear by *Dr. Lister*.

An Ingenious Author relating the History of a *Burning Fountain* in the *Palatinate* of *Cracovia*, affirms, that upon *evaporating* the *Water*, a *Dark* or *Pitch-like Substance* may be *Extracted*, which cures the most *Inveterate Ulcers* in

a very short time; and that the Mud it self is very Powerful against *Rheumatick* and *Gouty Pains, Palsies, Scabs, &c.* The Inhabitants of an adjacent Village, drinking much of this *Spring*, do generally *Live* to 100 or 150 Years, which he Attributes to the sanative Virtue of the Water.

The *Naptha*, or *Bituminous* Substance floating upon a Spring at *Pitchford* in *Shropshire*, and upon *St. Catherine's Fountain* near *Edinburgh*, hath been successfully used in *Ulcerous* and *Cutaneous* Distempers. Many such like Fountains of *Petroleum*, and *Oily Substances*, are to be met with up and down; as in the Island of *Zant*, very plentifully; near *Gabian* in the Road from *Montpelier* to *Beziers* in *Languedock*; in the *Valtaline*, subject to the *Grisons*; at the foot of *Mount Zebio* in the *Dutchy of Modena*: Not to mention any of the Places written of already by *Varenus*. The Inhabitants living near these *Fat Oily Springs*, take great care to gather and separate the *Bituminous Substances* from the Water, making very considerable Advantages of them, for *Mechanical* and *Medicinal* Uses. I have seen them gather it up with *Ladles*, and put it into large *Filtres*, or into great *Funnels* stopt at the bottom; or else into *Barrels* set on one end, which have *Spiggots* near their *Bottoms*; when they are full and have stood a while, they open the *Spiggot* or *Stoppel* to let out the Water, and when the *Oil* or *Bituminous* Substance begins to come, they presently stop it again.

XLIV. 1. The *Salt Springs* at *Hall* in *Saxony*, are 4 called *Gutiaar*, the *Dutch Spring*, the *Wettritz*, and the *Hackel-dorn*. The 3 first hold about 7 parts of *Salt*, 3 of *Marcasite*, and 14 of *Water*. The last holds less, but yields the *Purest Salt*.

Salt Springs at Hall in Saxony, and at Lunenburg; by---- n. 8. p. 136.

They are, (besides their *Oeconomical* use) employed, *Medicinally* to *Bath* in; and to draw a *Spirit* out of it, exhibited with good success against *Venom*, and the *Putrefaction* of the *Lungs, Liver, Reins* and *Spleen*.

The *salt Water* at *Lunenburg*, being more *Greenish* than *White*, and not very *Transparent*, is about the same Nature, and holds with that of *Hall*. It hath a mixture of *Lead* with it, whence also it will not be *Sod* in *Lead Pans*; and if it held no *Lead* at all, it would not be so good, that *Metal* being judged to *Purifie* the *Water*; whence all the *Salt* of *Lunenburg* is preferred before all others, that are made of *Salt Springs*.

2. I made *Trial* of that *Salt Spring* at *East-Chenock* in *Somersetshire* (above 20 Miles from the (Sea;) which tho' not so *salt* (by reason of the late *Rains*) as in *Summer*, yet from a *Wine Quart*, by *Evaporation*, we obtained near 80 *Grains*.

In Somersetshire; by Dr. Highmore. n. 56. p. 1130.

3. At *Salt Water-Haugh* near *Butterby*, about a *Mile* and a half from *Durham*, in the middle of the *River Weare*, rises a *salt Spring*. It is good to be seen and tasted, only in the *Summer* time, when the *Water* is discharged all on one side of the *Channel*: For in *Winter*, when the *River* is high it loses its *Salt* in the fresh *Streams*, so that they are not perceivable. The *Water* seems to *Bubble* up equally in all parts in the *Channel*, for the space of 40 *Yards* in length, and about 10 in breadth. The *saltest* of all the *Springs* issues out of the middle of a *Rock*, the *Surface* of which was manifestly *saltish*; and which, in a hot *Day* (as I was told) would be all covered over with a perfect *Salt*. I had all the *Water* laved out of the place where it seemed to stagnate, and immediately

In the Bishoprick of Durham; by Mr. Hugh Tod. n. 163. p. 726.

out of the Body of the Rock there Bubbled up Water, as *salt* as the former. It was as high as any *Brine* can be, and tho but little in quantity in comparison of the Fresh River, yet of that force to give a *brackishness* to the Streams a hundred Yards below. Those that have boil'd this *Brine* say that it affords a great quantity of *Bay Salt* not so Palatable, yet as Useful as Ordinary *Salt* is. It *Tinges* all the Stones with a *Red Colour*. The *Sea* is 8 Miles off, where nearest.

Salt-Springs
and Salt-Ma-
king at Nant-
wich in Che-
shire; by Dr.
Will. Jackson.
n. 53. p. 1060.
n. 54. p. 1077.
n. 55. p. 1122.

XLV. The *Depth* of the *Salt-Springs* is in some places not above 3 or 4 Yards: In *Nantwich*, the Pitt is full 7 Yards from the footing about the Pitt; which is guessed to be the Natural height of the Ground, though the Bank be 6 foot higher, accidentally raised by Rubbish of long *Making Salt*, or *Walling*, as they call it. In two places within our Township the *Springs* break up so in the Meadows, as to Fret away, not only the Grass, but part of the Earth, which lyes like a breach, at least half a foot or more lower than the Turf of the Meadow, and hath a *Salt Liquor*, Ousing as it were out of the Mud, but very gently.

Our *Country* is generally a Low Ground, witness the name given to it (the *Vale Royal* of England;) yet it is very full of Collicular Eminencies, and various Risings to distinguish it from being all Meadow. The nearest Hills (of those worth calling Hills) is about 7 Miles distant from the *Springs*; it is steeper but not much higher than *Highgate Hill*.

We have also a peculiar sort of ground in this County and some Adjacent Parts, which we call *Mosses*: And they are a kind of Moorish Boggy ground, very Stringy and Fat; which serveth us very well for *Turfs*, cut out like great Bricks and Dried in the Sun. And this kind of ground is so much here, that there are few Townships but they have their particular *Mosses*. In these is found much of that Wood we call *Firr wood*, which serves the Country-People for *Candles*, *Fewel*, and sometimes for small *Timber Uses*; and this the Vulgar concludes to have layn there since the *Flood*. But generally these *Mosses* seem to be places undermined by some *Subterraneous Streams*; or by the Dissolution of some matter, that made them equal with the rest of the ground formerly: In which conjecture I am confirmed by this, That near a place of my Lord *Cholmondeley's* called *Bilkely*, about 9 or 10 Years since, not far from one of these *Mosses*, without any Earthquake, a piece of ground, about 30 Yards over, fell in with an huge noise, and great *Oakes* growing on it *Fell in* with it together; which hung first with part of their Heads out, afterwards suddenly Sunk down into the grounds, so as to become Invisible: Out of which Pitt they drew *Brine* with a Pitcher tyed to a Cart-rope, but could then find no *bottom* with the Ropes they had there: Since, the Pitt is filled up with Water, and now doth not Taste *Salt*, but a very little *Brackish*, a very small Rivolet passing through it. The nearest *Salt Springs* to this place are at *Durtwich* about 3 Miles from it.

Our *Springs* are about 30 Miles from the *Sea*; and generally ly all along the River *Weever*: Yet there is an appearance of the same *Veine* at *Middlewich* nearer the River *Dave* than *Weever*; which notwithstanding seems not to be

out of the Line of the *Weeverish Stream*; and these lye all near Brooks, and in Meadowish grounds.

I could observe no Singularity at all in the *Plants*; for, where the *Salt* reaches the Surface, it *Frets* away all (as I said before,) and upon the Turf, near the old decayed Pits, grows the very same, that doth in the Remoest place of the Meadow; only I observe, that where the Turf was *Fretted* away, *Rushes* maintained their station longest.

The *Water* is so very *Cold* at the Bottom of the Pitt, that when the *Briners* sometimes go about to Cleanse the Pitt, they cannot abide in, above half an hour, and in that time they Drink much *Strong Water*. There is not any *Hot-Springs* (that I can hear of) nearer us, than *Buckston well*, which is about 30 Miles distant.

Several new *Brine Springs* have been of late both sought and found; yet none knows of any *Shells*, but rather a Blackish Slutch mixt with the Sand, which infects the whole Spring (like the *Scuttle Fish*) Black, when 'tis stirred; else the Water runs very Clear.

The *Springs* are Rich or Poor in a double Sense; for a *Spring* may be Rich in *Salt*, but Poor in the quantity of *Brine* it affords. Thus they have a Rich *Brine* in their chief Pit at *Middlewich*, which yields a full 4th part of *Salt*, yet is it so Thrifty of it's *Brine* that the Inhabitants are Limited to their proportions out of it, and their Quantity is supplied out of Pits that afford a *Weaker Brine*. Our Pitt at *Nantwich* yields about 1 pound of *Salt* for 6 pound of *Brine*; but then 'tis always (without any sensible difference) so Plentiful a *Spring*, that whereas they seldom *Wall*, that is *Make Salt*, in above 6 Houses at a time, and there are or should be about 50 *Wich Houses* in the Town, this Pitt is judged sufficient to supply them all, without falling much lower than a Yard or two at most. And this Advantage would accrew over and above, that such quick use of the Pit extreamly Strengthens the *Brine*, perhaps to a degree little less than that of *Middlewich-Pitt*: For, I have tryed it my self, that a quart of *Brine*, when the Pit had been drawn off 3 or 4 days first to supply 5 or 6 *Wich-houses*, hath yielded an Ounce and an half more of *Salt*, than at another time, when it hath had a Rest of a week or thereabout.

Mar. 8. 1668. I Weighed *two pounds* of *Distilled Water* in a Narrow-mouthed Glas-bottle, that I might take an exact Mark for a Quart. This Bottle being filled with our *Brine* to the very same Mark, Weighed (besides the Tare of the Bottle) *two pound 3 Ounces* and *5 Drachms*. This was taken up when the *Wich Houses* began to Work, so that the Pitt was but little drawn. I filled up the Bottle with the same *Brine*, and it weighed just *3 Drachms* more. This *Brine*, boyled away, without any Addition or Clarification, made *5 Ounces* and *2 Drachms* of *Salt*. Five days after, when the Pit had been Drawn all that while for the working of the *Wich-houses*, vid: Mar. 13: the same Bottle fill'd to the Quart Mark aforesaid with *Brine* then taken up, weighed, beside the Bottle, *two pound 4 ounces* and an *half*: The same time, the Bottle filled as in the former Experiment, weighed just *two Pounds* and an *half*, which is *3 Drachms* more than the Quart Mark before; which boyled into *Salt* made *6 ounces 6 Drachms* and *two Scruples*: Which exceeds the former

mer quantity of Salt, one Ounce 4 Drachms and 2 Scruples, though the Brine exceeded the former in Weight but 4 Drachms.

By which Trial I confuted also a Tradition, which the Briners have amongst them, viz, that the Brine is strongest at the time of the Spring Tides, to wit, at the Full and Change of the Moon. For Mar. 8. aforefaid was only one day past the Full, and then the Brine was Weaker than it was the 13th day, when 'twas 6 days past the Full. So that I conclude there could be no other reason, than that the much Drawing makes way for the Salt-Springs to come the quicker, and allows the less time for the admission of Fresh-Springs. But 'tis observed by the Briners that they make more Salt with the same quantity of Brine in Dry than in Wet Seasons.

Their manner of Working is this: They have formerly boiled their Brine in 6 Leaden Pans with Wood fire; upon which account they all Claim their interest in the Pitt by the Name of so many 6 Leads Walling; by which they each know their Proportion; but in the memory of many alive they Changed their 6 Leads into 4 Iron Pans, something better than a Yard Square, and about 6 inches Deep, still fitting the Content of these to that of the 6 Leads: And of late many have changed the 4 Iron Pans into Two greater; and some Wall but in one: But still the Rulers Gage it to their Old proportions.

They use for their Fewel Pit coals, brought out of Staffordshire. These Pans are set upon Iron Bars, and made in on all sides, very close (that the Flame nor Smoak break through) with Clay and Bricks. They first Fill their Pans with Brine out of the Pitt; which comes to them in several Wooden Gutters: Then they put into their Pans amongst their Brine a certain mixture, made of about 20 Gallons of Brine and 2 quarts of Calves, Cows or chiefly Sheep's Blood, mixt into a Clarret Colour: Of this mixture they put about 2 quarts into a Pan that holds about 360 quarts of Brine; this Bloody Brine, at the first Boiling of the Pan brings up a Scumm, which they are careful to take off with a Skimmer, made with a wooden handle thrust through a long Square of Wainscot board, twice as bigg as a good square Trencher: This they call a Loot. Here they continue their Fire as quick as they can, till half the Brine be Wasted, and this they call Boiling upon the Fresh. But when 'tis half boiled away, they fill their Pans again with new Brine out of the Ship, (so they call a great Cistern by their Pans sides, into which their Brine runs through the Wooden Guttur from the Pump, that stands in the Pitt;) then they put into the Pan 2 quarts of the mixture following: They take a quart of whites of Eggs, beat them thoroughly with as much Brine, till they are well broken; then mix them with 20 Gallons of Brine, as before was done with the Blood; and thus that which they call the Whites is made. As soon as this is in, they Boil sharply, till the second Scumm arise; then they Scumm it off as before, and Boil very gently till it Corn; to procure which, when part of the Brine is wasted, they put into each Pan, of the Content aforefaid, about a quarter of a Pint of the best and strongest Ale they can get; this makes a momentary E-bullition, which is soon over, and then they abate their Fires, yet not so but that they keep it Boyling all over, though Gently; for the Workmen say, that if they boil Fast here, (which they call Boyling on the Leach, because they usually

usually all this time lade in their *Leach-Brine*, (which is such *Brine* as runs from their *Salt* when it is taken up before it hardens) if, I say, they boil fast here, it wastes their *Salt*. After all their *Leach-Brine* is in, they boil gently, till a kind of *Scum* come on it like a thin Ice; which is the first appearance of the *Salt*: Then that sinks, and the *Brine* every where gathers into *Corns* at the bottom to it, which they gently rake together with their *Loots*: I say gently, for much stirring breaks the *Corn*. So they continue till there is but very little *Brine* left in the *Pan*; then with their *Loots* they take it up, the *Brine* dropping from it, and throw it into their *Barrows*, which are Cases made with flat cleft *Wickers*, in the shape almost of a *Sugar-loaf*, the bottom uppermost. When the *Barrow* is full, they let it stand so for an Hour and an half in the *Trough*, where it drains out all the *Leach brine* above said; then they remove it into their *Hot House* behind their *Works*; made there by two *Tunnels* under their *Pans*, carried back for that purpose. The *Leach-brine*, that runs from the *Barrows*, they put into the next *Boyling*; for 'tis to their Advantage, being *Salt Melted*, and wanting only *Hardning*.

Fig. 64

Fig. 65.

This work is performed in 2 *Hours* in the smaller *Panns*, which are shallower, and generally boil their *Brine* more away; wherefore their *Salt* will last better, though it does not *granulate* so well, because, when the *Brine* is wasted, the *Fire* and the stirring breaks the *Corns*. But this *Salt* weighs heavier, and melts not so soon; and therefore is bought by them that carry it far. But in the greater *Panns*, which are usually Deeper, they are about half an Hour longer in boiling; but, because they take their *Salt* out of their *Brine*, and only harden it in their *Hot-House*, its apter to melt away in a moist Air. Yet of this sort of *Salt* the bigger the *Grain* is, the longer it endures; and generally this is the better *granulated* and the Clearer, though the other be the *Whiter*. Upon which I rather think, 'tis the taking off the *Salt* out of the *Brine* before it be wasted, that causes the *granulating* of it, than the *Ale* to which the *Workmen* impute it. This kind measures profitably well; therefore it is much bought by them who buy to sell again.

They never cover their *Panns* at all, during the whole time of *Boyling*. They have their Houses like *Barns* open up to the *Thatch* with a *Louver-hole* or two to vent the *Steam* of the *Panns*. Possibly *Tiles* may do better, but no Body is yet so curious as to try; but the *Steam* is such, that I am confident no *Plaister* will stick, and the *Board* will *Warp*, and their *Nails* will rust so, as quickly to fret in pieces.

With our *Salt*, both *Beef* and *Bacon* is very well preserved, sweet and good a whole Year together; and I do apprehend this *Salt* to be rather more searching than *French Salt*, because I have often observed that *Meat* kept with this *Salt*, shall be more fiery *Salt* to the midst of it, than I have observed when I have eaten powder'd *Meat* on *Ship-board*, which was probably done with *French Salt*, I then being on the *South* side of *England*, and in a *Dutch Vessel*. 'Tis certain *Cheshire* sends yearly much *Bacon* to *London*, which yet had never any mark of *Infamy* set upon it; and *Hung'd Beef* (which others call *Martin-mass-beef*) is as good and as frequent in *Cheshire* as in any place; so that I conclude, that *this last* is fully effectual for any Use, and as good as any other.

The Sweepings of such Salt is constantly shed and scattered about on the Floor, not without taking much of the Dirt, (which occasions its Grayness) is called *Gray Salt*. This sells not at half the Rate of *White Salt*, and is only bought up by the poorer sort of People, and serves them in salting *Bacon*, course *Cheese*, &c. *Catts* of Salt are only made of the worst of Salt, when yet wet-tish from the *Panns*; molded and intermixt with interspersed *Cummin Seed* and *Ashes*, and so baked into a hard Lump in the Mouths of their *Ovens*. The use of those is only for *Pigeon-Houses*. But *Loaves* of Salt are the finest of all for *Trencher Use*. There is no difference in the boiling of these from the common way of the *fine Salt*; but in the making up, some care is used: For first they cut their *Barrows*, they intend for *salt Loaves*, with a long slit from top to bottom equally on both sides; then they tye both sides together with *Cords*; then they fill this *Barrow* with *Salt* boiled as usually, but in the filling are careful to *Ramm* down the *Salt*, with the end of some *Wooden Bar*, continuing this till the *Barrow* be fill'd to their Minds; then placing it speedily in their *Hot House*, there let it stand all the time of their *Walling*: Wherefore they prepare for these *Loaves* at the beginning of their Work, that they may have all the benefit of their *Hot Houses*, and when these begin to slack, they take out the *Loaves*, and untie the *Cords* that fastened the *Barrow*, that both sides of the same may easily open without breaking the *Loaf*. Then they take the *Loaf*, and bake it in an *Oven* where *Household Bread* hath been baked, but now drawn forth. This they do twice or thrice, 'till they see it baked firm enough; and this being placed in a *Stove* or in a *Chimney Corner*, and close covered with an *Hose* of *Cloth* or *Leather*, like the *Sugar Loaf-Papers*, will keep very *White*; and when they have occasion to use any, they shave it off with a *Knife* (as you do *Loaf-Sugar*) to fill the *Salt-seller*.

Explication of
the Figures.

Fig. 63. The *Loot*.

Fig. 64 *aa*, Two *Barrows* filled with *Salt*. *bb*. The *salt* heaped above the top of the *Barrows*, and patted down hard. *C*. The *Leach-Trough*.

Fig. 65. *aaaaaa*, The *Hot-House* between the *Wall* and the *Chimney*. *bb*, two *Tunnels*. *CC*, The *Chimney-back*, into which the *Tunnels* convey the *Smoke*. *dddd*, The 4. *Panns*. *E*, The *Partition Wall* between the *Panns* and the *Hot House*. *ff*. The *Fire-places*. *gg*. *Ash-holes*. *hh*. The *Hearth* below. *ii*. The *Descent* to the *Hearth*.

At *Droitwich*
in *Worcester-*
shire; by *Dr.*
Tho. Rastel.
n. 142. p. 1059.

The Country is neither *Plain*, neither hath it any great *Hills*, but many small *Risings*, the greatest *Hills* near us being the *Lichie* within 6 *Miles*, which some call *Look-high*, supposing it to be the highest *Ground* in these *Parts*, because the *Springs* which rise there, run into the *North* and *South Seas*; near to which are *Clent Hills*, about the same distance. On the other side the *River Severn*, are *Aberly Hills* at about 7 *Miles* distance from us. There are many *Salt-springs* about the *Town*, which is seated by a *Brook* side, called *Salwarp-brook*, which arise both in the *Brook*, and in the *ground* near it, though there are but 3 *Pits* that are made use of.

Where the *Springs* are *saltest* there grows nothing at all, but by the *Brackish Ditches* there grows *Aster Atticus* with a pale *Flower*, which I find no where else with us.

Some

Some of the *Salt Springs* rise on the top of the ground, which are not so *salt* as others. The *Great Pit* which is call'd *Upwich Pit* is three foot deep; in which are three distinct *Springs* rising in the bottom, one comes into the *Pit* North west, another North East, the 3d South-East, which is the Richest both in *Quantity* and in *Quality*. They all differ in *saltness*, which I can give no exact *Account* of, it being impossible to separate them, but there will be some mixture; the *Pit* is about 10 foot square, the sides are made with square *Elms* jointed in at the full length, which, I suppose, is occasion'd by the *Saltness* of the ground which appears to me to have been a *Bogg*, the surface of it is made of *Ashes*. That it was originally a *Bog*, I am induced to believe, for not many *Years* since, digging to try the *Foundation* of a *Seal* (for so we call our *Houses* we make *Salt* in) I thrust a long *Staff* over head.

Tho' the *Brine* be *Colder* than the other *Water*, yet it never *Freezeth*, but the *Rain Water* that lies upon the *Brine* (in extream hard *Frosts*) will *Freeze*, but not much.

The *Soil* about the *Town* on the lower side of it, is a *Black Rich Earth*, under which two or three foot is a ft ff *Gravelly Clay*, then *Marle*. Those that make *Wells* for fresh *Water*, if they find *Springs* in the *Marle*, they are generally *Fresh*; but if they sink through the *Marle*, they come to a whitish *Clay* mixed with *Gravel*, in which the *Springs* are more or less *Brackish*.

In the great *Pit* at *Upwich*, we have at one and the same time three sorts of *Brine*, which we call by the names of *First-man*, *Middle man*, and *Last-man*; these sorts are of different *strengths*: The *Brine* is drawn by *Pump*, so that which is in the bottom is first pumped out, which is that we call *First man*, &c. That I might make an exact *tryal* of the *strength*, I made me a *Quart* that contained 24 *Ounces Troy*, of *Distilled Water*, which *Quart* being filled with the *first Brine*, besides the *Tare* of the *Quart* weighed 29 *Ounces*, which made 7 *Ounces* and 3 *Drachms* of *Salt* without any addition; the next day I weighed the same *Salt* again, and it weighed 7 *Ounces* and 6 *Drachmes*: So that 4 *Tuns* of *Brine* make above one *Tun* of *Salt*. The same *Quart* filled with *Middle man*, which is the *second* sort of *Brine*, weighed 28 *Ounces*, I also weighed a *Quart* of *Brine* as it came immediately out of the *Springs* which weighed 28 *Ounces*, and the 3d sort 27 *Ounces*, so that what the *first* gets, the *last* looseth, which doth precipitate as much in 24 *Hours*, as if it stood a much longer time.

The *Quantity* of *Brine* that this *Pit* yields every 24 *Hours*, is as much as will make 450 *Bushels* of *Salt*, which is *Drawn* out twice or three times a *Day*, for so oft we ordinarily *Draw*, and that as long as the *Pump* will go.

In the *Best Pit* at *Netherwich*, a *quart* of *Brine* weighs 28 *Ounces* and an *half*; this *Pit* is 18 *Foot* deep, and 4 *Foot* broad, and yields as much *Brine* every 24 *Hours* as makes about 40 *Bushels* of *Salt*, there is but one *Spring* in the *Pitt*, that comes in 2 *Foot* and 8 *Inches* above the bottom.

The *Worst Pitt* at *Netherwich* is of the same breadth and depth as the former; a *Quart* of *Brine*, out of which weigheth 27 *Ounces*, and yields as much *Brine* daily, as makes about 30 *Bushels* of *Salt*. In this *Pitt* are three *Springs*, two

in the bottom, and one about two Foot higher. These Pits are within 6 yards of one another.

These Pits are near the *Brook*, the *Great Pitt* on the North side, and about a quarter of a Mile lower; the two *lesser Pits* on the South side.

In the *great Pitt* I found no variation, either in *Quality* or the *Strength* of the *Brine*, but the *Springs* in the other *Pits* are augmented by much *Rain*, and yield less *Salt*.

That every Man may know his own *Proportion*, the *Brine* is divided into *Phats Wallings*, a *Phat Walling* is divided into 12 *weaker Brines*, and every *weaker Brine* is divided into 8 *Burdens*, every *Burden* being a *Vessel* that contains about 32 *Gallons*, whereof every one hath 6 *Burdens* of *First-man*, 6 of *Middle-man*, and 6 of *Last-man*, so that every Man hath not only his just *proportion* in *Quantity*, but in *Quality* also. This *Brine* is carried in *Coolers* to every Man's *Seal*, by 8 sworn Men, which we call *Masters of the Beachin*, and 4 *Middle men*, and there put into great *Tuns* for use.

The *Fewel* heretofore used was all *Wood*; but since the *Wood* hath been destroyed by the *Iron Works*, we use almost all *Pitt-Coals*, which are brought to us by *Land* 13 or 14 *Miles*.

The *Phats* we boil our *Brine* in, are made of *Lead*, cast into a flat *Plate* 5 *Foot* and an half long, and 3 *Foot* over, and then the *sides* and *ends* beaten up, and a little raised in the middle, which are set upon *Brick-work*, which we call *Ovens*, in which is a *Grate* to make the *Fire* on, and an *Ash-hole* which we call a *Trunk*; in some *Seals* are 6 of these *Panns*; in some 5, and some 4, some 3, some 2. In each of these *Panns* is boiled at a time, as much *Brine* as makes 3 *Pecks* of *white Salt*, which we call a *Lade*, and is laded out of the *Pan* with a *Loote*, and put into *Barrows*, which are set into *Bastalls* over *Vessels* we call *Leach-coms*, that the *Brine* may run from the *Salt*; which *Brine* we call *Leach*, with which we dress our *Phats*, when the cold *Brine* they are first filled with is something boiled away. In these *Bastalls* the *Salt* stands till its dry, which is about 4 *hours*; then we carry it into *Cribs* (which are *Houses* boarded in the bottom and sides) where it is kept till sold, which is sometimes half a *Year* or 3 *quarters*; in which time if the *Crib* is good, it will not waste a twelfth part, the *Salt* it self being of so strong a *Body*: Whereas in *Cheshire* they are forced to keep their *Salt* in *Barrows* in *Stoves* to *Dry* it, and make it no faster than they sell.

For *Clarifying* the *Brine* we use nothing but the *Whites* of *Eggs*, of which we take a quarter of a *White*, and put it into a *Gallon* or two of *Brine*, which being beaten with one's *Hand*, Lathers as if it were *Soap*, a small quantity of which *Froth* put into each *Phat*, raiseth all the *Scum* (so that the *White* of an *Egg* will *Clarifie* 20 *Bushels* of *Salt*) by which means our *Salt* is as *White* as any thing can be, neither hath it any ill *Savour*, as that *Salt* hath that is *Clarified* with *Blood*.

For *Granulating* it, we use nothing at all, for the *Brine* is so strong of it self, that unless it be often stirred, it will make *Salt* as big grain'd as *Bay Salt*. I have boiled *Brine* to a *Candy* height, and it hath produced *Clods* of *Salt* as clear as the clearest *Allum*, like *Isle of May Salt*, so that we are necessitated to

put a small quantity of *Rosin* into the *Brine* to make the *Grain* of the *Salt* small.

Besides the *White Salt*, we have another sort which we call *Clod Salt*, which grows to the bottom of the *Phats*, that after the *White Salt* is laded out, is digged up with a *Picker* (which is made like a *Mason's Trowel* pointed with *Steel*, and put upon a short *Staff*) this is the strongest *Salt* I have seen, and is most used for salting *Bacon* and *Neats Tongues*, it makes the *Bacon* Redder than other *Salt*, and makes the *Fat* eat firm; if the *Swine* are fed with *Mast*, it hardens the *Fat* almost as much as if Fed with *Pease*, and salted with *White Salt*. It is very much used by *Country Women* to put into their *Runnet-Pots*, and (as they say) is better for their *Cheese*: These *Clods*, are used to broil *Meat* with, being laid on *Coals*. We account this *Salt* to be too strong to salt *Beef* with, it taking away too much of its sweetness.

A 3d. sort of *Salt* we have which we call *Knockings*, which doth Candy on the *Stails* of the *Barrow*, as the *Brine* runs from the *Salt*, after it is laded out of the *Phats*. This *Salt* is much used for the same uses as the *Clod Salt*, though it is not altogether so strong.

A 4th sort we have which we call *Scrapings*, that is a Course sort of *Salt* that is mixed with *Dross* and *Dust* that cleaves to the *Tops* of the sides of the *Phats*; This *Salt* is Scraped off the *Phats* when we Reach them (that is when we take our *Phats* off the *Fires* to beat up the *Bottom*) and is bought by the poor sort of *People* to *Salt* *Meat* with.

A 5th sort is *Pigeon Salt*, which is nothing but the *Brine* running out through the *Crack* of a *Phat*, and Hardens to a *Clod* on the out side over the *Fire*.

Lastly, the *Salt-Loaves* are the Finest of *White Salt*, the *Grain* of which is made something Finer than ordinary, that it may the better adhere together, which is done by adding a little more *Rosin*, and is Beaten into the *Barrows* when it is Laded out of the *Phat*.

Our *Salt* is not so apt to Dissolve as *Cheshire Salt*, nor as that *Salt* that is made by Dissolving *Bay-Salt* and Clarifying it, which is called *Salt* upon *Salt* which appears by our Long keeping it without any *Fire*.

I believe there cannot be better *White Salt* than ours for several Reasons.

1. There is none can be *Whiter*, and consequently more free from *Dross*:

2. It is the *Weightiest* as I have seen my self, and been informed by others; for the *Baggs* of *Salt* I have usually seen brought out of *Cheshire* on *Horse* back, contain 6 *Bushels* and a half or 7 *Bushels*, whereas the best *Horses* that carry *Salt* from Hence (if they carry it above 5 *Miles*) carry not above 3 *Strike* and 3 *Pecks*, or 4 *Strike*. A *Winchester* *Bushel* of our *Salt* Weighs half a hundred *Weight*, so that it must necessarily follow, the *Weightiest* and *Dryest* must needs be best.

3. In the time of the First *Dutch Warr*, our *Salt* was carried down into the *West*, where they had none before but *Foreign Salt*, where at first using ours they complained that it made their *Meat* too *Salt*, which was because they put as much of ours on their *Meat* as of others: If so, it must be better than *French Salt*.

4. I have been assured by many that have made use both of *ours* and *Che- shire Salt*, that both for *Flesh* and *White meat* they must lay on more of *Che- shire Salt* than *ours*.

5. It doth preserve all sorts of *Flesh* for *long Voyages*, viz. to *Jamaica*, as well as any; which hath been lately *Tried*.

6. I have seen *Herrings* that have been *Salted* with our *Salt* in *Ireland*, and brought over to this *Town*, which have been *Whiter* and better *Tasted* than those *Salted* with *Bay Salt*.

7. It is an ordinary way of *Powdering Beef* with us, to give it but one *Salt- ing* to keep it the *Whole Year*.

We use not *Iron Pans* as they do in *Cheshire* and other places, for we have found upon *Trials*, that the *Strength* of the *Brine* doth so *Corrode*, that it quickly *Wears out* those of *Forged Iron*, and *Breaks* those of *Cast- Iron*.

The Formation
of Salt and
Sand from Brine;
by Dr. Rob.
Plot. n. 145.
p. 96.

XLVI. At my request two *Curious Observers* (*Neighbours* to the *Brine Pits* in *Staffordshire*) to 8 folds of *Fine Holland* added as many more of *Finer Cambrick*, through both which they strained a competent quantity of the *Brine*, but found nothing left in this very close *Colander*, but a little *black Dust*, which they imputed only to the *Foulness* of the *Water*, it being nothing like *Sand*; for having examined the *Cloth* both with their *Fingers* and a *Micro- scope*, they could feel or see no more of *Sand*, than if they had percolated the *clearest Spring Water*; and yet this *Brine* is found to hold in *boiling* at least $\frac{1}{4}$ of as much *Sand* as *Salt*.

But notwithstanding this *Experiment*, it did not seem to their apprehensions necessary that the *Sand* should be generated in the *Boyling*, but might rather be originally there; for before they strained it, they observed in the *Water* (by the help of a *Microscope*) a great *Multitude* of very *minute Animals* (much smaller than those in *Pepper Water*) swimming about in it, together with many small *Transparent Plates*, some of them a little bigger than the *Animalcules*, and some less, but all of a *Rectangular Oblong Figure*, though some indeed seemed very near a *Square*, which they found also in the *Water* after straining as thick as before, the *Pores* or rather *Interstices* between the *Threads* of the *Holland* and *Cambrick* appearing in the *Microscope* 20 times greater than either the *Animalcules* or *Plates*. And these they judged to be the *Original Particles* both of the *Salt* and *Sand*, which as the *Water* *Evaporates* in *Boyl- ing*, they thought might gather together till they made up such a visible course *Body* as we see the greater *Corns* of each are. Wherein they were confirmed in a little time; for observing with an excellent *Microscope*, some of the strong *Brine*, which drops from the *Baskets* or *Barrows* when the *Salt* is first put into them, though at first it looks like *clear Water*, yet upon a more accurate *Observation*, it appeared exceeding full of these *Oblong Particles*, which as they lookt on them, they could sensibly perceive to gather together, and Club to make greater *Parts*; and as the *Water* dried off from the *Glass*, to grow far larger and larger, till they appeared as big, and not much unlike a large siz'd *Table Diamond*: Which made them guess that the *Sand* might be also gener-
rated

rated (if I may so say) after the same manner, it appearing to them to be nothing (pardon the Expression) but an *Inspid Salt* composed of parts not so sharp Pointed as the other, but Rounder and Blunter Angled, and consequently not so Pungent on the Tongue.

Upon this Suggestion, having some of the *Sand* by me, I endeavoured to *Dissolve* it in fair Water, to see whether I could reduce it again into its former State, but without Success; its parts being so inseparably Fixt, that they would by no means *Dissolve*. I also tryed the *Salt*, which though it *Dissolved*, yet would not render it self again into the *Plates*. Whereof sending an Account to my Friends in *Staffordshire*, they were pleased also to make a further Tryal of *Dissolving* the *Sand* separated from the *Salt* in *Boiling*; which though they confest, they could not do to any considerable Quantity, yet they found that after the straining, it was not so heavy by a great deal as before, the Water that came from it being very clear, which made them believe that it did *Dissolve* in some measure, unless (as is very probable) there were in the *Sand* some Particles of *Salt*, which upon *Dissolution* were separated from it, and so rendered it Lighter: Nevertheless they did not doubt, but a great part of the *Sand* might also be *Dissolved*, though perhaps no great Quantity in *Pump-water*, in which it seems they tryed it.

One of the aforesaid Gentlemen casually looking upon some of the *Salt* made at those *Pits* before it was Dried and beaten small, observed that many of the larger *Corns* were of the same Shape to the *Naked Eye*, as the *minute* ones appeared of in the *Microscope*, and that they were visibly made up of a great Number of small *Plates*, shooting up from a *Quadrangular Oblong Base* into a very *Obtuse Pyramid*, hollowed within.

XLVII. At *Northwich* in *Cheshire*, upon the *Weever*, in 4 *Pitts* is great plenty of *Brine*, it stinks of *Sulphur* apparently in all the *Pitts*; it becomes *Atramentous* with *Galls*.

Observations on
the Midland
Salt-springs, by
Dr. Lister.
n. 156. p. 489.

Here are used *Sand-pans*, which are let down in the Corners of the great *Iron Boilers*, before the *Salt* shoots into *Grains*, and these catch the *Sand*. Besides there are thick *Stone-Flakes* raised from the bottom of the said *Iron Boilers*, once a Week.

N. B. Within half a Mile of these *Brine pits* at *Marberry*, a *Salt Rock* was found by the Augur in Boring for Coals.

vid. Inf. Cap.
III.

Here, and at *Middlewich*, also at *Nantwich*, and all along the River *Weever*, which are places many Miles distant, sink on either side of the River, and you will scarce miss of *Brine*, as I was credibly inform'd by the most knowing Men in that particular: But yet it proves a Venture whether the *Brine* will be strong enough to *Boil*, and turn to Account; and for this Reason their *Pitts* sometimes fail them, to their great loss (as they shewed me one which had been wrought to very great profit) by a small *sweet Spring* breaking into it, and sometimes the River *Weever* it self does them this mischief.

Nantwich upon the same River, is one very large *Brine Pitt*. This Water also plainly *finens* as it were corrupted, or like *Sulphur*, but notoriously upon a few Days forbearance of the *Pitt*. It becomes *Atramentous* with *Galls*. It yields a *White Sand* or *Stone* adhering, in the manner of thin *Scales*, to the bottom of the *Iron Pans*, in which the *Brine* is Boiled.

Weston Brine-Pit near *Stafford*. This Water in the *Pit* Stinks like Rotten Eggs: With *Galls* it becomes suddenly *Atramentous*. It Purges and Vomits violently, and that drunk in a small Quantity. Here are used *Sand Pans* to catch the white *Sand*, and there are *Flakes* of *Stone* also, raised from the bottom of the great *Iron Boilers*.

Droitwich in *Worcestershire*. The *Upper Wich* or *Brine Pit* is very neatly kept, and exceedingly drawn, because there are so many Proprietors, and but a small *Pit*, comparatively to those which have been named above.

Mr. J. Collins
S. & Fish.

Here the *Salt* is boiled in small *Leaden Pans*, and there is not the least Grain of *Sand* at any time, which either falls before the *Graining* of the *Salt*, or that adheres to the *Pans* bottoms; notwithstanding what hath been said to the contrary: And therefore this *Brine* being naturally without *Sand*, it must yield the more *wholsome Salt*.

The *Lower Pit* at the *Netherwich* in the same Town, hath but one Proprietor, as I remember, and therefore is less drawn, but yet is constantly and well wrought. Here also is no News or Knowledge of any *Sand* at all. The Water of these *Pitts* stinks like Rotten Eggs, especially after *Sunday's* rest: And (N. B.) will, if *Flesh* be Pickled in them, make it stink in 12 Hours. And yet the *Salt* that is boiled out of these *Pitts*, is accounted the very best *Inland Salt* of *England*, and I believe as good as any in the World.

I observed in a Ditch over against the *Nether Wich-houses*, the Water standing with a *White Scum* as at the *Sulphur Spaws* in *Yorkshire*.

I shall add by way of Corollary,

1. That all our *Yorkshire Wells* called *Sulphur Spaws* (which are many) are no other then so many *Brine Pits*, and if they were well Drawn and Wrought would be as little offensive in *Smell*.

2. That this *Stone-Powder* is also to be found adhering to the *Iron Pans*, where the *Sea water* is boiled into *Salt*, as it is at *Shields* in the *Bishoprick* of *Durham*; but I do not remember it to be in the *Lead Pans* at *Medop* and *Milthrop* in *Lancashire*, where the *Sea Sands* are *Lixiviated*, and that *Lixivium* boiled into *Salt*; nor is it remembered in the Account given of the Making of *Sea-Salt* by *Insolation*: Nor could I observe it in the least, in *Distilling* of *Sea-Water* in a *Glass Still*, or in the *Yorkshire stinking Wells*; of which a good Quantity is Yearly made for Medical use, or rather Curiosity, to vend to Strangers.

Vid. Inf.
§. XLVIII.

N. B. This *Sand* falls to the bottom before the *Salt Grains*.

This is so also in all other *Mineral Salts*, whose *Brines* being boiled, ever let go first this stony part: The *Okar* falls in Powder upon the first boiling, but the *Lapis Calcarius* rises in *Flakes* like *Wafers*, which yet falls in Powder by *Frost*, as we have elsewhere observed.

3. This *Stone-powder* irrigated with fair Water, and kept moist, does yield an immature *Salt* of an uncommon Figure; which I have described at large and figured. De Font. Medic. Angl.

4. Notwithstanding the great Affinity betwixt the *Salt* of the *Midland Erine-Pits*, which is *Common Salt*, and the *Sea salt*: I must not omit (amongst others) a specifick Difference, which is by me (that I know of) now first published, and which, in my Opinion, makes the *Sea Water*, a Water of its own kind: And also shews that none of the Productions of Incinerated Plants are truly a *Marine Salt*.

The *Angles* of the *Crystals* of *Common Salt*, boiled out of the *Midland Brine Pits*; as also of *Salt Gem* or *Rock Salt*, which I take to be one and the same, are Intire, and so are all those *Lixiviated Marine Salts*, so called and described by Dr. Grew. But the *Angles* of the *Crystals* of true *Sea Salt*, are ever some of them cut off into *Triangular Planes*, at least on one of the sides. And this I learnt by suffering a *Bottle* of *Sea Water*, taken up upon the Coast at *Scarborough*, where no River near enters it, to *Evaporate* leisurely placed in the Shade, after it had been half boiled away; and here all the *Crystals* (which were many, and of different Magnitudes) did yet agree in a like Figure, as is described; and I do not doubt but it will succeed with any *Sea Water*.

XLVIII. *A A A*, is the *Sea*.

11. The *Entry*, by which the *Sea-water* passes into *B. B.*

B B. The *first* Receptacle; in which the Water is kept 20 Inches deep.

C C C. The *2d.* Receptacle, where the Water maketh 3 Turnings, as you see, and is 10 Inches deep.

2 2. The *Opening*, by which the *first* and *2d* Receptacle have Communication one with another.

E E F. The *3d.* Receptacle, which is properly called the *Marish*.

d d d d d d. Is a *Channel* very narrow, through which the Water must pass before it enters out of the *2d.* Receptacle into the *3d.*

33, Is the *Opening*, by which the Water runs out of the *2d.* into the *3d.* Receptacle.

The *Pricks* you see in the Water throughout the whole Scheme, do Mark the Course and Turnings which the Water is forced to make before it comes to *b b b b b*, which are the places where the *Salt* is made.

b b b b b, Are the *Beds* of the *Marish*, where the *Salt* is made; and in them the Water must not be above an Inch and an half deep. Each of these *Beds* is 15 Foot long, and 14 Foot large.

9 9 9 9 9, Are the little *Channels* between the *Beds*.

8 8 8 8 8, Are the *Apertures*, by which the *Beds* receive the *Sea-Water* after many Windings and Turnings.

When it *Rains*, the *Openings* 22, 33, are stopped to hinder the Water from running into the *Marish*. Unless it *Rain* much, the *Rain Water* doth little hurt to the *Marish*; the Heat of the *Sun* sufficiently Exhaling it, if it be not above an Inch high; only if it have rained very plentifully that Day, no *Salt* is drawn for the 3 or 4 next Days. But if it *Rain* 5 or 6 Days, the People are

The Way of
Making Salt in
France by Dr.
--- 1751 p. 1027.
Fig. 66.

then necessitated to empty all the *Beds* by a peculiar Channel, which cannot be Opened, but when it is *Low Water*. But 'tis very seldom that it Rains so long as to constrain Men to Empty those *Beds*.

The Hottest Years make the most *Salt*; and in the Hottest part of the Summer there is *Salt* made even during Night. Less *Salt* is made in *Calm*, than in *Windy Weather*.

The *West* and *Northwest* Winds are the best for this purpose:

Our Country People Draw the *Salt* every other day, and every time more than an hundred pound Weight of *Salt*.

The *Instruments* used to Draw the *Salt*, have many small Holes to let the Water pass, and to retain nothing but the *Salt*.

The *Reddish Earth* in *Marishes* maketh the *Salt* more *Gray*; the *Bluish*, more *White*: Besides, if you let run in a little more Water than you ought, the *Salt* becomes thence more *White*; but then it yields not so much. Generally all the *Marishes* require a *fat Earth*, neither *Spungy* nor *Sandy*.

The *Salt-man* who draws the *Salt*, must be very *Dextrous*. In this *Isle* of *Rbe* there are, that Draw very *Dark Salt*, and others that Draw it as *White* as *Snow*; and so it is in *Xaintonge*. Chiefly care is to be taken, that the *Earth* at the bottom of the *Beds* mingle not with the *Salt*.

The *Salt* we use at our *Tables* is perfectly *White*; being the *Cream* (or that *Salt* which is formed on the *Top* of the *Water*) drawn 4 or 5 Hours before the *Salt* is to be drawn. The *Grains* of it are smaller than of the other. Generally the *Salt* of *Xaintonge* is somewhat *Whiter* than ours. The *Bigness* of our *Salt* is of the *Size* of a *Pepper grain*, and of a *Cubical* shape.

The *Marishes* are preferred from one Year to another, by overflowing them a Foot high.

The *Timber* of the *Marishes*, if it be of good *Oak*, keeps near 30 Years; but there is used but little *Wood*, all the *Ditches* and *Apertures* being done with *Stones*.

In Lancashire;
by Dr. J. Beale.
n. 103. p. 51.

XLIX. At *Wire water* in *Lancashire*, *Salt* is gathered out of *Heaps* of *Sand* along the *Sea side* in many places: Upon which *Sand* (saith *Speed*) the People pour *Water*, until it gets a *Saltish* Humour, which they afterwards Boil with *Turfs*, till it become *White Salt*.

The *Water* of the *Brine Pits* in *Summer* time, when the *Brine* is strongest, being cast in any place where it may be soon *Dried* by the *Sun*, and where we would have *Pigeons* Resort, does please them well. So will any *Refuse Brine*, being boil'd up to a *Consistence*. But I know not, whether such *Brine*, taken from *powdred* *Flesh*, will be kind for *Sheep*.

In Germany; by
.... n. 7. p. 128.

L. An *Observing Gentleman* writes out of *Germany*, that no *Salt-Water* which contains any *Metal* with it, can well be sodden to *Salt* in a *Vessel* of the same *Metal* which it self contains, except *Vitriol* in *Copper Vessels*.

He adds, that to separate *Salt* from *Salt-Water* without *Fire*, if you take a *Vessel* of *Wax*, hollow within and every where tight, and plunge it into the *Sea*, or into other *Salt-water*, there will be made such a *Separation*, that the *Vessel* shall be full of *Sweet Water*, the *Salt* staying behind; but though this *Water* have no *Saltish Taste*, yet, he saith, there will be found a *Salt* in

the

The Essay, which is the *Spirit of Salt*, subtile enough with the Water to Penetrate the Wax.

L I. We have seen here (at *Leyden*) a Maid, of about 13 Years of age, which from the time that she was but 6 Years Old, and began to be about her Mother in the Kitchen, would, as often as she was bid to bring her Salt or could else come at it, fill her Pockets therewith, and Eat it, as other Children do Sugar: whence she was so Dried up, and Grown so Stiff, that she could not Stir her Limbs, and was thereby starved to Death.

The Joynts of a Girl made Stiff by Eating Salt; by n. 8. p. 138.

LII. *Papers, Of Less General Use, Omitted.*

1. Some Objections of the *Fr. Journalist* to the Engines for Drawing up Water from the Bottom of the Sea, and for Sounding the greatest Depths without a Line, Answer'd by Mr. Oldenburg. n. 13. p. 228.
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- n. 167. p. 862. 3. *De Origine Fontium Tentamen Philosophicum*, in Prælectione habita coram Societate Philosophica nuper Oxoniæ instituta ad Scientiam Naturalem promovendam. Per Rob. Plot. L. L. D. Oxon. 1685. in 8°.
- n. 233. p. 734. 4. *De Fontium Mutinentium admiranda Scaturigine*, Tractatus Physico Hydrostaticus Bernardini Rammazzini, in Mutinensi Lycæo Med. Prof. Mutinæ. 1691 in 4°. Translated into English, and illustrated with many curious Remarks and Experiments by the Auth. and Translator, Dr. Rob. St. Clair. Lond. 1697. in 8°.
- n. 51. p. 1038. 5. Dr. Tobias Whitaker of Drinking Mineral Waters. 1634.
- n. 42. p. 850. 6. *Hydrologia Chymica*, or the Chymical Anatomy of the Scarborough and other Spaws in Yorkshire, &c. by W. Sympson. Lond. 1668. in 8°.
- n. 49. p. 999.
n. 51. p. 1038. 7. An Answer to *Hydrologia Chymica* of Will Sympson; by Rob. Wittie. M. D. Lond. 1669 in 8°. Besides the Account of this Book, there is a Correction of a Mistake of the Printer in the 3d Page
Some Reflections made on this Account of Dr. Wittie's Answer to *Hydrologia Chymica*; by Dr. Dan. Foot.
- n. 52. p. 1050. Dr. Foot's Reflections consider'd; by Dr. J. Beal.
- n. 57. p. 1154.
n. 56. p. 1128. Some Considerations relating to Dr. Wittie's Defence of Scarborough Spaw; by Dr. Highmore,
- n. 60. p. 1074. A Discourse of Dr. Rob. Wittie, relating to the Notes and Quæries of Dr. Foot, and to those of Dr. Highmore, concerning Mineral Waters, and Extracts made out of them.
- n. 62. p. 2032. 8. A Vindication of *Hydrologia Chymica*, by Will. Sympson. M. D. Lond. 1670,
- n. 85. p. 5019. 9. Scarborough Spaw spagyrically Anatomiz'd. An. 1670; and a New Years Gift for Dr. Wittie. Lond. 1671. both in 12° by Geo. Tonstal. M. D.
- n. 144. p. 59. 10. 1. M. Lister M. D. *De Fontibus Medicatis Angliæ*; Exercitatio nova & Prior. Eboraci 1682. in 8°.
- n. 158. p. 579. 2. M. Lister. M. D. *De Fontibus Medicatis Angliæ*; Exercitatio Altera Lond. 1684. in 8°.
- n. 172. p. 1063. 11. Short Memoires for the Natural Experimental History of Mineral Waters; by the Honourable Rob. Boyle, Lond. 1685. in 8°.
- n. 206. p. 1003. 12. Tentamen Philosophicum de Aquis Mineralibus, &c. Auth. Carolo Leigh. M. D. Lond. 1694. in 8°. Dr. Cay here Objects many things to that Author's Observations.
- n. 245. p. 368.
n. 251. p. 146. 13. The Natural History of the Chalybeat and Purging Waters of England, with their particular Essays and Uses, &c. with Observations on the Bath Waters in Somersetshire; by Benj. Allen M. D. Lond. 1699.
- n. 125. p. 612. 14. Observations sur les Eaux Minerales des plusieurs Provinces de France, faites en l'Academie Royale des Sciences, en l'Anne 1670, & 1671. par le Sieur du Clos. A Paris. 1675. in 12°.
- n. 123. p. 573. 15. *Bathoniensium & Aquisgranensium Thermarum Comparatio*, variis adjunctis illustrata, a R. P. Lond 1676. in 8°.

C H A P. III.

Minerology.

I. 1. **T**HE *Mine* or *Adit* is to be made 7 or 8 foot high; which though it seem to make more work downwards, yet will be found necessary for making the better Dispatch by rendering the *Invention* more effectual.

To Break hard
Rocks; by M.
Du Sons. n. 5.
p. 82.

There is a *Tool* of Iron well Steeled at the end, which cuts the Rock, (of the Shape shewed by the *Figure* annexed,) 20 or 22 inches long or more, and some $2\frac{1}{2}$ inches Diameter at the Steeled end, the rest being somewhat more slender. The Steeled end is so shaped, as makes it most apt to Pierce the *Rock* the Angles at that end being still to be made the more Obtuse, the Harder the *Rock* is. This *Tool* is to be first held by the hand in the middle between the Sides of the *Rock* that is to be cut, but as near the bottom as may be. The *Tool* being placed, is to be struck upon with a *Hammer*, the Heavier the better; either suspended by a Shaft turning upon a Pin, or otherwise, so soon as one Man may manage the *Hammer* while another holds the *Tool* or *Piercer*. If it be hung in a Frame, or other convenient way, he that manageth it hath no more to do, but to pull it up at first as high as he can, and let it fall again by its own Weight, the motion being so directed as to be sure to hit the *Piercer* right. After the stroke of the *Hammer*, he that holds the *Piercer*, is to Turn it a little on its Point, so that the Edges or Angles at the Point may all strike upon a new Place; and so it must still be shifted after every Stroke; by which means small Chippes will at every stroke be broken off, which must from time to time be taken out, as need requires. And thus the Work must be continued, till the *Hole* be 18 or 20 inches Deep; the Deeper the better. This *Hole* being made as Deep as is required, and kept as Straight and Smooth in the sides as is possible, there is then a kind of *Double Wedge* to be made, and fitted exactly for it; the Shape whereof is to be seen in the annexed *Figure*.

Fig. 67.

This *Double Wedge* being 12 or 13 inches long, each piece of it, and so made as being placed, in their due Position, they may make up a *Cylinder*, cut *Diagonal wise*. The 2 Flat-sides that are Contiguous, are to be Greased or Oiled, that the one may slip the more easily upon the other; and one of them, which is to be uppermost, having at the Great end a Hollow Crease cut into it round about, for fastning a Cartridge Full of *Gunpowder* to it with a thred, the Round End of the *Wedge* being pared as much as the thickness of the Paper or Past board that holds the *Powder* needs, to make the outside thereof even with the rest of the *Wedge*. This *Wedge* must have a *Hole* Drilled through the longest side of it, to be filled with *Priming Powder*, for firing of the *Powder* in the *Cartridge*: Which needs have no more than half a pound of *Powder*; though upon occasion a greater quantity may be used, as shall be found Requisite.

Fig. 68.

Then this *Wedge*, being first thrust into the *Hole* with the *Cartridge*, the Round side, where the *Priming Hole* is, being uppermost, the other *Wedge* is to be Thrust in, home to the due Position, care being taken that they fit the

Hole

Hole in the *Rock* as exactly as may be. Then the End of the lower *Wedge* being about an inch longer than that of the upper, outwardly and Flatten'd, *Priming Powder* is to be laid upon it, and a piece of burning *Match*, or Thred dipt in *Brimsstone*, or other such prepared Combustible matter, fastned to it, that may burn so long before it *Fire* the *Powder* as he that orders it may have time enou^h to retire quite out of the *Pit* or *Adit*, having first placed a piece of *Wood* or *Iron* so, as one end thereof being set against the End of the *Lower Wedge*, and the other against the *Side wall*, so as it cannot Slip. Which being done and the Man retired, when the *Powder* comes to take *Fire*, it will first drive out the *Uppermost wedge* as far as it will go; but the flaunting Figure of it being so made, as the Farther it goes backward the Thicker it grows, till at last it can go no farther, then the *Fire* Tears the *Rock* to get forth, and so Cracks and Breaks it all about, that at one time a vast deal of it will either be quite Blown out, or so Crack't and Broken as will make it easie to be Re-moved.

By Mr. Beaumont. n. 167.
p. 854.
Fig. 69.

2. A considerable *Adventurer* in the *Lead Mines* on *Mendip Hills* acquaints me that the *Miners* there, within these 12 Months, had got a new way of *Cleaving Rocks* with *Gunpowder*.

Fig. 70

The *Borier* is made of *Iron*, and is 2 Foot 2 inches in length: It is an inch square at the Steeled end from *a* to *b*, and somewhat less in the other part. The use of this Instrument is to make a *Hole* in the *Rock* deep enough to receive the *Powder*. The *Gun* is 6 inches in length, $1\frac{1}{4}$ Diameter, and has a *Hole* drilled through it to receive the *Priming Powder*. When a *hole* is made with the *Borier* somewhat deeper than the length of the *Gun*, they Dry it with a Rag, and put into it about 2 or 3 Ounces of *Powder*, over which they put a Thin Paper, and on it place the *Gun*, which they bind firmly into the *Hole*, by driving in against the Flat side of the Upper part of it a little *Iron Wedge* 4 inches in length, by the *Miners* called a *Quinnet*.

Fig. 71.

When this is done, they pass down a wire through the *Hole* drilled in the *Gun*, and pierce the *Paper* which covers the *Powder*, and then they *Prime* the *Gun*, and lay a *Train*; and go up out of the work before the *Powder* comes to take *Fire*. The *Paper* is put at first over the *Powder*, lest when the *Gun* and *Quinnet* are driven down, the Tools may Strike *Fire* and Kindle the *Powder*.

These *Instruments* are of great advantage to *Miners*; for as soon as a Man has Fired his *Powder* and Broken the *Rock*, he may Presently go to *Work* again, whereas after a *Fire* is laid in a *Shaft*, a Man can scarce go to work in 24 hours, the *Rocks* being too *Hot* to suffer him.

Ookey-Hole,
and some other
subterraneous
Caverns in
Mendip-Hills;
by Mr. J. Beau-
mont. Ph. Col.
n. 2. p. 1.

II. 1. On the South side of *Mendipp Hills* within a Mile of *Wells* is a Famous *Grotto*, known by the Name of *Ookey-hole*, much resorted to by *Travel-lours*: The entrance of it is in the fall of those Hills, which is there all beset with *Rocks*, having near it a *Precipitous Descent* about 10 or 12 Fathom deep; at the Bottom of which there always issues from the *Rocks* a considerable *Current of Waters*. The naked *Rocks* above the entrance, shew themselves for about 30 Fathom in *Height*; though the whole *Ascent* of the Hill above it, is about a *Mile*, and is very *Steep*.

As you pass into this *Vault* you go upon a Level, but advancing further into it, you find the Way Rocky and uneven, sometimes Ascending, and sometimes Descending; as generally in all Caverns. The *Roof* of it, in the highest part, is about 8 Fathom from the *Floor*, and in some places it is so low that a Man must stoop to pass. The *Wideness* of it is also various; in some parts it is about 5 or 6 Fathom, in others not above a Fathom or two. It extends it self in *Length* about 200 Yards. People talk much of several Stones there resembling *Men* and other Things, but they are only Lumps of Common *Spar* without any *Regular Figures*.

At the farthest part of this *Cavern* there rises a good *stream* of *Water*, large enough to drive a Mill, which passes all along one side of the *Cavern*, and at length glides down about 6 or 8 Fathom betwixt the Rocks, and then pressing through the Clefts of them, discharges it self into a Valley.

This *River* within the *Cavern*, is well stor'd with *Eels*, and hath some *Trouts* in it, which must of necessity have been *Engendred* there, and not come from without, there being so great a Fall as I have mention'd near the Entrance. It happen'd some few Years since, that many Cattle which fed in Pastures through which this *River* passes, died suddenly after a Flood, the Cause of it being supposed to be, that these *Waters* had a Communication under Ground in *Mendip Hills*, with certain *Waters* which came from the *washing* of *Lead Ore* in the *Minery Ponds*, which are two Miles and an half distant from this *Cavern*, and were conveyed into the Ground by a *Swallow*, near the place where the *Ore* was *washt*; which *Swallow* has since been caused to be dam'd up.

In a dry Summer, I have seen a good number of *Froggs* all along this *Cavern*, even to the farthest part of it, and other little *Animals* in some small *Cisterns* of *Water* there.

Before you come to the middle of this *Vault*, you will find a Bed of very fine *Sand*, which is much sent for by Artists to *Cast Metals* in.

On the *Roof* of it, at certain places, hang Multitudes of *Batts*. And indeed we generally find them in all *Caverns*, whose Entrance is upon a Level, or somewhat Ascending or Descending, so it be not perpendicularly; and even in these, if the Passage into them be not narrow, and of a Considerable Height or Depth.

2. About 5 Miles from this, on the South-west part of *Mendip Hills*, near a place call'd *Chedder*, lies another *Cavern*, into which you must ascend about 15 Fathoms on the Rocks. This *Cavern* is not of so large Extent as the former; there is no *Current* of *Water*, nor does *Water* drop so freely from the *Roof* as generally in other *Caverns*, wherefore the *Spars* appear not of so lively Colours as commonly elsewhere.

3. These two *Caverns* have no *Communication* with *Mines*: But we generally observe, that wheresoever *Mines* of *Lead Ore* are, there are *Caverns* belonging to them, which are of a various Nature and Situation. The most Considerable of these *Vaults* I have known on *Mendip Hills*, is on the most Northerly part of them, in a Hill call'd *Lamb*, lying above the Parish of *Harptry*. Much *Ore* has been formerly Raised on this *Hill*; and being told

Some Years since that a very great *Vault* was there discover'd, I took six *Miners* with me, and went to see it. First we Descended a perpendicular *Shaft* about 10 Fathom, then we came into a *Leading Vault*, which extends it self in Length about 40 Fathom; it runs not upon a Level but Descending, so that when you come to the End of it, you are 23 Fathom Deep, by a Perpendicular Line. The *Floor* of it is full of loose Rocks; its *Roof* is firmly *Vaulted* with Lime-stone Rocks, having *Flowers* of all Colours hanging from them, which present a most Beautiful Object to the Eye, being always kept moist by the distilling Waters. In some parts the *Roof* is about 5 Fathom in Height, in others so low, that a Man has much ado to pass by Creeping. The *wideness* of it, for the most part, is about 3 Fathoms. This *Cavern* crosses many *Veins* of Ore in its running, and much Ore has been thence raised. About the Middle of this *Cavern*, on the East side, lies a narrow Passage into another *Cavern*, which runs betwixt 40 and 50 Fathom in length. At the End of the *First Cavern* a *Vast Cavern* opens it self. I fastened a Cord about me, and ordered the *Miners* to let me down: And upon the Descent of 12 or 14 Fathom I came to the Bottom. This *Cavern* is about 60 Fathom in the *Circumference*, above 20 Fathom in *Height*, and about 15 in *Length*; it runs along after the *Rakes*, and not *Crossing* them as the *leading Vaults* does. I afterwards caused *Miners* to *drive* forward in the *Breast* of this *Cavern*, which terminates it to the West, and after they had *driven* about 10 Fathom, they happened into another *Cavern*, whose *Roof* is about 8 Fathom, and in some parts 10 or 12 in Height, and runs in Length about 100 Fathom.

Vid. Inf. 3.

The frequency of these *Caverns* on those Hills may be easily guess at, by the frequency of *swallow Pits* which occur there in all Parts, and are made by the falling in of the *Roofs* of *Caverns*; some of these *Pits* being of a large Extent and very Deep; and sometimes our *Miners* *sinking* in the Bottom of those *Swallows*, have found *Oaks* 15 Fathom deep in the Earth.

Elden-Hole in Darbyshire; by Dr. Plot, ib. p. 7. Ph. Col. n. 2. p. 7.

III. Dr. Plot has learnt by an Inquisitive Gentleman, who purposely made Tryal of it, that one of those *Caverns* in the *Peak* in *Darbyshire*, hath been *sounded* in depth by a Perpendicular Plum-Line, no less than *Eight and Twenty Hundred Feet*, without meeting with the Bottom, or Water; and yet the *Mouth* of this *Cavern* at the *Top* is not above 40 Yards over.

Pen-Park-Hole in Gloucestershire; by Capt. Sturmy, n. 143. p. 2.

IV. I Upon the 2d of July 1699. I descended by Ropes affixt at the top of an *Old Lead-Ore-Pit*, 4 Fathoms almost perpendicular, and from thence 3 Fathoms more *Obliquely*, between two great Rocks, where I found the Mouth of this spacious Place, from which a Mine-man and my self lowred our selves by Ropes 25 Fathoms perpendicular, into a very large Place, which resembled to us the form of a Horse-shoe; for we stuck lighted Candles all the way we went, to discover what we could find remarkable. At length we came to a *River* or great Water, which I found to be 20 Fathoms Broad, and 8 Fathoms deep. The *Mine-man* would have perswaded me, that this *River ebbed and flowed*, for that some 10 Fathoms above the place we now were in, we found the Water had sometimes been: But I proved the contrary, by stay-

ing

ing there from 3 Hours *Flood* to 2 Hours *Ebb*, in which time we found no Alteration of this River. Besides, its Waters were Fresh, Sweet and Cool, and the Surface of this Water as it is now at 8 Fathom Deep, lies lower than the Bottom of any part of the *Severn-Sea* near us, so that it can have no Community with it. As we were walking by this River 32 Fathoms under the Ground, we discovered a great *Hollowness* in a *Rock* some 30 Foot above us; so that I got a Ladder down to us, and the *Mine man* went up the Ladder to that Place, and walked into it about 70 Paces, till he just lost sight of me, and from thence cheerfully called unto me, and told me he had found what he looked for, a *Rich Mine*. But his Joy was presently turned into Amazement, and he returned Affrighted by the sight of an *Evil Spirit*, which we cannot persuade him but he saw, and for that Reason will go thither no more.

Here are abundance of strange Places; the Flooring being a kind of white Stone Enamel'd with *Lead Ore*, and the Pendent Rocks were glazed with *Salt Peter*, which Distilled upon them from above, and time had *Petrify'd*.

Four Days together after his return, Capt. *Sturmy* was troubled with an Unusual and violent Head Ach, which he imputed to his being in that Vault; and falling from his Head-Ach into a Fever, he soon after dyed.

By Sir Robert Southwell. *ib.*

2. Tis down the *Tunnel*, C C, from the *Superficies* of the *Earth* A A, to the opening of the *Cavity* below, 39 Yards; Then the *Hole* E E, spreading into an irregular Oblong Figure, is in the greatest length 75 Yards, and in the greatest breadth 41 Yards. From the highest part of the *Roof* to the *Water*, was then 19 Yards. The *Water* H H, was now in a Pool at the North End, being the deepest part; it was in length 27 Yards, in breadth 12, and only five Yards and an half deep. Two *Rocks* G G, and L L, appeared above the *Water* all covered with *Mud*: But the *Water* was sweet and good. There was a large Circle of *Mud*, K K K, round the *Pool*, and far up towards the South End, which shew'd that the *Water* has at other times been 6 Yards Higher than at this present.

By Captain Collins. *ib.* p. 4.

Fig. 1. 72, 73.

Sep. 18, and 19, 1682. The *Tunnel* or Passage down, was somewhat Oblique, very Ragged and Rocky; in some places it was two Yards wide, and in some three or four; but nothing observable therein, save here and there some of that *Sparr* which usually attends the *Mines* of *Lead Ore*. In the Way 30 Yards down, there runs in Southward a *Passage* D D, of 29 Yards in length, parallel to the *Superficies* above; it was two or three Yards High, and commonly as Broad, and alike Rocky as the *Tunnel*, with some appearances of *Sparr*, but nothing else in it except a few *Bats*.

The *Cavity* below was in like manner Rocky and very Irregular; the Candles and Torches burnt clear, so as to discover the whole extent thereof; nor was the Air any thing Offensive.

The *Bottom* of this Hole I, where the *Land Waters* do gather, is 59 Yards down from the *superficies* of the *Earth*; and by good *Calculation* the same bottom is twenty Yards above the *Highest Rising* of the *Severn*, and lies into the Land about three Miles distant from it, and about as far from *Bristol*.

Air in Mines;
by Mr. J. Gill.
n. 26. p. 481.

V. One *John Gill* Affirms, from 20 Years Experience of his own, that it in digging deep under Ground, the Workmen meet with *Water*, they never want *Air* or *Wind*; but if they miss *Water* (as sometimes it happens, even at 12 or 16 Fathoms deep) they are destitute of convenient *Air*, either to Breath in, or to make their Candles Burn; and that when they Drive up an *Adit*, for drawing away a great Quantity of a Winter's standing *Water* from a deep Mine, as soon as it is brought up so near, that any of the *standing Water* begins to run away, the Men must secure themselves as well as they can, from Danger of being dashed in pieces against the sides of the *Adit*: For the included *Air* or *Wind*, in the *standing Water*, breaks forth with such a terrible Noise, as that of a piece of *Ordnance*, and with that violence, as to carry all before it, loosening the very Rocks, though at some Distance in the *Work* or *Adit*.

To Work in
Mines without
Air-shafts; by
Sir Rob. Moray.
n. 5. p. 79.

VI. At the *Mouth* or Entry of the *Adit* (to the *Coal Mines* of *Liege*) there is a structure raised of Brick like a Chimney, some 28 or 30 Foot High in all; at the bottom, two opposite sides are (or may be) some $5\frac{1}{2}$ foot Broad. and the other two 5 Foot; the Wall $1\frac{1}{2}$ Brick thick. At the lower part of it is a *Hole*, some 9 or 10 Inches square, for taking out of the *Ashes*, which when it is done, this *Ash Hole* is immediately stopt so close, as *Air* cannot possibly get in at any part of it. Then some 3 Foot above Ground, or more, there is on that side, that is next to the *Adit*, or *Pit* a square *Hole* of 8 or 9 Inches every way, by which the *Air* enters to make the *Fire* burn: Into this *Hole* there is fixt a Square *Tube* or *Pipe* of *Wood*, whereof the Joints and Chinks are so stopt with Parchment pasted or glewed upon them, that the *Air* can no where get into the *Pipe* but at the End; and this *Pipe* is still lengthened as the *Adit* or *Pit* advanceth, by fitting New *Pipes* so, as one end is always thrust into the other, and the Joints or Chinks still carefully cemented, and stopt as before. So the *Pipe* or *Tube* being still carried on, as near as is necessary to the *Wall* or place where fresh *Air* is requisite, while the *Air* is drawn by the *Fire* from thence through the *Tube*, fresh *Air* must needs come in from without, to supply the place of the other; which by its Motion doth carry away with it all the ill *Vapours* that Breath out of the Ground: By which means the whole *Adit* will be always fill'd with fresh *Air*, so that Men will there Breath, as surely as abroad, and not only Candles burn, but *Fire*, when upon Occasion there is Use for it for breaking of the Rock.

There must be Two of the *Iron Grates*, that when any Accident befalls the One, the other may be ready to be in its place; the *Coals* being first well kindled in it: But when the *Fire* is near spent, the *Grate* being haled up to the Door, is to be supplied with fresh *Fewel*.

The Higher the *Shaft* of the *Chimney* is, the *Fire* draws the *Air* the better. And this Invention may be made use of in the *Pits* or *Shafts* that are Perpendicular, or any ways inclining towards it, when there is Want of fresh *Air* at the bottom thereof; or any Molestation by *Unwholsome Fumes* or *Vapours*.

The whole Contrivance of the *Fabrick*, may be easily understood by the annexed *Figure*.

A, The *Hole* for taking out the *Ashes*. *B*, The *square Hole* into which the *Tube* or *Pipe*, for Conveying the *Air*, is to be fitted *C*, The *Border* or *Ledge* of *Brick* or *Iron*, upon which the *Iron Grate* or *Cradle*, that holds the *burning Coals*, is to rest; the one being exactly fitted for the other. *D*, The *Hole* where the *Cradle* is set. *E*, The *wooden Tube* through which the *Air* is convey'd towards the *Cradle*. *F*, The *Dore* by which the *Grate* or *Cradle* is let in, which is to be set 8 or 10 Foot Higher than the *Hole D*; and the *Shutter* made of *Iron*, or *Wood* that will not shrink, that it may shut very close. *G*, The *Grate* or *Cradle* which is narrower below than above, that the *Ashes* may the more easily fall, and the *Air* excite the *Fire*; the Bottom and sides being Barred. *H*, The *Border* or *Ledge* of the *Cradle*, that rests upon *Ledge C*, *I*, Four *Chains* of *Iron* fastened to the four Corners of the *Cradle*, for taking it up and letting it down. *K*, The *Chain* of *Iron* to which the other *Chains* are fasten'd. *L*, The *Pulley* of *Iron* or *Brass* through which the *Chain* passeth. *M*, A *Hook* on which the *Chain* is fastened by a *Ring*; the *Hook* being fixed at the side of the *Dore*. *N*, A *Barr* of *Iron* in the Walls to which the *Pulley* is fastned.

VII. 1. In a *Coal Pit* belonging to the Lord *Sinclair* in *Scotland*, where the *Coal* is some 18 or 20 Foot thick, and anciently wasted to a great depth: The *Colliers*, some Weeks ago, having wrought as deep as they could, and being to remove into new *Rooms* (as they call them) did, by taking off, as they retired, part of the *Coal* that was left as *Pillars* to support the *Roof* and *Earth* over it, so much weaken them, that within a short space after they were gone out of the *Pit*, the *Pillars* falling, the *Earth* above them filled up the whole space, where the *Colliers* had lately wrought, with its Ruines. The *Colliers* being hereby out of Work, some of them adventur'd to Work upon Old Remains of *Walls* so near the old *Wastes*, that striking through the slender Partition of the *Coal Wall*, that separated between them and the Place where they used to work, they quickly perceived their Error, and fearing to be stifled by the *Bad Air* that they knew possessed these Old *Wastes*, in regard not only of the *Damps* which such *Wastes* do usually afford, but because there had been for many Years a *Fire* in those *Wastes* that filled them with stifling Fumes and Vapours, retired immediately, and saved themselves from the *Eruptions* of the *Damp*. But next Day some 7 or 8 of them came no sooner so far down the Stairs that led them to the place where they had been the Day before, as they intended, but upon their stepping into the place, where the *Air* was infected, they fell down *Dead* as if they had been shot: And there being amongst them one, whose Wife being informed he was *stifled* in that place, she went down so far without inconvenience, that seeing her Husband near her, she ventured to go to him, but being Choaked by the *Damp*, as soon as she came near him, she fell down *Dead* by him.

2. *Damps* happen in most of the *Hungarian Mines*, not only in the *Cuniculi* or Direct Passages, where they walk on Horizontally (by these *Mine-*

Damps in Mines,
by Sir Rob.
Moray. n. 3.
p. 44.

By Dr. Edward
Brown. n. 48.
p. 952.

Mens

Men called *Stollen*) but also in the *Putei* or Perpendicular Cuts or Descents (termed *Schachts* by the same.) They are met with not only in Places where the Earth is full of *Clay* or the like Substances, but also where it is *Rocky*; and one Place they shewed me in the *Copper-Mine* at *Hern Groundt*, where there had been a very pernicious *Damp*, and yet the *Rock* so hard, that it could not be *Broken* by their Instruments, but the Descent was all made by the means of *Gun-Powder*, Ram'd into long round Holes in the *Rock*, and so Blown up. Another place they shewed me, where there is sometimes a *Damp*, and sometimes *Clear Weather*. When there is much *Water* in the *Mine*, so as to stop up the lower part of this Passage, then this *Damp* becomes discoverable, and commonly strong. I procured one to enter it, till his *Lamp* went out four or five times, in the same manner as at *Grotto del Cane* in *Italy*.

Some of these *Damps Suffocate* in a short space of time, others only render the *Work men Faint*, with no further Hurt, except they continue long in the place. The *Miners*, who think themselves no *Workmen*, if they be not able to *Cure a Damp*, or to *Cure the Bad Weather*, or *Make the Weather* as they Term it, perform it by *Perflation*, by letting the *Air* in and out, and causing as 'twere a *Circulation* of it. In the *Mine* at *Hern groundt* they did cure a bad *Damp* by a great pair of *Bellows*, which were Blown continually for many days. The *Ordinary Remedy* is by long *Tubes*; through which the *Air* continually passing, they are able to digg straight on for a long way without *Impediment* in *Breathing*: For some *Cuniculi* are 500 *Fathoms* long which will not seem strange to any one that shall see the *Map* of the *Copper Mine* at *Hern-groundt*, or the *Gold Mine* at *Chremnitz*; And in the *Silver-Trinity Mine* by *Schemnitz*, I passed quite under a *Hill*, and came out on the other side. At *Windschachmine* by *Schemnitz* they shewed me the place where 5 men and a *Gentleman* of *Quality* were *Lost*: For which reason they have now placed a *Tube* there. The like they place over all *Docrs*, and over all *Wayes*, where they digg right on for a great space and have no passage through. At *Chremnitz* they told me, that 28 men had been *Killed* at one time in 4 *Cuniculi*, 7 in each; and in the *Sinking* of *Leopold's Pitt*, which is 150 *Fathoms* deep, they were much troubled with *Damps*, which they Remedied in this manner;

They fixt a *Tube* to the side of the *Schacht* or *Pit*, from the *Top* to the *Bottom*: And that not proving sufficient, they forced down a broad flat board, which covered or stopped the *Pitt*, or couched very near the sides of it on all sides but where the *Tube* was, and so *Forced* out all the *Air* in the *Pit* through the *Tube*; which work they were forced often to Repeat. And now they have divers other passages into it, the *Air* is *Good* and sufficient, and I was *Drawn* up through it without the least *Trouble* in *Breathing*.

But besides this *Mischief* from *Poisonous Exhalations*, *Stagnation* of the *Air* or *Water* Impregnated with *Mineral Spirits*, they sometimes *Perish* by other ways. For there being in these *Mines* an *Incredible Mass* of *Wood* to Support the *Pits* and the *Horizontal Passages*, (the *Putei* and *Cuniculi*) in all places but where it is *Rocky*, Men are sometimes destroyed by the *Wood* set on *Fire*.

And

And in the *Gold-Mine* at *Chremnitz*, the Wood was set once on *Fire* by the carelessness of a boy, and 50 Miners *Smothered* thereby; who were all taken out but one, that was afterwards found to be *Dissolved* by the *Vitriol water*; nothing Escaping either of *Flesh* or *Bones*, but only some of his *Cloaths*.

By Mr. Jessop.
n. 117. p. 391.

3. There are 4 sorts of *Damps*. The *First* is the *Ordinary* sort. The *External Signs* of its Approach are the *Candles* Burning *Orbicular*, and the *Flames* Lessening by degrees until it quite Extinguish: The *Internal*, Shortness of *Breath*. I never heard of any great Inconvenience, which any one suffered by it, who escaped *Swooning*. Those that *Swoon* away, and Escape an absolute *Suffocation*, are at their first Recovery tormented with *Violent Convulsions*, the Pain whereof, when they begin to recover their Senses, causeth them to Roar exceedingly. The *Ordinary Remedy*, is to digg a *Hole* in the *Earth*, and lay them on their Bellies, with their Mouths in it: If that Fail, they Tun them full of *Good Ale*: But if that Fail they conclude them desperate. I have known some, who have been Recovered after this manner, (when some of their Companions have at the same time died) that told me, they found themselves very well within a little time after they had Recovered their Senses, and never after found themselves the Worse for it.

They call the *Second* sort the *Pease-Bloom Damp*, because, as they say, it smells like *Pease-Bloom*. They tell me, it always comes in the Summer time; and those *Grooves* are not free, which are never troubled with any other sort of *Damps*. I never heard that it was *Mortal*; the Scent perhaps freeing them from the danger of a surprize: But by reason of it, many good *Grooves* lie idle at the best and most profitable time of the Year, when the *Subterraneous Waters* are at the lowest. They fancy it proceeds from the Multitude of *Red Trifol-Flowers*, by them called *Honey Suckles*, with which the *Lime-stone Meadows* in the *Peake* do much abound.

The *Third* is the strangest and most *Pestilential* of any; if all be true which is said concerning it. Those who Pretend to have seen it (for it is visible) describe it thus: In the Highest part of the *Roof* of those Passages which branch out from the main *Groove*; they often see a Round thing hanging, about the bigness of a Foot-Ball, covered with a Skin of the Thickness and Colour of a Cob-web. This, they say, if by any Accident, as the Splinter of a Stone, or the like, it be broken, immediately Disperseth it self, and *suffocates* all the Company. Therefore to prevent Casualties, as soon as they have espied it, they say, they have a Way, by the help of a Stick and a long Rope, of Breaking it at a distance; which done, they Purifie the place well with *Fire*, before they Dare enter it again. I dare not Avouch the Truth of this Story in all its Circumstances, because the Proof of it seems impossible, since they say it *Kills* all that are likely to bear Witness to all the Particulars: Neither dare I deny, but such a thing may have been seen hanging on the *Roof*, since I have heard many affirm it. Our *Under ground Philosophers* say, The *Steam* which arises from their *Bodies* and the *Candles*, Ascends into the highest part of the *Vault*, and there Condenseth, and in Time has a *Film* grown round about it, and at length Corrupting, becomes *Pestilential*.

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The *Fourth* which they also call a *Damp* (although how properly I will not argue) is that Vapour, which being touch'd by their Candle, presently takes *Fire*, and giving a Crack like a *Gun*, produceth the like Effects, or rather those of *Lightning*. A Fellow they commonly call *Dobby Leech*, is at this Day a sad Example of the Force of one of those *Blasts* in *Hastleberg-Hills*, having his Arms and Legs Broken, and his Body strangely distorted.

Captain *Wain* told me, he saw one of them in a *Bloomery* near *Peniston*.

D. 119. p. 450.

This *Fulminating Damp* has lately done some Hurt in a *Coal-Pit* at *Wingersworth*, two Miles from *Chesterfield*.

The *Shaft* of the *Coal-Pit* is about 15 Yards Deep; the Soyl a Stiff Mire, *Shaly* about the Middle of the *Shaft*, Dry at the Bottom (as they say, though I observed some moisture about the Middle) and without any Quarry of *Stone*; the *Stones* in the Field about it are Grit stone. It lies almost at the bottom of a Rising ground, being encompassed with Hills on all sides, except towards the East, or rather South East.

There are 3 *Pits* which lie almost in a Direct Line, the middlemost of which is that we speak of. There is also a 4th which stands a little Higher than the rest.

From the Bottom run 4 *Binks*, as they call them; 4 Yards Wide, and 40 Yards long, except that in which they meet the *fiery Damp*, which wants 4 or 5 Yards of its due length.

The *Bink* in which the *Damp* is, is the farthest from the *Air*, which is communicated from the other *Pits*.

The Soyl of this *Bink* (as they tell me) is a stiff Clay; neither can they find in it the Sign of any *Mineral*, except *Coal* and *Shale*. The *Coal* they say is absolutely free from the *Pyrites*, with which most of our *Coals* are Infected.

The *Bink* in which the *Damp* is, was wrought forward 20 Yards on *Whitson-Monday* 1675, when *George Mitchel* (one of my Informers) going in to fetch some of his Tools, with a *Candle* in his Hand, and coming within four or five Yards of the further end, found himself on a sudden, he knew not how, invironed with *Flames*. His Face, his Hands, his Hair, and a great part of his Cloaths were very much *Burnt*. He heard very little *Noise*, although one *Edward Mitchel*, who was working at the same time in another *Bink*, told me that both he, and those that stood above ground, heard a very great one, like a Clap of *Thunder*, and that the Earth shaked; so that he was afraid the *Roof* would have fallen in and Buried him.

This being the first Accident of this nature, those without ran in a great Amazement, with their *Candles* in their Hands, to see what the matter was; which were twice Extinguished, but held in upon the 3^d Lighting: They saw nothing, but met with an intolerable stench of *Brimstone*, and an Heat as scalding as an Oven half heated for that was their Expression;) and forced them very Speedily to quit the place.

Notwithstanding this, they wrought forwards for about 3 Weeks, and carried it on till betwixt 30 and 40 Yards, until one *Henry Turnelly* met with the same Accident, which had formerly befallen *Mitchel*, and *Mitchel* had also the Misfortune to have his share in this: For being by chance under ground,

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at the *Mouth* of the *Bink*, he was shot forth for about two or three Yards, and had his Head broken, and his Body bruised against the further side.

About a Week after, *Edward Michel*, another of my Informers, adventuring in again, met with the same Misfortune, and was worse scorched than any of the rest.

The things I chiefly took notice of were these.

1. That those who were in the *Bink* whilst it was fired, never Heard any more Noise than that which is usually made by a *flash* of *Gun-Powder* in the open Air, although those in the other *Binks*, and out, heard a very great one.

2. It shot off the *Turn* at the *Mouth* of the *Pit*, and small Coals with other Rubbish from the *Bottom*, into the Air to a considerable Height.

3. They could perceive no *Smell* before the Fire, but afterwards a very strong *smell* of *Brimstone*.

4. They used to go with their *Candles* Low, as near as could be to the bottom, because they perceived the Vapour to lie towards the *Roof*: Which, if they held their *Candles* higher than ordinary; they could see descend like a Black Mist, and catch hold of the Flame, Lengthen it to two or three hand-fuls, which would nevertheless burn after the usual manner, without any further Mischiefe, if they suddenly held down their Hands close to the Ground.

5. The *Flame* would continue in the *Vault* for 2 or 3 *Minutes* after the *Crack*; The last time, which was the most violent, they thought it continued about *half a quarter* of an *Hour*.

6. The *Colour* of the *Flame* was *Blue*, and very bright, something inclining towards *Green*.

7. Although they told me, they were sensible of no *Smell*, before the *kindling* of the *Vapour*, yet the *Colliers* Cloaths that worked in the adjoining *Pits*, *smelt* very strong of *Brimstone*; which makes me suspect all the *Pits* to be infected, although the *Air* secures them from Mischiefe. Their Insensibility I ascribe to the Custom.

To the *Queries* suggested by Mr. *Boyle*, I Answer as followeth.

1. That *Damps* are generally observed to come about the latter end of *May*, and to continue during the *Heat* of *Summer*; and in those places which have *Damps* all the Year long, yet they observe them to be most violent at that *Season*. And I could meet with no other certain Rule for any *Periodical Returns*, except this *Annual*; although it be certain, they do often *Return* in the same *Summer*.

2. I never heard of any *Damps* that *Kindled* of themselves, although I have been told, that in some places they have been *Kindled* by the motion of the *Sled* in which they draw their *Coals*.

3. *Damps* generally are held to be heavier than the *Air*; but this was manifestly Lighter, for it lay towards the top of the *Bink*.

4. Upon the *Breaking* of the *fulminating Damp*, there proceeded a Dark Smoak, of the *Smell* and *Colour* of that which proceeds from *Gun-Powder* Fired.

5. Many *Damps* are seen, but many also are not seen; which whether they be visible or no, is hard to tell, but I suppose all would be Visible; had we a convenient light to view them by, because be they either Thicker or Thinner than the Air, that Density of Thinness will occasion a Refraction, and that must needs render them Visible.

6. Some *Damps* will quite extinguish all those *Fires* that are let down into them, be they never so many successively, or never so Great; and *Fire* is observed to be so far from *Curing*, that it often Creates *Damps* in places not otherwise subject to them. Indeed they are a present Remedy, if you can so order them as by their help to make a *Circulation* of the *Air* through the Infected place, otherwise they do Hurt; and those *Grooves* wherein they are forced to *Break* their *Rocks* by the help of great *Fires*, are seldom free from *Damps*.

7. Men usually Work in places Infested either by the *Fulminating* or other *Damps*, after they suppose the Vapour spent.

8. *Damps* are common both in Wet and Dry Ground; but I cannot tell in which most.

9. *Damps* are observed to be most *Pestilential*, and to Kill the suddainest, that are in *Grooves* not stirred for many Years; especially if such *Grooves* have formerly had great *Fires* in them.

10 The general Opinion of our Workmen is, That there are some *Damps* which Kill, by reason of the *Noysome Steam*, and others meerly by *Want* of *Air*. Which latter Opinion I have heard disallowed by the more Experienced sort: For they say that there is no *Groove* that wants *Air*, be it never so deep; but the *Air* stagnating in very deep *Grooves* or *Pits*, the grosser parts must needs at length separate themselves by their own Weight, and subsiding to the bottom, there *Corrupt*, and consequently get *Malignant Qualities*, especially in the *Summer time*, when the Sun promotes the *Fermentation*. Besides this, the standing *Air* being in a short time filled with the *Vapours*, arising from Men's Bodies and the *Steams* of *Candles*, and passing so often through the *Lungs* of the Work-men, is quickly rendred unfit for that Use (whatsoever it is) to which *Respiration* is Accommodated; and this they take to be the most frequent Cause of Ordinary *Damps*.

Damps will often follow the *Water*, and particularly this sort of *Fiery Damp*, if I am rightly inform'd.

By Mr. Roger
Mostyn. n.136.
p. 895.

4. The *Coal-Work* at *Mostyn* in *Flintshire* lies in a large parcel of Woodland, which hath a great Fall directly North to the Sea-side: But the *Dipping* or Fall of the *Coal* partly crossing the Fall of the Ground, is within a Point of due East, and lies 40, 50, and sometimes 60 yards under the level of the Sea. This *Work* is upon a *Coal* of 5 Yards in Thickness, and hath been begun upon, about six or eight and Thirty years ago. When it was first found, it was extream full of *Water*, so that it could not be wrought down to the bottom of the *Coal*, but a *Witchet* or Cave was driven out in the middle of it upon a Level for gaining room to Work, and drawing down the *Spring* of *Water* that lies in the *Coal*, to the *Eye* of the *Pit*; In *Driving* of which *Witchet*, after they had gone a considerable way under ground, and were

scanted

scanted of *Wind*, the *Fire-Damps* did begin by little and little to Breed, and to appear in *Crevises* and *Slits* of the *Coal*, where *Water* had lain before the opening of the *Coal*, with a small *blewish Flame*, working and moving continually, but not out of its first *Seat*, unless the *Work-men* came and held their *Candles* to it, and then being weak, the *Blaze* of the *Candle* would drive it, with a sudden *Fizz*, away to another *Crevise*, where it would soon after appear *Blazing* and *Moving* as formerly. This was the first *Knowledge* of it in this *Work*, which the *Work-men* made but a sport of, and so partly neglected it till it had gotten some strength; and then upon a *Morning*, the first *Collier* that went down, going forwards in the *Wicket* with his *Candle* in his *Hand*, the *Damp* presently darted out violently at his *Candle*, that it struck the *Man* clear down, singed all his *Hair* and *Cloaths*, and disabled him for *Working* a while after. Some other small *Warnings* it gave them, insomuch that they resolved to employ a *Man* on purpose, that was more resolute than the rest, to go down a while before them every *Morning* to chase it from place to place, and so to weaken it. His usual manner was to put on the worst *Raggs* he had, and to wet them all in *Water*, and as soon as he came within the *Danger* of it, then he fell down groveling on his *Belly*, and went so forward, holding in one *Hand* a long *Wand* or *Pole*, at the end whereof he tied *Candles* *Burning*, and reached them by degrees towards it, then the *Damp* would flie at them, and if it missed of putting them out, it would quench it self with a *Blast*, and leave an ill scented *Smoak* behind it. Thus they dealt with it till they had wrought the *Coal* down to the bottom, and the *Water* following, and not remaining as before in the *Body* of it, among *Sulphureous* and *Brassy Metal* that is in some *Veins* of the *Coal*, the *Fire Damp* was not seen nor heard of till the latter end of the *Year* 1675, which happen'd as followeth.

After long *Working* of this *Coal*, it was found upon the *Rising Grounds*, that there lay another *Roach* of *Coal* at the depth of 14 *Yards* under it, which prov'd to be $3\frac{1}{2}$ *Yards* thick, and something more *Sulphureous*. This encouraged us to sink in one of the *Pits* we had formerly used on the 5 *Yards* *Coal*; and we sunk down 20 *Yards* before we came to the said *Roach*, in regard it was at the *Sea side*, and upon the lowest of the *Dipp*, where the *Rocks* successively *Thicken* as they fall. As we sunk the lower part of it, we had many *Appearances* of the *Fire Damp* in watry *Crevises* of the *Rocks*, we sunk through *Flashing* and *Darting* from side to side of the *Pit*, and shewing *Rain-bow-Colour like* on the *Surface* of the *Water* in the bottom; but upon drawing up of the *Water* with *Buckets*, which stirr'd the *Air* in the *Pit*, it would leave *Burning*, till the *Colliers* at work, with their *Breath* and *Sweat*, and the *Smoak* of their *Candles* thickned the *Air* in the *Pit*, and then it would appear again; they lighted their *Candles* in it sometimes when they went out; and so in this *Pit* it did no further *Harm*.

But being desirous to get the *Work* in some forwardness before *Summer*, (when the *Heat* of the *Weather* at sometimes, and the *Closeness* of the *Air* in *Foggy* *Weather* at other, occasions the *smothering Damp*) it was resolved for expedition sake, and saving of some *Charges*, to sink a *Pit* within the *Hollows*

or *Deads* of the Upper *Work*, at 16 or 17 Yards distance from the *First Pit*. This we proceeded in, till we came 6 or 7 Yards deep; then the *Fire Damp* began to appear as formerly, accompanying the Workmen still as they *sunk*, and they using the same means as afore, sometimes Blowing it out with a Blast of their Mouth, at other times with their Candles, or letting it *Blaze* without interruption. As we sunk down, and the *Damp* got still more and more strength, we found that our want of *Air* perpendicularly from the *Day*, was the great Cause and Nourisher of this *Damp*: For the *Air* that followed down into this *Pit*, came down at the first sunk *Pit*, at the foremention'd Distance, after it had been dispersed over all the old Hollows and *Deads* of the former *Work*, that were filled up with *Noysome Vapours*, Thick smothering Fogs, and in some places with the *smothering Damp* it self. Nevertheless we held on *Sinking*, till we came down to 15 Yards, plying the Work Night and Day (except Sundays and Holy Days) upon which Intermission the *Pit* being left alone for 48 Hours and more, and the *Damp* gaining great strength in the interim, by that time the Workmen went down, they could see it *Flashing* and *Shooting* from side to side like Sword Blades Cross one another, that none durst adventure to go down into the *Pit*. Upon this they took a Pole and bound *Candles* several times to the end of it, which they no sooner set over the *Eye* of the *Pit*, but the *Damp* would Fly up with a long sharp *Flame*, and put out the *Candles*, leaving a foul *Smoak* each time behind it. Finding that these things would not allay it, they adventured to bind some *Candles* at a Hook hanging at the Rope's end that was used up and down in the *Pit*: When they had *lower'd* down these a little way into the *Shaft* of the *Pit*, up comes the *Damp* in a full body, Blows out the *Candles*, Disperseth it self about the *Eye* of the *Pit*, and *Burneth* a great part of the Men's Hair, Beards, and Cloaths, and Strikes down one of them, in the mean time making a *Noise* like the lowing or Roaring of a Bull, but lowder, and in the end leaving a *Smoak* and *Smell* behind it worse then that of a Carrion. Upon this discouragement these Men came up, and made no further Trial; after this the *water* that came from it, being up at the other *Pit*, was found to be Blood Warm, if not Warmer.

In this juncture there was a cessation of the *work* for three days, and then the *Steward*, thinking to fetch a Compass about from the *Eye* of the *Pit* that came from the *Day*, and to bring *wind* by a secure way along with him, that if it Burst again it might be done without danger of Men's Lives, went down and took two Men along with him, which served his turn for this purpose. He was no sooner down, but the rest of the Workmen that had wrought there disdaining to be left behind in such a time of Danger, halted down after them and one of them more undiscreeet than the rest went headlong with his *Candle* over the *Eye* of the *Damp-Pitt*, at which the *Damp* immediately Caught and Flew to and Fro over all the *Hollows* of the *Work*, with a great *Wind* and a continual *Fire*, and as it went keeping a mighty great Roaring *Noise* on all sides.

The Men at first appearance of it had most of them fall'n upon their faces, and hid themselves as well as they could in the loose *Sleck* or Small Coal, and under

under the Shelter of Posts, yet never the less the *Damp* returning out of the Hollows, and drawing towards the *Eye* of the *Pit*, it came up with incredible force; the *Wind* and *Fire* Tore most of their Cloaths off their Backs, and Singed what was left, burning their Hair, Faces and Hands, the Blast falling so sharp on their Skin as if they had been whipt with Cords; some that had least Shelter, were carried 15 or 16 Yards from their first Station, and beaten against the *Roof* of the Coal and sides of the Posts, and lay afterwards a good while Senseless, so that it was long before they could Hear or Find one another. As it drew up to the *day pit*, it caught one of the Men along with it that was next the *Eye*, and up it comes with such a Terrible Crack, not unlike but more shrill than a Cannon, that it was heard 15 Miles off with the Wind, and such a Pillar of smoak as Darkned all the Sky over head for a good while. The brow of the Hill above the *Pit* was 18 Yards High, and on it grew Trees 14 or 15 yards long, yet the Man's Body and other things from the *Pit*, were seen above the Tops of the Highest Trees at least 100 yards. On this *Pit* stood a Horse Engine of Substantial Timber and strong Iron Work, on which lay a *Trunk*, or Barrel, for Winding the Rope up and down, of above a 1000 pound Weight, it was then in motion one *Bucket* going down, and the other coming up full of *Water*: This *Trunk* was fastened to that Frame with Locks and Bolts of Iron, yet it was Thrown up and carried a good way from the *Pit*, and pieces of it, though bound with Iron Hoops and strong Nails, blown into the Woods about; so likewise were the two *Buckets*; and the Ends of the Rope, after the Buckets were blown from them, stood a while *Upright* in the *Air* like Pikes, and then came leisurely drilling down. The whole Frame of the Engine was stir'd and mov'd out of its place, and those Men's Cloaths, Caps, and Hats, that escaped, were afterwards found shattered to pieces, and thrown amongst the Woods a great way from the *Pit*. This happened the 3^d of Feb. 1675, being a Season when Other *Damps* are scarce Felt or Heard of.

5. About 2 Miles on the South East of *Stony-Easton*, at a Place nearly bordering to *Mendip Hills*, begins a *Running* of Coal consisting of several *Veins* which extends it self towards the East about 4 Miles. There is much Working in this *Running*, and *Fire Damps* continually there happen: So that many Men of late Years have been there *Kill'd*, many others *Maimed*, and a Multitude *Burnt*. Some have been blown up at the Work's Mouth; the *Turn Beam* (which hangs over the *Shaft*) has been thrown off it's Frame by the Force of it; and those other Effects whereof you had an Account from other Places are generally found. The Middle and other Easterly parts of this *Running* are so very subject to those *Fiery Damps*, that scarce a *Pit* fails of them: Notwithstanding which, our *Colliers* still pursue their Work; but to prevent Mischiefe, they keep their *Air* very Quick, and use no *Candles* in their Works but of a Single Wick, and those of 60 or 70 to the Pound, which nevertheless give as great a *Light* there, as others of 10 or 12 to the Pound in other places, and they always place them behind them, and never present them to the *Breast* of the *Work*.

By Mr. J. Beaumont. Ph: Col. n. 1. p. 6.

When

When any are *Burnt*, the usual Method they observe in their *Cure* is thus: They presently betake themselves to a Good *Fire*, and sending for some *Cow's Hot Milk*, they first *Bathe* the *Burnt* places with that; when they had done this a while, they make use of an *Ointment* proper for *Burnings*, which the *Masters* of the *Works* have always in a readiness for such *Chances*, being furnished therewith at the Cheap rate of 12 Pence the Pound by a Good old Woman living near the *Works*.

The *Colliers* assure me, That these *Works* are apt to take *Fire* all the Year, which it will freely do at any time if a *Candle* be carry'd within *Air*: But most and with most Violence in the Winter, and chiefly in a *Black Frost*, when the *Air* runs best; That the Danger of *Firing* is alike both in Wet and Dry Grounds; and that there are no *Fumes* coming out of the *Mouth* of any *Shaft* which will be Lighted by a *Candle* or *Torch*.

I have heard of one *Damp* here, which took *Fire* of it self, and kindled the *Vein* of *Coal* which burnt a Considerable time before it went out.

Our *Damps* lye as well towards the Bottom or *Soal* of the *Work*, as towards the *Roof*, it being nothing but an invisible *Sulphureous Breath* expanded through the whole *Work*.

I cannot perceive at the *Mouth* of any *Shaft*, or understand by any *Workman*, of any Unusual *Wind* or *Current* of *Vapours* coming from beneath. In Wet *Works* there are many times *Bubbles* on the Surface of *Water* there standing, which will presently take *Fire* if a *Candle* be held to them: But I cannot find that those *Bubbles* are caused by any *Subterraneous Breath*, but Rise from the Falling of *Coal* into the *Water*, or from Dropping of *Water* from the *Roof*, as we see they do in Ponds from Drops of Rain in the Summer.

I may here further acquaint you, as a Novelty, that this last Summer 1679 two *Fire Damps* happen'd in our *Lead Mines* on *Mendip Hills*: But they were of so small a Force, that the *Workmen* received no prejudice by them.

VIII. About the latter end of *Feb.* 1659. returning from a Journey to my House in *Wigan*, I was entertained with the relation of an odd *Spring* situated in one Mr. *Hawkley's* ground (if I mistake not) about a Mile from the Town, in that Road which leads to *Warrington* and *Chester*; The People of this Town did confidently affirm, that the *water* of this Spring did *Burn* like *Oyle*.

When we came to the said *Spring* (being 5 or 6 in company together) and applyed a *Lighted Candle* to the Surface of the *Water*, 'tis true, there was suddenly a large *Flame* produced, which *Burnt* vigorously: But observing that this *Spring* had its Eruption at the foot of a Tree, growing on the top of a Neighbouring Bank, the *Water* of which Spring filled a Ditch that was there, and covered the *Burning place*, I applyed the lighted *Candle* to divers parts of the *Water*, contained in the said Ditch, and found as I expected, that upon the touch of the *Candle* and the *Water*, the *Flame* was Extinct.

Again, having taken up a Dish full of *Water* at the *Flaming-place*, and held the

the *Lighted Candle* to it, it went out. Yet I observed that the *Water* at the *Burning-place* did *Boyle*, and heave like *Water* in a *Pot* upon the *Fire*, though my *Hand* put into it perceived it not so much as *Warm*.

This *Boyling* I conceived to proceed from the *Eruption* of some *Bituminous* or *Sulphureous Fumes*; considering this place was not above 30 or 40 yards distant from the *Mouth* of a *Coal-Pit* there; And indeed *Wigan*, *Ashton*, and the whole *Country*, for many miles compass, is underlaid with *Coal*. Then applying my hand to the *Surface* of the *Burning-place* of the *Water*, I found a strong *Breath*, as it were a *Wind*, to bear against my *Hand*.

When the *Water* was *Drained* away, I applied the *Candle* to the *Surface* of the *Dry Earth*, at the same point where the *water* *Burned* before; the *Fumes* took *Fire* and *Burned* very *Bright* and *Vigorous*. The *Cone* of the *Flame* *Ascended* a foot and an half from the *Superficies* of the *Earth*: And the *Basis* of it was of the *Compass* of a *Man's Hat* about the *Brim*s. I then caused a *Bucket* full of *water* to be poured on the *Fire*, by which it was presently *Quenched*. I did not perceive the *Flame* to be *Discoloured* like that of *Sulphureous Bodies*, nor to have any manifest *Scent* with it. The *Fumes*, when they broke out of the *Earth* and prest against my *Hand*, were not, to my best remembrance, at all *Hot*.

IX This *Subterranean Fire* keeps no *Analogy* with other *Vulcano's*; It increaseth or Decreaseth according to the *Subject* it feedeth on: Which is, for the most part, a *Day-Coal* (as they call it) for the *Upper Seam* of the *Coal* next exposed to the *Air*, so that you may *Light* a *Candle* at it in some places, in other places it is some *Fathoms* deep, according as the *Day-Coal* *Heightens* or *Deepens*.

A Subterranean Fire in a Coal-Mine near Newcastle; by Dr. Lucas Hodgson. n. 130. p. 762.

No *Sal-Armoniack*, nor any thing like it to be found except where an *Actual Fire* hath come. There being a mixture of the *Steams* of *Sal-Armoniack* and *Sulphur* rising together in most places, it is hard to *Distinguish* them; for though the *Flowers* of *Brimstone* seem to *Rise first*, yet there is commonly a *Crust* of *Sal Armoniack* under them.

There is a *Milky Substance* which is found no where, but where the *Sal Armoniack* and *Sulphur* are totally gone, and the *Acid* part or *Aluminous Spirit* of that *White Mass* will also take *Wing* by the *Increase* of the *Fire*, leaving a *Caput Mort. Dry*, *Stiptick*, and as hard as a *Stone*; yet I account that a *pound* of this *Mass*, before the *Fire* press too much upon it, will go near to afford by *Solution*, &c. *Half* a *pound* of tolerable *Crystallin Allum*.

The *Neighbouring Soil* differs little from other grounds with us, having neither *Common Salt*, nor *Niter* in it; for though there be a *Salt-Well* with us, yet it is both on the other side of *Tyne*, and a considerable distance from the *Fire*.

I have industriously observed the *Springs* that are near the *Fire*, and find none of them that give the least suspicion of *Sal-Armoniack*. The *Water* that runs from the adjacent *Colyeries* is *Vitrioline*, giving as deep a *Tincture* with *Galls* as *Scarborough-Spaw*. In a word, it Differs nothing from the *Waters* that ordinarily

ordinarily drown our *Colyeries*, and cost our Coal owners so much to be quit of them. The other *Springs*, most of which are Dry this Year, (1676) are of Ordinary use, containing no *Mineral Salts* in them. But I hope you will cease to wonder, that Coal should produce a *Volatile Salt* by the Action of the Fire, seeing I have gathered *Sal Armoniack* from a Burning *Brick-Kiln*, where nothing but *Clay* and *Coal* are burnt together, and I hope none will expect the *Volatile Salt* in the *Sal Armoniack* from Ordinary *Clay*. The reason which first prompted me to seek this *Salt* there, was that the *Smell* of the *Kiln* did somewhat resemble that of the *Subterranean Fire*. There is also a sort of *Mineral* we call a *Slate*, which is partly *Coal*, partly *Alumstone*, partly *Marcasite*, which being laid up in Heaps and Burnt, are used for hardning the *Coalways*; upon these Heaps, whilst Burning, I have often gathered both *Brimstone* and *Sal Armoniack*.

When I pour'd *Cold Water* upon the Powdred *Marcasite*, it produced a *Vitrioline Water*, but no *Heat*.

As to the resemblance betwixt this *Sal Armoniack* and that which comes from Mount *Aetna*, where no *Coals* are supposed to be, whence it seems to follow, that our *Volatile Salt* may proceed from somewhat else than *Coal*; to which difficulty I Answer, that when I deduced *ours* from *Coal*, I did not exclude other *Bituminous* Substances that are Analogous to it of which I suppose the Country, where Mount *Aetna* is, affordeth no Inconsiderable Quantity; neither will it follow, that no *Coals* have been wrought, therefore there are none; and if Trial hath been made, and no *Coals* found; yet it will be a Doubt still, whether those Trials have been sufficient. However it be, yet I think it were not impertinent (by the way) to enquire, whether the Sagacious *Venetians*, may not be beholden to Mount *Aetna*, or some other *Subterranean Fires*, for the great quantity of *Sal Armoniack* they sell to our Merchants: For this *Fire* affordeth no Inconsiderable Quantity thereof, especially in Dry Weather.

Though it may seem incredible to some, that *Black Coal* should yield a *White Snowy Volatile Salt*, yet they that know that all *Volatile Salts* whatever may be freed from their *Fætor* and Intense Colour, by transmuted them into a *Sal Armoniack* by the Mediation of an *Acid*, as *Spirit of Salt*, *Spirit of Vitriol Alum*, &c. And then Subliming them till they be *White*, will cease to doubt of this matter. The reason of which Change, I presume is, because, though these *Volatile Salts* carry over always some of the *Fætid Oyl* with them while in a state of *Volatility*, yet being thus in a manner *Fixed*, the *Fætid Oyl* must necessarily by force of *Fire* Rise first, leaving the subsequent *Compound Salt*, or *Sal Armoniack*, without *Smell*; though it is still a doubt, whether the *Volatile Salt* is Better or Worse for this Labour.

We have no *Petrescent Springs* near us; but there is a *Cave* some miles off, at the farthest end of which few have been, from the Roof of which hang large Lumps of *Petrified Water*, like *Icicles*, some of them reaching down to the ground like *Pillars*; these *Icicles* are good *Limestone*, as I have Tried.

X. I have lately received an Account from my Brother, that on a side of one of the *Appennine Mountains* half way betwixt *Bologna* and *Florence*, near a Place call'd *Petra Mala*, about 5 Miles from *Fierenzola*, there is a spot of Ground about 3 or 4 Miles Diameter, which incessantly sends up a *Flame* Rising very high without *Noise*, *smoke*, or *Smell*; yet it gives a very great *Heat*, and it has been observed to be thus in all Times, except of great Rains, which put it out for a time; but when that is over it Burns with Greater Vigour and Heat than before. The *Sand* about it, when turned up, sends up a *Flame*; but within 3 or 4 Yards of it there grows *Corn* all round about; for it continues always in the same Spot.

This *Flame* seems to proceed from a Vein of *Bitumen*, or *Naptha*, that *Cropes* (as the *Miners* call it) only here; which when by Plowing, or some other Accident, the upper Crust has been turned up, was Kindled into a *Flame* by the Heat and Agitation of the *Air*, as other *Salino Sulphureous* Bodies are, of which Esq. *Boyl's Phosphorus* is a particular Instance. The like *Spontaneous Ascension* is seen in many *Mineral* Substances, but none that I know of, so Quick in its Production, or so Lasting, as this is, the whole Wood and Fields having been Destroyed by them. The Neighbours there have been so little Curious to Observe it, that they believed there was a great *Hole* in the *Flame-place*; but he found it to be Firm Ground. Neither does any there Remember when, and upon what Occasion it first began. The *Flaming Well* near *Wigan* seems to proceed from a Cause much like this, in which you may *Boyl* an *Egg*, and upon the approaching of a *Lighted Candle* it takes *Fire*; both seem to proceed from a *Naptha* or *Subtile Bitumen*, only that in a Hotter Country, and being in a Dryer Soil, is more Subtile and Inflammable; just as the *Petroleum* which is found in *Italy* is a White like *Spirit of Turpentine*, and is more Penetrating than the *Petroleum* which is to be found in the *Northern Countries*; an instance of which we have in a *Well* two Miles distant from *Edinburgh*, call'd the *Baulme Well*, of a Black Red Colour and very Thick, but being Distilled, does in Colour, Taste, and Smell, resemble that of *Italy*.

The *Spontaneous Ascension* of the *Naptha* seems to be made out by the *Smell* that our *Bitumen* near *Edinburg* yields, being most like *Coal-Smoke*. There are three such *Fires* on the same Hills that are Extinguish'd in the Summer, but Burn in the Winter; The reason of which I judge to be, that the Bowels of the Earth being Cooler in Summer than in Winter, do not send forth that Quantity of those *Subtile Exhalations* as may be sufficient to maintain a *Flame* in Summer; but in Winter, the Bowels of the Earth being Hotter (which is made evident by the Smoaking of Springs in Winter, and not in Summer, and the Experience of Miners) greater Plenty of Steams are sent forth, which in the Air are agitated into a *Flame*, the Brisk Motion of the Parts one against another, being Promoted by the Subtilty and Brisk Motion of the *Aerial Particles*, *quæ mutuas dant Operas*.

An Historical
Account of the
Eruptions of
Mount Ætna;
by Mr. Olden-
burg. n. 48.
p. 967.

Lib: 3. Æneid.

XI. To pass by what is related by *Berosus*, *Orpheus*, and other less credible Authors, about the *Eruptions* of this Mountain, both at the time of the Ingress of the *Ionian Colonies* into *Sicily*, and that of the *Argonauts* (which latter was in the 12th Age before the *Christian Account*;) we shall first take notice of that, which happen'd at the time of the Expedition of *Æneas*, who being Terrified with the Fire of this then *Burning Mountain*, left that Island; whereof *Virgil* gives a notable Description.

After this we find in *Thucydides*, that in the 76 *Olympiad*, which is about 476 before *Christ*, there was another *Fire*, and about 50 Years after that Another.

Then, in the time of the *Roman Consuls* there happen'd 4 *Eruptions* of *Ætna*, recorded by *Diodorus Siculus* and *Polybius*.

The Next was in the time of *Julius Cæsar*, related by the said *Diodorus*, to have been so Fierce, that the Sea about *Lipara* (an Island near *Sicily*) by its fervent Heat, Burnt the Ships and Killed all the Fishes thereabout.

Another we read of in the Reign of *Caligula*, about 40 Years after *Christ*, which was so Dreadful, that it made that Emperor, then being in *Sicily*, to Fly for it.

About the Martyrdome of the Romish *S. Agatha* it Burned again very Fiercely; though some say, that by Vertue of her Intercession it was stay'd from reaching *Catania*.

Again it Burnt A. C. 812, in the Reign of *Charles M.*

Then from the Year 1160 to 1169, whole *Sicily* was Shaken with many Terrible *Earth quakes*, and the *Eruptions* of the same Mountain destroyed a vast Tract of Inhabited Land round about it, and Reached as far as *Catania*; the Cathedral of which it Destroyed; and the Religious Men living in it.

Again in the Year 1284, there happened another Terrible *Fire* about the time of the Death of *Charles King of Sicily and Arragon*.

A. 1329. until 1333, there was another.

A. 1408. another.

A. 1444. another, which lasted till 1447.

A. 1536. another which lasted a Year.

A. 1633. another continuing several years.

A. 1650. it Burnt on the North East side, and Vomited so much *Fire*, that by the *Fiery Torrents*, caused thereby, great Devastation was made; as *Kircher* relates in his *Mundus Subterraneus*; whose assistance we have also made use of in the foregoing *Chronology* together with that of *Philotheus*.

The same Author, having been in *Sicily* himself, observeth that the People of *Catania*, digging for *Pumice Stones*, do find at the Depth of 100 *Palmes* (which is about 68 *Feet*) Streets Paved with Marble, and many Footsteps of Antiquity; an Argument that Towns have Stood there in former Ages, which have been Overwhelmed by the Matter cast out of this Mountain. They have also found several Bridges of *Pumice*

Stones

Stones, doubtless made by the Flux of *Fiery Torrents*, the Earth being very much Raised since.

XII. There was for the space of 18 Days before this *Fire* broke out, a very Thick Dark Sky in those parts, with *Thunder* and *Lightning* and frequent *Concussions* of the *Earth*, which the People make terrible reports of; though I never saw nor heard of any Buildings cast down thereby, save a small Town or Village called *Nicolosi*, about half a *Mile* distant from the New Mouth, and some such other slight Buildings among those Towns, that were after over-run by the *Fire*. Besides, it was observed that the Old Top or Mouth of *Ætna* did, for 2 or 3 Months before, Rage more than usual; the like of which did *Volcan* and *Strombolo*, two Burning Islands to the Westward. And the top of *Ætna*, much about the same time, have sunk down into its Old *Vorago*, or Hole, in that 'tis agreed by all, that had seen this Mountain before, that it was very much lower'd.

An Eruption of M. Ætna in 1669. by some English Merchants. n. 51. p. 1028.

It first *Broke out* on the 11th of *March* 1669, about two Hours before Night, and that on the South East Side or Skirt of the Mountains, about 20 Miles beneath the *Old Mouth*; and 10 Miles from *Catania*. At first it was reported to advance 3 Miles in 24 Hours; but at our being there (*viz. April 5*) when we were come within a short Mile of *Catania*, it scarce moved after the rate of a Furlong a Day; and after this Degree of Progress it continued for 15 or 20 Days after, passing under the *Walls* of *Catania* a good way into the Sea; but about the latter end of this Month, and the beginning of *May* (whether it was that the Sea could not receive this matter fast enough, or rather that the Mouth above did cast out a larger quantity) it bent all its force against the City; and having wrought it self up even with the *Walls* thereof, over it passed in diverse places; but its chief Fury fell upon a very pretty Convent, which was that of the *Benedictins*, having large Gardens and other Grounds betwixt them and the *Wall*: Which when it had filled up, it fell with all its Force on this Convent, where it met with strong resistance, which made it Swell, (as usually it did, where it met with any obstruction) almost as high, as the higher Shops in the old *London Exchange*, this Convent being built much after that fashion, though considerably bigger. Some parts of this Wall were driven in, whole and entire, almost a foot, as appeared by the rising of the Tiles in the midst of the Floor, and Bending of the Iron Bars that went cross above. And 'tis certain, had this Torrent fallen in some other part of the Town, it would have made great Havock amongst their Ordinary Buildings; but here its fury ceased upon the 4th of *May*, running henceforward in little Channels or Streams, and that chiefly into the Sea. It had overwhelmed in the Upland Country, some 14 Towns and Villages, whereof some were of good Note, containing 3 or 4 thousand Inhabitants, and stood in a very fruitful and pleasant Country, where the *Fire* had never made any Devastation before: But now there is not so much as any sign where such Towns have stood; only the Church and Steeple of one of them, which stood alone upon an High Ground, does still appear.

As to the Matter, which thus ran, it was nothing else but diverse kinds of *Metals* and *Minerals*, rendred liquid by the Fierceness of the *Fire* in the *Bowels* of the Earth, boiling up and gushing forth, as the Water doth at the head of some great River; and having run in a full Body for a Stones cast or more, the Extremity thereof began to Crust and Curdle, becoming when cold, those Hard, Porous Stones which the People call *Sciarri*, having the nearest resemblance to huge Cakes of Sea-Coal full of a fierce Fire. These came roling and tumbling over one another, and where they met with a Bank, would fill up and swell over, by their weight bearing down any Common Building, and Burning up what was Combustible. The chief Motion of this Matter was forward, but it was also dilating it self as a Flood of Water would do on even ground, thrusting out several Arms or Tongues, as they call them.

About two or 3 a Clock in the Night, we mounted an high Tower in *Catania*, whence we had a full view of the *Mouth*, which was a terrible sight, *viz.* To see so great a Mass or Body of meer Fire. Next Morning we would have gone up to the *Mouth* it self, but durst not come nearer than a Furlong off, for fear of being overwhelmed by a sudden turn of the Wind, which carried up into the Air, some of that vast Pillar of Ashes, which to our apprehension, exceeded twice the bigness of *Paul's Steeple* in *London*, and went up in a streight Body to a far greater height than that; the whole Air being thereabout all covered with the lightest of those *Ashes* blown off from the top of this Pillar: And from the first breaking forth of the *Fire* until its Fury ceased (being 5+ Days) neither Sun nor Star were seen in all that Part.

From the Outside of this Pillar fell off great quantity of Stones, but none very big, neither could we discern any *Fire* in them, nor come to see where the Fiery stuff broke out, there being a great Bank or Hill of *Ashes* betwixt it and us. At the *Mouth*, whence issued the *Fire*, or *Ashes*, or both, was a continual noise, like the beating of great Waves of the Sea against Rocks, or like Thunder afar off, which sometimes I have heard here in *Messina*, though situated at the foot of High Hills, and 60 Miles off. It hath also been Heard 100 Miles Northward of this place in *Calabria* (as I have been credibly informed) whither the *Ashes* have been also carried: And some of our Sea men have also reported, that their Decks were covered therewith at *Zant*, though it is likely not very Thick.

About the Middle of *May* we made another journey thither, where we found the face of things much Alter'd; the City of *Catania* being 3 Quarters of it compassed round with these *Sciarri*, as high as the top of the Walls; and in many places it had broke over. The first Night of our arrival, a New Stream or gutter of *Fire* broke forth among some *Sciarri*, which we were Walking upon an hour or two before, and they were as High as to be even with the Top of the Wall. It poured it self down into the City in a small Gutter of about 3 foot broad, and 9 foot long of meer *Fire*; the Extremities still falling off into those *Sciarri*; but this Stream was Extinct by the next morning, though it had filled up a great void place with its *Sciarri*. The next Night was a much Bigger Channel discovered, pouring it self over another part of the Wall into the *Castle-Ditch*, which continued (as we were informed) some Days

Days after our Departure. Divers of those small *Rivulets* did run at the same time into the Sea.

It was observed, that those *Streams* of *Fire* never grew *Broader*, nor visibly *Longer*, nor *Moved* out of the place they were seen in; which puts us a little more to *Examine* their *Working*, and we did conclude, that not only then, but in the *Fury* also of its *Running* it made it self certain *Crusted* *Gutters* to run in, to keep it self, as it were from the *Air*, which by *Degrees* did cool and fix it; as more plainly appeared above at the *Mouth*, where, the first time of our going thither, we found the *Sciarrri* generally thus cold and *Fixt*. And hence also it might proceed, that these live *Sciarrri*, Meeting with any *Bank* or *High* ground, would puff and swell up, till they had overcome it; so that in many places, especially under the *Walls* of *Catania*, were *Valleys* of those *Sciarrri*, and the *Fire* never broke forth, or discovered it self in those *streams*, until it had gained its *Height*; for those *Rivulets* ever went *Declining*.

It having spent two *Days* about *Catania*, we again went up to the *Mouth*, where now, without any danger of *Fire* or *Ashes*, we could take a free view both of the *Old* and *New* *Channel* of the *Fire*, and of that great *Mountain* of *Ashes* cast up. That which we guessed to be the *Old* *Bed* or *Channel*, was a three corner'd *Spot* of about 2 *Acres*, with a *Crust* or *Sciarrri* at the bottom, and upon that a small *Crust* or *Surface* of *Brimstone*. It was hedged in on each side with a great *Bank* or *Hill* of *Ashes*, and behind and at the upper end rose up that huge *Mountain* of the same matter. Between those 2 *Banks* the *Fire* seems to have had its passage. At the upper end in the *Nook*, upon a little *Hillock* or *crusted* *Sciarrri*, was an *Hole* about 10 foot wide, whence it is probable the *Fire* Issued; and it might have had several other such *Holes*, since either *Crusted* over, or *Covered* with *Ashes*. At the *Bottom* of this *Hole* the *Fire* was seen to flow along, and below it was a *Channel* of *Fire*; beneath that surface of *Sciari*, which being cleft a-top for some space, we had an easie and leisirable view of the *Metal* flowing along, whose *Superficies* might be a *Yard* broad, though possibly it carried a greater breadth underneath, the *Gutter* going sloping. What depth it had we could not guess: It was impenetrable by *Iron* *Hooks* and other *Instruments* we had. We were very desirous to have got some of this *Matter* at the *Spring* *Head*, but we could penetrate no more into it, than with ones *Finger* into the *Palm* of the *Hand*. 'Tis likely that some *Running* may have been more yielding than we found this. From this *Channel*, but especially from that *Hole* above it, issued great store of a strong *sulphureous* *Smoak*, wherewith some of our *Company* were at first almost stifled, through *Inadvertency*. About once in a quarter of an *Hour*, there would rise a *Pillar* of *Smoak* or *Ashes*, but nothing comparable to the former; which seemed to come from the *Middle* *Top* of that *New* made *Mountain*.

At this our last being at *Catania*, we found the *People* busie in barricading the *Ends* of some *Streets* and *Passages*, where they thought the *Fire* might break in; and this they did by pulling down the *Old* *Houses* thereabouts, and laying up the loose *Stones* in manner of a *Wall*, which they said would resist the *Fire*, as not being mixt with *Lime*; though it was the great *Weight* and
Force

Force of that *Fiery Matter* in Pressing forward, and not its Burning, that overthrew the Buildings, as plainly appeared in the Convent of the *Benedictins* and in the *Town-Walls*, where the great Deluge of *Fire* did pour it self; it not Breaking into the City, but pouring it self over the *Walls*, as hath been said.

Unto this very Time, 'tis said to have run a Mile into the Sea, and as much in Front, though it was much less, when we were there. The Shore goes gently declining; having at the extremity of the *Sciarri* about 5 Fathoms, and about half as much they are above Water. The Superficies of the Water, for 20 Foot or more of those *Rivulets* of *Fire*, was Hotter than to endure one's Hand in it, though Deeper it was more Temperate; and those *live Sciarri* still retained their *Fire* under Water, as we saw, when the Surges of the Sea retreated back in their ordinary Reverberations.

The general face of these *Sciarri* is in some respect not much unlike, from the Beginning to the End, to the River of *Thames* in a great Frost, at the top of the *Ice* above *Bridge*; I mean lying after such a Rugged manner in great Flakes, but its Colour is quite different, being most of a Dark Dusky Blew, and some Stones or Rocks, of a vast bigness, close and solid.

But notwithstanding their Ruggedness, and store of *Fire*, which we could see glowing in the Clefts and Cavities, we made a shift to ramble over a good part of them; as 'tis said also, that People would do the same in its greatest violence of Burning. For as those *live Sciarri*, and those *Rivers* of *Fire* themselves, were so tough and impenetrable as to bear any Weight, so the superficies of the *Sciarri* might be touched and Handled, the *Fire* being inward, and not to be discerned but near Hand, especially in the Day time: And 'twas somewhat a strange Sight to see so great a *River* come so tamely forward; for, as it approached unto any House, they not only at good leisure removed their Goods, but the very Tiles and Beams, and what else was Moveable.

I shall add, that the whole Country, from the very *Walls* of *Catania* to 20 Miles on this side, is full of those Old *Sciarri*, which former *Eruptions* have cast forth, though the People Remember none so Big as this last, or that Burst out so low. This Country is notwithstanding well Cultivated and Inhabited; for length of Time hath either Molified much of those Old *Sciarri*, or new Mould or Ashes have overgrown them; though there still remains much Country, which, it may be, will never be made serviceable.

What is the Perpendicular Height of this Mountain, I cannot learn. It cannot perhaps be rightly taken, being so subject to alter its Height and Shape. But it is a very goodly Mountain to look upon, as one passes by Sea to the Eastward, standing Alone by it self, Rising from the very Shore; and at shortest Passage is reckoned Twenty Miles up to the Top, though from *Catania* it hath Thirty Miles as before.

Æ. 52. p. 1041.

A good Quantity of *Ashes* being taken up in diverse parts of and about *Ætna*; some at the Top, or the *Mouth* of the new made Mountain, some a Mile off, some Four, some Ten Miles; some but Half a Mile distant, and others on the Skirts of the said Mountain; the four first were found very Dry like Dust; but the two latter being very Moist, though
in

in *Sicily* (as we are inform'd) they have lain a good while exposed to the Heat of the Sun; besides that, the Two last differ from one another, in that one sort of them consists of Hard and small Lumps, the other of very soft Dirty Grains, yet both moist and of a *Vitriolate* Taste.

Some of the *Sciarr*i are Courser, taken up at some distance from the *Mouth*; and of these some Black, with a Crust of *Brimstone*, some of a Red Hew; others are finer, and said to be got out of the *Gutters* of *Fire* at the very *Mouth*. Both these kinds are Light; but then there is a third sort of Stone, very Solid and Ponderous, which seems to be made up of a Conflux of diverse *Minerals* melted together.

The *Fire* spread about Three Miles in Breadth, and Seventeen Miles in Length.

XIII. 1. When the Easterly Wind had blown about 6 or 7 Weeks, till as I guess about the Fourth of *June*, 1693. The *Mountain* in the Island *Soroca* began early in the Morning, about Day-break, to cast out more *Fire* than ordinary, which continued for five or six Days, during which it was Dark and Cloudy Weather, till at last it brought forth not only a most prodigious *Flame*, but also such a Black and *Sulphureous Vapour*, that the Inhabitants of *Histo* (being a Village in the Western part of the Island, and nearest to the *Opening* of the *Mountain*) were wholly covered by it; and afterwards followed a whole stream of *Burning Brimstone*, which consumed many that could not escape. Afterwards the Inhabitants perceived that a Part of the said *Mountain* was sunk down, and three or four Days after another Part; and so from time to time, until the *Burning Lake* was become almost as great as half of the Island: Wherefore the Inhabitants went on board of their Vessels and Boats, from whence they perceived that huge great Pieces of the *Mountain* fell into this *Fiery Lake*, as into a Bottomless Pit, with a most prodigious *Noise*, as if a Whole Cannon were discharged. But the most Remarkable thing was, that the more vehement the *Fire* was, the lesser the Island was shaken. The Inhabitants of another Town, called *Woroc*, upon the East side of the Island, not thinking themselves in so great Danger, the *Opening* or *Fiery Lake* being yet at some Distance, remained a Month longer, until they saw the same continually Approaching them. They observed that when great Pieces fell down, and that the *Lake* became Wider, the *Noise* was so much the greater. So that they saw no likelihood but that all the Island would be swallowed up. Wherefore they unanimously transported themselves to *Banda*, leaving all their Moveables for want of Vessels; and arrived at *Amboina* this 18th of *July*. 1693.

An Account of several Burning Mountains in the Molucca Islands; sent to M. Nich. Witsen. by --- n 216. p. 49.

Several *Burning Mountains* have now been filled up and Quenched; others have begun to Open themselves, and cast out *Fire*, as in the Isle *Chiaus*.

There

There is likewise a *Burning Mountain* upon the Island *Celebes*. And in an infinite Number of Places, there is *Hot Water* found, if you digg but 10 Foot Deep.

In the Mountains of *Ternata* is always heard a Terrible *Noise*, as of the Crying of a great many People, caused by the *Fire*. It often casteth out *Stones*, and is probably exceeding Deep: And the rather because it is likely that the several *Burning Mountains* of the *Molucca* Islands, are beneath consumed by the *Same Fire*, which Joyneth the spacious *Openings* together.

The *Burning Mountain* upon *Banda* casteth forth a prodigious Quantity of *Smoak* and *Ashes*, oftentimes much *Fire*; and makes a *Noise* as if a great many of the greatest Cannon were heard all at once. This *Mountain* hath cast out so many *Stones* (and some near 6 Foot long) that the Adjacent Sea, which has been 40 or 50 Fathoms deep, is not only Fill'd up there, but become many Fathoms Higher than the Water; whereby it may be conjectured how Large the *Inward Cavities* of this *Mountain* are.

By n. 216.
p. 42.

2. After several Vain Attempts to search and Examine the Constitution of the Opening of the *Burning Mountain* in the Isle of *Ternata*, at last, having passed through great Difficulties and Mounted very Dangerous Precipices, we arriv'd at the Top *Octob. 12. 1693*. When I first approach'd this Terrible *Fire-Vomiting Opening*, wherein there is an inexpressible *Noise*, I could see nothing of the Inward Parts, by Reason of the *Smoak*: Wherefore I went back a little, tarrying for a better Opportunity: After some time, I found the *Smoak* very much diminish'd, and making hast to the *Mouth* of it, I saw the *Opening* which is underneath the North side, from whence the *Cavity* extended it self towards the South, till the Edges on both sides came to Terminate at the North side of that which was fallen in. Wherefore we went towards the East side, to look into the *Western Cavity*, but we saw nothing but a *Fiery and Flaming Substance*, and the Conveyances of it. We did not Venture to go to the North side, to see into the *South Cavities*, not only because of the Southerly Wind, but also because 'tis like, that the most Spacious *Antra* are on the South side, which causeth the *Smoak* to be driven Northerly and because we had formerly met with pieces of *Burning Matter* that was cast out, towards the North-side. Having seen enough and satisfied my Curiosity, we withdrew and returned to *Malayen*; bringing with us some pieces of Branches of the Fruitful *Clove Trees* that we had passed by.

The Northerly side of this *Burning Hole*, is at the utmost height of the *Mountain* to the Northward, or from *Hori*. To the West and Eastward of it there is on each side a Hill Higher than the Brinks of this *Hole*; both of them grown over with Reed or Cane, by the Inhabitants call'd *Cannacanna*: The most Westerly, is situated more Northerly from the *Hole*; on the South-side of this we got up. The most Easterly, on the Contray Part, lyeth more backwards from it, and to the Southward of it. The Southerly Hill, on the West side of the *Mountain* turns about to the Eastward with a Riff or Ridge, and Terminates at the North side of the *Mountain*. The *Mouth* of this fearful *Hole* on the West and South-East Sides is surrounded, as by a Bank; each Bank having a several Ditch: and the Brink of the *Mouth* is upon the Highest part,

part, Descending on the Outside. The three Hilllets nearest to the *Hole*, are quite Barren, and nothing but Stone; but the most remote is covered with thick *Reeds*.

Round about the *Hole* lyes scattered much of the Matter that hath been Cast forth; and it is perceivable, that it must be *Soft* when it comes out, because it falls Flat, according to the Figure of the Place where it Falls. The *Colour* of it is Dark Green, not Clear but somewhat Gray; and this Matter generally does Burst or separate it self as the Dung of a Cow. There are of this both Great and Small Pieces now turned into *Stone*, being inwardly Blackish and Spongeous, Mixt with White Spots. And to give you some further Particulars of this *Burning Mountain*, I have observed that the Extremest or most Southerly round Bank is all covered with *Cannacanna*; and it is the Highest also. The *Smoak*, which in respect of *Malayen*, seem'd to come forth out of a Higher Place, now in the Descending of the *Mountain*, doth notwithstanding seem to come forth at the same Height.

There is a Barren Hill that seems to be situated on the North side of the *Top*, a little Descending towards *Malayen* but it is about the same Height as the Highest *Top* that is seen from *Malayen*. Furthermore the Reason why the *Smoak* Seems to come forth from a Higher place is, because the *Opening* is more Southerly, and then in regard of *Malayen*, only it seems that the *Smoak* comes forth more towards the Midst. Wherefore I do certainly believe that the right *Opening* formerly has been where the Round Banks now lye; that is, to the Southward: For whereas after a good space of Violent *Burning*, there groweth a small Bank; any Person that should see the Situation, would be of my Mind. And besides it being 9 or 10 Years, since the last *Burning* was perceived, there are to be seen round about the *Opening* (besides the Barrenness on both Sides, which is some Distance from the *Opening* in Descending towards the West and North sides, as also above on the South and East sides) Trees all about, of an unequal Thickness, as all grown since that time, and now newly Burst and *Burnt* by the *Fire*.

Lastly, My Opinion is, that although the *Smoak* of it has not been seen from below, the *Fire* nevertheless hath not Discontinued, because the *Inward Noise* is so Terrible, that any Person whosoever hears it, would judge with me that it is a *Bottomless Pit* of the *Vehementest Fire*, which cannot be *Quenched* while the World lasts. The Horror and Danger that one undergoes who will see this, is rather to be conceived by Thoughts, than expressed by Words.

3. Nov. 2. 1694. A very thick *Smoak* was seen about the *Top* of the Mount *Gornong Apy*, which was much augmented on the 21 and 22. and that Night the *Flame* broke out: On the 23, 24. and some following Days, the *Fire* was continually Increasing on the West side, and with such *Blows* as if the greatest Pieces of Cannon had been Discharged: So that we were fearing that the whole *Mountain* should have been Cast upon us. A Day of *Humiliation* and *Prayer* was Proclaimed by the Government against the 7th throughout all *Banda*. Sometimes the Mount brought forth such a *Noise*, as the greatest Storms can do about the Rigging of a Ship, or a Building on Shoar, and afterwards followed *Stones* on the West side as far as the Sea, which was a Hor-

By . . . n. 228.
p. 530.

rible Spectacle. Fishermen have related unto me, that so many *Stones* have been cast out already, that the Place where they used to Fish with Lines at 40 Fathom Water is now Dry, and the *Fire* cometh out of the *Water* so vehemently, that it is Dreadful to see, and the *Water* is so *Hot* that we cannot come near it. And now the Mountain *Burneth* most towards the side of the *Loutoir*. The *Trees* on the East and West side are altogether Spoil'd, and the West side is covered with *Stones* God knoweth how high. The Stink of *Brimstone* during the *Westerly Monsoon* is so intolerable, that one could scarce endure it in the Streets of *Neira* where it causeth a great *Sickness*. The *Water* which runneth down, is by Reason of the *Brimstone* and *Salt Petre* become sower, and without a Natural Taste. The *Gardens* which were on the *Gounong Apy*, and formerly brought forth great store of Fruits for Man's Livelihood, are partly covered with *Stones*, and partly *Desert*. The greatest Fear is because it is *Consum'd Inwardly* towards the *Old Hole*, which was *Blown-up* in the Year 1615, and because the *Fire* seemeth to take its Course towards the Southwest, and that it being quite *Hollow* there, will Tumble inwardly, or be Subverted.

By ... *ib.* p. 531. 4. The Mount *Gounong Apy* Casteth out *Stones* round about the Mountain, and the *Fire* Ascendeth so High, that we can see it above the High-land at *Denter*.

By ... *ib.* p. 532. 5. Mount *Gounong Apy* (*Burning* continually) doth Cast out so great a Quantity of *Fire* and *Ashes*, that the *Trees* of the Country *Neira*, and part of those on the High Country of *Loutoir*, is so much covered with *Ashes*, that not one good *Fruit* is to be expected from them.

By ... *ib.* 6. At *Neira* there is neither *Leaf* nor *Herb*. The Ground is cover'd with *Stones* and *Ashes*; One half of the High Country is likewise in a Sad Condition, many *Trees* be wholly or partly *Dead*, and the rest *Lingring*. There is not one House at *Neira* without Damage, several are quite Demolished to the Ground by the Weight of the *Dust* and *Ashes*.

Those of *Denter*, *Weyer*, *Celam*, and the inward Coast, as far as *Walking*, have likewise a sad Experience of this Calamity. We are sometimes Vilited with *Earthquakes*; and especially *May 11th 1695*. about 2 a Clock in the Afternoon, we had two hard *Motions*.

By M. Nich. Wizen. n. 228. p. 529. 7. The Mountain *Kemas* or Brothers, in the Territory of *Manado*, is blown up with a most *Dreadful Noise*, as of the Hardest Thunder, which caused *Darkness* and an *Earthquake*, with very Heavy Blows, and other Dismal Signs at *Ternata*: Which Noise hath also been heard at *Amboyna*. The Mountain of *Brimstone* upon *Amboyna*, call'd *Wawany*, does also *Burn* Dreadfully.

From all which it seemeth Evident that in those Parts and Seas, there are *Subterraneous Fires*, having a mutual *Communication* one with another: Which God knoweth but may, at some time cause the sudden *Subversion* of them; and consequently a Notable Change or Alteration of the World's Globe. Those who have seen these things with their own Eyes have told me, that when a *Hole* is made in the Ground 10 or 12 *Foot* deep, the Ground is *Warm*.

XIV. 1. On the 19th of *Jan.* 166 $\frac{1}{2}$ at divers places near *Oxford*, was observed a small *Earthquake* towards Evening. In *Oxford* it self, I do not hear that it was observed to be an *Earthquake*; yet I remember about that time (whether precisely then or not I cannot say) I took notice of some kind of *Odd Shaking* or *Heaveing*, I observed in my Study, but did impute it to the going of *Carts* or *Coaches*, supposed to be not far off; though yet I did take notice of it, as a little differing from what is usual on such Occasions; (and wondred the more that I did not hear any: But not knowing, what else to refer it to, I thought no more of it. And the like Account I have had from some others in *Oxford*, who yet did not think of an *Earthquake*; it being a rare thing with us.

An Earthquake
near Oxford,
1665. by Dr.
Wallis. n. 10.
p. 166.

I find my Notes, concerning my *Thermoscope* and *Baroscope* for that Day to be these.

166 $\frac{1}{2}$. Day	January. Hour	Thermo. Inches	Barosc. Inches.	Weather.
19.	8. Morn.	14 $\frac{1}{12}$	29 $\frac{1}{2}$	Hard Frost. Close.
	4. Even	14 $\frac{3}{8}$	29 $\frac{1}{4}$	Hard Frost. Cloudy.
	9. Even	14 $\frac{3}{4}$	29 $\frac{3}{4}$	Rain. Wind.
20.	8. Morn.	15 $\frac{1}{4}$	28 $\frac{3}{4}$	Sunshine. Wind.

I hear, it was observed at *Blechington*, above 5 Miles to the North of *Oxford*, and so along by *Bostol*, *Horton*, *Stanton*, *St. Johns*, and so towards *Whately*, which is about 4 Miles Eastward from *Oxford*. Not at all these Places at the same time, but Moving forwards from *Blechington* towards *Whately*. For it was at *Stanton* about 6 of the Clock, or later (as I understood from *Mr. Boyle*, who was there at that time) but had been at *Blechington* a good while sooner. And I am told that it was taken notice of by *Dr. Holder* (a Member of our Society) who was then at *Blechington*, to be observed by those in the further part of the *Garden*, some very discernable time before it was observed by those in the House; creeping forward from the one place to the other.

2. Riding somewhat late betwixt *Oxford* and a Lodging I have at a place 4 Miles distant from it, I found the *Cold* very piercing, which put me upon Galloping at no very lazy rate; and yet before I could get to my Lodgings, I found the *Wind* turned, and felt the *Rain* falling. This Accident, considering the shortness of the Time, and that it was preceded by a settled *Frost*, was surprizing to me, being one of the Greatest and Suddainest Alterations of the *Air*, I had ever observed. Soon after (by my Guess about an Hour) there was a manifest *Trembling* in the House where I was (which stands high in Comparison of *Oxford*:. But it was not there so great, that I should have taken any notice of it as an *Earthquake*; if I had not been Advertised of it as being taken Notice of by the People of the House. Soon after there happen-

By Mr. Robert
Boyle; n. 11.
p. 179.

ed a *Brisk Storm*: Whereupon I sent to make Inquiry at a place called *Brill* which standing upon a much higher Ground, I supposed might be more Obnoxious to the Effects of the *Earthquake*. The Person I sent to, writ me a Ticket, whose Substance was, That the *Earthquake* there was much more Considerable, than where I lodged, and that a Gentleman's House in the Neighbourhood *Trembled* very much, so as to make the Stones manifestly to *Move* to and fro in the Parlour, to the great Amazement and Fright of all the Family. The Hill whereon this *Brill* stands, I have observed to be very well stored with *Mineral* Substances of several kinds. I have been informed by others, that this *Earthquake* Reached a good many Miles.

By Dr. J. Beale.
n 116. P. 357:

3. I conceive the *Subterraneous Steams* might be the Cause of such a *Midland Earthquake*. And I know no surer or better way to find out the Nature and Properties of those *Steams*, than by Observing the Effects, and all the Alterations of the *Air*, as Mr. *Boyle* and Dr. *Wallis* have done.

An Earthquake
at Oxford. 1683.
By Mr. Tho.
Pigott. n. 151.
p. 311.

XV. *Sept. 17. 1683.* An *Earthquake* happened here at *Oxford*. The Rarity of such Effects makes many People not know what they are; and by heightning their Surprise, imposes upon their Judgments. One fancied it to be the falling of something about his House; Another the tumbling of Wood; a Third the Ratling of a Cart; one one thing, and one another, till either a mature Deliberation, or Intelligence from other Hands, convinced them to the contrary; and satisfy'd them it was an *Earthquake*. Besides, the *short continuance* of the *Trembling*, would hardly permit them to make any Accurate Observation.

I, for my part, perceived the *Sound* and *Motion* very plainly, and though when I saw the Clearness of the Morning, I judged that to be an *Earthquake*, which otherwise I might have thought to have been only a Distant Thunder, yet had I not so clear an Impression of it in my Mind as to make any Considerable Observations of my own: So that what I can afford you, will be only some Occasional Reflections upon *Earthquakes* in general, and Remarks upon the Intelligence, which I have picked up here and there concerning this in particular.

1. This *Earthquake* happened at a time in which such Effects are commonly Experienced, if we may credit *Aristotle*, who tells us that they are most frequently, tho' not always in *Spring* and *Autumn*; in which there is generally a greater Abundance of *Moisture* sucked up, more *Vapours*, and a larger quantity of *Nitre* (as Experience doth Demonstrate) all which Ingredients may conspire to the producing of an *Earthquake*. For, if we consider how capable they are of a large *Expansion*, how forcible they are when *Rarify'd* in Vessels Closed and placed over the Fire; in *Aeolipyle*, from which they break out with forcible Blasts, or in Winds, which frequently proceed from the *Rarefaction* of such Principles, we may suppose that those *Vapours* which produce such great Commotions in the *Air*, may cause a considerable Disturbance in the *Earth*, when pent and locked up by Cold, or any such like Accident.

2. The

2. The latter part of the first Week in *September* was so *Rainy*, that most People were apprehensive of a *Flood*, and upon *Sunday* the 9th of *September*, there fell some very considerable *Showers* in the *Afternoon*; but from that time it *Cleared up*, and to the *End* of the next Week continued very *Warm* and *Pleasant Weather*. The *Evening* of *Sunday* the *Sixteenth*, was inclinable to *Frost*, and the next *Morning* it was found to be a very *Hard Frost* for the *Season*, and then about *Seven* of the *Clock*, the *Day* being very *Clear* and *Calm*, the *Earthquake* happen'd. The like *Observations* of *Cold* preceding that of 1662 were made by *Dr. Wallis* and *Mr. Boyle*.

3. The *Quicksilver* in the *Barometer* (as I am told by the *Operator* in *Chymistry* here) stood as *High* then, as at any time these *Three Years*; which together with a remarkable *Calmness* of the *Air*, a matter generally looked upon as one of the *Circumstances* which accompany *Earthquakes*, and by many reckon'd amongst the *Signs* which fore-run them, may be sufficient to shew how free the *Air* was from *Vapours* at that time; and surely the fewer there were *Above*, the *More* may be supposed *Below*.

4. *Ignes Fatui* were frequently seen a few *Days* before this *Earthquake* happen'd; which may pass for a *Probable Argument*, at least, to shew how full the *Earth* was then of *Damps* and *Exhalations*, since a *Stench* that hath *Tainted Well-Water* after an *unusual manner*, hath upon the same *Account* been generally *Reckon'd* amongst the *Signs* of an *Earthquake*, by which it may be *Predicted*: For by this it was that *Pherocydes* is said to have *Presaged* the *Earthquake* of *Lacedemon*, and *Helmont* mentions another who pretended to the same *Fore-sight*, by *Tasting* the *Water* of a very deep *Well* in the *Castle* of *Lovain*.

5. The *Motion* of this *Earthquake* was not of that sort, which are termed *Pulses* or *Succussions*; such as strike the *Ground* at *Right Angles* with a *Violent Shock*, or *intermittent Knocking*, so as oftentime to raise the *Earth* to a considerable *Height*, or force their way by a *Breach*; but it appear'd rather to be such a *Trembling Motion* as *Vibrates* and *Shakes* without *Altering* the *Position* of the *Earth*, and leaves all things in the same *Posture* in which it found them. For it *Shook* the *Earth* with a *Tremulous* and *Vibrating Motion*, whose *Reciprocations* were repeated with a great deal of *Quickness*. The *Pulses* were, as I could perceive, a little discontinued, and yet they came so *Thick* that I could not *Count* them, tho' the whole *Earthquake* Continued here, scarce more than 6 *2ds* of *Time*; and when that Ended the *Motus Restitutionis*, or settling of the *Building* in which I was, did seem to be with a *Crash*.

6. Now as *Tremulous* and *Vibrating Motions* are proper to produce *Sounds*, so was this *Earthquake* accompanied with a *Hollow Murmuring Sound*, like distant *Thunder*, as I have observed before, which *Sound* kept *Time* so exactly with the *Motion*, and was so *Conformable* to it in all respects, that it plainly appears there was the same *Reason* for Both. To those that were within *Doors* it appear'd to be more *Considerable*, and as it were in the *Air* above, occasioned chiefly

chiefly by the *Shaking* of the Building; as we may guess by a Blow or a Stamp in a Room, which besides the Principal *Sound* from the part that is Stricken, causes another Obscure one, together with a Small *Shaking* throughout the whole; and in the *Laboratory* it was heard more Loud: For all *Sounds* have a great Advantage there, But those who were Abroad in the Fields and open Air, perceived with a gentle *Shaking*, a *Hollow Murmur* towards the Surface of the Earth, not unfitly compared to the Groaning of some planks of Elm, Ash, or Firr, when the Application of Fire causes both a *Trembling* and *Sound*. That there is a considerable *Heat* within the Earth is manifest, from the Experience of *Miners* working in the Deeper Grooves; from those *Hot-Springs* which break out thence; from *Fermentations* occasioned by *Mineral Spirits*. Nor is it less commonly Observed, that such *Heats* and *Fermentations* within the Earth are Augmented by *Frosty* Weather, when the *Steams* being more Pent up, and hindred from breaking out, do Work more forcibly upon one another. And that *Sounds* and *Tremblings* may be produced by such *Heat*, though it did but work upon *Air*, *Watery Vapours*, or *Nitre*, only included in Pores and Cavities, appears by several Experiments; as that of filling Glass bubbles half full with *Water* and *Nitre*; which being set to the *Heat* of the *Fire* will *Tremble* with a sort of *Humming Sound*, and after that Break with a great deal of *Noise* and *Violence*.

7. This *Sound* as well as *Trembling* appears to have been the same in most of those places where they were perceived; from whence we may infer, that they were not Caused by the Falling of the Earth or Rock from the upper part of some *Cavern*; nor from any Commotion of *Vapours* within the Hollow, as Powder works in a Mine, by which Similitudes it is usual to expound some *Earthquakes*: For then it would have been perceived more plainly in places above it, or those that were near adjoining, and not Equally considerable in Towns of such various distances, as *Oxford*, *Burford*, *Watlington*, *Benson*; *Brill*, and *Ailsbury* in *Bucks*; *Wallingford*, *Radley*, *Appleton*, and some other places in *Barkshire*; with many more round about.

8. Yet I cannot but say that it was less considerable in some places than in others: The Men of some Towns speak dubiously, especially towards the North of *Oxford*; and some talk of a Neighbouring Town *feeling* it, tho' their own did not. Yea even here in Town the *Earthquake* was not perceived so plainly in some places as in others; but that may depend upon Circumstances, as the Position and Form of the Houses, or some Accidents, as Noise of Carts intervening, which might render it less observable. Besides, I do not deny but there may be some *Cuniculi*, little Passages or Hollows here and there under ground, which might advantage the *Trembling*, and elsewhere more solid parts which might Damp and Obstruct it.

9. This might occasion some Difference in the Sound too. One perceived it like a *Voice* under ground, but he could not tell which Way it passed, perhaps there might be a *Cavern* there. Another who was travelling over *Shotover* heard the same; and it is very likely that there are considerable Hollows there. One who was Fishing in the *Charwel* informs me, that whilst his Boat

trembled

trembled under him, and the lesser Fishes seemed much affrighted by an unusual Skipping, he heard the *Murmur* as of a Rising Wind, Which he fancied just then Breaking out, and Rumbling upwards but felt none. The like relation, as to Rumbling in the Air, I have from good hands concerning some People that were in *Dourton-park* in *Buckinghamshire*; which I mention only for the Distance sake: For most hereabouts Agree in the same Fancy. My self Heard it like a *Distant Thunder*, a Noise determined to one Place, not Fleeting or Passing from me, tho' the *Crash* which Ended the *Shaking* of the building, little deceived me in my first Imaginations.

Aristotle (*de Mundo*) calls the *Earthquakes* of this kind, by the name of *Bp&wau*, as if they Boiled, because they Ply up and down. And I take this that happened here, to be no such Forcible, or Irregular Ebullition Raising the Earth with intermitting Shocks, as that of *Mecklin* for instance *Apr. 4. 1640.* described by *Van Helmont*: But a Regular *Effervescence* of inclosed Vapours, more evenly dispersed, working up and down the Earth with a *Trembling* of each Part, and a Reciprocal Agitation of the Whole. For I could never meet with any, who pretended to Determine from what part this *Earthquake* Came, or whither it Went.

10. All who felt this *Earthquake*, say it happened about 7 a Clock: But I dare make no Inference from hence, that the *Shaking* really was in all Places at the same Time, unless the Time had been exactly observed, to a Minute at least, in several Places. For since all *Tremours* and *Sounds* are found to Move above 15 Miles in a Minute, and above 94 in an hour, and consequently the *Trembling* of the *Earth* passing along with a Continued Noise, may be supposed as Quick in it's Motion. It might according to this Calculation in a minutes time have reached the Extremity, of its Sphere or Compass: For the Circuit of this *Earthquake*, was but 70 Miles, or thereabouts; it's Largest Extent was from South-East to North-West, the least from N. to S. For it was perceived a little short of *Kirklington N. of Oxford* at *Blechington* and at *Alysbury, S. E.* where it was perceived plainly; as also at *Thame* which is E. and so at *Aston, Kinston* and *Stocken-Church-hill*; at *Watlington S. E.* (some say at *Reading* which is more S. and then it's compass may be supposed Larger) at *Wallingford S. E. b S.* as much as any place; at *Abington South* but not much; not so far as *Farington S. W.* but at *Bampton W.* at *Burford* to the North; at *Lo. Harborough N. W.* not much: at *Woodstock* which is more N. little or none; and at *Glympton* Two Miles beyond it, not at all, as I am informed. But this is a very inconsiderable Space, if compared with that which happened in the Southern Parts of *Norway Apr. 24. 1657.* and took up 160 Miles in Length and so much in Breadth, saith *Michael Peterson Escholt*, that describes it; And *Kircher* mentions one 200 Miles in Length.

11. The *Effects* too of this *Earthquake* were very inconsiderable, as Shaking down some Pewter in a very few places; Casting out a Truckle bed Westward, which when looked upon I found so very easie to Move and apt to Run, as also the Room so Smooth and Declining towards that Point, that I could as little Infer from thence that the Motion came this or that Way, as from

from the Falling of many Books from the Northside of a Ware-house when a Few only fell from the South. And of whatever Nature the Enclosed *Vapours* were, which caused this *Earthquake*, it seems as if they were not able to Force their Passage through the Earth (at least but Slowly): For the *Air* till the End of the Week continued *Fair*, tho' the Week ensuing was very *Windy* and *Boysterous*.

12. We have *Earthquakes* here very *Seldom*; not one before for almost a score of Years, except that which is doubtfully reported to have happened about 4 a Clock in the same morning. But seeing the Earth abounds with such great Variety of Matter, which may Produce them, as also with so many *Caverns* and *Chinks* of such Various Figures, through which they may be Agitated with such Different *Motions*, it seems more easie to shew how they may Begin, how they may be Carried on, how they may Produce such Different Effects, and how they may Continue; than to Determine why they should happen so *Rarely*, do no more *Mischief*, or be Stopped so soon in their *Motion*.

An Earthquake
in the Midland-
Counties. 1683.
by Mr. Tho.
Pigot. n. 151.
p. 321.

XVI. There was another *Earthquake* far more considerable, which happened Oct. 9. about 11 at Night: And was in *Oxfordshire* Northwards very much; some say they felt it here at *Oxford*. It spread all over the *Midland Counties*, and Extended into *Darbyshire*: In which, as in the Coal-Countrys, it was very *Violent*. They Report that it was in all its several places at the same Time, not Determining precisely: And that it Produced some Remarkable Effects.

An Earth-
quake in Si-
cily. 169²/₃.
by Mr. Martin
Hartop. n. 202.
p. 827.

XVII. 1. It seems highly probable that these *Tremblings* of the *Earth* proceed from the same *Incens'd* matter, which finding a way at other times through the *Mongibello*, has so furiously broken out in *Smoak* and *Fire*, This appears by the Tragedy of *Catania*.

The *Eruptions* of these *Mountains* are of two sorts; the one not so very Violent as to disturb much the Adjacent Country, and this happens once in Two or Three Months, and lasts three or four Days. The other is more Furious and of longer continuance, and is observed here at *Naples* to happen to Mount *Vesuvio* once in about 80 years, as I heard the Ingenious Mr. *Peccacio* say. Of these the last in 1632. was so very Violent, that by the best of his Observation it Cast the Rocks three Miles into the Air. Now from the *Burning* or not *Burning* of this Hill, *Naples* (and without doubt the same holds in *Sicily*) Calculates its Safety or Danger of *Earthquakes*, For without doubt the Matter is continually *Burning* under the Mountain; and those vast Clouds of *Smoak* which daily issue out of the Top, if the Cavity happen, by any Rock or inward Alteration, to be stopt, must Deviate through other Passages underground, heaping up continually Magazines for a Future Calamity. Now this Combustible matter seems to me to be nothing but *Nitre* mixt with some other *Minerali* and *Sulphur*. He that has seen the way of making *Salt* of *Tartar* by *Deflagrations*, where you Mix an equal Quantity of Pulveriz'd *Nitre*, has seen an exact Type of these *Burnings* Hills, For after each Spoonfull you put

put into the Burning Crucible, arises first a black Thick Smoak, after which the Fired Mineral Boils up, as if it would over run the Top of the Crucible.

The *Motion* of the *Earth* is not from the *Perpendicular*, but *Horizontal*; as appears by the *Cracks* in the *Earth*, which they say, are to be found now all over *Sicily*: 'Tis a *Vibration* so Quick, that it Cracks the Glass in the Windows; 'Tis Disputable whether the *Reciprocations* of a Lute string are more Frequent. Now when the *Vibrations* are so Quick, and the Body Moved so Great, the Motion must be prodigiously Violent. We observe that *Thunder* which is the Effect of the *Trembling* of the *Air*, caused by the same Vapours dispersed through it encountering one the other, has Force enough to Shake our Houses. And why there mayn't be *Lightning* and *Thunder* Under Ground, in some vast Repositories there, I see no reason; especially, if we Reflect, that the Matter which composes the Noysie Vapour above us, is in much larger Quantities to be found Under-ground. I can attribute this *Horizontal Trembling* to nothing else but the Furious Passage of the *Incensed* Matter from one Grotto to Another: For 'tis very Probable these are continued, in some Parts of the Earth, for several Leagues together; Witness your Last *Earthquake* about 4 or 5 Years ago, which was felt, (with little difference as to Time) in *England* and *Ireland*. Another Confirmation of this is, the Manner how these *Trembling Fits* are performed; which is not all of a suddain, like that of *Gunpowder* in a *Mine*, but is small at First, afterwards gradually more Terrible, like a growing *Tempest*. A Third may be, the Observation of some here in *Naples*, that when Mount *Vesuvio* ceases to Burn, the *Sulfaterra* sends out it's *Fumes* more violently, & vice versa. Now this *Sulfaterra* is a Hill near *Puzzolo*, as distant from *Naples* on the one hand, as the Hill *Vesuvio* is on the other; so that 'tis more than probable that *Naples* stands upon a *Burning Arch*, through which, as a Pipe, these two furious Neighbours do reciprocally receive the above said *Exhalation*. This seems to me a Growing Evil to this wealthy and Populous City. And what may possibly make good the Prediction of *Sanazarus*, who was born here.

*Et te, quis putet hæc? Altrix mea, durus Arater.
Vertet: et Urbs, dicet, hæc quoque Clara fuit.*

2. The Island of *Sicilia*, of 700 Miles Circuit, and divided into 3 Valleys, began on *Friday* the 19th of *January* 1693. about half an hour past 4 a Clock, to be Sensible of the Shake in the Valley of *Mazara*: But in the Two other Valleys of *Emone* and *Noto*, the Shakes were so Terrible, as to throw down some Buildings, obliging the Inhabitants to Seek Refuge either in the Fields, or with Prayers and Tears implore the Divine Pity in the Churches. On *Sunday* following, being the 11th of the same Month, at 20 hours and 3 quarters, the Hand of God appeared much more Terrible, awakening the most Lethargick Sinner. The Shakes of this *Earthquake* did no damage in the Valley of *Mazara*, only Frighting the People.

Palermo received some Detriment in most of the Buildings, especially the Palace and Hospital of *St. Bartholomews*, The Steeple of *St. Nicholas*, be-

longing to the *Augustines*, was Ruined and some Hurt done to the Church; but little Mischief else done, and no Body Hurt.

In *Messina* all the Buildings of the *Theatre* are shattered, the Royal and Archbishop's *Palace*, with the Seminary, are all Crack'd. The Vast and stately Church of the *Franciscans* Broken in many places, and the Roof of the Vestry Fallen; The Steeple of the Church of the *Annunciation*. Thrown down, with the Death of the Sexton; the Top of the Spire of the *Dome* Cleft. Many Private Buildings were Thrown down, and all the rest Shored up. There were but few persons Killed.

Troina, *Randazzo*, *Nicosia*, Cities in the Mountains, suffered in their Buildings. The First had half of the Mother Church Destroyed, with the Parish-Church of St *Lucy*, and was much Damaged in his Monasteries; one whereof is not Habitable. The last had it's *Dome* very much Hurt. *Castiglione* had the Castle and many Houses Thrown down; in *Franca villa* and *Linguagrossa*, the greater part of the Buildings and some Churches; *Mascali* quite Ruined, but not many Killed, most of the People being abroad a Procession with Reliques of St. *Leonard* their Protector.

Aidone received a considerable Mischief, Two whole Quarters, with many of its Inhabitants being Destroyed. In the Quarter of St. *Laurence* there is not one House Standing, and the Churches Ruined: In that of St *James* the Church of the *Annunciation* and its Oratory Thrown down, with several other Sacred Edifices. In the other part of the City, which stands Lower, there were not so many Houses nor Persons Lost, yet the Church of Pope *Leo* is quite Flat; and the Magnificent Church of the *Dominicans* in Ruines, with the Convent of the *Reformati Osservanti*, one of the best in the whole Province

Abi Aquilea, commonly called *Jaci Reale*, Situated at the foot of *Aetna*, is almost quite Destroyed, and its Inhabitants Buried in the Ruines, with many Convents; amongst the rest the Famous one of the *Osservanti Reformati*.

Aci St Antonio, *Aci St. Filippo*, *St. Gregorio*, *Pedara Trecastragni*, *Bonaccorei*, *Nicolosi*, *Motta*, *Mesterbianco*, *Fenicia*, and several other Fruitful Villages situated near *Mongibello*, are Destroyed, with all the Habitations of Pleasant Hills about *Cananea*, which are now in the Dust.

Paterno, about 12 Miles from *Catania*, a Populous City at the foot of *Mongibello*, lost most of its Buildings, all the Convents of Fryars, and a very Fine Monastery. In the Ruines were Buried 40 Persons. *Aderno*, had the same Fate.

Cantabiano Piemonte in the Valley of *Emona*, *Francofonte*, *Palagonia* in the Valley of *Noto*, are little less than wholly Level'd, and about 300 Persons Destroyed. The Marquis of *Francofonte* was Miraculously Saved by Leaping out through the Crack in the Wall of the Falling Edifice

Catania, one of the most Ancient and Famous Cities of the whole Kingdom; Honoured by the Courts of several Monarchs, and an Episcopal See even from the Time of the Apostles: Giving place to none in the Beauty of its

its Sacred Edifices, amongst which the *Dome* was the most Sumptuous and Large in all *Sicily*, Adorned with excellent Pictures, and richly Furnished, and Blessed with the Reliques of the Invincible Martyr *St. Agatha*, Honoured with the Bodies of Several Kings; besides it had a very High and curiously built Steeple. Here were a great many Nunneries; amongst the rest the Monastery of the *Trinity*, and that of *St. Benedict*, with that Prodigy of Workmanship the Magnificent Monastery of *St. Nicholas*, with its Temple, a place Famous for several Reliques. Next the *Jesuits* College, the Convent of the *Minorites*, and two of the *Dominicans*, the Beautiful one of *Capuchins*, the Imperial Convent of the *Carmelites*, that of the *Reformed Minorites*, that of the *Reformed Augustines*, with several other Frieries, with an infinite Number of the Ancient and Modern Churches, Colleges, and other publick Buildings, inhabited with 23000 Souls

Its Nobility many and Ancient. Learning was here in its Glory; the Citizens were themselves Learned, and Lovers of Knowledge, assisted with the many privileges granted by the King. The University where the Learned Laurel was conferred on the Worthy, made this place the *Sicilian Athens*. This once so Famous now Unhappy *Catania*, had the greatest share in this Tragedy. Father *Antonio Serrovita*, who was to Preach at *Catania* the Lent following, was on his Way thither on the 11th at 20 hours and $\frac{3}{4}$, and at the Distance of a few Miles; He observed a black Cloud like Night hovering over the City; that there arose from the Mouth of *Mongibello* great Spires of Flame, which spread themselves all round; that the Sea all of a Suddain began to Roar, and raise it self in Swelling Billows; that there was a very great and Dreadful Blow, as if all the Artillery in the World had been at once Discharged; that the Birds Flew about Astonish'd in the Air; that the Beasts and Cattle in the fields ran Crying about Affrighted; that His and his Companions Horses were so Startled, that they stood stock still, Trembling so as that they were forced to alight, which they had no sooner done, but they were Lifted from the Ground above two *Palms*; and casting his Eyes towards *Catania*, he with Amazement saw nothing but a very thick Cloud of Dust in the Air. This was the Scene of their Calamity. For of the Magnificent *Catania* there is not the least Footstep to be seen. All its Edifices are Levelled with the Ground, except the Chappel of *St. Agatha*, the *Rotunda*, the Castle of *Ursino*, the Walls that encompassed it, and a few Mean Houses. There was a very great Destruction of the Inhabitants buried in the Ruines of the Bishop's Palace, the Steeple, and *Dome*, where most of the City, frightned with *Friday's Earthquake*, were got together to carry the Reliques of *St. Agatha* in Procession. Many of the Nobility were Saved under the Chappel of the Saint, and some of the Clergy. The Number of the Dead was about 15000; for though the People had staid in the Fields all the *Saturday* yet the Solemnity obliged them to be in the City on the *Sunday* to pay their Devotions, at the Procession. Of the *Benedictines* about 25 were Killed in the Quire, of the *Jesuites* 21, of the *Conventuals* 11, the Number of the *Dominicans* is not known; the *Carmelites* were all Buried except One, as they went in Procession; and so were the greater part of the other *Religious Orders*; and of the Nuns

Few were saved. This was the Tragedy of *Catania*, which was accompanied with dreadful Lightnings and Thunder from Heaven, with Deluges of Rain; and in the Ruines were heard nothing but Cries, Schrieches, and Dying Groans. On the Heaps of Stones we may now write, *Here was Catania*.

Lentini, a very Ancient City, Honoured with the Births of many Illustrious Persons, amongst the rest, that Father of Eloquence, *Gregorio Leontino*, of a long time an Episcopal See, &c. Felt that Shock on the 9th, with such violence, as threw down and Ruined the greater part of its Buildings; amongst which was the Ancient Convent of *Minorites*, famous for being the Dwelling place of *St. Anthony of Padua*; the *Royal Convent*, so called from the Tomb of one of our Queens buried there; under the Ruines of which 4 Religious were Buried, the rest escaped miraculously. But the last *Earthquake* on the 11th. laid in the Dust the Remainder of the City, with the Death of about 4000 People that returned thither after the first Shake, to take care of their Goods. So that now there is but the Carcass of a City all shatter'd to pieces, not one House left standing.

Carlentine, a Modern City, being as a Citadel dependent on *Lentine*, had the same Fate. The Beautiful Castle of *Licodia* all ruined, with the Marchioness of *Martini* and all her Children Buried therein.

Bizzrini, a City of Rich Inhabitants, is Levelled with the Ground.

Sortino and *Cassero* are quite Demolished; in the first, about 3000 Perished.

Agosta, a Trading Town, built on an Island in a large Bay, which makes a capacious Port, was all Blown up into the Air; for besides the Damage of the *Earthquake*, there was a great quantity of Powder in the Castle that took Fire, and killed several of the Citizens that had escaped into the Fields, with the Stones of the Buildings. Here perished about 3000. The Enraged Sea grew terrible Boisterous, and Tempestuously beat against the Walls of the *Dominican Convent* with such fury, that some Galleys belonging to the *Knights of Malta*, scarcely escaped Shipwreck in the Port. In fine,

Luctus ubique, Pavor, & plurima Mortis Imago.

The Country of *Milili* in the Dutchy of *Montalto*; felt the same Fate, with the Destruction of the Inhabitants.

Syracusa, famous in Old Time, an Episcopal See; in our time like the Phœnix arising from the Ashes, standing upon a Peninsula, by Art made an Island, having a Bridge to the Main Land; strengthened with a Modern Fortification, sufficiently Populous; by reason of its convenient situation for Trade, full of Nobility, and Beautify'd with Churches, Convents, Monasteries, and Palaces, now Mourns in Ruines. It was sensible of *Fridays*, but Shook to pieces by the *Sunday's Earthquake*, with the Loss of many thousand Persons. Most of the Nobility saved themselves by a timely Flight. Of the Religious not many Perished. Scarce a Village in the whole Diocess is left; Confusion Reigns every where; and the Misery is encreased by want of Food, caused by the Granaries and Mills being Destroy'd.

Laferla, Palazz'olo, and Busceni lie in Ruines, with many Inhabitants Destroy'd

Spacaformo, a Populous Place situated near the Sea, which washes the foot of the Promontory *Pachino*, has Lost all its Buildings: Here they reckon about 2000 Dead.

Giarratana with its Fall Killed most of the Inhabitants. The Marquis himself, with his Wife and 3 Children, escaping on *Friday*, were on *Sunday* Buried in the Ruines; the Marquis and his Children were taken out alive, to bewail the loss of his Lady.

Melitello, in the Valley of *Noto*, is shaken to Pieces, the Churches and chief Buildings even with the Ground, and the Religious Orders all turned out into the open Air, or under Huts and Cabins.

Occhiula escaped not the common Calamity.

Mineo, an Ancient City; is now no more; and the greater part of the Citizens and Religious.

Caltagirone, a City conspicuous for its Senate and Nobility, suffer'd in this Universal Calamity, the total Ruin of its Proud Edifices: As the Principal Church, with its very High Steeple or Spire, the famous College of *St. Julian*, the Temple of *St. George*, the Parish Church of *St. James*, Admired for the Pictures of *Epiphanius*, the Chappel only remaining, with the Image and Reliques of the Saint. The Temple of the *Conventuals* thrown down, the famous Bridge that joins the Convent to the Town shattered to pieces, and the Dormitories not to be Inhabited; the Famous Convent of *St. Bonaventure*, the Fall of whose Temple and Spire was the Destruction of the Lower Buildings; the College of the *Jesuits*, and the Steeple of that Noble Church are quite Ruined. The *Carmelites*, *Dominicans*, *Augustines*, *Crouched Friars*, &c. are all without Churches and Convents. The Monasteries of *St. Gregory*, *St. Chiara*, *St. Salvator*, and *St. Stephen*, with a *Conservatory* of Orphans, are all shook down. In fine, the Senate-House, Adorned with most Curious Statues, and all the other Buildings, are either Fallen, or Threaten a sudden Ruine. In these Desolations, about a 1000 People were lost.

Modica, a Populous place, and a Chief of the Seigniory of the *Admiral* of *Castile*, has its Buildings and famous Castle laid in the Dust. Seignior Abbot *Frederick*, the *Procurator General*, saved himself in the College of the *Jesuits*, from whom we have the Account; and that the Cities of *Ragusa*, *Sicily*, and *Chiaromonte*, had the same Misfortune.

Comiso suffered much in its Buildings, though but few were killed. The Convent is Down, but the Church stands.

Noto, an Ancient and Ingenious City, full of Nobility and fine Buildings, Convents and Monasteries, as we hear from a Courier from thence, is all Ruin'd; the Convents of the *Dominicans*, *Conventuals*, *Reformati*, *Carmelites*, and *Capuchins*, which was indeed a Wondrous Fabrick, are all Torn to Pieces. The Church of the *Crucifixion*, the *Dome*, and all the Nunneries are down, with the Deaths of many Citizens and Nobles.

To conclude, there is not a Corner in all the Valley of *Noto*, that is not Ruined wholly, or for the most part, with a Dreadful Slaughter of the People.

People. The Southern Coasts, as *Licati*, *Terra Nova*, and *Gircuti*, have suffered Dammage in their Buildings. And all the Castles of the Valley of *Emone* near *Mongibello*, are Cracked and Broken or Thrown down.

By the Noble
Vincentius Bo-
najutus. n. 207.
p. 2.

3 The continual *Fiery Eruptions* of *Aetna* (of which the *First* that we have any Account of, happened 500 Years before the Destruction of *Troy*, as *Diodorus Siculus* Relates) have been taken for the most likely Causes of the Horrible Shakes that from Time to Time have laid Waste the Island of *Sicilia*; as is observed by *Fazello*, where he Remembers that of the Year 1542, which on the 10th of *December* at the 23d *Hour*, Shook the whole Island, and especially *Val di Nota*, *Syracusa*, *Lentini*, *Sortini*, *Mililli*, *Catania*, *Agosta*, *Noto*, *Caltagirone*, *Militello*; and in short, the same Cities and Castles which were miserably ruined by the *Two* late violent *Earthquakes* of this present Year 1693.

In Dec. 1. 1. 1.
Cap. 14. and
Dec. ult. 1. 10.

The *First* of which was at 5 a Clock the next Night after the 9th of *January*. Its Motion was of that sort which *Aristotle* and *Pliny* call the *First Species*, and is by them likened to the Shaking Fit of an *Ague*, causing such a Motion as *Shakes* the *Earth* from Side to Side. In this first almost all the Edifices in the Country were Thrown down, whereof some were very High and Strong built Towers. A great part of the City of *Catania*, with many, others were Demolish'd, and a great many Buildings in *Val di Noto*. *Syracusa* was also much shattered, but not Ruined. This was not Preceded by any *Darkness* in the *Air*, but a Pleasing, Serene, Warm Time, which was the more Observable, as being Unusual at that Time of the Year, yet it was not to any Excess.

Some Persons, which the Evening before were Travelling in the Country, observed a great *Flame* or *Light*, at about an Italian Miles Distance, and so bright, that they took it for a Real Fire made by some of the Country People, and though they went directly towards it, yet it seemed to keep at the same Distance from them. Whilst they were observing this Appearance, the *Earthquake*, began which was sensible even to the Horses they rode upon, that were Affrighted thereat, and the Trees were all shaken. Upon this, the Amazed Travellers looking for the *Light* they saw just before, found it quite Vanisht. We perceiv'd, Turning towards the Sea, that the Waves which before the *Shake* only beat gently upon the Shoar, began now to make a Dreadful Noise. The next Day, which was the 10th, the Night and Day following, the *Air* was Overshadowed with *Darkness*, and Tinged with a deep Yellow, and the Obscured Sun struck our Minds with the Melancholy Presage of the Approaching *Earthquake*; Which was the 2d, and happen'd on the 11th of the same *January*, about the 21 Hour, and lasted about 4 Minutes. It was much like the 2d sort, which *Aristotle* and *Pliny* call a *Pulse* or *Stroke*, from its resemblance to the Beating of an Artery. And by *Possidonius* in *Seneca*, is Represented by the Name of *Vibrations*, it being a Perpendicular Lifting up of the *Earth*. Its *Impulse* was so Vehement and Powerful, that not only many Cities and Countries of the Kingdom of *Naples*, but the Island of *Malta* participated also of its Fury. It was in this Country impossible to keep upon our

Legs,

Legs, or in One place on the Dancing Earth; nay, those that lay along on the Ground, were tossed from side to side, as if on a Rolling Billow.

In Open places the *Sea* Sunk down considerably, and in the same proportion in the Ports and inclosed Bays, and the Water Bubled up all along the Shore.

The *Earth* opened in several places in very long Clefts, some an Hand's breadth, others half a *Palm*, others like great *Gulfs*. From these *Openings* that were in the *Valleys*, such a quantity of *Water* Sprung forth as overflowed a great space of *Ground*, which to those that were near it, had a sensible *Sulphureous smell*, though in a low degree, and without that Unpleasant Stifling produced by the Smoak of *Brimstone*.

In the Plain of *Catania*, an Open Place, it is reported, that from one of these *Clefts*, Narrow, but very Long, and about 4 *Miles* off the *Sea*, the *Water* was thrown forth altogether as *Salt* as that of the *Sea*.

In the City of *Noto* is a Street of half a Mile long, Built of Stone, which at present is fetled into the ground, and quite hanging on one side, like a Wall that Inclines; and in another Street before the *Assent del Durbo*, is an Opening big enough to swallow a Man and Horse.

Great Rocks were loosened and Thrown down from the Mountains every where: And in the Country of *Sorino*, Inhabited by about 5000 Persons, a great Number Perished in the Houses which were beaten down by them in their way, as they rolled down from the Hills. A great Cistern or Reservatory of *Water* Hollowed on the top of a Rock was loosened and Thrown off from the rest of the Rocks, and slid down to the Bed of the River that runs in the bottom, where the Cistern remains as it was full of the same *Water* it had received before the *Earthquake*.

A very great many *Grotto's* made by Art or Nature, are now fallen in.

In *Syracusa*, and other places near the *Sea*, the *Water* in many *Wells*, which at first were *Salt*, are become *Fresh*, and have not as yet lost their Goodness, so they are still fit to Drink.

The Fountain *Aretbusa*, for the space of some Months, was so *Brackish*, that the *Syracusans* could make no Use of it; and now that it is grown Sweeter, its Spring is encreased to near double.

In the City of *Termini* all the running *Waters* are Dried up, and amongst the rest a small River near to it, with which they Watered their Gardens and Orchards. It was contrary with the *Hot Baths*, which were Augmented by a 3d part of what they were before the *Earthquake*.

In many plain and level places very high Walls leaped from their Foundations above two paces, leaving that whole space perfectly clear and free from Rubbish and Ruins, as if they had been taken up and carried off. And in *Syracuse*, two Side-Walls of a small House Jumped up from each other, the one Upright, and stood upon its bottom at a great Distance from its former place; and the other, leaving its Companion, flew away so as to make an Angle with the other, to the wonder of the Beholders of so Extravagant an Accident. Not far from the Country of *Cassaro*, from the Tops of 2 Mountains, between which through a long Valley ran a River, two very great Rocks were loosened, which tumbling down over against each other, met so exactly as to close up the Valley,

ley, and stop the Current of the River, which not finding any *Subterraneous* or side Passage, has fill'd up the Valley to the top of the Rocks that were thrown down, and runs over them, forming a Lake 3 Miles round of a considerable Depth.

In the Territory of *Sortini*, in a piece of ground half a Mile long, but much narrower, the Ground at several little interstices, is Sunk from the Level in some places Two, in other Three *Palms*, and ends in a very deep Circular *Gulf* or Swallow.

A Fountian in the very Minute of the *Earthquake* on the 11th Threw forth its Waters Tinged of a *Blood red*, which continued for 3 Hours, and then it Dried up, leaving many Holes in the Mud at the bottom, through which Real *Ashes* were thrown out; and the next day the Waters Returned of the former Quality, without the least Alteration.

In the City, encompassed with Caves on 3 sides, although by the considerable *Shakes* that were given it there was not much Ruine made, yet a very Dreadful Sound and Noise was heard for a great while.

The South Winds have Blown very much, which still have been impetuous in the most Sensible *Earthquakes*, and the like has happened at other times.

From the 11th of *Jan.* to this 14 of *Sept.* there have been considerable and Strong South Winds, preceded by a Noise like Cannon at a great distance, some of a Longer some of a Shorter continuance; this has been observed in all parts, but louder in Cavernous places, and in the Valleys between the Mountains, where the *Shakes* were more Violent, in proportion to the Distance from the Sea.

Darkness and *Obscurity* of the *Air* has always been over us, but still Inferiour to that on the 10th and 11th of *Jan.* and often these *Clouds* have been Thin and Light, and of a great Extent, such as Authors call *Raræ Nubeculae*. The Sun often, and the Moon always Obscured at the Rising and Setting; and the Horizon all day long Dusky, so that our wonted Prospects are Shortned; but for some little time past it has grown something Clearer.

The Heat at the beginning of Summer was not Extream, but the Sun entering *Virgo*, it grew very Great, and at Noons Intolerable.

Since the First of *August*, which was a most Tempestuous Day, not only for the Excessive Rains for about four hours, but for the Hail and very Loud Thunder, the *Shakes* of the *Earthquake* have been less sensible and seldomer, and for two Months not so Universal, but sometimes in one place, sometimes in another.

It has been observed that in less solid Ground such as Chalk, Sand or Loose Earth, the Mischief was without comparison Greater than in the Rocky places. And in *Syracusa* the Difference was Visible in 3 places; that is in the Middle of the City, in the little Island, and in *Zaracati*, where the Ancient *Syracusa* stood; in all which places the Buildings being on a Rocky Foundation remain for the most part Untouch'd, or only *Shaken* or at least not Quite Demolished. Whereas on the contrary, in the rest of that Territory which is not Rocky, a very great Number of Noble Structures and Towers lye like a Horrid Desert, and Heap of vast Ruines.

The *Effects* it has had on *Humane Bodies* (although I do not believe they have all immediately been caused by the *Earthquake*) have (yet) been *Various* such as *Foolishness*, but not to any great Degree, *Madness*, *Dulness*, *Sottishness*, and *Stolidity* every where: *Hypochondriack*, *Melancholick*, and *Cholerick* Distempers. Every day *Fevers* have been *Common*, with many *Continual* and *Tertian*; *Malignant*, *Mortal* and *Dangerous* ones in a great Number, with *Deliria* and *Lethargies*. Where there has been any *Infection* caused by the *Natural Malignity* of the *Air*, infinite *Mortality* has followed. The *Small Pox* has made great *Destruction* among young *Children*. And in short, there has been no *State*, nor *Condition*, which has not had its share in so *Universal* a *Calamity*.

The Number of Inhabitants before the Earthquakes, and of those that Perished therein.

The Names of the Cities.	Number of Inhabit.	Numb of those Kill'd.	Names of the Cities.	Numb of Inhab.	Number of those Killed.
Agosta.	6173	2300	Mazzarino.	7696	
S. Agata.	1402	20	Nicolosi.	844	4
Avola.	6225	800	Nixerni.	1483	
Buscema.	2192	900	Noto.	12043	3000
Bonaccurso.	844	94	Occhiella.	2910	100
Bontello.	172	2	S. Giovanni Lapunta.	1082	15
Butera.	3492		Faci Realé.	12895	739
Buccheri.	3295	300	Faci S. Antonio.	6363	1335
Castagirone.	12339	800	Leontini.	10063	1212
Catania.	18914	18000	Licodia.	4898	741
Comiso.	5305	269	Mineo.		1355
Castel di Faci.	331	32	Palagonia.	1862	29
Carleontini.	2751	77	Pedara.	1582	475
Cassaro.	1458	15	Palazzolo.	5571	700
Chiaromonte.	4830	303	Ragusa.	9946	5000
Floridia.	1037	20	Sortino	6316	2500
Ferla.	3610	800	Syracusa.	15399	4000
Fenicia Moncada.	1651	14	Sicchili.	9382	2000
Francofonte.	2039	345	Scordia.	907	33
Giarlatana.	2981	541	Spaccafurno.	7987	2200
Mascali.	1300	15	Trezza.		200
Massa Nunziata.	394	55	Trecastagni.	3264	1000
Militello Val di Noto.	6438	600	Terranova.	5289	
S. Michele.	1838	1	Tremisteri.	996	90
Melilli.	5480	900	Vittoria.	3950	200
Monterosso.	234	232	Terra Grande & Via Grande.	1602	200
Modica.	18203	3400	Vizzini.	10678	2000
			Sum.	154936	59963

An Earthquake
at Lima 1687.
by P. Alvarez de
Toledo. n. 209.
p. 81.

XVIII. On *Monday, Oct. 20. 1687. (N. S.)* at 4 of the Clock in the Morning, came a Horrible *Earthquake* and *Noise*, with which some Houses Fell, and some Persons were Killed under their Ruines.

At 5 of the Clock in the same Morning was Another *Shake* with the same *Noise*.

At 6 of the Clock in the aforesaid Morning, when we thought we had been all in Safety, came Another *Shake* with great Fury and Rushing *Noise*; The *Sea* with great Bellowing came beyond its Bounds; the *Bells* Rung of themselves; and the Destruction was so great, that no Building Stood. The *Noise* was such, that those in the Fields assure us, that the Cattle were in great Astonishment, *Callao, Canete, Pisco, Chancay, and Los Chorillos*, are all Ruined. There are more than 5000 Dead Bodies Found, and they Find more dayly, so that we know not their Number

An Earth-
quake in Ja-
maica 1687⁷/₈
by Dr. Hans
Sloan. n. 209.
p. 81.

XIX. The Inhabitants of *Jamaica* Expect an *Earthquake* every year, &c. Some of them are of Opinion, that they follow their great *Ruins*. One of them happened on *Sunday* the 19th of *Feb. 1687⁷/₈*. about 8 in the Morning. I found in a Chamber one Story high, the Cabinets, and several other Moveables on the Floor, to Reel as if the Foundations of the House had been Raised. I looked out at a Window to see what was the Matter, and found that the Pigeons, and other Birds in an Aviary hard by, were on their Wings in a great Astonishment. It came by *Shocks*; there were Three of them, with a little Pause between. It lasted about a *Minute* of time in all; and there was a Small *Noise* accompanied it. A pair of Stairs Higher it Threw Down most things off the Shelves, and had much more Visible Effects than Below. This was generally Felt all over the Island, at the same Time or near it; some Houses therein being Cracked and very near Ruin'd, others being Uncovered of their Tiles, very few Escaped some Injury, and the People in them were generally in a great Consternation, seeing them Dance. The Ships in the Harbour at *Port-Royal* Felt it; and one who was Eastward of the Island, coming thither then from *Europe*, met with, as he said, at the same time, an *Hurricane*. One Riding on Horse-back was not sensible of it. A Gentleman being at that time abroad in his Plantation, told me, he saw the Ground Rise like the Sea in a *Wave*, as the *Earthquake* passed along, and that it went Northward; for that some small time after he had Felt it, he saw by the Motion of the Tops of the Trees on Hills some Miles distant, that it had then reached no Further than that Place. The *Spaniards* who Inhabited this Island, and those Neighbouring, Built their Houses very Low; and they consisted only of Ground-Rooms, their Walls being made of Posts, which were as much buried under ground as stood above, on purpose to avoid the Danger which attended other manner of Building from *Earthquakes*. And I have seen in the Mountains a far off Bare Spots, which the Inhabitants told me, were the Effects of *Earthquakes* throwing down part of the Hills, which continued Bare and Steep.

XX. 1. The Terrible *Earthquake* which happen'd *June 7. 1692.* between Eleven and Twelve of the Clock at Noon, *Shook* down and *Drown'd* 9 Tenths of the Town of *Port-Royal* in two *Minutes* time: And all by the *Wharf-side* in less than One; very few escaped there. I lost all my People and Goods, my Wife and two Men, Mrs. B. and her Daughter. One white Maid escaped, who gave me an Account that her Mistress was in her Closet two pair of Stairs high, and she was sent into the Garret, where was Mrs. B. and her Daughter, when she felt the *Earthquake*, and bid her take up her Child and run down; but turning about, met the Water at the top of the *Garret* Stairs; for the House *Sunk downright*, and is now near 30 Foot under Water. My Son and I went that Morning to *Liguania*, the *Earthquake* took us in the Mid-way between that and *Port-Royal*, where we were near being overwhelmed by a *Swift Rowling Sea*, 6 Foot above the Surface, without any Wind; but it pleas'd God to Save us, being forced back to *Liguania*, where I found all Houses even with the Ground; not a Place to put ones Head in, but in Negro Houses. The Earth continues (*June 20*) to shake 5 or 6 times in 24 Hours, and often *Trembling*. Great part of the Mountains fell down, and fall daily. I pray God divert those Heavy Judgments which still Threaten us.

An Earthquake
in Jamaica, 1692.
by ---- n. 209.
p. 83.

2. We have had a very great *Mortality* since the *Great Earthquake* (for we have little ones daily) almost half the People that escaped upon *Port-Royal* are since Dead of a *Malignant Fever*, from Change of Air, want of Dry Houses, Warm Lodging, Proper Medicines, and other Conveniencies. *September 23. 1692.*

By ----ib.

3. A great Part of *Port-Royal* is *Sunk*; that where the Wharfs was, is now some Fathoms of *Water*: All the Street where the Church stood, is *Overflowed*, that the Water stands so High as the Upper Rooms of those Houses which are Standing. The *Earth* when it Opened, swallowed up People, and they rose in other Streets; some in the middle of the Harbour, and yet were saved; though at the same time I believe there was lost about 2000 Whites and Blacks. At the North above 1000 Acres of Land *Sunk*, and 13 People with it. All our Houses were thrown down all over the Island, that we were forced to live in Hutts. The 2 Great Mountains at the entring into 16 *Mile-Walk* Fell, and Met, and stopt the River, that it was Dry from that Place to the *Ferry* for a whole Day; and vast quantities of Fish taken up, which was greatly to the Relief of the Distressed. At *Yellows* a great Mountain *Split*, and Fell into the Level Land, and Covered several Settlements, and Destroy'd 19 White People. One of the Persons whose Name was *Hopkins*, had his Plantation *Removed* half a Mile from the Place where it formerly stood; and now good Provisions grow upon it. Of all *Wells* from one Fathom to 6 or 7, the Water flew out at the Top with the great *Motion* of the *Earth*. Since, it has Continued *Shaking* sometimes two or three times in a Day; so at Night, sometimes more, sometimes less; but God be praised they are but small. Our People settled a Town at *Leguanca-side*, and there is about 500 Graves already, and People are every Day a Dying Still. *Sept. 20. 1692.*

By ----ib. p. 88.

By---ib. p. 85.

4. Between 11 and 12 a Clock, we felt the Tavern (where I then was) *Shake*, and saw the Bricks begin to Rise in the *Floor*, and at the same Instant heard one in the Street cry, *An Earthquake*. Immediately we ran out of the House, where we saw all People with lifted up Hands, begging God's Assistance. We continued Running up the Street, whilst on either side us, we saw the Houses, some *swallowed* up, others *Thrown* on Heaps; the Sand in the Street *Rise* like the Waves of the Sea, *Lifting up* all Persons that stood upon it, and immediately *Dropping down* into Pits; and at the same Instant a *Flood* of *Water* breaking in, and Rowling those poor Souls over and over; some catching hold of Beams and Rafters of Houses, others were found in the Sand that appeared, when the Water was Drained away, with their Legs and Arms out; we Beholding this Dismal Sight; the small piece of Ground whereon 16 or 18 of us stood (praised be God) did not sink. As soon as the Violent *Shake* was over, every Man was desirous to know if any part of his Family were left Alive. I endeavoured to go towards my House upon the Ruines of the Houses, that were floating upon the Water, but could not: At length I got a Canoa, and Row'd up the Great Sea-side towards my House, where I saw several Men and Women floating upon the Wreck out to Sea; and as many of them as I could, I took into the Boat, and still rowed on till I came where I thought my House had stood, but could not hear of neither my Wife nor Family. Next Morning I went from one Ship to another, till at length it pleased God that I met with my Wife and two of my Negroes. She told me when she felt the House *Shake*, she ran out and called all the House to do the same: She was no sooner out, but the *Sand* lifted up; and her Negro Woman grasping about her, they both *dropt* into the Earth together; and at the same instant, the *Water* coming in, Rowled them over and over, till at length they caught hold of a Beam, where they hung till a Boat came from a *Spanish Vessel* and took them up.

The Houses from the *Jews-street* End to the *Breast-work* were all shak'd down, save only 8 or 10 that remained from the *Balcony* upwards *above Water*: And as soon as the *violent Earthquake* was over, the Water men and Sailers did not stick to *Plunder* those Houses; and in the time of their Plunder, one or two of them fell upon their Heads by a *second Earthquake*, where they were lost.

As soon as the *violent Shake* was over, the Minister desir'd all People to join with him in Prayer; and amongst them were several *Jews* that Kneeled, and answered as they did. Nay, I heard one say, They were heard to call upon *Jesus Christ*: A thing worth Observation.

Several Ships and Sloops were *Overset* and *Lost* in the *Harbour*: Amongst the rest the *Swan Frigate* that lay by the Wharf to Careen, by the Violent *Motion* of the *Sea*, and *Sinking* of the Wharf, was forced over the Tops of many Houses; and passing by that House where my Lord *Puke* lived, part of it fell upon her, and Beat in her Round House: She did not *Overset*, but helpt some Hundreds in saving their Lives.

As to the *Fire-Balls* which you heard was seen in the *Air*, it was a great Fallshood; but a Great and Hideous *Rumbling* was heard in the Mountains; infomuch

nsomuch that it frightened many Negroes that had been run away some Months from their Masters, and made them come Home.

The *Water* that *Issued* from the *Salt panns-Hills*, forced its Passage, in I believe 20 or 30 several Places, some more forcibly than others: For in 8 or 10 Places, it came with that violence, that had so many Sluices been drawn up at once, they could not have run with greater Force, and most of them 6 or 7 Yards High from the Foot of the Hill: 3 or 4 of the least of them we observed were near 10 or 12 yards High in the Mountain. We Tasted the Water in most of the Places and found it to be *Brackish*. It continued running that Afternoon, all Night and till next Morning about Sun rise, at which time the *Salt Panns* were quite Overflowed.

The *Mountains* betwixt *Spanish-Town* and 16 *Mile-Walk*, as the way lies along the River, if you remember about the Midway they are almost Perpendicular, especially on the other side the River; those *two Mountains* in the *Violent Shake* of the *Earthquake* Joyned together, which stopt the Passage of the River, and forced it to seek another, which was a great way in and out amongst the Woods and *Savana's*; for (as I have heard by several hands) it was 8 or 9 days before the Town had any Relief from it: In so much that before it came, the People were in thoughts of Removing into the Country, concluding it had been *Sunk* as *Port-Royal* was. The *Mountains* along the River are so *Thrown on Heaps*, that all People are forced to go by *Guanaboa* to the 16 *Mile-Walk*.

Mr. *Bosby* (who with his Wife had a Miraculous Escape) told us, That that Afternoon, coming to his Plantations, he found the Ground *Opened* in several places; and in one two Cows were *dropt in* and smothered.

The *Weather* was much *Hotter* After the *Earthquake* than Before; and such an Innumerable Quantity of *Musquetoës*, that the like was never seen since the Inhabiting of the Island.

The *Mountains* at *Yallowes* far'd no better than those of 16 *Mile-Walk*, a great part of one of them *Falling* down, Drove all the Trees before it; and at the Foot of the Mountain, there was a Plantation that was wholly Overthrown and Buried in it.

The *Mountains* in *Leguaneë* Fell in several places, and in some very steep.

The *Water* in the Streets of *Port-Royal* did not spout up, as you have heard; but in the *Violent Shake* the Sand cracking and Opening in several places where People stood, they sinking into it, the Water Boiled out of the Sand, that covered many and Saved others.

ib. p. 88.

5. The Year 1692 Began in *Jamaica* with very Dry and Hot Weather, which continued till *May*, when there was very Blowing Weather and much Rain till the End of the Month, from which time till the *Earthquake* happened, 'twas excessive Hot, Calm, and Dry; and on *Tuesday* the Seventh of *June*, about 40 *Minutes* past Eleven in the *Forenoon*, it being then a very Hot, Clear, Sun-shine Day, scarce a Cloud to be seen in the Sky, or a Breath of Air to be felt, happen'd that *Great Shake*, so Fatal to this Place, and to the Whole Island.

By---Communi-
cated by Dr. Ch.
Love-Morley.
ib. p. 89.

It began with a small *Trembling*, so as to make People think there was an *Earthquake*, which Thoughts were immediately confirmed by a 2^d *Shake* something Stronger, accompanied all the while with a *Hollow Rumbling Noise*, almost like that of Thunder, which made them begin to Run out of their Houses. But alas! this was but short Warning for them to provide for their Safety; for at the Heels of this 2^d, came the *Third Violent Shake*, which in less than a Minutes Time (it continuing near a *Minute*) Shook the very *Foundation* of *Port-Royal* in such a sort that I believe 3 parts in 4, of the *Houses*, and the *Ground* whereon they Stood, and most part of those who inhabited them, all *Sunk* at once quite *Under Water*; and on the place which was Left, and is now Standing, *Shook* down and *Shatter'd* the Houses in so violent a manner, that at our Landing it looked more like a Heap of Rubbish, than any thing else, there being (I believe) scarce One House in Ten left Standing, and those so Cracked and Shatter'd that few of them were fit, or thought safe to Live in, and stand now (*Jul 3. 1693.*) Empty. All those Streets which were next the Water, towards the Harbour-side, where there were Excellent Wharfs, close to which Ships of 700 Tun might Lie and Deliver their Loading, where were the Best Store-Houses and conveniencies for Merchants; where were Brave Stately Buildings, where the Chief Men of the place lived, and which were in all respects the Principal parts of *Port-Royal*, now lie in 4, 6, or 8 *Fathom Water*. That part which is now standing, is part of the End of that Neck of Land which runs into the Sea, and makes this Harbour (at the Extremity of which stands the *Fort*, not *Shook* down but much *Shatter'd* by the *Earthquake*) and is now a perfect Island; the whole Neck of Land from the *Fort* of *Port-Royal* now standing to the *Pallisadoes*, or other end of *Port-Royal* towards the Land, (which is above a Quarter of a Mile) being quite Discontinued and Lost in the *Earthquake*; and is now also with all the Houses, which stood very thick thereon, quite *Under-Water*; all which part or Neck of Land which is discontinued) as also all the other parts of this place which *Sunk*, were, for what I can Learn, nothing but Perfect Sands and by the People Driving down Timber and Wharfing, &c. were by little and little Gained in time out of the Sea, which now has at once Recovered all again.

Capt. *Hals* and some others say, That when they came hither with *Venables*, the place whereon *Port Royal* was since Built, was like one of the Keys or little Islands that lye off this Harbour, (which by the way are all *standing*) but Continued by a small Ridge of Sand, which then just appear'd above Water, with the other part of the Neck of Land, and I believe there is now as much Ground left standing as then.

And one, who had been there some years before under one *Jackson* (who took and plundred *St. Jago* &c and Return'd with *Venables*, told Capt. *Hals* at his Coming hither, that the *Point* or Place now standing, when he was here before under the said *Jackson*, was wholly *Separated* from the Land by the Sea, (as it is at this time) and Pointing to the Ridge of Sand above mentioned, said, That did not appear when I was here before. This is very Probable, for already since the *Earthquake*, the Sandy Ground at the *Pallisadoes*, or other side, hath Gained from the Sea several Acres. On this Sandy Neck of Land did

did People Build great Heavy Brick Houses whose Weight, on so Sandy a Foundation, may be supposed to Contribute much to their Downfal; for the Ground gave way as far as the Houses stood only, and no further; part of the *Fort* and the *Pallisadoes*, at the other end of the Houses, standing.

This Part of *Port-Royal* which is now Standing, is said to stand upon a Rock: But alas! The strange *Rents* and *Tearings* of the *Mountains* here, sufficiently evince, that Rocks and Sand are equally Able to withstand the Force of a *Violent Earthquake*. If this place be nothing but Sand (as some would have it, that are it's no Well-wishers) it seems strange that the Force of the *Earthquake* did not Dissipate and Dissolve the very Foundation of it, and that it did not Fall to Pieces and Scatter under Water, as the Rest of the Place did; for the *Shake* was so Violent, that it *Threw* People down on their Knees, and sometimes on their Faces, as they run along the Streets to Provide for their Safety; and it was a very Difficult matter to keep ones Leg. The Ground *Heav'd* and *Swell'd* like a Rolling Swelling Sea; ('tis a strange Comparison but every body here Using it, I venture to do so likewise) by which means several Houses now Standing were *Shuffled* and *Moved* some yards from their Places. One whole Street (a great many Houses whereof are now also standing) is said to be Twice as Broad now, as before the *Earthquake*, and in many places the Ground would Crack, and Open and Shut, quick and fast: Of which sm ll *Openings* I have heard Major *Kelley* and others say, They have seen 2 or 3 Hundred at one time, in some whereof many People were *Swallowed* up; some the *Earth* Caught by the Middle, and *Squeezed* to Death; the Heads of others only appeared above Ground; some were *Swallowed* quite down, and *Cast up* again with great quantities of Water; others went down and never were more seen. These were the Smallest *Openings*: Others that were more Large, *Swallowed* up great Houses; and out of some *Gapings* would issue forth whole Rivers of Water *Spouted* up a great Height into the Air, which seemed to Threaten a Deluge to that part of *Port-Royal*, which the Earth seemed to favour, accompanied with Ill *Stenches* and Offensive Smells: by means of which *Openings*, and the *Vapours* at that time belch'd forth from the Earth into the Air, the Sky which before was Clear and Blue, was in a Minutes time become Dull and Reddish, (as I have heard it compared often) like a Red Hot Oven. All these Dreadful Circumstances occurring at once, accompanied all the while with Prodigious Loud *Noises* from the *Mountains*, occasioned by their *Falling*, &c. and also a hollow *Noise* Under ground, and People Running from one place to another, with Fear looking like so many Ghosts, and more resembling the Dead than the Living, made the whole so Terrible, that People thought the Dissolution of the whole Frame of the World was at hand. Indeed 'tis enough to Raise Melancholy Thoughts in a Man now, to see the *Chimneys* and *Tops* of some *Houses*, and the *Masts* of *Ships* and *Sloops*, which partaked of the same Fate, Appear above Water; and when one first comes a shore, to see so many Heaps of Ruines, many whereof by their Largeness shew, that once there had stood a brave House; to see so many Houses Shattered, some Half *Fallen down*, the rest desolate and without Inhabitants; to see where Houses have been *Swallow'd* up, some appearing Half above ground, and of others the *Chimneys* only; but

but above all to Stand on the Sea Shore, and to look over that part of the Neck of Land, which for above a quarter of a Mile was *Swallowed* up, there where once Brave Streets of stately Houses stood, Appearing now nothing but Water, except here and there a Chimney, and some Parts and Pieces of Houses, serving only to mind us of their sad Misfortune.

And tho' *Port-Royal* was so great a sufferer by the *Earthquake*, yet it left more Houses standing there, than in all the Islands besides. It was so violent in other places, that People could not keep their Legs, but were violently *Thrown* down on the ground, where they lay on their faces with their Arms and Legs spread out, to prevent being *Tumbled* and thrown about by the Incredible *Motion* of the *Earth*, like that as is the General Comparison of a Great Sea. It scarce left a Planter's House or Sugar Work standing all over the Island: I think it left not a House standing at *Passage-Fort*, and but one in all *Ligane*, and none in *St. Jago*, except a few Low Houses built by the Wary *Spaniards*. And 'tis not to be doubted, but that had there been 500, or 5000 Towns in *Jamaica*, the *Earth quake* would have Ruined every one. In several Places in the Country the *Earth Gaped* prodigiously: On the North side the Planters Houses, with the greatest part of their Plantations, (and the Planters Houses be not very near to one another) were *Swallowed*, Houses, People, Trees, all up in one Gape; instead of which appeared for some time after a great *Pool* or *Lake* of *Water*, covering above 1000 Acres, which is since Dried up, and now is nothing but a Loose Sand or Gravel, without any the least Mark or Sign left whereby one may Judge, that there ever had stood a Tree, House or any thing else. In *Clarendon* Precinct, the *Earth Gaped*, and *Spouted* up with a prodigious force great quantities of *Water* into the Air, 12 Miles from the Sea; and all over the Island, there were abundance of *Gapings*, or *Openings* of the *Earth*, many thousands; Marks of many whereof, which upon their *Closing* they left behind them, any one cannot chuse but see, that goes into the Country; and I have seen several. But in the *Mountains* are said to be the most violent *Shakes* of all; and 'tis a generally received opinion, that the nearer to the *Mountains*, the greater the *Shake*; and that the Cause thereof, whatever it is, lies there. Indeed they are *strangely Torn* and *Rent*; insomuch that they seem to be of quite Different Shapes now from what they were, especially the *Blw*, and other *Highest Mountains*, who seem to be the greatest sufferers; which during the time of the *first great Shake*, and as long as the *Great Shakes* continued, which was above Two Months after the *first Shake*, (during which time the *Shakes* came very Strong and Thick, some times 2 or 3 in an hour) bellowed out *Prodigious Loud Noises* and *Echoings*.

Not far from *Yallowes*, a *Mountain*, after having made several *Leaps* or *Moves*, Overwhelmed a whole Family, and a great part of a Plantation, lying a Mile off. And a large High Mountain, near *Portmorant*, near a days Journey over, is said to be quite *Swallowed* up; and in the place where it stood there is now a Great *Lake* of 4 or 5 *Leagues* over.

In the *Blew Mountains* and its nigh Neighbours, from whence came those *Dreadful Roarings*, Terrible and Amazing to all that heard them, may be reasonably

reasonably supposed to be many strange Alterations of the like Nature: But those Wild, Desert Places, being very rarely or never visited by any body, not by Negro's themselves, we are yet Ignorant of what happened there. But whereas they used to afford a Fine *Green* Prospect, now one half part of them at least, seem to be wholly Deprived of their Natural *Verdure*. There one may see, where the *Tops* of Great Mountains have fallen, Sweeping down all the Trees, and every thing in its way, and making a *Path* quite from Top to Bottom; and other places, which seem to be *Peeled*, and *Bare* a Mile together; which vast *Pieces* of *Mountains*, with all the *Trees* thereon, falling together in a Huddled, and Confused manner, *Stopped up* most of the *Rivers* for about 24 Hours; which afterwards having found out new Passages, brought down into the Sea, and this Harbour, several Hundred Thousand Tun of Timber) as I have heard computed from the most knowing People there, which would sometimes float in the Sea in such Prodigious Quantities, that they looked like moving Islands. I have seen several of those large Trees on this Shore, all Deprived of their Bark and Branches, and generally very much Torn by the Rocky Passages, through which, by the force of a falling Stream and their own Weight, they might be supposed to be Driven. One great Trunk of a Tree particularly, I have seen amongst the rest, so *Squeezed* as a *Sugar-Cane* after it had passed the Mill. Some are of Opinion that the *Mountains* are *Sunk* a little, and are not so High as they were: Others Think the whole Island is *Sunk* something by the *Earthquake*. *Port-Royal* is said to be *Sunk* a Foot; and in many Places in *Liganee*, I have been told, are *Wells* which require not so long a Rope to Draw Water out of them now as before the *Earthquake*, by 2 or 3 Foot.

In this Harbour in *Port-Royal* at the time of the *Great Shake* (though the Seas were very Calm) was suddainly Raised such a strange *Emotion* in the Water, that immediately it *swelled* as in a Storm, Great Large *Waves* appearing on a sudden Rolling with such a force, that they drave most Ships (if not all) in the Harbour from their Anchors, breaking their Cables in an Instant: but this was soon over, and in a little time all was *smooth* again. One Capt. *Phips* told me, That he and another Gentleman happened at the time of the *Earthquake*, to be in *Leganee* by the Sea side; and that at the time of the *Great Shake*, the *Sea Retired* from the Land in such sort, that for 2 or 3 Hundred Yards the Bottom of the Sea appeared Dry, whereon they saw lye several Fish, some whereof the Gentleman who was with him ran and took up, and in a Minute or two's time the Sea Returned again and overflow'd great part of the Shoar. At *Yallhouse* the Sea is said to Retire above a *Mile*.

'Tis thought there were lost in all parts of the Island 2000 People, and had the *Shake* happened in the Night, very few would have escaped alive.

Since my Arrival here I have felt several *Shakes*; the *first* and Greatest whereof was on *Good-Friday*, 1693. it Lifted me compleatly off my Chair, and set me on my Legs, and was said to be a small *Shake*: but I did not then hear the *Noise* (minding something else) which always immediately foreruns or rather Accompanies it, but I have since felt several less *Shakes*, and Heard the *Noise* often, which is very Loud, and may be easily taken, by those not

Used to hear it, for a Ruffling Wind, or for a Hollow Rumbling Thunder; but hath some Puffing Blasts peculiar to it self, and are most like those of a Match made of Brimstone, when Lighted, but in a much greater Degree, and such as a large Magazine of Brimstone may be supposed to make, when on Fire. It is observable, that Every small *Shake* is felt on *Shipboard* as sensibly as on *Shore*, the Water shaking as well as the Land.

It is likewise Observed, that in Windy Weather there never comes a *Shake*, but in very calm Weather it is always expected. This Observation hath held true in every *Shake* that hath happened since the *First* Great One.

'Tis observed, that after Rain, they are generally smarter than at other times; which may be from the shutting up of the Pores of the Earth, whereby the Force is more Pent in, and hath not so free a Passage as to Perspire and spend it self, &c.

Shakes often happen in the Country, not felt at *Port-Royal*; and sometimes are felt by those that live in and at the foot of the *Mountains*, and by No body else.

'Tis observed, That since the *Earthquake*, the *Land Breezes* often fail us, and instead thereof, the *Sea-Breezes* often Blow all Night; a thing rarely known before, but since common.

In *Port-Royal*, and in many places all over the Island, much *Sulphureous*, Combustible Matter hath been found, supposed to have been thrown out, upon the opening of the Earth, which upon the first touch of Fire, would Flame and Burn like a Candle.

St. Christophers, one of the *Caribee Islands*, was heretofore much troubled with *Earthquakes*, which upon the *Eruption* of a great Mountain there of Combustible Matter, which still continues, wholly Ceased, and have never been felt there since: Wherefore many expect some such *Eruption* in some of the *Mountains* here, though we hope there is no necessity for it; the *Shakes* having been observed to lose their Force, and to become Weaker and Weaker ever since the *First* Fatal one; and 'tis now so long since we have heard any, except now and then one so Weak as scarce to be felt, that we have great Hopes they will now quite Cease.

After the Great *Shake*, those People that Escaped, (as many as could) got on board the Ships in the Harbour, where many continued above 2 Months after; the *Shakes* all that time being so Violent, and coming so Thick, sometimes two or three in an Hour's Time, accompanied with frightful *Noises*, both from under the Earth, and from the Continual *Falling* and Breaking of the *Mountains*, that they dared not come Ashore. Others went to the place call'd *Kingstown* (or by others *Killcown*) where, from the first Clearing of the Ground, and from Bad Accommodations, the Huts built with Boughs, and not sufficient to keep out Rain, which in a great and an unusual manner followed the *Earthquake*, lying Wet, and wanting Medicines, and all Conveniences, &c. they Dyed miserably in Heaps. Indeed there was a general *Sickness*, (supposed to proceed from the Hurtful Vapours belched from the many *Openings* of the *Earth*) all over the Island, so general that few escaped

escaped being sick; and 'tis thought it swept away in many parts of the Island; 3000 Souls; the Greatest part from *Kingstown* only, yet an Unhealthy Place. Besides the great quantities of Dead People Floating from one side of the Harbour to the other, as the *Sea* and *Land-Breezes* blew them, sometimes 100 or 200 in a Heap, may be thought to Add something to the *Unhealthfulness* of this Place. *July 3. 1693.*

6. Most of the *Ships* lost their Anchors and Cables which were towards the Wharfs or Town, which I suppose came from the Sands and Houses falling on them; and they, After the *Earthquake*, rode in fewer Fathoms Water than before; and one may Believe that some of the *Phænomena* may be Accounted for from that.

By Dr. Sloan.
ib. p. 80.;

XXI. The *Earthquake* which happen'd between the 4th and 5th of *Jan.* 1699. hath had strange Effects about the *Tungarouse* and *Batavian Rivers*. The great *Batavian River* from above *Tangala Warna*, being a Place from whence the said River receiveth the greatest part of its Water, is stopt up, or Covered with Earth from the *Faln Hills*, till beyond the River *Tsyouspokitsyl*; so that the Place where the River had its Course formerly, was not to be seen. But far beyond that Hill towards *Batavia*, the Water comes forth again from Under the Earth, which is sunk down, but Thick and Muddy, passing Over and Thorow the Trees, wherewith the River was Formerly stopt up. The Trees lying in the River are of a special Bigness, and so close Packt together, that it is impossible to Conceive how they came so.

An Earthquake
in 1699. at Ba-
tavia; sent to
M. Nih. Wit-
zen. by---n. 264.
p. 595.

From the *Mountains* Situated near the Beginning of the *Batavian River*, call'd by the *Javanians* *Songsy-tsiawong*, seven Hills are Sunk down, viz. 5 on this side, and two on the other. But the *Mount* from whence the River hath also its source, above *Tangal Warna*, within the *Mountains Terbackti*, is not sunk down, nor hath received any Damage.

The *Tangarang River*, call'd by the Natives *Songhy Sedany*, is also stopt up, and Covered with Earth, from the Hill and Branch *Salack*, to the River *Antum*, and from thence to *Tangarang*, being fill'd up with Trees; but not in such a Quantity, nor so close together, as in the *Batavian River*. On this side the *Tangarang River*, 9 are sunk down by the *Earthquake*; and Seven Branches, that had formerly their Issue in the River *Tangarang*, are also Covered with the Earth; but Three other Hills, lying also on this side of the same River, and call'd *Minjan*, *Dauw*, and *Halfichi*, had not sustained any Damage, whereby the Branches *Autan* and *Kaniki*, (the latter into the first Branch, and the first into the River *Tangarang*) have kept their Course. And the Hill *Oudjong-teboc*, being call'd also *Sedani*, from whence the *Tangarang River* had its source, is not Sunk down nor Hurted. It is also observed in the *Tangarang River*, at the Place where it is stopt up with Trees, that the Descending Water being Thick and Muddy, went backward with a Motion not unlike the Waves of the Sea, when moved by a Tempest.

The High-Land between the *Batavian* and *Tangarang Rivers*, behind the Old Court of the *Jaccatra Kings*, called *Pakkawang*, having been a great

Wood is Changed since the *Earthquake*, into a great and Open Field, wholly Destitute of Trees, the Surface of the Ground being Covered with a Red Clay such as the Masons use here; which in some places was so hard that it could endure Treading and going upon it, and in other places Men did Sink above a Foot into it. At the Place of the Old Court called *Pakowang*. Situated between the *Batavian* and *Tangarang* Rivers, no other Damage hath been seen, than that the Land thereabouts hath been Rent and Divided asunder with great Clefs more than a Foot wide. The River *Tsicome*, proceeding from a Pit or Well in the aforesaid Court of *Packowang*, and running a great way under Ground, and then coming Forth again, taking its Course towards *Anke*, had not received any Harm: But kept its Course uninterrupted.

The *Tominagon Porbo Nata* in his Going towards the Mountains, Heard a Noise like unto Thunder; and Fearing that a *Sinking down* of the Ground, or an *Eruption* of Water would Follow, he stood still with those that were about him, and saw afterwards that the *Earth* from the Top of the Mountains *Sunk* down; and Hearing no further *Noise*, he went on his Journey, having in Going and Coming back spent 19 Days by the Way, and felt 40 times an *Earthquake*: And since his Return from the Mountains, he hath felt the like *Shakings* 208 times.

The Cause of Earthquakes and Vulcanos; by Dr. Mart. Lister. n. 157. p. 512. De Font. Med. Angl.

XXII. I have elsewhere shewn that the *Breath* of the *Pyrites* is *Sulphur ex tota Substantia*; Also that it naturally Takes *Fire* of it self; Again that the Material Cause of *Thunder* and *Lightning*, and of *Earthquakes* is one and the same; viz. the *Inflamable Breath* of the *Pyrites*; the Difference is, that one is *Fired* in the Air, the other Under Ground: Of which last, these (I think) are sufficient Arguments; A Thing burnt with *Lightning* Smells of very *Brimstone*; again the Subtilty and Thinness of the *Flame*; also the Manner of its *Burning*, which is often observed to be *particulatim* or in small Spots, Vapour like. And of *Earthquakes*, the *Sulphureous* Stink of Waters smelt before, and of the very Air it self after them: Of which innumerable Instances occur in the Relations of them.

They also Agree in the manner of the *Noise*, which is to be carried on, as in a Train *Fird*; the one Rowling and Ratling through the Air, taking *Fire* as the Vapours chance to Drive; as the other *Fird* Under Ground in like manner Moves with *Desultory Noise*, as it shall chance to be continued.

That the Earth is more or less Hollow is made probable, by what is found every where in the Mountains; viz. Natural *Cavities* or *Chambers*, which the Miners of the North call *Self Opens*. These they meet with frequently, some vastly Great, and others less, running away with Small *Sinus's*: And I doubt not, but upon diligent Inquiry, a great Catalogue of such might be had, discovered in the Memory of Man. Besides, many there are, which are known to open to the Day, and to discover themselves without Digging, as *Pools Hole*, *Okie-Hole*, &c. Again, the Great and Small *Streams*, which do arise

arise from under the Mountains do evidence the *Hollowness*, and *Sinousness* of them. Add to these that many *Sinus's* are made in that Instant, and are continued by the *Explosion* and Rending of the first Matter *Fired*; which may, and do very probably, close again, when the Force of that *Explosion* is over; but are sufficiently Open to continue the *Earthquake*.

That these *Subterraneous Cavities* are at certain times and in certain Seasons full of *Inflamable Vapours*, the *Damps* in our *Mines* sufficiently witness; which *Fired* do every thing as in an *Earthquake*, save in a lesser Degree.

Now, that the *Pyrites* alone (which is our present Task) of all the known Minerals, yields this *Inflamable Vapour*, I think highly probable, for these Reasons.

1. Because no Mineral or Ore whatsoever is *Sulphureous*, but as it is wholly, or in part, a *Pyrites*: I have carefully made the Experiment in very many of the Fossils of *England*, and do find them all to contain *Iron*, wherever there is *Brimstone*.

2. Because there is but one Species of *Brimstone*, that I know of, at least with us in *England*: And since the *Pyrites* Naturally and Only yields it, it is but Reasonable wherever *Brimstone* is found, though in the Air, or Under Ground in Vapour, to think that also proceeds from it. The *Sulphur Vive* or *Natural Brimstone*, which is found in and about the *Burning Mountains*, is certainly the Effects of *Sublimation*; and those great Quantities of it said to be found about the Skirts of *Vulcano's*, is only an Argument of the long Duration, and Vehemency of those *Fires*. And though the *Sulphur-Vive* or *Rough Brimstone*, as they call it, had from *Hæcla* and *Italy* is Opake, and agrees not with the Transparent and Amber-like *Sulphur-Vive* of the Antients; yet it does not follow, that that also was not Produc'd by *Sublimation*, no more, than that the *Stalactites*, or Water wrought Stone, is not so made, for that some of it is Opaque and some Chrystaline.

But possibly the *Pyrites* of the *Vulcano's*, or *Burning Mountains*, may be more *Sulphureous* than ours. And indeed it is plain, that some of ours in *England* are very Lean, and hold but little *Sulphur*; others again very much. And this may be one Reason, why *England* is so little troubled with *Earthquakes*, and *Italy*, and almost Round the *Mediterranean Sea* so very much. Another Reason is, the Paucity of *Pyrites* in *England*; where they are, indeed, some little in all places, but mostly *Sparsim*: and if perchance in *Beds*, those are comparatively Thin, to what probably they are in the *Burning Mountains*, as the vast Quantity of *Sulphur* thence *Sublim'd* doth seem reasonably to imply. Also, if we compare our *Earthquakes*, and our *Thunder* and *Lightning* with theirs; there it *Lightens* almost Daily, especially in Summer-time, Here seldom; There *Thunder* and *Lightning* is of Long Duration, Here soon over; There the *Earthquakes* are Frequent, Long, and Terrible, with many *Paroxisms* in a Day, and that for many Days, Here very Short, a Few Minutes and scarce Perceptible. To this Purpose, the *Subterraneous Cavities* in *England* are Small, and Few compar'd to the Vast Vaults in those Parts of the World; which

which is Evident, from the Sudden Disappearance of whole Mountains and Islands.

There are indeed other *Inflamable Minerals* besides the *Pyrites*: But by the Providence of God not to be found in *England*, that I know of, and not in any Quantity in any Place of the World, that I can Learn; Which is well for Mankind, because they are very *Poysons* as the *Orpiments*; but they are Specifically Distinct from *Brimstone* which no Ore yields but *Iron*; so the *Orpiments* are all *Gold Ore*. And by the by, some Authors have assign'd this as a Good Reason, against any Medicine, that shall be made out of *Gold* (as fond as we are of an *Aurum Potabile*) as having naturally a Deleterious Quality.

It may be Objected that no Body is *Kindled by it self*: But it seems to me apparently otherwise; for that *Vegetables* will Heat and *Take Fire* of themselves, as in the frequent Instance of *Wet Hay*; And *Animals* are Naturally on *Fire*, and *Man* doth then sufficiently Demonstrate it, when in a *Fever*: And amongst *Minerals*, the *Pyrites*, both in *Gross* and in *Vapour*, is actually of its Own Accord *Fir'd*. Dr. *Power* has recorded at large, in his *Micrographia*, a famous instance of it; and the like not very Rarely happens. And that *Damps* Naturally *Fire* of themselves, we have the General Testimony of *Miners*, and the same *Author*.

Again, the *Vulcano's*, all the World over, Argue as much; for we, with great Probability, Believe them to be Mountains made up in great part of *Pyrites*, by the Quantities of *Sulphur* thence *Sublim'd*, and the Application of the *Loadstone* to the *Ejected Cinder*. I go further,

That these *Vulcano's* were *Naturally Kindled* of themselves, at or near the Creation is Probable: Because there is but a certain Known Number of them which have all continued *Burning* beyond the Memoirs of any History; Few or none of them that I know of, have ever Totally Decay'd or been Extinct, unless possibly by the *Submersion* of the Whole, being Absorpt in the Sea. Though they indeed, do *Burn* more Fiercely sometimes than at others for other Reasons So that it seems to me as Natural to have *Actual Fire* in the *Terrestrial World* from the Creation, as to have *Sea and Water*.

Again if these *Vulcano's* did not *Kindle of themselves*, what Cause can we imagine to have done it. If the *Sun*; we answer, *Hæcla* placed in so Extream Cold a Climate was *Kindled*, for ought I can see by the Natural History of both, as soon as *Ætna* or *Fuegos*, or the most Southerly.

Not the Accidents happening from Man; for, if Man was (as we must Believe) Created Solitary and Topical, they were none of his *Kindling*, because they seem to be *Fired* before the World could be all over Peopled: Besides, they are mostly the very Tops of Vast High Mountains, and therefore the most unfit for the Habitation of Man.

If we say *Lightning*, and *Thunder*, or *Earthquakes*; we beg the Question: For the Cause of the one is the Cause of the other; and they are one and the same. It remains therefore (very probably) that they were *Kindled of themselves*.

I for my part know no Subject in the whole Mineral Kingdom so general and Lasting for the *Fuel* of these *Mountains*, as the *Pyrites*; which I have said Alone does Yield *Sulphur*, and Naturally Resolves it self into it, by a kind of Vegetation.

About the *Durable Burning* of the *Pyrites* these are Instances. *Scotch Coal* hath less of the *Pyrites* in it, being mostly made up of *Coal Bitumen*, and therefore it Burns and Consumes Quickly, and leaves a White Cinder. *Sea-Coal*, or that Coal which comes from *Newcastle* by *Sea* to us, and for that Reason so called, Burns slowly; and the *Sunderland Sea Coal* so slowly, that it is said, by Proverb, to make Three Fires; this hath much *Pyrites* mixt with it, and Burns to a Heavy Reddish Cinder, which is *Iron*, by the *Magnet*. But I have seen, and have a Specimen by me of a *Coal* from *Ireland*, (the Proprietor of the Pits is Sir *Christopher Wandsford*) which is said to be so Lasting, that it will continue 24 Hours Red Hot, and almost Keep its Figure: This seems to be in great part *Pyrites* by the Weight and Colour.

XXIII. In the *Moors* from *Yeovil* towards *Bridgewater*, in the extreme Drought we have endured this Summer 1666, some Lengths of Pasture grew much sooner withered and Parched, than the other Pasture. And this Parched part seemed to bear the Length and Shape (in gross) of *Trees*. They Digg'd and found in the place, *Oaks* indeed, as Black as *Ebony*. And hence they have been Instructed to find and take up many Hundreds of *Oaks*.

Subterraneous
Caks in Somers-
setshire; by
Dr. J. Beal.
n. 18. p. 323.

XXIV. In that *Fenny Tract*, called the *Isle of Acholme*, lying part in *Lincolnshire*, and part in *Yorkshire*, has been abundance of *Oak*, *Firr*, and other *Trees*, of late frequently found in the *Moore*; whereof some *Oak* are 5 Yards in Compass, and 16 Yards Long; others Smaller and Longer, with good quantities of *Akorns* near them, lying somewhat above 3 Foot in Depth, and near their Roots, which do still stand as they grew, viz. infirm Earth below the *Moore*. The *Firrs* lie a Foot or 18 Inches Deeper, more in Number than *Oak*, and many of them 30 Yards Long; one of them being, not many years since, taken up of 36 Yards long besides the Top; lying also near the Root, which stood likewise as it grew, having been Burnt and not Cut down; as the *Oak* had been also. Mr. *Dugdale* concludeth that this *Moore* hath been so for Divers Hundreds of Years; and that the Cause thereof has been the Muddiness of the *Tides*, which flowing up *Humber* into *Trent*, left in time so much Filth, as to Obstruct the Currents of *Idle*, *Dun*, and other Rivers, which thence flowed back and Overwhelmed that Flat Country.

Wood found Un-
derground in
Lincolnshire;
by--- n. 67.
p. 2050.

Of Draining
the Fenns.

XXV. At *Youle* about 12 Miles below *York*, near the place where the *Dun* empties it self into the *Humber*, There are several Persons which are call'd *Gryers*, who, with a long piece of *Iron*, search in the soft and Boggy Ground for *Subterraneous Trees*; and by this way of Tryal, can in a great Measure, discover the Length and Thickness of these *Trees*, and get a Livelyhood by it.

Fossile Wood
near York; by
Dr. Richardson.
n. 228. p. 526.

Some

Some are so large, that they are used for Timber in Building Houses, which is said to be more Durable than *Oak* it self; others are split into *Latbs*; others are cut into Long *Chips*, and tied up in Bundles, and sent to the Market Towns, several Miles off, to Light Tobacco. Those that I viewed, were all Broken off from the *Roots*; I suppose by violence of Storm or Water, or both; and upon enquiry do find, that they are all after the same manner. These *Tryers* do affirm, that at three or four Yards Deep they find *Stumps* of *Trees* broken off; some Two, Three or Four Foot from the Ground, and to be exactly the same *Wood* with the *Subterraneous Trees*. The *Bate* or *Texture* of this *Wood* is the same with *Firr*, easily *Splitting*: If *Burnt* it sends out the same *Resinous smell*, and it affords the same *Coal*. The *Branches* generally grow in *Circles*, as the *Knots* do *Testifie*: The *Knots* do easily part from the rest of the *Wood*, as is usual in *Firr wood*. The *Straightness* and *Length* of these *Trees*, are also a *Presumption*, that they must be such; if one consider that some of these are nigh 100 Foot Long; and at the *Bottom*, not much above a Foot in *Diameter*. They affirm'd to me, that their *Tops* lay all one way, (*viz.*) with the *Current* of the *Water*. There are also *Oaks* found there, though not in so great *Quantity*. The *Vitriolick* parts of the *Earth* (in which they have *Lain*, hath given them a *Black Tincture* quite through, which (when *Wrought* and *Polished* fine) is not much inferior to *Ebony*. This *Wood* doth not emit the same *smell* when *Burnt*, with that call'd *Firr wood*; therefore I hope the *smell* of that *Wood* will not be attributed to the *Bituminous* parts of the *Earth* in which it hath lain. About 60 or 70 Years ago, several *Dutchmen* undertook to *Drain* a Large *Marsh* in that place; and in *Cutting* a *Channel* in the *Dry Ground* betwixt the *Fen* and the *River*, at the first they threw up a *Rich* and *Firm* *Soil*, afterwards they met with a *Stratum* of *Sand*, under that a *Stratum* of *Boggy Ground*, in which they found of these *Subterraneous Trees*, and under that *Firm* *Ground*; and a *Gentleman* attested unto me, who had it from several *Persons* then living, that were *Eye-Witnesses*, that the *Firm* *Ground* in some *Places* lay *Ridge* and *Furrow*. There are several of these *Roots* of *Trees* to be seen in the *Channel* at *Low-Water* to this *Day*, and yet there are neither *Firr* nor *Pine* growing naturally here, nor have been in the *Memory* of any *Man*; neither doth there remain any *Tradition* of the *Growth* of any such.

Fossil wood
in Craven; by
Dr. M. Lister.
n. 224. p. 381.

XXVI. *Pimco* is one of the Highest Mountains in *Craven* in *Yorkshire*, lying on the *Southside* of that *Country*, some 2 Miles above *Carleton*. On the *Southside* of the *Pike*, (as they call the very *Top* of that *Mountain*) is a place where the *Water* stands; this is called a *Moss*, and is some *Fathoms* perhaps *Deep* in *Black Mud*. Here are *Dug* up, if we will believe the *Inhabitants*, not only *Roots*, but whole *Trees* of *Fir*.

I saw there no small *Marks* of a *Wood* in former *Ages*; as the *Roots* or *Stumps* of *Trees* appearing *Above* ground; which upon due examination of the *Grain* and *Bark*, I found to be the *Roots* of *Birch*. These *Roots* split easily and soon *Dry*, and when *Dryed* they burn with a *Lasting Flame*: and for this purpose

purpose they use them upon any sudden Occasion about their Houses. And altho' the *Flame* be Great, yet it is without any *Resinous smell*: However, it seems, that their having Lain so long Under Ground has prepared the Juice for *Burning*. There have been *Oaks*, as I have been told, Dug up hereabouts also, but I saw none.

XXVII. On the South side of *Mendipp Hills*, at a place call'd *Doulton*, there are great Quarries of *Freestone*, where the Workmen at Five or Six Fathom deep, Sawing *Stones* of Four or Five Tun Weight, have often found large pieces of *Cleft* and *Fair Oak* in the Midst of them. Wood found in Stone by Mr. J. Beaumont. Ph. Coll. n. 2. p. 6.

XXVIII. S. *Septali*, in a Voyage he made a few Years since over some *Mountains* to *Genoa*, met with some Peasants who Digging on the sides of an Hill, had found and Gathered very many *Cockle Shells* of Divers Kinds, which he wonder'd at, and therefore went to the very place: where he was satisfied of the Truth of the Relation, finding great store of different *Shells*, as the *Turbinets*, *Echini*, and some *Pearl-Shells*, whereof one had a fair *Pearl* in it. Fossile Shells in Italy; by S. Manfredus Septalius. n. 27. p. 493.

XXIX. Upon the Way of *Beziers* to *Narbonne*, in a place pretty large, raised by Estimation above the *Level* of the *Sea*, (which is two Leagues distant from it) about 15 or 16 *Fathoms*, I saw *Rocks*, which inclosed a good number of Big *Oysters Petrified*: And upon the same Way above the place, which is called *Nice*, at the Highest place of the Descent, very Cragged, where the Rock is Cut to make a passage, is seen a *Bed* two foot large, of many *Cockle-shells Petrified*, Heaped up, as ordinarily they are on the *Sea-shore*; which notes sufficiently, that the *Sea* formerly covered this Place. Fossile-Shells in France; by M. de Martel. n. 58. p. 1183.

XXX We will easily believe (what I have Read in *Steno's Prodrumus*) that all along the *Shores* of the *Mediterranean Sea*, there may all manner of *Sea-shells* be found promiscuously included in *Rocks* or *Earth*, and at good distances too from the *Sea*. But for our *English Inland Quarries*, I am apt to think, there is no such matter, as *Petrifying* of *Shells* in the business: but that these *Cockle-like Stones* ever were as they are at present, *Lapides sui generis*, and never any part of an *Animal*. It is most certain that our *English Quarry Shells* (to continue that Abusive name) have no Parts of a Different Texture from the *Rock* or *Quarry* where they are taken, that is, that there is no such thing as *Shell* in these Resemblances of *Shells*, but that *Iron stone Cockles*, are all *Iron Stone*; *Lime* or *Marble*, all *Lime-stone* or *Marble*; *Sparre* or *Chrystalline Shells*, all *Sparre*, &c. and that they were never any Part of an *Animal*. My reason is: That *Quarries* of Different *Stone* yield us quite Different sorts or Species of *Shells*, not only One from another (as those *Cockle-stones* of the *Iron-Stone-Quarries* of *Adderton* in *Yorkshire*, Differ from those found in the *Lead Mines* of the Neighbouring Mountains, and both these from that *Cockle Quarry* of *Wansford Bridge* in *Northamptonshire*, and

all three from those to be found in the *Quarries* about *Guntbrop* and *Beavour-Castle*, &c.) but, I dare boldly say, from any thing in Nature besides, that either the *Land* or *Salt*, or *Fresh Water* doth yield us. 'Tis true that I have pick'd out of that one *Quarry* of *Wansford* very resemblances of *Murices*, *Telinae*, *Turbines*, *Cochleæ*, &c. and yet I am not convinced, when I particularly Examined some of our *English Shores* for *Shells*, also the *Fresh Waters* and the *Fields*, that I did ever meet with any one of those *Species* of *Shells* any where else but in their Respective *Quarries*, whence I Conclude them *Lapides sui Generis*, and that they were not Cast in any *Animal Mold*, whose *Species* or *Race* is yet to be found in Being at this Day. I have two or three sorts of our *English Cockle-Stones* of different *Quarries*, nearly resembling one the other, and all of them very like a common sort of *Sea shell*; and yet there is enough in them specifically to distinguish them, and hinder them from being sampled by any thing of the Spoils of the *Sea* or *Fresh Waters*, or the *Land-Snails*.

Fossil Shells, in
Kent, by Dr.
Griff. Hatley.
n. 155. p. 463.

XXXI. At *Hunton*, 5 Miles from *Maidstone* in *Kent*, and about a quarter of a Mile from the River *Medway*, after the Copping of a piece of Ground was taken off, (which was of a Clay about 3 Foot deep) we came to a very good *Blew Marle*, which continued such three Feet and a $\frac{1}{2}$ deep more; and then there appeared a Hard Floor or Pavement composed of *Shells*, or *Shell-like Stones*, crowded closely together; the Interstices whereof were filled up with the same *Marle*. This Layer (which runs as the Veins of *Flints* do in *Chalky Earth*) was about an Inch deep, and several Yards over, and we could walk on it as on a *Beach*; Under this Layer we came to *Marle* again. I cannot upon Inquiry, find that in the Memory of any Man thereabouts, any Floods from the River have reached so far as this place.

These *Stones*, (for I take them to be *Lapides sui Generis*) are of that sort which is call'd *Conchites*; and resemble *Sea-Fish* of the *Testaceous* kind. Most of them are *Turbinated*, or *Wreathed*, the rest are of the *Bivalvular* sort, but I have not found any of them with *Valves* Closed together, but *Single*.

The bigness of the *Turbinated*, is from a *Wetch* to a *Hassel Nut*; they are fill'd with a *Terra Lapidosa*, like the *Marle*, and are of that Colour till you have Washed and Rubbed them, and then they appear of the Colour of *Bezoar*, and of the same Politure. After they have been Boiled in Water, they are Whitish, and leave a Chalkiness upon your Fingers, which when it is rubbed off, gives you a view of very fine *Black Striae*, thick set on the outside. These *Wreathed Stones* are all perfectly formed; they Differ not in Figure one from another, but that some have their sides a little depressed; upon a few of them there Adhered a little proportion of a Glittering Mineral like *Iron*. In *Vinegar*, they made a strong and a Boiling *Effervescence*.

The *Bivalvular* are most of them no bigger than a *Kidney Bean*, some Lesser, a few as broad as the Largest sort of *Beans*, but the *Valve* much Thinner than any of that kind, which had been the *Exuvia* of an *Animal*; the *Gibbous* part of the *Valve* is Smooth, and of the same Colour with that of the *Turbinated*. In a few there are some Oblong *Lineations* bent Circularly

ly to the Commissure of the *Valve*: I have a piece of such an one by me, consisting of several *Lamellæ*; which hath this further observable in it, that the Gibbous part is of a most beautiful Black shining Colour, and the Inner part of a Shining Pearl-Colour'd Substance.

Of this *Bivalvular* sort, many of them seem to be *in fieri*, not as to their Shape, but as to their Hardness and Thickness, there being in some only the *prima stamina* and in others, the several Steps and Progresses toward a perfect *Figuration*, which seems to me an unanswerable Argument, for their never having been the *Spoils* of *Animals*. Some of these appeared in the Inner side White, and it came off upon the Fingers like Chalk, and seemed as if a Depression had been first made in the Bed of the Shape of a *Valve*, and then the Convex side rubb'd with Chalk or painted White.

Those Pieces of this odd *Concretion*, which I keep by me (now the *Marle*, which is in the Interstices, is grown hard) appear much like that Course sort of *Marble-Stone* which is dug about *Pluckley* in the *Wild* of *Kent*. Which *Marble* seems to be a *Coagmentation* of such *Shell like Stones*, the *Marle* betwixt them having acquired a firm Solidity and Hardness. With this *Stone* they make their *Causeys* in that part of the County: and they are apt to be worn into little Cavities, or Holes, where they have lain long exposed to the Air; the Rains, in length of time, Washing away the portions of *Marle* (which is less Hard than the rest) from the Orifices and Interstices of those *Shell like Stones*. I am much confirmed in this Opinion by a piece of *Marble*, Inlaid, as it were, with such *Stones*, which was dug out of a *Marle Pit*, at a little distance from, and on the same level with that at *Hunton*.

The Imperfect as well as the Complete Formation of some of the *Bivalvular* kind (the *Valves* being only found single, and both sorts in a ground never heretofore disturbed) are no Light Arguments for their being *Stones*. Perhaps the *Salts* of *Plants* or *Animal Bodies*, washed down with Rains, and Lodged under ground, may be there Disposed into such like *Figures*, as well as Above it:

Vid. Mus. Reg. Societ. part. 3. Cap. 1.

XXXII. Near *Reading* in *Barkshire*, for many succeeding Generations, a continued Body of *Oyster-Shells* has been found through the whole Circumference of 5 or 6 Acres of Ground. The Foundation of these *Shells* is a Hard Rocky Chalk, and above this Chalk the *Oyster-Shells* lie in a Bed of Green Sand upon a Level, as nigh as can possibly be judged; this *stratum* of Green Sand and *Oyster-shells* is (as I measur'd) nigh Two Foot deep. Now immediately above this Layre, or *stratum* of Green Sand and *Shells*, is a Bed of a Bluish sort of Clay, very Hard, Brittle and Rugged, they call it a *Pinny Clay*, and is of no use. This Bed, or Layre of Clay, I found to be nigh a Yard Deep; and immediately above it, is a *stratum* of *Fuller's Earth*, which is nigh two Foot and a half Deep; this Earth is often made use of by our Cloathiers: And above this Earth is a Bed or Layre, of a Clear, Fine White Sand, without the least Mixture of any Earth, Clay, &c. which is nigh 7 Foot Deep: Then immediately above this is a stiff Red Clay, (which is the uppermost *stratum*) of which we make our Tiles. The Depth of this cannot

Fossil-shells; In Barkshire; by Dr. Ja. Brew-er. n. 26. p. 484.

be conveniently taken, it being so high a Hill, on the top of which hath been, and is dug up a little Common Earth about 2 Foot Deep.

I have, with a Mattock, dug out several *Whole Oysters* with both their *Valves*, or *Shells* lying together, as *Oysters* before Opened: In their Cavity there is got in some of the forementioned Green Sand. These *Shells* are so very Brittle, that in digging for them, One of the *Valves* will frequently drop from its Fellow; but 'tis plainly to be seen that they were United together, by placing the *Shell* that drops off to its *Fellow Valve*, which exactly Corresponds: But I dug out several that were *Entire*; nay, some *Double Oysters* with all their *Valves* United.

Fossile-shells
and Fishes in
Lincolnshire;
by Mr. Abr. de
la Pryme.
n. 266. p. 678.

XXXIII. In a *Quarry* at the East End of *Broughton* in *Lincolnshire*, they get a Clayie Substance or Earth that lies under the *Stone* in which are innumerable Fragments of the *shells* of *Shell fish* of various sorts, of *Pectinites*, *Echini*, *Chonchites*, and others, with some Bits and Pieces of *Coral*, and there are sometimes found *Whole Shell-fish*, with their Natural *Shells* on, in their Natural Colours, most miserably Crack'd, Bruised and Broken, and some totally squeez'd Flat by the great Weight of the Earth that yet lies, and that was cast upon them in the *Noachian Deluge*

There is another *Quarry* in the Field on the South side of the *Town*, of a Hard Blue *Stone*, which was most certainly a pure fine Blue Clay in some *Antediluvian Lake*, in the *Stones* of most of which are innumerable *Petrify'd Shell Fish* of various sorts, but so United to the *Stone*, that it is very difficult to get them whole out, and I have always found that they lie in the Superficies of the *Quarry*, within a Foot of the Top thereof, and few or none deeper therein. In many Places of the Surface of the *Quarry*, (which looks Rugged and Drifted, as Snow does after a Storm, and by which one may find what Quarter the Storm or Wind was then in;) there are many *shell fish* half in the *Stone*, half out. That part which is *within* the *Quarry* is *Entire* and whole, but a Hard *stone*, and that part which is *without*, which the *Petrifick Effluvi-ums* did not Touch, is Consumed and gone, all but a little of the Edges which are Plain *shell*, and have all the *Radii* and *Striae* on them that the Common *Shells* of those sorts of *Fishes* have.

All these *Fishes* have their *Shells* on, some of which *shells* are exceeding thin, to what other some are. Sometimes the *shells* of some of them are in their *Petrification* so thoroughly United unto and Incorporated with the *Stone*, that they are scarce Visible. Others in the same *Quarry* have a thick White *shell* on them *Petrified*, but not Incorporated and Turned into the Substance of the Bed in which they Lie. As you get that *Fish* out, all the *shell* sticks so fast to the *Rock*, that most commonly it is left behind, but sometimes the *shell* Cleaves in two, one Half of the *shell* on both sides of the *Fish* sticks thereto, and the other Half to both sides of the Bed, but others come out by Lying in the Air in Frosty Nights, with the whole Natural *shell* on them, and the *Radii* or *Striae* very exact. Other *Fish* there are here, that have a Black smooth *shell* on them, with several *Striae* but no *Radii*, very like if not the same with the *Concha Nigra Rondel*.

I have also seen in this *Quarry* some *shell-fish* half open and fill'd with the Matter of the Bed in which they Lye, and *Petrify'd* with it. Others being in Heaps together, I have found some of them Broken; others Bruised; and the Edges of one *Fish* thrust into the sides of another; some with the One *shell* thrust half way over the other, &c. and so *Petrify'd* in the Bed together. Others in the same Bed have been so Close, that the Matter of the Bed could not insinuate it self into them. These that are thus found, are some of them totally Empty, others are filled with *Cristaline Fluors*; others I have seen half full of the said Blewish Clay of the Bed, and half full of the said *Cristallizations*, which have stuck therein, from nothing but *subterraneous Heats* and *Effluvioms*.

Amongst these *Fish* in this *Quarry*, I have seen several great *Horse Muscles*, such as breed in *Fresh-water Rivers* and *Ponds*, which are exactly like the *Concha Longa Rondel*, but are more Thick, Full, and Pubble, than Ours commonly are at this Day; which Greatness and Largeness proceed from nothing but the Fertility and Fatness of the Bed on which they Bred; and at This Day in an Old Pond beyond *Broughton Hall*, there are some of the Largest of this sort of *shell fish* that ever I saw, as if this Soil agreed better to the Breeding of this sort of *Fish* than any else, just as the *Cornu Ammonis*, *Nautili*, and others Breed Best upon *Allum Soils*: And that is the Reason that they are found so much at *Whitby*, *Rochel*, *Lunenburg*, *Rome*, and other places, where are Famous *Allum-Mines*. And if any one would find any of those sorts of *Fishes* (which some Learned Men have Ridiculously thought to be Species totally Lost) they ought in all Probability to seek for them upon *Allum Soils* in the Sea, and there they would undoubtedly find them.

Others love an *Oazey Soil*, a sort of a Confused Mixture of several *Soils* together, as part of the Country about *Frodingham*, *Brambee*, *Ashbee*, *Botsworth*, &c. Seems to be; in the Fields and Stones of which Towns is one particular sort of *Fish*, which I know not what *Genus* or *Species* to compare to, bending somewhat like a *Ram's Horn*, and exactly Creased like one on the outside, with an *Opusculum* thereon, which the *Fish* opened and shut as it had Occasion. The Bed whereon the said *Shell fish* Bred in the *Anti-diluvian Sea*; is not over a Foot Thick (to the best of my Memory) in all which, but for the most part in the Superficies thereof, are Millions of the said *Fish* sticking half within the Stone, half without; which *Shell fish* having a most durable *shell*, that part which sticks out of the Stone, is not consum'd, as in the *Shell-fish* of *Broughton*, but remains Whole and Entire. And yet I have seen and found whole Lumps of them, that by some Huge Weight cast or fallen upon them, in the *Noachian Deluge*, have been miserably Broken and Shattered in pieces, and so *Petrify'd* in the Bed as they lay.

In the Parish of *Broughton* aforesaid in the loose Earth above the aforesaid Blue *Quarry*, and elsewhere, I have found in a Whitish Stone, the *Echini Galeati Punctulati Lluydii*, the *Turbinites Major Lluydii*. Tab. 7. N. 341. the *Cocclites Lævis Vulgatiior Lluydii*. T. 7. N. 322; in Blue Stone, the *Concha altera Longa Rondeletii*, exactly agreeing to the Picture and bigness thereof

in *Gesner de Piscibus*. p. 231. only the *Neb* is much Longer: I have found also multitudes of *Belemnites*, great and little, Perforated and Flat at the Root, by which they grew in the *Antidiluvian Sea*, unto some of which I have found little *Shell-Fish Sticking*.

There have been many Contests and Disputes amongst the Learned concerning these Appearances; But my Notion of them is, that the *Antidiluvian World* had an External Sea as well as Land, and Mountains, Hills, Rivers, and Fruitful Fields, and Plains; that it was about the bigness that our Earth is at present of; and that when God had a Mind, for the Wickedness of the Inhabitants that Dwelt thereon, to Destroy the same by *Water*, he broke the *Foundations* and *Subterraneous Caverns* and *Pillars* thereof, with most Dreadful *Earthquakes*, and caused the same to be for the most part, if not Wholly *Absorb'd* and Swallow'd up, and Covered by the Seas that we now have, and that this Earth of Ours Rise then out of the Bottom of the *Antidiluvian Sea* in its Room; just as many Islands are Swallowed up, and others thrust up in their stead.

From this Happy System of the *Deluge*, which is the most Concordant to the *Scriptures* of all others, all those things are easily Solved that were Hard and Difficult before. It is no longer a Wonder that *Shells*, and *Shell-Fish*, and the *Bones* of other *Fishes* and *Four Footed Creatures*, and *Fruits*, &c. are found (as they commonly are) in Beds and *Quarries*, in Hills and Mountains, and in the Bowels of the Earth; for here they *Bred* in the *Antidiluvian Sea*, thither they were Elevated with the Hills and Mountains in the Time of the *Deluge*, there they Fell into, were *Absorb'd*, and *Bury'd* in Chasms, and Holes, and Clefts that would necessarily happen in the Thrusting up of the Earth, and are found in the Soil that was Flung and carried with wonderful Violence and Confusion from one place to another, by the working of the Waters, and the Ferment and Hurry that they were put into.

And as all Countries were thus Raised out of the Bottom of the *Antidiluvian Sea* and *Lakes*, so that Part of the Country about *Broughton* aforesaid, appears manifestly in the *Antidiluvian World* to have been the Bottom of some *Fresh-Water-Lake*, because that those are *Fresh-Water Shell-Fish* that are found there, and the Bed upon which they *Bred*, was a Fine Blue Clay, which is the Colour of the Stone to this Day: Which Bed being *Elevated* and lifted up (and Dashed over with other Earth in the Workings of the Waters, and the great Hurry and Confusion that then happened) the said Bed by the Power of the *Subterraneous Elevating Heats*, *Streams*, and *Effluviiums* was Turned by Degrees into *Stone* with all the *Fishes* therein.

I have before told you, that some of the *Shell Fish* in the same Bed, are not Full of the Matter of the Bed, but of *Fluors*, tho' such are not very common: Some might wonder, seeing that the *Shells* are Closed, that the Matter of the Bed could Insinuate it self into them; but that is nothing but what is common in like Cases, for I have frequently seen in the Bottoms of Ponds and Rivers, where such *Shell-Fish* in plenty are, that when the Fish is Dead and Consumed, and the *Shell* in the *Mud*, with the Edges as Close as if the Fish was Alive, that nevertheless the *Mud* or Clay

Clay will by Degrees insinuate and Fill the same, and now if the Bottom of any one of the said Rivers or Ponds was Raised by *Earthquakes*, and Turned into *Stone* by *Petrifick Effluviiums*, they would exactly be found as these are.

That many *Shell Fish* suffered such wonderful great Violence and Force in the said great *Flood*, in so much as to be Crushed, and Bruis'd, and Squeez'd Flat, as some of those manifestly are, is likewise nothing Strange or Wonderful, if we do but consider the great pieces of Rising Rocks, and Hills, and Mountains, that must needs Roll down, and Fall, in such a general Hurry and Confusion as that must needs have been in the *Quarry*, at the East End of this *Town of Broughton*: where Fragments of Innumerable *Shells* are found, and some *Shell Fish* Squeezed Flat, all which are Natural, and not *Petrify'd*. There was in the *Deluge* Flung upon the same a Huge Bed of a Mix'd Confused Substance, now turned into a Whitish Soft Canckr'd *Stone* and upon that was Cast vast Quantities of Earth, all which Weigh'd and Pressed the tender *Shells* so much, that they Squeez'd some Flat, and Broke others to Pieces, as we find them to be at this Day.

I have a hard *Stone*, part of the aforesaid *Blue Quarry*, with little Bits of *Wood Coals* therein, and whole *Leaves* of *Vaccinia*, or *Whortle Berries*, such as grow upon Heath very Exact: And Mr. *Llwyd* and others have given us several large Accounts of whole *Leaves* and *Plants* found in *Stones* and *Rocks*, and Deep in the Bowels of the Earth, some Folded, some Plain, some Imperfect; all which is very easily Solvable, having in that General Confusion and Hurry been Seized upon and Embod'y'd in Lumps of Clay and other Matters, and others Caught and intercepted in Rolling Beds of Earth, as they Tumbled down from Rising Hills and Mountains, and so Lodg'd deep in Chasms of the Ground and *Petrify'd*, and so Preserv'd unto this Day.

XXXIV. I have had out of the Isle of *Sheppy* in the River of *Thames*, very *Sharks Teeth* dug up there; which could not be said to be *Petrifyed*. They were somewhat Guilded with a *Vitriolick Tarnish* at our first receiving them; but they were White, and in a Short time came to their Natural Colour.

Glossopetra; by
Dr. Lister.
n. 110. p. 223.

In the *Stone Quarries* in *Hinderskelf-Park* near *Malton* in *Yorkshire*, I took out of the Rock my self a Fair *Glossopetra* with 3 Points of a black liver Colour, and Smooth; its Edges are not *Serrate*; its Basis is (like the *True Teeth*) of a Rugged substance; it is Carved round the Basis, with Imbossed Work: it hath certain Eminent Ridges, or Lines like Rays, drawn from the Basis to each Point.

XXXV. Dr. *Tancred Robinson* received lately from *Maryland* a considerable Number of *Fossile Bones* and *Shells* of several sorts. Some of them had received little Alteration in the Earth, others more, and some were so Changed as to be Stony: But all of them Retained their Ancient Shape. One of these *Fossiles* I compared with the *Tongue* of a *Fish* I had Observ'd in *Jamaica*, and

*The Fossile
Tongue of a
Pastinaca Ma-
rina*; by Dr.
Hans Sloane.
n. 232. p. 67.

with

with another of the same *Tongues* in Pieces which I saw in Mr. Charleton's most Useful and Admirable Collection of *Natural Curiosities*, and found a Perfect Agreement. Another of these *Fossiles* I suppose is the Upper *Mandible* or *Palate* of this *Fish*, which is Opposite to, or Answers this *Tongue*: The Agreement of this in all parts with the *Tongue* making it very likely to belong, if not to this same, yet to this Kind of *Fish*.

A Part of one of the Joynts of this *Tongue* was dug up in *England*, and given to Mr. Charleton, by Mr. Lbwid of Oxford, by the Name of *Siliquastrum Subnigrum Pectinatum maximum*.

Fig. 87, 88.

Dr. Robinson thinks the *Fossile Palate* or *Mandible* Fig. 87 and 88. may be of the same kind with that taken Notice of by Lachmund, in his Book *de Lapidibus* p. 17. where 'tis call'd *Pentacrinus*.

Fig. 75.

Fig. 75. Is the *Whole Tongue* of a *Flat Fish* a kin to a *Thornback*, which I call *Pastinaca Marina, Lævis, Livida, Albis Maculis notata*. It is made up of many *Bones* (about 19 in this) which are each of them Crooked, their two sides making an obtuse Angle, such as the sides of the *Under-Mandible* of a *Man* does; the *Uppermost* sides of these several *Bones* have *Furrows* and Pieces standing together after the manner of the *Teeth* of a short Small *Toothed Comb*, the Extant Ends of which Answer the like Parts in the *Bones* of the *Upper Jaw* of this *Fish*, between which and this *Tongue* the *Food* of this *Fish* is to be Cut, Torn, or Ground to Pieces.

Fig. 76.

Fig. 76, Is the *Underside* of the same Divided into several Pieces also, but having no *Furrows* or *Teeth*, as those of the *Upper side* have.

Fig. 77, 78, 79, 80.

Fig. 77, 78, 79, 80. Shew the *Joynts* or Pieces of the same *Tongue*, Separated in several Positions of their *Upper* and *Under sides*, to shew the Perfect Agreement is between the Pieces of the *Tongue* of the *Fish* taken lately from it, and those taken *Out of the Earth*, which are Figur'd in the like Positions.

Fig. 81, 82, 83.

Fig. 81, 82, 83, 84, 85, 86.

84, 85, 86.

Fig. 87, 88.

Fig. 87, 88. Are the *Upper* and *Under sides* of what, I suppose is the *Upper Mandible* or *Palate* of this *Fish*, which is Opposite to, and Answers this *Tongue*.

Mr. Willoughby and Mr. Ray call this *Fish* *Nari-Nari*; and I am apt to believe the Anonymous *Portugal*, whose Description of *Brazil* is Published in *Purchas, Lib. 7. Cap. 1. p. 1313*. Means this, when he says there were *Rays*, having in their *Mouth* 2. *Bones* breaking *Wilks* with them.

Horns of American Deer found under Ground in Ireland; by Dr. Tho. Molinæux. n. 227. p. 489.

XXXVI. I had lately an Opportunity of particularly Examining a compleat *Head*, with both it's *Horns* entirely Perfect, not long since Dug up in *Ireland*, and given to my Brother *Will Molyneux*, as a *Natural Curiosity*, by Mr. *Henry Ostorn*, that lives at a place call'd *Dardistown*, in the County of *Meath*, about two Miles from *Drogheda*. This is the *Third Head* which hath been found by casual *Trenching* in his *Orchard*; they were all Dug up within the *Compass* of an *Acre* of *Land*, and lay about 4 or 5 *Foot* *Under ground*, in

a sort of *Boggy Soil*. The First Pitch was of *Earth*, the next Two or Three of *Turff*, and then followed a sort of *White Marble*, where they were found.

I took the *Dimensions* of this *Head* carefully as follows; from the extrem Tip of the Right *Horn*, to the extrem Tip of the Left *AB* was 10 Foot 10 inches; From the Tip of the Right *Horn*, to the Root where it was fastened to the *Head CD* 5 Foot 2 inches; from the Tip of the Highest Branch (measuring one of the *Horns* Transverse, or directly across the *Palm*) to the Tip of the lowest Branch *GF* 3 Foot 7½ inches; The Length of one of the *Palms* within the Branches *GH* 2 Foot 6 inches; The Breadth of the same *Palm*, still within the Branches, *IK* 1 Foot 10½ inches; the Branches that shot forth round the Edge of Each *Palm*, were 9 in Number, besides the *Brow Antlers*, of which the Right *Antler DL* was 1 Foot 2 inches in Length, the other was much shorter; The *Beam* of each *Horn M* at some Distance from the *Head*, was about 8 inches in Circumference; at the Root where it was fastened to the *Head*, about 11 inches in Circumference. The Length of the *Head* from the Back of the Skull to the Tip of the Nose, or rather the Extremity of the upper Jaw-bone *NO* 2 Foot; the Breadth of the Skull where largest *PQ* was a Foot. There were two *Holes* near the Roots of the *Horns* that look'd like *Eyes*, but were indeed Large Open Passages, near an inch in Diameter in the *Fore-head Bone*, to give way to great *Blood Vessels*, that here issue forth from the *Head*, and pass between the Surface of the *Horn*, and the Smooth Hairy Skin that covers them whilst they are growing, (which is commonly call'd the *Velvet*) to Supply the *Horns* with sufficient Nourishment, while they are Soft, and till they Arrive at their full Magnitude, so as to become perfectly Hard and Solid.

These Vessels, by reason of their Largeness and great Turgency of the Humour in them, whilst the *Horn* is Sprouting and pliant, make Deep and Conspicuous Furrows all along the outside of it where they pass; which may plainly be seen after the *Horn* is bare and come to its full growth; at which time all these Veins and Arteries, with the outward *Velvet* Skin, Drying by the Course of Nature, Shrivell up and Separate from the *Horn*, and the Beast Affects Tearing them off in great Stripes against the Bows of Trees, exposing his *Horns* Naked; when they are thoroughly Hardned, without any Covering at all.

Such then were the Vast *Dimensions*, according to which the Lofty Fabrick of the *Head* and *Horns* of this Stately Creature was built: And yet it is not to be Question'd, but these Spacious *Horns*, as Large as they were, like others of the *Deer-kind*, were Naturally Cast every Year, and Grew again to their Full Size in about the space of 4 Months. For all Species of *Deer*, yet known, certainly Drop their *Horns* yearly; which I conceive to Proceed from the same Cause, that *Trees* annually cast their Ripe *Fruit*, or let fall their Withering *Leaves* in Autumn: That is, because the Nourishing Juice, say it is *Sap* or *Blood*, is stop'd and flows no longer, either on the Account it is now Deficient, being all Spent, or that the Cavous Passages which Convey it, Dry up and Cool; so as the *Part* having no longer any Communication with, must of Necessity by Degrees Sever from, the *Whole*; but with this Difference, that *Horns* by

Reason of their Hard Material and Strong Composition, Stick fast to the *Head* by their Root 7 or 8 Months after all their Nourishment perfectly Retires, whereas *Leaves* and *Fruit*, consisting of a much more Tender Substance, and a Finer Texture of parts, Drop sooner from their Native Beds where they Grew, when once the Supply of usual Nourishment is Stopt, This Analogy that Nature Observes in *Casting* the *Horns* of *Beasts* and *Dropping* the *Fruit* of *Trees*, will appear much more Evident to any one that will observe the end of a Stalk, from which a *Ripe Orange* or any Large Fruit, has been lately Sever'd, and the Butt-End of a *Cast Horn*, where it fasten'd to the *Os Frontis*; For by Comparing them together, he shall Find so great a Congruity in the Shape of both, that 'twill be apparent Nature Works according to the same *Mechanism* in One as in t'other.

Such another *Head*, with both the *Horns* Entire was found some Years since by one Mr. *Van Delure* in the County of *Clare*, Buried 10 Foot under Ground in a sort of *Marle*, and was Presented by him to the Late *Duke of Ormond*. In the year 1691. Major *Folliot* told me, that Digging for *Marle* near the Town *Ballymackward* near *Ballyshanon* in the County of *Farmanagh*, he found Buried 10 Foot under plain Solid Ground, a Pair of these sort of *Horns*. In the Year 1684. There were two of these *Heads* Dug up near *Turvy* within 8 Miles of *Dublin*.

Not long since a *Head* of this Kind, with its *Horns*, was found near *Portunny*, seated on the River *Shannon*, in the County of *Galloway*. Such a *Forehead* with two extraordinary *Beams* of these Kind of *Horns*, may be now seen fastened against one side of the Common-Hall of his Grace *Michael Lord Archbishop of Ardmagh's* House here in *Dublin*; they are both Imperfect and want their *Palms*, yet by the vast Thickness and Length of the *Beams*, I judge when Entire they much Exceed the Size of those I have given the *Dimensions* of above. The *Primate* told me, they were found some where in the Province of *Ulster*.

To these I might add many more Instances of the like; as those found by the late Lord *Mountjoy*, near his House at *Newton Stewart*, and those kept at *Stockallen* in the County of *Meath*; for to my Knowledge within less than 20 Years, above 20, I might safely say, 30 Pair of these sort of *Horns* have been Dugg up in several Places of this Country, all Found by Accident; and we may well suppose vast Numbers still Remain Undiscovered: But these may suffice plainly to shew, this Creature was formerly Common with us in *Ireland*; and an *Indigenous Animal*, not Peculiar to any Territory, or Province, but Universally met with in all Parts of the Kingdom. We may also reasonably gather, that they were a *Gregarious Animal*, as the *Naturalists* Call them, or such a sort of Creature as Affect naturally keeping together in *Herds*; as we see the *Fallow Deer* with us, and as 'tis Reported of the *Elches* in *Sweden*, and the *Rain Deer* in the Northern Countries of *Europe*; for otherwise we cannot easily Fancy it should Happen, that three of their *Heads* should be all found within the Narrow Compass of One Acre of Ground.

That these and several others, and indeed I think I may say all that I have been particularly inform'd of, though *Dug up* in far distant Places of *Ireland*, should be constantly found Buried in a sort of *Marle*, seems to me to intimate, as if *Marle* was only a Soil that had been formerly the *Outward Surface* of the *Earth*, but in Process of Time, being Covered by Degrees with many Layers of *Adventitious Earth*, has by Lying under Ground a certain Number of Ages acquired a peculiar *Texture, Consistence, Richness* or *Maturity* that gives it the Name of *Marle*. For of Necessity we must allow the place where these *Heads* are now Found, was certainly once the *External Superfice* of the *Ground*, otherwise it is hardly possible to suppose How they should come there.

And that they should be so *Deep* buried as we at present find them, appears to have happen'd, by their *Accidentally* falling where it was *Soft Low Ground*; so that the *Horns* by their own considerable Gravity might easily make a *Bed* where they settled in the yielding *Earth*; and in a very long course of Time, the Higher Lands being by Degrees Dissolved by Repeated Rains, and Wash'd and brought down by Floods, Covered those Places that were Scituated lower, with many Layers of *Earth*: For all High Grounds and Hills, unless they consist of a *Rock*, by this means naturally lose a little every Year of their Height; and sometimes sensibly become Lower even in one Age; of which we may see several Satisfactory instances related by *Dr. Plot* in his *Natural History of Staffordshire. Chap. 3. Page 113*. As for all such *Heads* that might Chance to fall on High or Hard Grounds, where they could not possibly be covered, or Defended, these must of Necessity Rot, Perish, and be Destroyed by the *Weather*.

By what Means this *Kind* of Animal, formerly so *Common* and Numerous in this Country, should now become utterly Lost and *Extinct*, deserves our Consideration.

Some have been apt to Imagine this, like all other Animals, might have been Destroyed from off the Face of this Country by the *Deluge* in the Time of *Noah*: But if we consider what a Fragil, Slight, and Porous Substance these and the *Horns* of all *Deer* are, we cannot well suppose they could by any means be Preserved Entire and Uncorrupt from that *Flood*, now above 4000 Years since; and I have by me some of the *Teeth*, and one of the lower *Jawbones* of this Creature so Perfect, Solid, Ponderous and Fresh, that no one that sees them can possibly Suspect they could have been in Nature so many Ages past: And therefore it seems more likely to me, this *Kind* of Animal might become *Extinct* here, from a certain ill Constitution of Air in some of the past Seasons long since the *Flood*, which might occasion an *Epidemick Distemper*, if we may so call it, or *Pestilential Murren*, peculiarly to Affect this sort of Creature; so as to Destroy at once great Numbers of 'em, if not quite Ruine the *Species*. For this Island may very well be thought neither a Country nor Climate so truly proper and Natural to this Animal, as to be perfectly agreeable to its temper, since for ought I can yet learn it neither is, nor ever has been an Inhabi-

tant of any of the adjacent Kingdoms round about us. And besides the three Heads above mentioned, found so close to one another in the County of *Meath*, and the Two near *Turvy*, seems not a little to Countenance this Opinion, as if these Animals Dyed together in Numbers, as they had lived together in *Herd*s. To this Purpose *Scheffer* in his *Laponia* speaking of the *Rain-Deer*, an Animal that agrees in *Kind* with ours, though it be a quite different Sort of *Deer*, says, That whole *Herd*s of them are often Destroyed by a *Raging Distemper*, like a *Plague*, common amongst them; and, that sometimes they All Dye, so that the *Laplander* is forced to supply himself with new.

'Tis probable however, that some of them might have Escaped this *Common Calamity*: But these being Few in Number, I imagine as the Country became Peopled, and thickly Inhabited, they were soon Destroy'd, and Kill'd like other *Venison*, as well for the sake of *Food*, as *Mastery* and *Diversion*. And certainly these *Savage Ages* of the *World* would not have spared the rest of the *Deer-Kind*, *Stags* and *Hinds*, *Bucks* and *Does*, which we still have, but that these, being of much smaller size, could Shelter and Conceal themselves easier under the *Covert* of *Woods* and *Mountains* so as to Escape *Utter Destruction*.

And here I cannot but observe, that the *Red Deer* in these *Our Days*, is much more *Rare* with us in *Ireland*, than it has been formerly, even in the *Memory* of *Man*: And though I take it to be a *Creature*, naturally more peculiar to *This Country* than to *England*, yet unless there be some *Care* taken, to preserve it, I believe in process of time this *Kind* may be lost also, like the *Other sort* we are now speaking of.

It remains that we Enquire what *Species* of *Animals* it was, to which these stately *Horns* formerly belong'd. I know it is an *Opinion* generally received, that they belonged to the *Alche*, *Elche*, or *Elende*, and therefore are vulgarly call'd *Elche's Horns*: But I have seen a *Pair* of *Genuine Elche's Horns* brought out of *Swedenland*, and they differed extremely both in *Figure* and *Size*, from These we have now Described. They were abundantly smaller, and quite of another *Shape* and *Make*; not *Palmed*, or *Broad* at the *End* farthest from the *Head*, as *Ours*, but on the contrary, *Broader* towards the *Head*, and growing still *Narrower* towards the *Tip*s *End*, the smaller *Branches* not *Issuing* forth from *Both Edges* of the *Horns* as in *Ours*, but growing along the *Upper Edge* only, whilst the other *Verge* of the *Horn* was wholly plain without any *Branches* at all. The *Faithful Gesner* speaking of the *size* of them says, *Cornua singula Libras circiter Duodecem appendunt, Longitudine fere duorum Pedum*: Whereas the *Horns* we find here in *Ireland* are near *Thrice* that *Length*, and above *double* that *Weight*, though *Dryed* and much *Lighter* from their being so long *Kept*. Moreover the *Elche*, as described by *Apollonius Menabenus*, who had seen many of them, is no larger than a *middling Horse*. And *Mr. Duncombe* told me, when he was *Envoy* in *Sweden*, he had seen there above *100 Elches* together in a *Herd*, and none of them above *5 Foot High*: And if so, we cannot imagine a *Creature* of that small size, could possibly support so *Large* and *Heavy* a *Head*, with so *Wide* and *Spreading* a *Pair* of

Horns

Horns as these we are speaking of; considering that exact *Symetry*, and due Proportion of Parts, Nature observes in the Formation of all the Larger and Perfecter sort of Animals.

But the Description of that *Lofty Horned Beast* in the *West Indies* call'd a *Moose*, much better Agrees with our *Irish Animal* than that of the *Elche* does. This Animal I find described by Mr. *John Josselyn*, among his *New England Rarities* in these Words: *The Moose Deer, Common in these Parts, is a very goodly Creature, some of them 12 Foot high, (in Height, says another Author more particularly, from the Toe of the Forefoot to the Pitch of the Shoulders 12 Foot; in its full Growth much bigger than an Ox) with exceeding Fair Horns with Broad Palms, some of them two Fathom or 12 Foot from the Tip of one Horn to that of the other. That is 14 Inches Wider than Ours was. Another thus describes the Manner of the Indians Hunting this Creature: They commonly Hunt the Moose which is a Kind of Deer, in the Winter, and run him down sometimes in Half, otherwhile a Whole Day, when the Ground is covered with Snow, which usually lies here 4 Foot Deep; the Beast, very Heavy, sinks every step as he runs, Breaking down Trees as big as a Man's Thigh with his Horns; at length they get up with it, and darting their Lances, wound it so, that the Creature Walks heavily on, till Tired and Spent with loss of Blood, It sinks and Falls like a Ruined Building, making the Earth shake under it. So that we have not the least Reason to question but these vastly large Irish Deer and the American Moose, were certainly one and the same sort of Animal, being all of the Deer kind, carrying the same sort of Palmed Horns, which are of the same size and Largeness, as well as Figure; and the Bulk of their Bodies corresponding exactly in Proportion to the Wide spreading of their Horns. So that we may securely Assert, that Mooses formerly were as frequent in This Country, as they have them still in the Northren parts of the West Indies, New England, Virginia, Maryland, and Canada or New France.*

And lest we may think this Animal peculiar to the Continent, and not to be found in Islands, A remarkable Passage in *John de Laet's Description* of the *West Indies* clearly shews the contrary: *There are found, says he, great Numbers of these Animals in an Island near the Continent, call'd by the English Mount Mansell.* This may give us reasonable Grounds to Believe, that as this *Island of Mount Mansell* must of Necessity have had some Communication with the *Main-Land of America*, to have been thus plentifully stockt with this sort of Beasts; so *Ireland*, for the same Reason, must in the many Past Ages, long before the late Discovery of that *New World*, have had some sort of *Intercourse* with it likewise, (though 'tis not easie, I acknowledge for us at present, to explain how) for otherwise I do not see, how we can conceive this Country should be supply'd with this Creature, that for ought I can yet hear, is not to be found in all our Neighbourhood round about us; nay, perhaps in any other part of *Europe*, *Asia*, or *Africa*: And then, 'tis certain, as *Ireland* is the Last or most Western Part of the *Old World*, so 'tis Nearest of any Country to the most Eastern Parts of the *New Canada*, *New England*, *Virginia*, &c. the great Tract of Land, and the only one I yet know, Remarkable for Plenty of the *Moose Deer*.

An Elephant
found under
Ground near
Erfurt in Ger-
many; by Wilh.
Ern. Tenzeli-
us. n. 234.
p. 757.

XXXVII. *Tonna* inter *Thuringiæ* Dynastias haud postrema, *Erfurto* propinqua, Comitibus olim *Glichensibus* paruit, iisque Extinctis varios sortita Dominos Ducatui tandem *Saxo Gothano* annexa est, ex quo serenissimus Princeps, *Fredericus*, cujus Filium Cognominem feliciter hodie Regnantem suspicimus, A. 1677. jure Emptionis Hæreditario sibi suisque eam comparavit. Binos habet Pagos seu villas ejusdem Nominis, quorum alter appellatur *Burg Tonna*, quasi *Castrum Tonnam*, alter *Grafen-Tonna*, quasi *Comitis Tonnam* diceres. Uter illorum Antiquior sit, definire nequeo: Id saltem constat Annalibus vetustissimum Pagum esse, qui *Dornaha* audit in Diplomate *Ottonis Magni*, A. Chr. 973 dato, meaque Opinione ad *Burg Tonnam* spectat. Proxime Pago huic adjacet Mons live Collis *Arenosus*, Arenam in fundo præbens purissimam albissimamque, in variorum Artificium usum longè latèque transportari solitam: Quam effodientes Mense *Decembri* An. 1695. Ossa quædam Maxima reperiunt, ad *Pedes Posteriores* spectantia, unum 19 *Librarum* pondere; deinde Globum live *Caput Rotundum* Acetabulo insertum, Capite Viri majus, 9 *Librarum*; hinc Majus Os *Femeri* simile 32. *Librarum*. Soluto post Novi Anni initium Frigore amplius inquirentes, offendunt *Spinam Dorsi* cum *Costis* adhærentibus, profundiusque in *Arena* abditos *Globos* longè majores binos, una cum *Ossibus* eo pertinentibus, *Pedum* nempe *Anteriorum*; tum *Os Humeri*, 4. *Pedes* longum, *Duasque Spithamas* latum cum *dimidia*: Mox *Vertebras Colli* cum vertice *Acuminato*; denique *Caput* prægrandè cum 4. *Dentibus Molaribus*, quorum singuli 12. *Libras* pendeant, & Duobus maximis *Dentibus* live *Cornubus*, 2½ *Spithamæ* Crassitie, & 8. *Pedum* Longitudine ex *Capite* prodeuntibus. Ut *Caput* melius conspiceretur, Collis 12. fere *Cubitorum*, live 24 *Pedum* Altitudine perforatus est; quo facto ipse serenissimus Princeps 10. *Kal. Feb* accessit, meque inter *Comites* esse clementissime jussit, ubi omnes quidem in magno *Hominum* Concursu *Caput* illum cum *Dentibus* prægrandibus admirabundi contemplati sumus, maxime autem indoluimus, & *Caput* & *Dentes*, exceptis *Maxillaribus*, quos integros fere accepimus, & reliqua *Ossa*, adeo Fragilia, consumpta *Carie*, lituque corrupta jacuisse, ut nullum eorum ex omni parte in contaminatum erui potuerit, sed in plurimas *Particulas* disjecta fuerint.

Cum primum *Fama* emaneret, vulgarem simul *Opinionem* de *Ossibus Gigantis* ea circumferebat, qua tamen nec mihi, nec aliis prudentioribus arrisit, & *Vitæ Capite* statim Evanuit. Postea a vero *Dux* *Opiniones* emerferunt, quarum Altera, pro *Elephanti sceleto*, *Temporis* diuturnitate maximam partem *Petrificato*; Altera pro *Uni Cornu Fossili*, ut vulgo vocant, seu *Minerali* jocantis *Naturæ Fœtu*, habuit. Prior sententia mihi comprimis placet. Ex *Collatione* enim *sceleti nostri* cum *Anatomia Elephanti* quam *Dublino* in *Hybernia*. A. 1681. dedit *A. Meulinus* clarissimè liquet omnia huic nostro convenire, quæ ad vera *Elephanti Ossa* requiruntur. Ante omnia Notandum est, quod *Moulinus* refert in *Cranio Elephanti* extare magnam *Cellularum* Numerum, plerumque *Triangularium*, *Membranulis* obductarum, in quibus multa sint *Vasa sanguinea* curiose disposita, istasque *Cellulas* ex *Tenuibus Bracteis Ossis* factas esse. Enimvero *Cranium Tonnense* non tantum intus *Concavum* & instar *Tumuli Formicarum* perforatum fuisse referunt *Fossares*, sed è *Fragmentis* idem liquet mani-

manifestissime, quæ *Cellulas* istas, modo oblique modo directe *Cranium* transeuntes, nobis ob Oculos ponunt, ex Tenuibus Bracteis constantes, & maximam partem Triangulares: Membranulas autem, *Vasis sanguineis* exsiccatis firmissime agglutinatas deprehendimus, Colore flavo subrubicundo tinctas, scilicet pro forte tentatas in frustula dissilire, simulque Colorem istum auferre, ut Albedo *Cranii* emineat. Præterea quem *Moulmus* in *Crania* observat Meatum *Medullæ spinalis*, & singularem Cavitatem pro *Cerebro* capiendo, in nostris etiam Fragmentis apparet: & quam ille metitur Distantiam *Cranii* ab uno extremo ad alterum $20 \frac{3}{4}$ *Digitorum*, in nostro dicitur fuisse $3 \frac{1}{2}$ *Pedum*, qui cum 42 *Digitos* faciunt, tum Conjecturam nobis præbent, *Elephantem Tonnessem Hibernico* fuisse ad minimum duplo majorem; quod ex sequentibus clarius patebit. De externa *Cranii Elephantini* forma alius *Anglus*, *Joannes Raius*, in *Synopsi Animalium Quadrupedum* observat, *Posticam* ejus partem in duos prægrandes *Sinus* seu *Lobos* ita dividi, ut *Clunes Humanos* referre videatur; neque, ut in aliis multis *Quadrupedibus*, *Cerebello* excipiendo Cavitatem, seu *Alveum* productum extrorsum conspicuum habere, sed potius *Cranii Humani* Figuram imitari. Obtestor omnes, qui *Caput* in *Arena* jacens viderunt, non hæc *Definitio* ipsi apertissime conveniat. Cæterum *Longissimi Dentes* illi sive *Cornua*, præter *Crassitiem* & *Longitudinem* indicatam, simul referebant *Nativum Lavorem*, *Colorem Subflavum* nigricantibus *Maculis* subinde conspersum, *Curvaturam*, & *Strias* nullis aliorum *Animalium Dentibus* *Cornubusque* communes: Imo quod maxime notari meretur, superest adhuc *Cuspis Dextri Dentis*, apertissimo *Limationis* signo conspicua, de qua *Plinius Arbore Exacuere Limareque Cornua Elephantos* memorat. Neque præterierim, inter alios, qui ad visendum *Tonnesse* spectaculum undique adfluebant, venisse etiam *Mercatorem*, qui multos *Annos* in *India* consumpserat, & secundum *Regulas Indorum*, quas sibi probe cognitas dicebat, ex *Dentibus* sive *Cornubus* judicabat *Elephantem nostrum* plusquam 200 *Annos* vixisse. Quam in rem *Aldrovandus* allegat *Aloysii Cadamusti* Testimonium, vidisse se aliquando *Elephantem* occisum perquam *Mediocre*, cujus *Dentium* amplitudo *Palmos* (i. e. *Spithamas*) *Ternos* excedebat, eminebat ad *duos Palmos*, verum *Palmus* contactus *Carne Maxillæ* immergebatur, ut totus occultaretur, ut sunt aliorum *Radices Dentium*; & quoniam eorum *Senecta* *Dentibus* cognoscitur, aiebant *Argumento Dentium* fere despicabilis, ipsum haud quaquam *Annosum* fore, si conferretur aliis *Procerioribus*, quorum *Dentes* tantæ sunt *Magnitudinis*, ut vicem *Postium* suppleant, & pro *Palis* sepes muniant, Teste *Plinio*, & ut *Nigritæ* referebant, nonnullis eo *Amplitudinis* crescunt *Dentes*, ut 12. *Palmorum* *Mensuram* excedant. Ultima *Verba* cum primis ad *Propositum nostrum* faciunt: *Palmum* enim *Cadamustus* intelligit *majorem*, quem *Spithamam* alioquin dicimus; 12. igitur *Palmi* 8 faciunt *Pedes*, quæ *Longitudo* est *Dentium Tonnesium*. Non multum hinc abit *Dens Harduino*, *Commentatori Plinii* novissimo, *Dieppæ* visus, septenum fere *Pedum*, *Centum* & amplius *Librarum* pondere; Præterea *Gillius* adserit, eos sæpe ad *Longitudinem* 10 *Pedum* augescere. Nec est quod *Pondus Centum* & amplius *Librarum* in *Dentibus Tonnesibus* quæquam deterreat: Reperiuntur enim, quorum singuli pendent 140 *Libras*, qualem apud *Batavos* vidit *Amicus*; vel 150. sive 200 *Romani Ponderis Duodecim unciarum*, quales *Erasmus Francisci* memorat, vel 160. qualem in *Musæo Septali*

ano describit *Terzagus*; quin *Vertomannus* in *Sumatra* duos vidit, qui appensi *Libras* 336 pendeant. Nobis interea sufficere potest certum *Ministri* cujusdam *Ducalis* Testimonium qui aliquot Annos in *Sumatra* aliisque *Indiæ* Regionibus vixit, Testaturque *Dentes* sibi visos fuisse Longitudine *sex* vel *O. 10 Pedum*, Crassitie *Duarum* & *Dimidiæ Spithamarum*, Pondere *Centum* & *125. Librarum*. Veterem Disputationem, *Cornua Dentisve* sint appellandi, non *Dentio*; neque tamen negaverim, placere mihi *Aldrovandi Bochartique* de *Media* illorum *Natura* Sententiam, quam *Origo* confirmat; *Pausaniæ* pridem notata, quia *Temporibus* superne descendere, & ita foras tendere, non *Auritus*, sed *Oculus* Testis scripsit, viso in *Campanio Elephantis Cranio*: Eundemque *Situm Tonneses* præ se ferebant; quibus non obstare potest *Moulini Raiique* Observatio, è *Maxilla Superiore* eos derivantium, internamque eorum *Constitutionem* ita nobis depingentium; quod *Intus* concavi sint, & *quadam Velut Medullâ*, *verum Compactiore*, quæque *Glandularum aliquam Mixturam* habere videbatur, repleti: addit *Raius*, ex *Observatione Lewenhoekii*, *Eos* ex *conjunctis* iisque *admodum Exilibus Tubulis* constare, ex *intima parte seu Cavitate* *Dentis* *Originem* trahentibus, & *ad Circumferentiam ejusdem* terminatis. (æterum hos *Tubulos* manifestissime in qualibet *Dentium Tonnesium* parte conspicimus, una cum *Corticibus* quasi illis in rotundum extensis, quibus *Elephantorum Dentes* singulis vel *Annis* vel majoribus *Vitæ* interstitiis, distingui videmus; verum, ne quid Dissimulem, Neuter *Nostrorum* latiori pollet *Cavitate*, quam quousque *Capiti* seu *Tempori*, vel potius *Maxillæ Superiori*, inserti fuerunt; nec majorem *Cardanus Aldrovandusque* in omnibus agnoscunt, & quanquam ea à *Moulini Raiique* latius extenditur, non alios tamen, quam *Juniorum Elephantum Dentes* producere poterunt, *Seniores* autem non alio modo comparatos puto, quam *Tonneses*, ejusque differentię *Causam* in eo sitam esse, quod in *Senioribus Tubuli* isti *Corticesque* non tantum ad *Extra* augeantur, sed etiam ad *intra* magis magisque constipentur & Coalescant, ac simul *Medulla* compactior *Glandulisque* mixta sensim Conglobetur & Condensetur.

Progredior ad *Dentes Molares*, quorum quatuor *Stupendæ Magnitudinis* *Ponderisque* in *Capite Tonnesi* reperti fuerunt, iisque exactissime convenit *Raii* *Definitio*, his *Verbis* concepta: *Os Beviæ* quatuor in *utraque Maxilla* *Dentium Molarium Massis* instructum. *Siquidem plurimi Dentes* in *Os Solidum* & *Durum* ita infixi sunt, ut cum eo & inter se *unam* & *continuum* *Corpus* efficiant. *Dentes hi Lineas Parallelas undulatas* octo vel novem in *superficie Massæ* efficiunt, suntque *reliquo osse* *Candidiores*. *Massæ integræ* *Dentium singularium* modo per *Gomphosin* *Maxillis* inseruntur: *anterior* tamen in *Superiore Maxilla* *extremitate* *altera* in *Maxillam* *infigitur*, deinde *Palato* *Oris Parallelos* *Antrosum* *producta*, in *acutum* tandem *Mucronem* *desinit*, qui in *Sinu* ad id *facto* in *extremitate* *Maxillæ* excipitur.

Incisoribus omnino caret. Equidem his caret etiam *noster Elephas Tonnesis*, *lingulæ* vero *Massarium Molarium* constant *Osse Duro* & *Vitri* *instar* *candenti*, *nucleoque*; tum in *Superficie* *duodecim* *Lineas Parallelas Undulatas*, sive *Strias Molares* habent, *reliquo Osse* *Candidiores*; in quolibet latere *Sedecim Striæ* expressæ sunt, totidemque *Cavitatibus* per *Gomphosin* *Maxillis* inserti fuerunt, quas ubi *Sculpro* *perideris*, repletas invenies *Dura* *quadam* ac *Rubicunda* *Materia*

teria, *Medullæ Vasorum Nervorumque* Petrefactæ simillima: Præterea parte illa qua ex *Maxilla* prominuerunt, luculenter apparet *Lævitas duorum* fere *Digitorum*, qualem in *Hibernicis* notavit etiam *Moulinus*. Nec est, quod deterreri nos patiamur octonario *Hibernicorum* Numero, quanquam eundem in alio *Elephanto Peirescium*, Brachio suo in Os Belluxæ ingesto, deprehendisse *Gassendus* narrat: pro *Quaternario* enim stant non tantum ex Antiquis *Aristoteles* & *Plinius*, sed & ex Recentioribus *Walter Schultze*, qui diu in *India* versatus est, ipseque, ut videtur, *Rains* qui alioqui non in utraque sed in singulis *Maxillis* Quatuor *Dentes* dicere debuisset. Causam differentix quærere licet vel in Naturæ Varietate, quæ ut in aliis Animalibus, Homineque ipso, ita etiam in *Elephantis* Numerum *Dentium* non semper eundem producat; vel in Ætatis differentia, ita ut *Dentibus Posterioribus* in juventute excisis *Anteriores*, copioso adfluente Nutrimto, spatium expleant. Certe *Quatuor Tonnenses* in Posteriore sui parte manifestissimas habent *Extremities* processusque incurvatos, ex quibus liquet, in *Maxillæ* extremitate illos constitisse; eosdem pars Anterior ostendit, & qui *Superiori Maxillæ* inserti fuerunt, non solum Longiores sunt Inferioribus, secundum *Moulini* Observationem, sed in Acutum quoque Mucronem desinunt a *Kaio* observatum: Imo omne fere *Maxillæ* expleant spatium, quod *Octo* isti apud *Moulinum*; metitur enim Longitudinem *Anterioris Dentis* in *Maxilla inferiori* sex *Digitis* cum Dimidio *Posterioris* tribus; Totius vero *Maxillæ* $21\frac{1}{4}$. *Digitis*, uti *Superioris Maxilla* 18 *Fossores Tonnenses* Discrimen hoc non satis observantes eandem utriusque *Maxillæ* Longitudinem dixerunt, Trium nempe *Pedum*, sive Triginta sex *Digitorum*; *Dentes* autem *Maxillares* sibi invicem insistentes reppererunt, Longitudinem singulis Unius & Dimidiæ *Spithamæ* assignantes, quam tamen accuratiori examine diversam reperi; *Superiorum* quidem propter Acutum Mucronem Quindecim fere *Digitorum Inferiorum* vero Quatuordecim. Accipimus autem Distantiam *Maxillarum*, quam iidem dederunt *Fossores*, Trium & Dimidii *Pedis*, sive 42. *Digitorum*: eaque cum Distantia 21 *Digitorum*, quam inter *Ossa Lygomatica* sive *Fugalia* statuit *Moulinus*, collata, denuo deprehendimus Magnitudinem *Elephantis Hibernici Tonnensem* Bis æquasse: idem confirmat distantia *Cranii* ab uno Extremo ad alterum, in *Hibernico*, $20\frac{1}{2}$ *Digitorum*, in *Tonnensi* Trium & Dimidii *Pedum*.

Repertæ fuerunt etiam *Vertebræ Colli*, seu *Cervicis* (juxta Dimensiones a *Fossores* indicatas) Crassitie Quatuor *Spithamarum* in Circumferentia, Duarum altitudine; quarum adhuc Tres optime sibi respondentes supersunt, earumque præcipua monstrat Verticem Acuminatum. Repertum est Os *Humeri* cum *Acetabulo* & *Capitibus* sive *Globis* duobus Maximis adhuc residuis, *Pedumque* *Anteriorum Ossibus*, *Ulnæ*, *Radii*, *Carpi* & *Metatarsi*, quorum nonnulla tantæ fuerunt Cavitationis, ut manus tota inferi potuerit; singula autem referta non Arenis, sed minutissimis *Medullæ* Petrefactæ particulis, quæ Ori indita non Stridorem *Dentium* causantur, Arenæ instar, sed in Lingua liquecunt Gustaque Terreo Transmutationem istam produnt. Repertæ sunt *Vertebræ Dorsi* cum *Costis* adstantibus, sed nihil ex iis integrum evasit; Duo tantum Fragmenta *Costarum* exigua vidi, alterum Crassitie Undecim, alterum plus quam 7. *Digitorum*. Repertum porro est Os *Coxendicis* $2\frac{1}{2}$ *Pedis* Longitudine

cum *Acetabulo* & inserto *Femoris Capite*; *Moulinus* Longitudinem illius non exprimit, sed *Ossis Innominati*, 25. *Digitorum*: at *Os Coxendicis* tertia tantum pars est *Ossis Innominati*, reliquas duas, *Os Ilion* & *Pubis*, Fossores dimetiri neglexerunt. Reperta sunt *Ossa Crurum Pedumque Posteriorum*, *Tibiæ*, *Fibulæ Tarsi*, & *Metatarsi*; e quibus adhuc superat pars *Tibiæ*, Principio & Fine carens, Crassa tamen superiori parte 22. *Digitos*, quibus sursum versus sex alios facile accrevisse *αυτοψία* docet; inferiori parte habet Crassitiem 17 *Digitorum*, indeque rursus Duplex emergit Crassities, ac Longitudo *Hibernici*, cujus *Tibiam* dicit *Moulinus* Longam 19. *Digitos*; Rotundam, ubi *Crassissima*, plusquam 14. & ubi *Tenuissima*, $7\frac{1}{2}$ *Digitos*. Hic notanda est major *Pedum Anteriorum* præ *Posterioribus* Validitas & Crassities *Elephantis* propria, & ab *Alberto Aldrovandoque* explicata. Neque enim tantæ Capacitatis est *Tibia*, ut *Manum* intrudi patiatur, quod in quibusdam *Ossibus*, *Ulnæ* sine dubio, licuisse Fossores aliique memorant. Denique supersunt Bina ex *Tarsi* *Ossibus* sibi invicem contigua, ne quisquam dubitet, illa etiam adfuisse. Omnia isthæc *Ossa* Porosa & Rimosa sunt, ut in reliquis *Animalibus*, alteriusque *Planæ Formæ*, ac *Dentes*, tam *Maxillares*, quam *Exerti*.

Situm quoque *Totius Animalis* attendere juvat. *Cornua* sive *Dentes* *Maximos* versus *Ortum* ac *septentrionem* protendebat; *Pes Anterior sinister Lateri Capitis* adjacebat extensus; *dexter* sub *Corpore* deorsum inclinatus; *sinister Posterior* in *Acetabulo* incurvatus, *Dexter* denique initio statim reperi- tus & hinc inde distractus fuit. Quæ omnia situm minime naturalem vel *Ordinarium*, sed *Extraordinarium* plane violentumque produnt. Tandem Fossores referunt, *Ossa* quidem illa jacuisse debita series, sed ubi sunt *Inarticulationes*, partim *Palmi*, partim *Semipalmi* [*Palmum* *Minorem* *Quatuor digitorum* intelligo] spatio distincta fuisse. Quorum *Rationi Pinguedine*, *Cartilaginibus* ac *Ligamentis*, *Carne* denique ac *Intestinis* sita est, quibus *Putrefactis* vacuum *Locum* *Arenam* occupavit, *Artusque* *Pondere* suo magis magisque disjunct.

Nunc ad *aliam Disquisitionem* venio, An illa sint *Unicornum Fossile* sive *Minerale* in *Terræ Gremio* Generatum, vel potius *Animal Putrefactum*? Equidem nemo *Rerum Physicarum* non prorsus Imperitus inficias iverit, dari ejusmodi *Fossilia* seu *Mineralia*, *Calvariarum Prægrandium*, *Dentium Ostiumque* specie efficta: Et quomodo *Natura* tam *Immanes Calvarias*, tam *Immania Humani* (adde & *Animalis*) *Corporis Membra*, ad *Femorum*, *Tibiarum*, *Costarum*, *Dentium*, similitudinem producat, omnium optime clarissimeque explicatum dedit *Kircherus* dicens, *Latere in subterrestribus visceribus intra saxosorum Montium Iliatus*, *Terram* quandam *Limosam*, quam *Margam* cum *Agricola supra nominavimus*, *Gypseæ Materiæ* mistam: quæ *Terra* ubi per *Rimas Montium* *Nitrosam* *Fluorem* receperit, fit, ut illa veluti *Cortici* quodam *Gypseo* induatur, qui uti cum *Tempore* *Lapidescit*, ita quoque *salis N. tri splendore Albedine* sua *Os proxime æmulatur*, utpote *Candidum*, *Rimosum*, & *friabile*. Si itaque *intra Torræ Concauitatis Rotundæ locum* invenerit, nascetur *Pila Rotunda*, quæ *discussa Calvariam proximæ æmulatur*; si *Matrix fuerit disposita sub Forma Femoris Humani* (alteriusve *Animalis*) aut *Costæ* aut *alterius Membri*, *Marga* in ea contenta super affuso

Sal Nitroso Liquore, Femur Humanum Minus, Majus, Maximum, & prorsus, Giganteum, pro Matricis Magnitudine exprimet. Atque hæc sunt Ossa ista, quæ Natura producit, & passim Ossa Gigantum communi Hominum persuasione dicuntur; quæ tamen si confregeris, nulla in eis nec Medulla, nec Medullæ Fistulosus Meatus reperitur, quod fieri deberet, si (Hominum Animaliumque) Ossa forent. Has Observationes suas certissima Experimenta Kircherus ipse confirmat, Visis abs se in Pariete Antri Panormitani Dentibus Parvis Mediocribus, Maximis & Excessivæ Magnitudinis, ea serie, quæ Natura Maxillis Animalium inserere solet, infixos, tanta Copia, ut centum Carros inde onerari posse facile crediderit: alibi protuberabant Vertebrarum, Genum, Tibiarum & Calvariæ Vestigia, nullo tamen Ordinis nexu, nec quidquam inter omnia Ossæ substantiæ vestigia, Organizatum, uti sunt Caput, Manus, Pedesque reperiebatur; Unde Luculenter admirabilem Naturæ in Ossibus, aut Ossibus similibus Saxis formandis Industriam primo se cognovissent fatetur Kircherus, in Marchione Ventimiglia, Lustrationis Comite, duo eductus, nobis maxime proficua; quorum Alterum est, In Agro Solonio juxta Mare, Drepanum & Panormum inter, ab Agriculis vera adhuc erui Ossa Elephantum, qui præteritorum seculorum Temporibus ab Afris in Siciliam contra Hostes in Bellum educti, ibidem interfecti Tumulati sunt, postens Temporibus tandem detectis Ossibus, quæ & imperiti passim pro Gigantium Ossibus venditant: Alterum, hoc discrimen esse inter Ossa vera & a Natura Minorali producta, quod Illa semper Tibiarum Canales, Fistulosque Meatus olim Medulla refertos retineant, Hæc vero solidum Lapidem sine ulla Tibiarum Concavitate mentiantur. Tonnensia verum, tantum abest ut Meatibus Medullaribus careant, aut, ne reliquas Kircheri Regulas omittamus, nullo Ordinis Nexu inter se jaceant, nihilque Ossium Organizerum contineant, ut potius ea omnia ibi Luculentissime extent omniumque Oculos incurrant.

Quæcumque enim in Elephanto sunt Ossa Concava & Fistulosa, Medullisque Referta, ea in nostro etiam Sceleto paria faciunt: Nec Turbare nos debet Exertorum Dentium Soliditas ad eam usque partem, qua in Maxilla figuntur, quippe in Maximis Nativis etiam deprehensa. Omnia porro isto Ordine inter se connexa sunt, quem Natura requirit, situ Violenta & Extraordinario non Impedita, Ossa quæ Kircherus Organizata, vocat, & inter Mineralia Antri Panormitani Ossa frustra quæsit, nostro Sceleto, ne Minimo quidem Excepto, quod ex Reliquiis colligitur, Perfectissime comparuerunt.

Cranium sane Cellulis pro Vasis Nervisque Transmittendis curiosissime distinctum est, nec Cavitate Cerebri, Medullæve Spinalis Processu destituitur: Dentes Exerti nativum Colorem, Lævorem, Strias, Tubulos, Interstitia sive Cortices, referunt, imo Dexter ab Animalis Vivo Limatum se prodit: Maxillaris Descriptioni Raiannæ optime convenientes suâ gaudent Gompofi; seu Cavitatibus Sinuibusque, quibus Maxillæ inserti fuerunt, Medulla Rubicunda Petrefacta adhuc repletis: Vertebræ Colli Acuminato Vertice præditæ, & Ossa Tarsi, sibi invicem respondent: Capita Maxima seu Globi Acetabilis suis, Costæ Spinis Dorsi, juncta fuerunt. Nec plura ex præcedentibus repeto, cum hæc altius expensa cuilibet persuadeant, non posse Naturam Ludentem sibi que relictam, nec Animalis cujus Partes sunt concurrente, Corpus ejusmodi Organicum omnibus Numeris absolute

lutum formare: aut si quis regere Soluerit, dari nonnulla *Unicornua Fossilia* vulgo dicta, & *Mineralia*, quæ *Fistulosos Meatus* habent, illi ex *Kircheri* Principio, in ipsa *Experientia Fundato*, facile reponerem, *Fossilia* isthæc non ex *Mineralium*, sed *Animalium Genere* esse, contrariam *Sententiam* probandi *Onus* eidem relinquens. *Inviçtum* enim *Argumentum* est, quod in *Conjecturis* de *Antiquissimo Statu Helmstadii* p. 13. proponit *Conringius*: *Posse* vero *Naturam*, *Relictum Sine Omnibus Adminiculis*, *Ossa* undequaque *Perfecta* condere *qualia* in *Fætu primum conformantur*, deinde in *Adultis diuturna Nutritione Animali* perfici solent, id vero est ἐν τῶν ἀδυνάτων. *Eoque Solius Naturæ* *Luxuriantis Lusui* tribuere, *confectionem* tot in *Usus Vitæ conformatorem* & *omnibus modis absolutorum* *Ossium*, utique *sine Nota Summæ Absurditatis* haud licuerit.

Accedit alterum *Argumentum* non *Minoris Ponderis*, quod eodem loco *Kircherus* nobis suppeditat, dicens, *Margam* pro diversa *Cavitatis*, seu *Matricis* in *Terræ Visceribus Dispositione*, diversa *Ossium Simulacra* producere. Licet itaque in *Arenis Tonnensibus Margam* Succumque seu *Aquam Lapidescentem*, quæ *Kirchero Fluor Nitrosus* audit, recondi facile concesserim, tamen quis unquam sibi imaginabitur, *Cavitatem* seu *Matricem* ita ibi olim dispositam, ut *Skeleton Elephanti* *Situ Extra ordinario supra Descripto* injectum representarit, quam postea *Marga* *Fluens* fortuito deprehensam repleverit, *Temporisque Successu* in istam excreverit *Molem*? Certe influit eadem *Natura*, eadem *Materia*, idem *Calor*, idem *Humor*, idem *Fomentum Terræ*, eadem *Generandi Ratio*, sed *Diversissima Producta* sunt pro *diversitate Ossium Elephanti* *Genuina*; quatenus sunt in *Capite Cellulis Distincta*; in *Dentibus Maxillaribus* *Vitri* instar *Dura* & *Candentia Striis undulatis prædita*; in *Cornubus* sive *Dentibus Prominentibus* *Lævia*, *Flavescentia*, in *Cuspide Limata*, *Striata*, *Tubulis* ac *interstitiis conspicua*; in reliquis *Ossibus* *Porosa*: & *planæ* ad *Normam Rationemque Corporis Organici* formata? Quis inquam, rebus sic stantibus, illam in *Sententiam* se unquam abduci patietur? Nonne multo est *verisimilior Altera Anselmi Boetii de Boodt, Rudolphi II.*

Imperatoris Archiatri, in *Historia Gemmarum & Lapidum Lib. 2. Cap. 242.* qui postquam docuerat, *Margam Lapidescente & Subterranea Aqua* *fluente irrigatam vel solutam*, *Lactis instar Fluere per Terræ Cavitates*, *absorptaque* *Seriores Aquæ parte*, *crassiorem Cavitates implendo* *sisti*, & *absumpto Humore* *omni coalescere*, *Lapidisque Formam & Cornuum præ se ferre*; quæ *Kircheri* aliorumque *communis* est *Opinio*: Subjicit; *Verum si Lactens hic Humor non in Cavitatem*, sed in *Lignum aliquod vetustate arefactum* incidat, *illiusque Corpus jam Leve & Porosum* subeat, *tandemque vel exhalata* *Aquæ Tenuioris* *portione* *Crassior remaneat*, *tandem coagulata Lignum* *transmutat* *ejusque partes sibi assimilat*, *ita tamen*, ut *Species Ligni nosci & interdum Odor deprehendi* possit. *Quod Ligno contingit id etiam Cornubus Cervinis Dentique Elephantis aliisque Quadrupedum partibus*, si in *hujusmodi loca decidant*, *contingere potest*. *Hinc fit*, *Cornua ista Fossilia inter se multum Differre*, & *Pauca eandem Faciem ostendere*, imo *aliqua Dentes*, *Tibias*, *Maxillas*, *aliasve Corporis Partes* referre. *Hanc Sententiam proxime ad Veritatem accedere* *judicat Olaus Wormius* in *Museo* pag. 54. *Quid igitur vetat*, *Epicrili horum Doctissimorum Medicorum* *acquiescere*, *modumque*, quo in *Petram* *conversa* sunt *Ossa Elephanti Tonnenfis*,
verbis

verbis eorum exprimere, præsertim cum non solum *Dentes Elephantis*, sed alias quoque Partes Quadrupedum, (quidni & omnium maximi?) hac ratione *Mutari* posse disertissime fateantur?

Devenerat igitur quovis Modo ac Tempore (de quo infra dispiciemus) in Collem Arenosum *Tonnensem Elephas*, cujus *Ossa* Temporis longitudine Arefacta calcinavit Ignis Subterraneus, eaque jam Levia & Porosa subiit *Lacteus* ille *Margæ* Humor, & exhalata Aquæ tenuioris portione Crassior remansit, [cujus particulas in *Ossibus* Porosis ob majorem Albedinem ab eorum Substantia facillime discernere licet,] & tandem Coagulata totum *Elephantis Sceleton* Transmutavit, ejusque Partes sibi Assimilavit, ita tamen ut *Species Ossium* interna & Externa nosci, & forte etiam *Odor* deprehendi possit. Ultimum de *Odore* subdubitans adjeci, quoniam tentare nondum licuit. Si tamen *Boetius Odorem* intelligit, quem *Ligna* & *Ossa Petrefacta* in *Furno Chymico* spargunt, id de novissimo Examine adseverare possum, quod *Nares* propius Admoventium idem profus adflaverit *Odor*, quem *Ossa Cornu* quoque Adusta dare solent. Aliquot *Eboris* sive *Dentium Elephantis Fossilium* Exempla protulit *Bartholinus* postremo de *Unicornu Capite*, in medio quidem relinquens, num *Dentes* fuerint in *Lapideam* duritiem compacti *Ætatis Moræque* Ambitu, an ex prima *Lapidum* Mole incertam tantum *Dentis Cornu* figuram effecti à Natura; Falsus tamen, utriusque suam esse Rationem, si alterutrum Nolis; neque spernenda *Petrefactionis* Exempla Causasque adjiciens. Ad eundem modum hæsitabundus pronuntiat de *Dente Maxillari Elephantis*, alteroque *Rosmari* in *Petram* seu *Silicem* conversis: Nostram tamen Sententiam diserte amplectitur alioque *Rosmari Dente* illustrat Medicus *Islandus Arngrimus*. Eidem apertius favet *Antonius de Pozzis*, Archiater *Cæsareus*, in Epistola ad *Lambecium*, quam ipse *Lambecius* una cum *Figura Dentis Elephantini Maxillaris Tomo VI. Commentariorum de Bibliotheca Cæsarea* appendit p. 315, 316. Is enim non solum *Dentem* istum, sed & *Femoris Tibiarumque Ossa Badenæ* reperta, pro veris *Elephantis*, sed *Petrefactis*, habet; addito Ratiocinio, quod si lapideam *Mentiat* Naturam, hoc accidit a *Terræ*, cui sepeliuntur, occultis Conatibus, quæ suo concentrato *Archeo Semina* extrahit *Lapidi* ficationis atque *Indurat*. Plura ejusmodi *Ossa Elephantina Petrefacta* in *Romanis Cimeliis* ex *Celeberrimi Ciampini* Observatione colligo, quam in *Ephemeridibus Naturæ Curiosorum An. 1688. p. 446.* deprehendi.

Refert enim *Ossa* quædam miræ Magnitudinis effossa, *Femoris*, *Scapulæ*, & *Vertebrarum* quinque, inter quas erat illa *Cervicis*, quæ *Pondere* simul 180 *Libras Romanas* excedebant; & a plerisque pro *Giganteis* habitæ, cumque aliis ejusmodi in *Urbis Cimeliis*, *Chisiano* præsertim, collata, omnium Maxima erant. Dubio autem exorto, an revera *Gigantis*, aut potius *Elephantis* essent, ad Eruditum Amicum *Florentiæ* commorantem datæ fuerunt Literæ, ut Exemplar *Sceleti Elephantis*, qui in *Celebri Medicorum Museo* visitur, mittere non dedignaretur; qui *Petitioni* benigne annuens, optatum transmisit Exemplar, quare facta cum *Ossibus* Collatione Unanimi Consensu judicatum fuit, tam illa noviter reperta, quam in *Cimeliis* asservata *Elephantum* esse, & pro certo habuimus, illorum *Elephantum* fuisse,

quorum

Act. Med. Hafn. Tom. I. pag. 83, 84.

ib. Tom. IV. pag. 182.

Lib. VIII. Cap. 2. quorum *Plinius* meminit; Addit *Ciampinus*, varia deinde alia *Ossa Lapidefacta* *Dentesque Fossiles* collata Fuisse.
 & 6.

Non diffiteor, *Optime Magliabechi*, cum mihi de *Ossibus Tonnenfibus* cogitanti hæc in mentem redirent, primum inde ortum Consilium, rem totam tibi exponendi, quod spe tenerer haud infirma, *Litis Romanæ Sceletæ Mediceo* feliciter sopitæ Exemplo, nostram quoque terminari posse. Ratum interim firmumque esto, *Sceleton Elephanti Tonnenfis* pristinam *Ossium* Naturam Calcinatione Subterranea, Philosophicæ Analoga, maximam partem perdidisse, adeoque *Ossium* Calcinatorum instar Friabile esse, ac insigni Adstringendi Robore pollere. Equidem si *Ebori* nativo Adstringens vis est, quæ tamen Gustu non percipitur, ut *Aldrovandus* adnotavit quidni ea potius se exerat Linguæque adhereat in *Ebore*, tot Annis in Terræ Gremio latente, Calcinato & Maximam partem *Petrefacto*? Neque enim *Ossa Nostra* in *Lapidem* ita conversa sunt, ut nulla Osse Naturæ intrinseca remanserint Indicia, quæ *Examina Chymico* per ignem instituto extorqueri possunt. Id sane cum apud nos susciperetur, non solum in Vase Fictili, quod *Retortam* vocant, remanserunt frustula *Ossium* injecta, & Colorem Figuramque *Spodii*, & Odorem *Ossis Cornuque* adusti manifeste referentia; sed etiam *Plegma* vitreo Vase, cui *Recipientis* Nomen, exceptum, *Sal Volatile* Gustu, & *Oleum* Pinguedine tenui innatante prodiderunt. Postea Particulæ istæ *Ossium* in Figuli Fornace fortius Calcinnatæ, Albo Colore præditæ, Tubulos Striasque *Dentium Elephanti* aperte monstrabant; tam Elutriatæ & Inspissatæ, ut *Chymicorum* Vocabulis utar, tam in Sedimento, seu Lixivio, *Sal ChrySTALLINUM* continebant, quam in *Pblegmate* Saporem multo Acriorem Linguæ Gustandum præbebant, Oculis jucundo Spicularum *Salinarum* innatantium Spectaculo relicto. Quæ omnia quidem ex *Ossibus Cornubus* que Animalium quotidie eliciuntur, nulla tamen hujus Generis ex *Lapidibus*, *Margis* aut *Osteo Collis* erui possunt, cum *Lapides* ne Calcinnari quidem sese patientur, sed in *Calcem* Igne degenerent; cujus Rationem *Kircherus* in *Exigua Humiditate* quærit, qua fit, ut partes

Mund. Subt.

Lib. X. Cap. IV.

Spirituosæ Lapidum ob Sulphuris Pinguidinem partes *Fixas* in *Calcem* resolvant. Quis igitur amplius dubitaverit meæ subscribere Sententiæ, faterique, Vera *Elephanti Ossa Tonnae* reperta, sed Igne Subterraneo, quem satis prodit Odor *Sulphuris Terrestris* in *Pblegmate* Residuisque Particulis, Calcinata, & maximam partem *Petrefacta*? quæ Causa est, quod nec *Sal Volatile* nec *Oleum* ea Quantitate sperare inde liceat, quam *Ossa* Recentia suppeditant; idque magis, cum in his etiam, ex Medici *Angli Cloptoni Havers*, in novissima *Osteologia*, Observationibus, *Sal Volatile* vix Trigesimam, *Oleum* non multum ultra Vigessimam quartam, *Ossium* partem constituent; tantillum vero in *Ossibus Lapidefactis* fere absorptum, ejusque vix super esse Vestigia, quis iverit inficias?

Cæterum alius nonnullis Eximendus restat Scrupulus, qui negant, ullum in Rerum Natura *Elephantem* unquam fuisse, cui tantæ Magnitudinis *Ossa* convenient. Enim vero hos ego Jubeo securos esse, & *Indiæ Africae* que Itineraria adire, in quibus non solum Tantæ, sed Majoris etiam Proceritatis *Elephantos* reperient. *Hibernicus* quidem *Moulini*, ad cujus Normam

mam *Nostrum* sæpius exegimus, vix major fuerit *Antwerpiensi*, quem *Goropius Becanus* apud *Aldrovandum* accurate Dimensus est, ejusque Altitudinem octo *Pedum* reperit. In *Scelecto autem Hibernico* Longitudo *Ossis Innominati* est 25. *Femoris* 28, & *Tibiæ* 19 *Digitorum*, qui simul efficiunt 72. *Digitos*, sive *Sex Pedes*: his *Duos* addo *Pedes* pro explendo spatio, quod *Plantæ Pedum*, *Curvatura Dorsi*, *Cartilagines*, *Caro* denique & *Cutis* requirunt: indeque colligo, quam dixi, *Hibernici Elephanti Octopedalam* Altitudinem. Cum vero *Collatio* supra instituta docuerit, *Tonnensis Offa* ad minimum altero tanto majora fuisse, inde simul conficitur, *Sedecim* circiter *Sedum* Altitudine illum eminuisse. Hæc autem tantum abest, ut insolita sit, ut potius *Julius Cæsar Scaliger* *Exercitatione* 204. eandem diserte notaverit, ex *Indicarum Navigationum Scriptoribus* referens, *Elephantos Senum Denum Pedum* excedere Proceritatem. Sed dantur longe *Majores* *Joannes Jacobus Saar* in *Itinerario* refert certum *Mensuræ Genus*, *Gobdel* appellatum, *Tres partes Ulnæ* (*Norinbergensis*, ut arbitror, propter *Auctoris Patriam*) æquans, & *Trecentorum* sive *Quadringentorum Imperialium* *Prætio* æstimatum, cui *vendibiles Insulæ Ceylon Elephantes* subjiciunt, *Altitudine* 7. 8. 9. 10. & *undecim Gobdel*: neque *Majores* sibi visos esse. *Ulna autem Norinbergensis* 4 circiter *Digitis* superat *Duos* illorum *Pedum* quos hætenus adhibui: unde sequitur *Mensuram Gobdel* circiter esse 21. *Digitorum*, adeoque *Maximum Elephantorum Saario* visum, plusquam 19. *Pedum* *Altitudinem* habuisse. *Philippus Pigafetto* in *Descriptione Regni Congensis Africani* fidem facit, *Vestigia Maximorum ibi Elephantorum* in *Diametro* 4. *Spithamas*, quæ *Duos Pedes*, & 8. *Digitos* referunt, excedere; in *Elephanti Antwerpiensi* *Calcis* sive *Plantæ Imæ Diameter Pedis unius & Duorum*, paulo plus minus, *Digitorum* erat. *Collato utroque Diametro* *Deprehendemus*, *Maximorum in Africa Elephantum* *Altitudinem* 18. *Pedes* superare. Sed inde simul liquet, *Hodienuum Elephantos Judicos Africanis* *Majores* esse; quod *Aldrovandus & Bochartus* ex antiquis probant *Scriptoribus*. Nec dubito, quin ex *India* fuerit allata *Costa Elephanti*, quæ *Anatomico Academiæ Leidensis Theatro* ostenditur, juxta *Exteriorem Flexuram* 8 admodum *Pedes* longa, & ubi *Spississima* est, circa *Ossis Sterni Commissuram*, *Pedem unum* cum *tribus unciis* *Circuitu* suo implens, a *Theodoro Rickio* in *Oratione de Gigantibus* descripta; at *Longissima Elephanti Hibernici Costa* vix 32. *Digitorum* erat; cumque 8. *Pedes* 96. *Digitos* contineant, sequitur *Elephantum istum* cujus *Costa Lugduni Batavorum* servatur, 24. *Pedes* *Altitudine* æquasse; ac *Tales profecto ad minimum fuerint Elephanti Cosrois, Persarum Regis*, ab *Anonymo Arabe* apud *Bochartum* *Celebrati*: *Nonnulli duodecim Cubitos Proceri erant*, quod valde rarum est; quia plerique non superant 7. *Cubitos*. Si *Cubitus* in sensu *Vulgari* apud nos accipitur, vix *duos Pedes*, i. e. 24. *Digitos* æquat, eoque *Pactio* hi *Elephanti* ejusdem cum *Leidensi* fuissent *Proceritatis*: Sed mihi videtur *Cosroes Elephantos* suos *Dimensus Antiquis Persarum Cubitis*, a *Golio* in *Notis ad Alferganum* p. 74. 75, ex *Scriptore Arabi Geodætico* explicatis, quorum singuli *Digitos* 27. comprehendebant. Hoc autem modo quilibet istorum *Elephantum* fuisset *Altitudine* 27. *Pedum*. O *Stupendam vereque Rarissimam*

& Regio stabulo dignam illorum Proceritatem! Quam quicumque consideravit, *Tonnensem* nostrum, plusquam Dimidia parte Minorem, non adeo mirabitur.

Verum Unde tandem in has Terras, Collemque hunc Arenarium pervenit *Elephas* hic, solito saltem Major? Hæc sane Quæstio, *Eruditissime Magliabechi*, plurimas Curiosorum Conjecturas peperit, quorum alii a *Romanis Mercatoribus*, alii ab *Attila*, alii a *Carolo Magno*, alii a *Comitibus Glichensibus*, alii superiori Demum Sæculo, in hanc Regionem Delatum Tumulatumque finxerunt. At præterquam, quod earum singulæ suis laborant Difficultatibus, quas nunc enarrare supersedeo, omnes certe variis Argumentis simul infringi possunt. Cujusmodi est, quod *Eboris* usus Antiquissimos credere non permittit, Defosso ibi *Elephanto Dentes* Prestantissimos, ac Longissimos, haud fuisse ademptos; nec tantæ Proceritatis Bellua ex *India* vel *Africa* facile transferri Antiquioribus Temporibus, aut Recentioribus circumduci potuit; & ab aliis observatum est, non Seniores Ætate, sed Juniores, in *Europam* deportari; multo minus quisquam in Mortui *Elephantis* Gratiam tantæ Profunditatis, 24. *Pedum*, foveam fieri curaverit. Maximè autem illis adversatur ipsa Montis Arenosi Ratio, quæ diligentius inspecta nunquam se Perfossam, & deinceps rursus Repletam, manifestissime prodit. Primum stratum suppeditat Humus Atra 4 *Pedum*; succedit *Glarea Friabilis duorum & dimidii Pedis*, cujus Medium *Osteo collæ Tofaceique Lapidés duorum Pedum* altitudine explent, ut & sub ea *dimidii Pedis* spatium; sequitur *Argilla Arenosa* 6 circiter *Pedum*, in qua iterum *Osteo colla duorum Digitorum*, & infra unius *Pedis* Altitudine occurrit; hanc excipit alterum *Glareæ* stratum 6. circiter *Pedum*; eique demum subjacet *Arena Alba & Pura*, cujus Profunditas nondum explorata est, quod in ea, vix *Tres Pedes* effossa, *Elephanti Sceleton* apparuit. Enim vero si unquam perfossus injectoque *Elephante* repletus iterum fuisset hic Collis, minime strata stratis ordine imposita; sed omnia illa Arenarum genera Terræ Nigræ permixta inveniremus; ut quotidie in *Tumulis* Fodiendis fieri solet. Multo minus *Tofacei Lapidés*, in hanc duritiem coalescere, aut *Osteocollæ* Radices suas venasque, per totum Montem ad ipsum usque superficiem conspicuas, spargere, tantave Quantitate crescere, potuissent, ut statim in medio Primæ *Glareæ*, quæ Atram Humum proxime contingit, *duos Pedes*, & sub ea *Dimidium* explerent seque inferius in *Argillam* Arenosam extenderent, spatium *duorum Digitorum* & sub ea *Pedis unius* occupantes. Nihil igitur superest, præterquam *Universale Diluvium*, in quo Periit cum aliis sui Generis diversique Animantibus, *Elephas noster*, Undique immanibus Raptus & Jactatus, Aquis tandem decrescere incipientibus, fundum petiit; cui Aquæ ista diversarum Arenarum Strata induxerunt; iisque in superficie exsiccatis, *Atra* tandem *Humus* sensim accrevit. Quemadmodum enim *Diversa Arenarum strata* satis probant, Collem *Tonnensem* ex *Diluvio* Originem trahere; ita *Altitudo Terræ Nigræ* idem confirmat. Utrumque breviter ostendendum mihi video.

Prius faciam præclaris Observationibus, a *Nicolao Stenone*, Medico apud Vos quoque Celebri, in Dissertatione de Capite *Canis Carchariæ* Dissecto, cum *Myologia Specimini* adjecit, suppeditatis, quas tamen omnes describere vetat *Epistolæ Ratio*. Loquitur quidem ille præcipuè de *Aquatiliis* Animantium

tium *Partibus*, uti sunt *Ostreorum Testæ* & similia, cum & Terris Eruuntur: Sed nihil prohibet de *Terrestrium* quoque Animantium *partibus* eo modo *Effosis* idem pronuntiare. Etenim Colli *Tonnensi* applicari plane possunt, quæ *Steno* refert de Terra, unde Corpora hæc Eruuntur. Nam & iste quibusdam in locis durior est, *Tophumque* & *Osteocollam* continet, in aliis Mollior, *Argilla* *Sabuloque* refertus, compositus ex *stratis* sibi mutuo impositis, & ad Horizontem obliquis. Bene autem Arguit *Steno*; *Terram Mollem* spectat, cum eo *Molliora* sint Corpora illa, (nos *Elephantis nostri Ossa* subaudiamus) minusque contactum ferant, quo *Profundius* latent; tantum abest, Producat ea Terra, ut potius eadem destruat: Nec est, quod quis credat, ideo *Molliora* ea esse quia nec dum *Perfecta* sunt; quæ enim *Mollia* sunt, dum *Generantur*, quodam quasi *Glutine* unitas inter se *Partes* continent, [ut videre est in *Recentibus Pinearum & Amygdalorum Corticibus*:] at Hæc Corpora omni *Glutine* privata in *Pulverem* dilabuntur, adeoque *Mollities* ea *destructionis*, non *Productionis*, *Argumentum* videtur. Quæ in sequentibus disputat *Steno*, *Terram* istam non fuisse *Compactam*, cum prædicta Corpora ibi *Producta* sunt; eamque *Aquis* olim non solum *Tectam*, sed plane *Immistam*, imo pro *Aquæ* sedimento sensim congesto, habendum esse nullo *Negotio* ad *Collem Tonnensem* referri possunt: Mihi tantum *Excerptum* *Quædam* placet ex p. 211. 212. Quod *Argilla*, & *sabulum* *Aquæ* vehementius *agitata* immisceantur, præceptis *Torrentium* per id *Generis Terras* prolapsus, & *Aquarum* a ventis *agitatio*, notius reddidere, quam quod pluribus exponi mereatur. Nec pro' atu difficile est, in *Aquis Stagnantibus*, imo in *Limpidissimis Aquis*, *Sabulum* *Argillam*, & *Tophos*, omnisque generis *Solida* sæpius delitescere. Quis ergo amplius dubitaverit, *Collem Tonnæ Arenarium* ex *Diluvii Sedimento* superesse? Plura hanc in rem ex *Terræ* visceribus petita *Argumenta* suppeditat *Jacobus Grandius*, *Medicus Venetus*, in *Epistola* de *veritate Diluvii Universalis*, & *Testaceorum*, quæ procul a *Mari* reperiuntur, *Generatione*, e quibus tantum *Tria* priora excerptum juvat. I. In multis *Montibus Altissimis*, non solum *Europæ* & *Asiæ*, sed etiam *Africæ* & *Americæ*, extant certa *vestigia* *Maris*, quod illic *sedimenta* deponens *strata* produxit *uniformia*, & *Horizonti Parallela*, quod nulla *Ratio* suadet contingere potuisse, nisi *Tempore Diluvii* universalis. II. Idem *Testantur* *longissimi Terrarum Tractus*, *obducti variis Collibus Arenosis*, ex *Alluentis* & *Turbidi Fluidi* *sedimento* ortis, & *magnam* cum *Maris Fundo* *Similitudinem* habentes. III. *Magnæ Aperturæ Montium*, *Fluminum* atque *Torrentium* *Corrosione* factæ, ostendunt *diversa solida* ex *affuso* & *supernatante Fluido*, *diversis modis* *diversa Corpora* comprehendente atque *Lapidescente*, *producta*; *Itemque varia* *Sedimenta* sibi *invicem imposita*, *Veris Conchis*, & *aliis Marinis* *abundantia*.

Cæterum, de *Atra Humo* post *Diluvium* *Terræ* adnascente, multa *Peculiariora* observavit *Olaus Rudbeckius*, *Medicus Suecus*, Tom. I. *Atlantica*. Cap. VI. quæ aliis quoque *Doctissimis* probata *Viris*, nunc *Transcribere* nihil attinent: ad nostrum tamen *Collem Arenarium* si applicare placuerit, sciendum prius est, in illis quidem *Sylvæ Thuringicæ* *Montibus*, qui *Metalla* continent, & ex *durissimo* constant *saxo*, *Atram* istam *Humum* duorum circiter *Pedum* deprehendi, multoque *Tenuiorem* pro *Montium*

Declivitate: Aliis vero in locis quatuor *Pedes* æquare vel excedere, cum primum in Vallibus, quæ illam Pluvia ex Montibus ad se derivatam ex-
ciperunt. Quod uti facit ad *Rudbeckii*, desiderium, *Altitudinem Nigræ Terræ*
in Regionibus *Sueciæ* Calidioribus, & Pluvia copiosiori irrigatis nosse cupientis;
ita vicissim Ostendit, *Altitudinem* ejus quatuor *Pedum* in Colle *Tonnensi* à *Dilu-*
vii Tempore haud frustra derivari, indeque evinci, nullum *Elephantem* ibi
Postea sepultum esse. Quid autem vetat, his Exteris Medicis *Germanum* jun-
gere, *Hermannum Conringium*, qui in Conjecturis de Antiquissimo Statu *Helm-*
stadii & Vicinæ, Nostras quoque Regionis *Diluvio* inundatas probaturus, Tri-
plici potissimum Argumentorum genere pugnat, ex *Marinis Conchyliis*, *Ossibus*
Belluarum, & *Arboribus* sive Integris sive Partibus, quæ cum in Altissimis Mon-
tium jugis tum Sub Terra locis Profundissimis reperiuntur, petito: nec ea inter
præterit *Sudem in Sepis usum paratam*, *Cornu item uri*, quæ *Thuringi profun-*
dissimis Saxorum Cavernis reppererunt, quorum istam *Salze*, quæ vix unius Ho-
ræ spatio *Tonna* distat hoc in Monte *Seebergensi*, *Gothæ* Nostræ Vicino (unde
etiam *Conchyliis* elegantissima Eruuntur) extitisse memorat *Albinus* in *Misnensi-*
um Montium Chronico Tit. 22. n. 7. quibus addi forsitan merentur *Arborum*
Folia, *Lignorum Fasciculi*, & *Spicæ Culmis Adherentes*, quæ omnia *Petresacta*
in *Lapidicina Tonnensi*; non admodum procul à Monte nostro, Reperta sunt.
Singularis quoque est *Conringii* Observatio, his Verbis p. 37. expressa: *Sunt*
porro Arbores illæ fere omnes uno quasi eodemque collocatæ Situ, Radice nempe
inter Septentrionem & Occasum, Cacumine inter Orientem & Meridiem porrectis
cujus Causam non profecto ulla vere similitudine dixeris Jocantem Naturam. At
Prostratas Arbores à Paludosa Terra, per Oceani Septentrionalis Cæcia aut Cauro
Ventis agitati superjecta, id saltem quam simillimum est Vero: Præsertim quum
ex illa Cæli Plaga & illis Ventis Sævientibus, hodieque omni Germanicæ Mari-
timæ Oræ pericula Inundationum plerumque creari soleant. Novum hinc *Meæ*
Sententiæ accedit Argumentum, quoniam *Elephas noster Cornua* sua versus Or-
tum ac *Septentrionem* protendebat; & quanquam id paulo diversum videtur a
Conringiano, Notandum tamen est, tantum *Belluam* Mari Abreptam sese Va-
rie Movisse, *Arbores* autem Eodem, quo prosternuntur, Situ obrutas jacere.
Cæterum Elephantem Undis immanibus agitatum non mirum est, Situm plane
Extraordinarium Violentumque tandem acquisivisse, ejusque membra Putre-
facta latius extensa: nec alia forsitan de Causa *Dentes Exerti* sive *Cornua* In-
trorsum incurvata fuerunt, quanquam eorum situs in *Delineatione Capitis*
Hibernici apud *Moulinum* similis fere deprehenditur; accuratius procul
dubio expressus, nisi pleraque eorum pars *Adulta* fuisset; ut proinde po-
tius à Morte vel Putredine, quam Undis Fatalibus id derivandum vi-
deatur.

Mineral Maps;
by Dr. M. Lister.
M. 164. p. 739.

XXXVIII. We shall then be better able to judge of the Make of the Earth
and of many Phænomena belonging thereto, when we have well and duly Exa-
mined it, as far as human art can possibly Reach, beginning from the Outside
downwards. For this purpose it were advisable, that a Soil or Mineral Map,
as I may call it, were Devised. It might be Distinguish'd into Countries,
with the Rivers and some of the noted Towns put in. The Soil might either
be

be Coloured, or otherwise distinguished by Variety of *Lines* or *Etchings*; but the great Care must be, very exactly to Note upon the *Map* where such and such *Soils* are Bounded. As for Example in *Yorkshire*. 1. The *Woolds*; *Chalk*, *Flint* and *Pyrites*, &c. 2. *Blackmoore*; *Moores*, *Sandstone*, &c. 3. *Holderness*; *Boggy*, *Turf*, *Clay*, *Sand*, &c. 4. *Western Mountains*; *Moores*, *Sandstone*, *Coal*, *Iron-stone*, *Lead-Ore*, *Sand*, *Clay*, &c. *Nottinghamshire*; mostly *Gravel*, *Pebble*, *Clay*, *Sandstone*, *Hall-Playster*, or *Gypsum*, &c. Now if it were Noted, how far these Extended, and the limits of each *Soil* appeared upon a *Map*, something more might be Comprehended from the whole, and from every part, than I can possibly foresee; which would make such a Labour very well worth the pains. For I am of the Opinion, such *Upper Soils*, if Natural, infallibly produce such *Under Minerals*, and for the most part in such Order.

XXXIX. I have some Reason to think that *Sand* was once the most *Extensive* and *General Cover* of the Surface of the whole Earth: Because all our *Northern Mountains* are more or less *Covered* with it at this Day, and the Higher the Mountains, still the more, and the Courser the *Sand*: Because the Rivers arising in the *Mountains* do yet daily bring it down in great Quantities; and that it has been so in all probability, in all Ages, since the first Rains fell upon the Face of the Earth, seems to me to be Truth like, in that the Sea shores, or Mouths of Rivers, are usually *Barr'd* with it; Besides the *Sandy Sea grounds* in most places of the Sea; and which seems a clear Evidence for the length of Time) for that the Low-ground near these Rivers (which have been in all Ages upon Record, *Mosses*) if you pierce so Deep into them, as to discover their bottom, you meet with this *Mountain Sand* in great Quantities, and in some places a *Moss* under that, and the same *Sand-bed* under that. Now if we consider how long these *Mosses* or *Turf* is in growing, it being mostly the *Leaves* and *Roots* of Plants, we must allow very many Ages for this purpose. And although *Herodotus*, one of the most Ancient Historians that are, boldly conjectures that the *Nyle* in *Egypt*, long before our times, would be Dammed up and Useless by the great Plenty of *Mud* yearly brought down that vast River; yet it does not appear, that the Country is much Different from what it was in his Time; so that the *Sand* and *Mud* is still carried to Sea.

Another Argument of the *Sand's* being the *Universal Cover* of the face of the Earth is, from the great *Hardness*, and consequently the *Durableness*, and unalterable Quality of this *Mineral*, above any other in Nature. For though many things are Called *Sand*, from the smallness and little *Cohesion*, or *Dryness* of the Grains, yet this kind of *Mountain-Sand* above all others, keeps its Natural and Original Magnitude; and is not made (as most *Sand* is) by the Attrition or Wearing of one Particle of *Stone* against another, but is of a constant and durable Figure; and therefore, I say, it seems to me for this Reason, to be the most fit for an *Outside* or *Cover* to the Globe of the Earth.

Schemes of
Sands, &c.
Clays; by Dr:
Lister. n. 164.
p. 740.

It may be *Objected*, that the Uppermost Beds of *Stone* on the *High-Woolds* all over *England*, are soft *Chalk*, and on the smooth Surface no Appearance of *Sand*. This indeed is in part granted; but that there is no where any *Sand* upon the *Chalk Mountains*, is not true; for to instance in those *Inland Sand Hills* above *Bulloigne* in *Picardy*, which *Sand* is the very same with that on the *Sea-shore* at *Calais*, and although this is not *England*, yet the *Sea* hath but accidentally Divided us. For from *Dunstable* in *England*, even as far as the Walls of *Paris* by *Calais*, is, as it were a continued *Woolds* of *Chalk* and *Flint*. What difference there is betwixt the *Woolds Mountain sand*, and that of the *Northern Mountains*, will best appear in the *Table*. Now the Nakedness of the *Woolds* is from the smallness of its *Sand*, which readily yielded not only to the *Rain* that fell, but to the *Wind* also. Which is Evident from that vast Tract of *Sandy Hills*, which bound the Coasts of *France*, *Flanders*, and *Holland*, and which have made their Coast so *Shallow* in respect of ours, as being in great part blown off the *Yorkshire*, *Lincolnshire*, *Suffolk*, or *Essex*, and *Kentish Woolds*, and Wrapt up upon their Coasts; and the Reason of this is partly from the more constant *Westerly Winds* blowing over from our Coasts; and also from the Meeting of the 2 *Tides*, viz. That of the *Channel*, and that other of *North Flood* upon their Coasts.

I am very well aware, that the finding of *Cockles* or *Shells*, as most Writers are pleased to Call them, upon *Mountains*, and *Sand* also there, is by the same *Herodotus* used as an Argument of a great *Deluge*, or Inundation of Waters; but as I have elsewhere, I think, Demonstrated, that the *Rock Cocklites* are no *Shells*, so neither can I grant that the *Sand* was Adventitious to the *Mountains*, but Naturally Originated there; for that it is there plainly to be found, some Loose, and the rest in Beds, yet Unloosened, as I could name very many Places; for instance, on *Silden* and *Thorp Fells* in *Craven*, this *Mountain-Sand* is a White and Transparent *Pebble*; and as some of it is Small, and easily swept and blown away, so is there much of it upon the *High Mountains* mixt with White *Pebbles* of Greater size.

'Tis the Character of this *Sand*, not to Yield to Fire, as *Flint* will do; and though it Agree with that and some other *Metals* to strike Fire from *Steel*, yet it does not Calcine, as *Flint* will be brought to do. And therefore this *Sand* is the True *Tarso* of the *Italian Mountains*, of which the Fine *Venetian Glass* is made; and for this Reason the *Flint Glasses* were here in *England* ill compounded, the Foreigners mistaking the Materials, which yet our Country affords in Plenty, all over the *Northern*, and (I doubt not) the *Western Mountains* too: I have seen from the *Scotch Mountains* very Excellent and Large.

A Table of Sand (drawn up about the Year 1673.) Such chiefly as I have found in the Northern Parts of England.

Sharp, or Rag Sand, composed of small Transparent Pebbles, naturally found upon the Mountains, not Calcinable.

Fine

White

Stitneham Moor, in the Road wash'd up very White Pebble.

Flamborough Head, of which the Light House there is cemented.

Calice Sand; burns Reddish, but falls not in Water.

Fine

Grey

Seaton-Banks near Hartlepool, or the Tees Mouth; Eserick in the Gravel Pit there, A Vein of exceeding fine Sand.

Reddish

The Pillow Sand in the Baltick.

Brown

In a Spring at Heslington.

The Sand at the Bath in Somersetshire.

Sand

Acome near York; Drifted Sand.

Greisly

Hutton Moor Wash.

Throp Fells.

{ Owze at York.

{ Nid at Mountains.

Course

Dug up at Rawcliff near Snath.

Wharfe at Ickly and Denton.

Air at Carleton in Craven.

Eure at Bolton.

Brown

Gauton.

Santon in Lincolnshire.

Bromeby Common.

Skipwith Common.

{ At — in Yorkshire.

{ A Vein at Oswell-

{ Beacon in Lincolnsh.

Soft, or Smooth with Flat Particles.

{ From Lime-

{ stone with Mica of Glistening Par-

ticles.

Of Westmorland.

Silver-like.

Gold-like.

Sea-Sand about the Scilly-Islands.

In Cleveland and about Scarborough.

Ouze Dust, or Sediment, at Rawcliff.

A Vein of Mica in Hestington Gravel Pit.

Mica Argentea in Red Sand Rock near Rippon plentifully.

Mica Aurea of Cleveland.

Clay seems to be another Coat of the Terrestrial Globe in the more Depressed and Hollow Parts thereof. The mixture of Sand and Clay is not unusually called Earth: Yet this Term being too large it will be convenient, as I think, to Limit it to such a Mixture as we usually find upon the Surface of the Ground, which hath ever in it, besides such Sands and Clays, as either the Soil naturally Produces; or have by Floods and Winds, or other Accidents, been brought thither, a great part of the Rotten parts of Plants and Animals; And in this Sense Turf is Earth, which is mostly where the Erica or Heath grows, because 'tis made up of the Diciduous Leaves of that Plant, which being by the Current of Showers brought together, make up the Moors, Mosses, and Fens, and in the Mountains, in Hollow Basons or Depressures without Vent, Mosses of incredible Depth; 1. or 2. Fathom ordinarily in the same kind of Black Earth, called Peat or Turff.

A Table of Clays.

Pure, that is, such as is Soft like butter to the Teeth, and has little or no Greetiness in it.

Greasy, to be Reckoned amongst the Medicinal Earths, or Terre Sigillate.

1. Fuller's Earth

Yellowish { At Brickhill in Northamptonshire. At under the Yorkshire-Woods.

Brown, about Halifax.

White, in Darbyshire Lead-Mines.

2. Boli { In Cleveland.

At Linton upon Wharfe.

3. Pale Yellow, in the Marle-Pit at Ripley.

4. Cow-shot Clay, or the Soap Scale lying in Coal-Mines.

5. A Dark-Blew Clay, or Marle at Tolthrop.

Clay

Harsh and Dusty when Dry.

- 6. *Creta* properly so called, or the *Milk-White Clay* of the *Ile of Wight*.
- 7. The *Potter's Pale Yellow Clay* of *Wakefield-Moor*.
- 8. The *Blew Clay* of *Billingbrook Pottery* in *Lincolnshire*.
- 9. A *Blew Clay* in *Bugthorp Beck*, in which the *Astroites* are found.
- 10. *Yellow Clay* in the *Seams* of the *Red Sand Rock* at *Bilbro*.
- 11. *Fine Red Clay* in *Red Sand Rock* at *Bilbro* and *Rippon*.
- 12. A *Soft Chalky Blew Clay* } at *Buttercraim*.
- 13. A *Soft Chalky Red Clay* }

Clay } Stony when Dry.

- 14. A *Red-Stone Clay* } In the *Banks* of *Whitear-Beck*, near *Leppington*; and
- 15. A *Blew-Stone Clay* } at *Housam* in the *Mishfar*.
- 16. *Clunch*, a *White Stone Clay* in *Cambridgeshire*.

With Round Sand or Pebble.

- 17. The *Yellow Loame* of *Skipwith-Moor* in *Yorkshire*.
- 18. A *Red Sandy Clay* in the right hand bank of the *Road* beyond *Collingham* near the *Lime Kilns* going to —
- 19. A *Red Sandy Clay* in the *Red-Sand Rock* near *Rippon*.

Mixt

With Flat or Thin Sand, Glittering with Mica.

- 20. *Crouch White Clay* in *Derbyshire*, of which the *Glass-Pots* are made at *Nottingham*.
- 21. *Grey or Blewish Tobacco Pipe Clay* at *Hallifax*,
- 22. A *Red Clay* in the *Red Sand-Rock* at *Rotherham*.

X.L. These Wonderful Sands have not yet exceeded one Century, since they first broke Prison. Their Original is in a Warren in *Laken heath* (a Town belonging to the *Dean and Chapter* of *Ely*, distant not above 5 Miles, and lying *Southwest* and *by West* of this place); where some Great *Sand Hills*, (whereof there is still a Remainder) having the Superficies, or *Sword* of the *Ground* (as we call it) Broken by the Impetuous *Southwest Winds*, Blew upon some of the *Adjacent grounds*; which being much of the Same Nature, and having nothing but a *Thin Crust* of *Barren Earth* to Secure its Good Behaviour, was soon Rotted and Dissolved by the Other *Sand*, and thereby easily fitted to Increase the *Mass*, and to bear it company in this strange Progress.

A Sand-flood at *Downham* in *Suffolk*; by *Mr. Tho. Wright*. n. 37. p. 722.

At the First *Eruption*, I suppose the whole *Magazin* of *Sand* could not Cover above 8 or 10 *Acres* of ground, which Increased into 1000 *Acres*, before the *Sand* had *Travail'd* 4 *Miles* from its aboad. All the opposition it met with

in its Journey hither, was from one Farm-House, which stood within a *Mile* and a *half* from its first *Source*. This the Owner at first endeavoured to have Secured by Force and building of Bulworks against the Assaults thereof; but this Wing'd-Enemy was not to be so Opposed: Which, after some Dispute, the Owner perceiving, did not only Slight the former Works, but all his Fences, and what else might Obstruct the Passage of this unwelcome Guest, and in 4 *Years* Effected that by a Compliance and Submission, which could never have been done upon other Terms; In which he was so Successful, as that there is scarce any Foot-Steps left of this mischievous Enemy.

'Tis between 30 and 40 *Years*, since it first Reach'd the Bounds of this Town; where it Continued for 10 or 12 *Years* in the Out Skirts, without doing any Considerable Mischief to the same. The Reason of which I guess to be, that it's Current was then Down-Hill, which Sheltered it from those Winds, that gave it motion. But that Valley being once Past, it went above a *mile* (Up Hill) in 2 *Months* time, and Over-ran 200 *Acres* of very good Corn that same Year. 'Tis now got into the Body of this little Town, where it hath Buried and Destroyed divers Tenements and other Houses, and has inforced us to Preserve the Remainder at a greater Charge than they are Worth. Which doubtless had also Perished, had not my Affection to this Poor Dwelling obliged me to Preserve it at a greater Expence than it was Built. I have at last given it some Check; for by Stopping of it 4 or 5 *Years* (what I could) with *Furze* hedges set upon one another as fast as the *Sand* Levell'd them (by which I have Raised *Sand-Banks* near 20 *Yards* high) I brought it into the Circuit of about 8 or 10 *Acres*: And then in *One-Year* by laying some Hundred Loads of Muck and good Earth upon it, I have again Reduced it to *Terra Firma*, have Cleared all my Walls, and by the assistance and kindness of my Neighbours (who Helped me away with above 1500 Loads in one Month) Cut a Passage to my House through the Main body thereof.

At the other End of the Town divers Dwellings are Buried or Overthrown, and our Pastures and Meadows (which were very Considerable to so Small a Town, both for Quantity and Quality) Over-run and Destroyed: And the Branch of the River *Ouse* upon which we Border, (being better known by the Name of *Thetford* or *Brandon River*, between which Two Towns we Lye,) for 3 *Miles* together is so Filled with *Sand*, that now a Vessel with two Load Weight Passeth with as much Difficulty as before with 10. But had not the Stream interposed, to Stop its Passage into *Northfolk*, doubtless a good part of that Country had ere now been left a Desolate Trophy of this Conquering Enemy. For according to the proportion of its Increase in these 5 *Miles*, which was from 10 *acres* to 1500 or 2000; in 10 *Miles* more of the Same *Soil* it would have been Swell'd to a great Vastness.

It is Observable that the Situation of the Country, in which this Trouble-some Guest first took his Rise lyes E. N. E. off a part of the *Great Level* of the *Fenms*, and is thereby fully Exposed to the Rage of those Impetuous *Blasts* we

we yearly Receive out of the Opposite Quarter : Which I suppose acquire more than an Ordinary Vigour by the *Winds* passing through so long a Tract, without any Check. Another thing which Contributes to it, is, the Extream *Sandiness* of the *Soyl*, the *Levity* of which, I believe gave occasion to that Land-story of the *Actions* that use to be brought in *Northfolk* for *Grounds* blown out of the *Owners* Possession.

XLI. Besides the *Bolus Armenus*, and the *Terra Silesiaca*, there is an *Earth* found in *Hungary* about the River *Tockay*, thence called *Bolus Tockaviensis*, having as good Effects in *Physick* as either of the former. An Hungarian Bolus; by n. 1. p. 11.

XLII. *Soap Earth* is found only in two places near *Duraclea*, a large open Village, about 6 *Leagues* to the E. stward of *Smyrna*; and in a very Flat Plain, about a *League* Westward of the River *Hermus* and several *Leagues* from the Sea. 'Tis a Fine *Soap*, and at the first gathering *Whitish Earth*, which Boileth or shoots up out of the *Earth*. 'Tis gathered always before *Sun-rise*, and in Mornings when there falls no *Dew*, so that a Stock must be laid up for the whole Year in the Summer Months. It comes up in some places an *Inch* or two above the Surface of the *Ground*. But the Sun Rising upon it, makes it to Fall down again. Every Morning there is a New Crop, tho' all be taken away which the preceeding Day afforded. The *Earth* Producing it lies low in both places, and is in the Winter *Washy*; 'tis Cover'd, tho' but thinly, with *Grass*. The Soap-Earth from Smyrna; by Dr. Edw. Smith. n. 220. p. 228.

Three Hundred *Drams* of this *Earth* put into a *Retort in Balneo Arenæ* for 12 Hours *cum Igne Violento*, gave between 5 or 6 *Ounces* of an *Inspid Phlegma*, the Smell only such as Proceeds in such Operations from the Fire.

Finding therefore no *Volatile Salt*, as what must have come over by the foregoing Experiment; 200 *Drams* *Calcin'd* at a *Bagnio Fire*, in a *German Crucible*, were Dissolved in *Water*. The Composition of *Earth* and *Water*, Boil'd into a *Lixivium*, made 500 *Drams*.

It was Boil'd for 3 Hours, still Scumming off the Froth, then *Filtrated*, after *Evaporated* over a Gentle Fire, it was kept to *Chrystalize*, and appear'd of a *Fix'd Salt*.

At the *Soap Houses* they mix $\frac{3}{4}$ of *Earth* with $\frac{1}{4}$ of *Lime* and Dissolve the Composition in *Boyling Water*; where stirring it often with a Stick there Floats a Top a thick *Brownish* Substance, which *Scumming* off they preserve in *Balons* a part, and this *Scum* is much Richer than the *Liquor* underneath: yet both are used in making the *Soap*. Into a large *Copper Caldron* they put 50 *Kintals* of *Oyl*, applying a very Hot Fire, which Burns continually until the *Soap* is made: When the *Oyl* has Boil'd, they begin to throw in of the *Scum*, and sometimes of the *Liquor* from which the *Scum* was taken. They often Repeat this Throwing in of the *Scum* and *Liquor* for 13 or 14 Days, in which time the *Soap* is usually Perfected. The *Brownish Scum*, and what is useful of the *Liquor*, incorporating with the *Oyl*, what is uselefs Sinks to the Bottom of the Caldron, where it is let out to make Room for Throwing in

more. The *Water* thus let out is again Thrown upon a new Composition of *Earth* and *Lime*, but when the *Liquor* becomes wholly *Inspid*, 'tis then judged to be Exhausted. After 13 or 14 *Days* when the *Soap* is Finished, 'tis laded out of the Boiler, and laid upon a *Lime Floor* to Dry.

They proportion two *Load* of *Earth* of 5 *Kintals* each, to 50 *Kintals* of *Oyl*; the Produce is between 70 and 80 *Kintals* of *Soap*.

The *Earth* is bought at a *Dollar* a *Load*, and the *Soap* when this Account was made, at 6 $\frac{3}{4}$ a *Kintal*. There is employ'd in making *Soap* Yearly at *Smirna* 1000 *Kintals* of *Oyl*.

Bringing *Soap* *Earth* employs 1000, or 1500, *Camels* *Dayly* for 8 *Months*; the 4 *Summer Months* being too Hot for *Camels* to Travel.

An ordinary *Soap House* produces 1000 *Dollars* a *Year* clear Profit, *communibus Annis*.

XLIII. This *Black Earth*, which is call'd *Rusma*, and seems as if it were Burnt, must be Beaten in an *Iron* or *Marble Mortar* to a fine Powder, and Sifted diligently; when you use it take one part of the said Powder, and two parts of unslacked *Lime*, put these mix'd together into a *Linnen Rag*, which Infuse in *Warm Water* the Space of a *Quarter* of an *Hour*, or till it becomes of a *Black Colour*, then apply it to the Place from whence you would Take the *Hair*; as soon as the *Hair* begins to be loose, the Part must be Washed with *Warm Water* and *Soap*.

The Use of
Turkish Ru-
sma; by Mr.
Smith, n. 243.
p. 295.

XLIV. Within 5 *Miles* Northward of *Stony Easton*, there are 6 distinct *Coal Works*. The Chiefest Observables I met with in them are:

1. The *Branched Clift*, which usually lies over the *Coal*, and is all wrought with the *Representations* of Sundry Sorts of *Herbs*.

2. A *Clift* all Intervoven with *Arborescent Marchasites*, which commonly lies Over the Former, and is call'd by our *Colliers* the *Thorny Clift*.

3. We here Observe, that some *Coal Veins* are much more Tinged with *Sulphur* than others; a *Vein* being wrought in one of these Works some Years since, which received such a Resplendency from its *Sulphury Tincture*, that in all its Joynts it seem'd as though it were Cover'd with *Leaf Gold*, and hence by the *Colliers* it was call'd the *Peacock Vein*.

4. I may here take Notice that about 4 Years since in one of these Works was found about 2 or 300 Weight of very good *Lead Ore* growing to a *Vein* of *Coal*, the Ore being Tinged somewhat Yellow by the *Sulphur*: We look upon this as a *Rarity* with us, None ever having been found in a *Coal Pit* before; the *Sulphurous Spirit* being there generally too strong for the *Generation* of that *Metal*.

Coal-Mines in
Somersetshire;
by Mr. J. Beau-
mont. Ph. Coll.
n. 1. p. 6.

A Subterraneous
Fungus; by Mr.
Jeslop. n. 100.
p. 6179.

XLV. 1. The *Fungus Subterraneus* I sent you a large Quantity of, was gotten in a *Rocky Lime-stone Ground*, on a Common about two Miles distant from *Castleton* in the *Peak* of *Darbyshire*, 15 or 16 Yards Deep, in the *Old man* (as they call a Mine formerly wrought and Stopt up) cover'd with *Earth*, and that

that had either Fallen or was Thrown in. There is no *Coal-Bed*, that is known of, within 5 or 6 *Miles* of the Place.

2. The Pieces of this *Fungus* which I received, are much like, *Peats*, or *Turff*, cut up in the *High Moors*, both in the Sooty Colour and Inward substance; This only is more Clammy and Tough, and Dries not. And some of this *Fungous Substance* is very Soft and like Gelly, In and about the more Solid Pieces, (of which I have some, half a Foot square,) are many big Lumps of a *Bituminous Substance*. This *Bitumen* is very Inflammable like Rosin; it is very Light, it breaks Firm, and Shines like good *Aloes*; and for Colour it is not much unlike it, Save that it is more Dark Colour'd and Purplish; yet there is much of it of a Dark Green Colour. We Distill'd a parcel of it, which Yielded us an *Acidulous Limpid Water*; then a *White Liquor*, which was, I guess, from some of the Oily parts Precipitate; And in the last place, a Copious *Yellow Oil*, not unlike that of *Succinum*, or *Pitch*. In the Neck of the *Retort* we could discern no *Volatile Salt*, as in the like Process upon *Amber*. I have not Read of any such *Fungous Earth*, in which *Bitumen* naturally Grows and Adheres: And the finding of it in an *Old Mine* doth much favour an Opinion of its being a *Vegetable Substance*: either the very Substance of the Props of *Wood*, they make use of in Lining and Supporting the *Grooves*, thus Altered, or certain *Fungus's* Growing out of them. That *Birch*, (of which there is great Plenty, and hath been vast Woods, all these Mountainous Parts of *England* over) will yield a *Bitumen*, as *Limpid* as the Sap is which runs from it by tapping, if we now had the Skill to extract it, *Pliny* is very express *l. 16. c. 18. Bitumen ex Betula Galli excoquant*: And moreover it is certain, that much of that *Wood*, if not all, which is Dugg up in the *High Moors* of *Craven*, and which the People there call and use for *Candle Wood*, is no other than *Birch*, as it appears from the Grain and Bark; and yet this *Wood* Kindleth, Flames, and Exudates a *Rosin*, which makes many pronounce it very *Firr Wood*. Whatever this *Bitumen* is, which this *Fungus Subterraneus* Yields, it much Differs from the *Asphaltum* of the Shops.

By Dr. Lister.
ib. p. 6180.

XLVI. Mr. *Jessop* sends me word, that *Capt. Wain* has given him a *White Liquor* resembling *Cream* both in Colour and Consistence, which he found in great Quantities at the Bottom of a *Coal Pit* 49. Yards Deep. And *Mr. Geo. Planton* Writes from *Sheriff-Hales* in *Shropshire*, that in the *Iron-Mines*, especially that which the Country People there call the *White-Mine*, which yields the best *Iron-Stone*, the Miners do commonly, upon the breaking of a Stone, meet with a great Quantity of *Whitish Milky Liquor*, inclosed in the Center of it; they sometimes find a *Hogshhead* contained in one Cavity. 'Tis in Taste Sweetish; only it hath a *Vitriolick* and *Iron-like Twang* with it.

A Mineral
Juice; by Dr.
Lister. ib. p. 6181.

XLVII. In *Brosely*, *Bently*, *Pitchford*, and other Places adjacent in *Shropshire*, there lies over most of the *Coal-Pits* or *Mines*, a *Stratum* or Layer of a

A Blackish Stone
in Shropshire,
yielding Pitch,
Tar, and Oyl;
by Mr. Martin
Etc. u. 28. p. 5442.

Blackish Rock, or Stone, of some Thickness, which is Porous, and Contains in it great Quantities of *Bituminous Matter*.

This *Stone* being brought to the Work House is Ground small by Horse Mills, such as are used for grinding Flints to make Glass of; the Powder is thrown into great Coppers of Water, where by Boiling, the *Bituminous Matter* is Separated from the *Stony* or Gritty, this last sinking to the bottom, the other Swimming at the top of the Water.

This *Bituminous Substance* being Gathered together and Evaporated, comes to the Consistence of *Pitch*, and with the help of an *Oil* Distill'd from the same *Stone*, and Mixed with the *Pitch* comes to be Thinner, or like *Tarr*; the Uses of both which Materials, either for Shipping or otherwise, These Substances are said to supply, nay even go Beyond. And this has been Tried on several Boats this 3 or 4 Years past, and does not Crack as the ordinary *Pitch* or *Tarr*, but always keeps Black and Soft, and therefore is proposed to hinder the *Worm* from Getting into the Ships *Pitched* with it.

There is likewise Distill'd from this *Stone*, an *Oil* which may be used for *Oil of Petre*, or *Turpentine*, and has been Tried by divers Persons in *Achevor Pains*.

A Mineral Balsom in Alsatia; by n. 8. p. 135.

XLVIII In the Valley call'd *Jiberthal*, near *Geesbach*, (an ancient Mine work in *Alsatia*) there runs out of a *Cavern* a Foul, Fattish, Oily Liquor: Which affords an excellent *Balsom*, by taking a Quantity of it, and putting it in an Earthen Pot well Luted, that no Steam may Exhale; and then with a Gentle Fire at first, but a Stronger afterwards, Boiling it for 3 hours together, in which space it will boil in a 4th part, and an Earthen matter, like *Pitch*, will settle it self at the Bottom; but on the Top thereof, when cold, there will swim a Fatty substance, like *Line Oyl*, Limpid and somewhat Yellowish, which is to be Decanted from the Thick Sediment; and then gently Distilled in an *Alembick* in *Arena*; by which means there will come over two Differing Liquors, one *Phlegmatick* the other *Oily*, which Latter swimming on the *Phlegm*, is to be severed from it. The *Phlegm* is used as an excellent Resister and curer of all the *Putrefactions* of the *Lungs* and *Liver*, and it Heals all *Foul Wounds* and *Ulcers*. The *Oily* part, being Diluted with double its quantity of Distilled Vinegar, and brought 3 times over the *Helm*, yields a rare *Balsom* against all inward and Outward Corruptions, stinking *Ulcers*, Hereditary *Scurfs* and *Scabs*. 'Tis also much used against *Apoplexies*, *Palsies*, *Consumptions*, *Giddinesses*, and *Head aches*. Inwardly they take it with *Succory Water* against all *Corruptions* of the *Lungs*. It is a kind of *Petroleum*, and contains no other Mineral Juice but that of *Sulphur*, which seems to be thus Distilled by Nature under Ground; the Distillation of an *Oyl* out of *Sulphur* by Art, not being so easy to perform.

A Mineral Balsom in Italy; by S. M. Antonio Castagna. n. 79. p. 3059.

XLIX. In the Territory of *Bergamo*, Sig. *M. Ant. Castagna*, upon the Confines of his Jurisdiction, lighted accidentally upon a not ordinary sweet *Balsamick Scent*, which directed him to a Rocky Hill, where he found the Stones Harbour'd that *Fragrancy*, which was so strong, and by Trials found so Friendly to the

Uterus

Uterus, that being applyed they did in a very short time Cure it of any Evil, 'tis subject to. Encouraged hereby, he made his Workmen Dig into the very Bowels of the Hill, where he discovered Holes in some Stones, as if Excavated by Art, of a Greenish Colour, in which he found, as Distilled by Nature and kept in Vessels, that *Liquor* and *Balsom*, which proved the Source of that *Scent* which was *Limpid* and of a *White* Colour, like the White of an Egg, but somewhat *Oleaginous*, Floating upon all sorts of Liquors like *Oyl*. Besides, he met in the same Cavities some small Grains Concreted of the same Liquor, resembling that which they call *White Amber*; which being Chymically Distill'd, had the same *Odour* with the *Balsom*.

L I find that *Osteocolla* grows in a Sandy, yet not Gravelly Soil, and not at all that (I know) in any Rich or Clayie Ground. It Shoots down 2 Mens depth under ground; the Branches most commonly growing straight up, yet sometimes also they Spread side ways. The Branches are some of them Thicker, some Slenderer, and the farther they are Distant from the Common Stem, the Thinner they are; the Stalk being Thickest of all, usually equalling the Thickness of an ordinary Arm or Legg, and the Branches the Thickness of ones little Finger.

*Osteocolla about
Franckfort on
the Oder; by
John Christoph.
Beckman. n. 39
p. 771.*

Upon the Sand which is here every where Yellowish, there appears a Whittish, Fatty Sand, which if it be Dug into hath under it a Dark Fatty, and how Hot and Dry soever the other Sand be, a somewhat Moist and Putrid Matter, like Rotten Wood; which Matter Spreads it self here and there in the Earth, just as the *Osteocolla* it self doth, and is call'd by those whom I have employed to look for it, the *Flower* of this Substance. The *Osteocolla* being thus Found, is altogether soft yet rather Friable then Ductil. Wherefore if one hath the Curiosity of getting out of the ground a Whole Piece of it with its Branches, he must very carefully remove the Sand every way from it, and then let it lye so a while; its Quality being, that Remaining exposed to the Sun for half an hour or somewhat longer, it grows to that Hardness as 'tis found in the Shops.

It seems to be a kind of *Marle*, or to have great Affinity with it; of which we here have also great Store, yet not near those Places where I have found *Osteocolla*. It requireth also time to come to Maturity, which appears from hence, that in the very same Place, where I digg'd some of it Last Year, I this Year found Other, yet with this Difference, that those grew Hard, after the manner before described, but these remain still soft and Friable, though now in the 5th Month.

The Cause of its being Divided into so many Branches, I conjecture to be from the Roots, which Spread themselves here and there in the Earth, so that the Matter Gathers and Setleth its self about them, and afterwards according to the Division of the Roots, acquires a *Plantal* Form and Appearance. Whence it seems also to proceed, that through the Midst of the *Osteocolla* there always passeth a *Dark Line*, which is thought to be a piece of the Root. And it often happens, that that *Stroke* looseth it self by little and little, and the *Osteocolla* in the Middle

grows

grows *Clear*; which comes to pass when the Root by the corruption begun in the *Osteocolla*, is Reduced to Powder. Yet have I found a place hereabout, where the *Osteocolla* was not Hollow at all; but there I observed, that instead of setting about a Big Root, it had Gathered it self about many small Fibres; whence also this sort had acquired Pores through its whole Length, but no Cavity like the other.

Black-Lead; by
Dr. Plot. n. 240.
p. 183.

LI. The Mineral substance call'd *Black Lead*, found only at *Keswick* in *Cumberland*, and there call'd, *Wadt* or *Kellow*; by Dr. Merret, *Nigrica Fabrilis*, from its use in scoring, as the *Rubrica Fabrilis*, or the *Red Ochre* is; is certainly so far from having any thing of *Metal* in it, that it has nothing of *Fusion*, much less *Ductility*; nor can it be Reckoned amongst the *Stones*, for want of *Hardness*; it remains therefore that it must have place amongst the *Earths*, tho' it dissolve not in *Water*, as most *Earths* will, except *stiff Clays*, and *Ochres*; among the Latter whereof I guess it may be Reckoned, it seeming to be a sort of *Close Earth*, of very fine and Loose Parts, so *Burnt* that it is become *Black* and *Shining*, *Discolouring* the *Hands*, as all the *Ochres* do; whence the most Proper Name that can be given it perhaps, may be *Ochra Nigra*, or *Black-Ochre*, being a *Stony* sort, as there are *stony* sorts of the *Red* and *Yellow-Ochres*, as well as *Clay*.

Irish-Slate; by
..... n. 243.
p. 271.

LII. It having been discours'd to the *Philosophical Society* at *Oxford*, by Mr. *Hemwick* Physician at *Worcester*, that the *Irish-Slate* Pulveriz'd, and infused in *Water* for a *Night* or less, would impart its *Vitriolick* Quality so far forth to it, that it would strike of a *Faint Reddish* Colour with Powder of *Galls* (as the *Vitriolick Waters* of *Tunbridg*, *Astrop*, and divers others do) it Led me to Believe that these *Waters*, some of them, might as well issue from *Salt* as an *Iron-Ore*; unless it should appear, that this sort of *Slat* were an *Iron-Ore* too, which put me upon *Calcining* it for 3 or 4 *Hours* after the Manner of Dr. *Lister*, to Experiment whether it would then (like other *Iron Ore*) Apply to the *Magnet*; wherein altho' I was altogether *Unsuccessful*, the *Magnet* not taking the least Notice of it, yet it afforded me another *Discovery* altogether as satisfactory viz. that upon *Torrefaction* it was all become a *Yellow Ochre*, and would *Score* like it; which further perswades me, that the *Yellow*, or rather *Orange Colour'd Sediment* we find at the Bottom of These *Fountains*, comes rather from this sort of *Slat*, than an *Iron-Ore*; for I much Question, whether some of the *Yellow Ochres* (tho' its plain the *Red* ones do) come from, or are, *Iron Ores*, because the *Shotover Yellow Ochre* will not Own the *Magnet* after 36 *Hours* *Calcination*, or better.

Chalk and some
other Bodies not
Properly *Stones*
though commonly
Reputed so;
by Dr. Fred.
Slare. n. 182.
p. 144.

LIII In a small Treatise of the *Calculus Humanus*, I found reason to complain of the Imposition of our Senses upon our Conceptions, in Calling that a *Stone* by its External Appearance, when it has no Real Properties of a *Stone*. I have also, in this, Reason to except against *Chalk*, commonly taken for a *Stone* (for being brought to the *Hydrostatical Examen*, (if that may be allowed as a *Standard*) it wants much of the True Consistence of a *Stone*, For it

wants

wants much of that *Weight*, which *Real Stones* are proved to have in *Water*, and it may perhaps be better reckoned amongst *Boles* than *Stones*. I found this True not only in *Chalk*, but various other Bodies taken for granted to be *Stones* at large: Some of which are nearer *Earths* than *Stones*, others have nothing but *Earth* and *Sulphur* and *Metals*, and yet must be called *Stones* (as all *Marchasites* are; Of these the former, (namely the *Boles*) many of them fall short of our *Standard* of *stone*, others are more ponderous, and so exceed our *Standard*, whereas true *stones*, though differing much in *Hardness*, whether *Pebbles*, *Flints*, *Petrified Waters*, &c do Answer the same *Standard* of *specifick Gravity* that a *Diamond* does; which is, as about $2\frac{1}{2}$ to 1.

LIV. Upon the River *Done* near *Aberdeen*, a little below the *Bridge* near the River's Mouth, there is a *Bank*, the Face of which is Broken down, and it is full of *stones* which one would think were *in fieri*; They are all either *Round* or *Oval*, of different *Sizes*; the *Faces* of most of them are Broken off; they are *soft* and will easily rub down with your *Hand*; They are of different *Grits* and *Colours*, and are made up of different *Sands* and *Clays* Mingled together; the *Clay* is soft both to *Hand* and *Taste*, in some of them *White*, in others *Gray*, tho' in some places the *Clay* and *Sand* are *Hardened* to the *Consistence* and *Colour* of such *Oval stones* as we usually see in the *Fields*; but where they are at the *softest*, the *Bed* that each *stone* lies in, is always *Hard*, and of another *Grit* and *Colour*.

Imperfect Stone
in Scotland, by
Dr. George
Garden. n. 175.
p. 1157.

LV. There is an Excellent *Quarry* within Canon shot of *Maestrich*, lying in a *Hill*, where there are about 25 *Fathoms* of *Rock* and *Earth* over Head; it hath one *Entry* towards the River *Maese*, where *Carts* can pass with great ease, and unload the *stones* upon the *Brink* of the *River*, the *Quarry* within being parallel to the *Horizon*, and Elevated but very little above the *River*. It affords one of the most surprising *Prospects*, when well lighted with many *Torches*, that one can imagine. For there are *Thousands* of square *Pillars* in large level *Walks*, and those almost every where, above 20, and in some places many more *Foot* high; and all wrought with much *Neatness* and *Regularity*.

A Stone Quar-
ry near Mae-
strich, by-----
n. 67. p. 2051.

This *Quarry* serveth the *People*, that live thereabout, for a kind of im- pregnable *Retreat*, when *Armies* March that way. For being acquainted with all the *Ways* in it, they carry into it whatsoever they would have safe as well their *Horse* and *Cattle*, as their moveable *Furniture*, till the *Danger* be over; there being so vast a deal of *Room*, that 40000 *People* may shelter themselves in it.

In this vast *Grotto* 'tis Remarkable, that there is but little *Rubbish*: Which shews both the goodness of the *Stone*, and the Carefulness of the *Work men*. And in diverse places there are little *Pools* of *Water*, perhaps made on Purpose for *Beasts* to drink, and to serve for other *Uses* in time of *Need*: For in no place almost are there any *Droppings* to be seen; nor are the *Walks* at all Wet under *Foot*; only it seems, that *Rain* gets in by the *Air shafts*, which for saving of *Labour*, and perhaps too, to make these *Pools*, are let down
from

from such Places commonly, as are the *Pools* thereabout; and so the Rain, that falls on the Higher Grounds, does easily find the Way thither.

Quarrys and
Rocks in Au-
stria and Hun-
gary, &c. by
Dr. Edward
Brown. n. 59.
p. 1050.

LVI. Upon the North side of Mount *Calenberg*, two German Miles from *Vienna*, are *Stones* marked with *Trees* and *Leaves*, In the *Hermitage* of the *Carmaldulenses*; seated upon a Peak of this Hill, I saw fair ones, with which they Paved the Walk in their Gardens.

Not far from *Manners-dorf* is the *Emperour's Quarry of Stone*, out of which are made the best Buildings in *Vienna*: In which, wheresoever there is a Cleft or separation of one Stone from another, the *Water* falling betwixt them, leaves a *Petrification*, thereby, as 'twere, Healing the *Wound*, by making a *stony Callus*, not exactly like the Parts which it joins together.

An English Mile from *Freistat* in *Hungary*, Northward, is a Quarry of *stone*, out of which many great stones are digged, *Transparent* and resembling *Sugar candy*.

At *Banca*, two Hungarian Miles from *Freistat*, Northward, is a Quarry of *White stone* nigh the *Hot Baths* of that place, over which is a lay of *Chalk* of about a Yard thick, very *Beautiful* to the Eye, as being of all Colours, except *Green*; so finely mixt, streaked and shaded, that it surpasseth *Marble-Paper*; and the *Water* Dropping upon it, doth as 'twere *Varnish* it.

At *Schemnitz* in *Hungary*, famous for *Silver Mines*, is an high Perpendicular Rock, part of which, from the Top to the Bottom, is naturally *Tintur'd* with a shining fair *Blew* and *Green*: And I have heard from a *Spaniard*, who lived long in the *West Indies*, that there is also a Rock like this nigh to the *Silver Mines* in *Peru*.

The Mountain of *Cliffura*, being a part of Mount *Hæmus*, as also Mount *Pyrlipe* do shine like *Silver*, and Day and Night, either by the Light of the Sun or Moon, afford a Glittering pleasant shew, caused by the great Quantity of *Muscovy-Glass* wherewith these Hills abound. There are also *Talcum Rocks* nigh *Spital* in upper *Carinthia*: And a Hill nigh *Sarvizza*, which consists of an *Earth* of a fine *Red Colour*, out of which the *Red Earthen Vessels* of that Country are made.

White Marble
in Ireland; by
Dr. Ash. Bishop
of Cloyne.
n. 243. p. 294.

LVII. A Quarry of *White Marble* is lately discovered in the County of *Antrim*; and tis of an extreamly fine Grain, soft at first, but grows very hard afterwards, like *Portland Stone*.

Stones Growing
at the End of a
Rush; by Sir
R. Redding.
n. 198. p. 663.

LVIII. I send you herewith some *Stones* of an *Amber Colour*, taken out of a Spring called *Cranbourn Spring* near *Lough-Neab*, which the Country People tell us Grow at the End of a little *Rush*, and drop off, and are to be found only on *May-day Eve*, and good for God knows what: They look like the *Germinations* of some of your *Salts*, but in the *Fire* shew no Signs thereof by *Crackling*: They are *Electrical* and angular, and being pounded the Powder is *White*.

LVIII. I send

LIX. 1. The Highest *Icy Mountains* of *Helvetia*, about *Valesia* and *Augusta*, in the Canton of *Bern*, about *Taminium* and *Tavetsch* of the *Rhætians*, are always seen covered with *Snow*. The *Snow* melted by the Heat of the *Summer*, other *Snow* being fallen within a little while after, is hardened into *Ice*; which by little and little, in a long Tract of Time depurating it self, turns into a *Stone*, not yielding in Hardness and Clearness to *Crystal*. Such *Stones* closely joined and compacted together, compose a whole *Mountain*, and that a very firm one; though in *Summer* time the *Country People* have observed it to Burst asunder with great *Cracking*, Thunder like. Such *Cracks* and *Openings* being by the *Wind* covered with *Snow*, are the Death of those that pass over them.

The Icy Mountain Gletscher, by M. Muraltus. n. 49. p. 282.

At the Foot of these *Mountains*, are with great labour digg'd out *Crystals*, which are found among other *Fossiles*, of two sorts and Colours; some of them are *Darkish* and *Troubled*, which by some are call'd the *Crystal-Ore*, to be plenteously found in the Ascent of *Mount Gottbard*; others *Transparent*, very *Pure*, and as Clear as *Venice Glass*, *Sexangular* both great and small; as in the *Mountains* about *Valesia*, and the *Town* call'd *Urselen*, at the Foot of the Hill *Schelenin* they are digg'd out, and Sold at a good Rate; one particularly for 80 *l. Sterling*.

2. This *Icy Mountain* call'd the *Gletscher*, is very high, and Extends it self every year more and more over the *Neighbouring Meadows*, by *Increments* that make a great *Noise* and *Cracking*. There are great *Holes* and *Caverns*, which are made when the *Ice* Bursts; which happens at all times, but especially in the *Dog-days*. Very little of the *Surface* Melts in the *Summer*, and all freeze again in the *Night*. When the *Sun* shineth, there is seen such a variety of Colours as in a *Prism*.

By---- to Mr. Justel. n. 100. p. 6191.

At the Foot of the *Mountain*, a *Rivolet* issues forth from under the *Ice*, which is pretty *Deep* and extremely *Cold*.

There is such another *Mountain* near *Geneva* and upon the *Alps*. A certain *Capucin* told me, he had been upon the Highest of these *Mountains* with a *Trader* in *Crystal*, who having driven his *Hammer* in one of these *Rocks*, and found it *Hollow* and *Resonant*, made a *Hole* into it, and thence drew forth a *Substance* like *Talk*; which to him was a *Sign* there was *Crystal*. After which he made a great *Hole* with *Gunpowder*, and found *Rock Crystal* in it.

LX. Being in the *Val Sabbia*, at a Place call'd *Le Mezzane*, where I knew that *Crystals* are Generated, I observed in a spacious round of a *Meadow*, seated on a *Hillock*, some narrow places bare of all *Herbs*, in which alone, and no where else thereabout, *Crystals* are produc'd, being all *Sexangular*, both Points of them Terminating in a *Pyramidal Figure*, *Sexangular* likewise.

The Formation of Crystals; by P. Francisco Lanna. n. 83. p. 4068.

I was told, that they were Produc'd from the *Dews*, because (forsooth!) being Gathered over *Night*, the next *Morning* there would be found others at such a *Time* only, when it was a *Serene* and *Dewy Sky*. But when I had Examined, that in the *Neighbourhood* of that *Hill*, there was no *Mark* at all of any *Mines*, I did conclude that it might be a plenty of *Nitrous Steams*, which might withal

hinder *Vegetation* in those Places, and *Coagulate* the *Dew* falling thereon; for *Nitre* is not only the Natural *Coagulum* of *Water*, as is manifest in *Artificial Glaciations*; but also it ever Retains the abovesaid *Sexangular* Figure, altogether like that of these *Crystals*. Which may also be the very Cause of the *Sexangular* Figure in *Snow*; this being nothing else but *Water* Concreted by its natural *Coagulum*, which is a *Nitrous Exhalation*. And to make it yet more Manifest, that these are indeed Expirations of *Nitre*, I digg'd up some of the *Earth*, and Drew a *Salt* from it, which had both the Taste and Figure of *Nitre*; though some Grains of it were of a *Square*, others of a *Pyramidal* Figure. And since these *Crystals* are only found in those Narrow places, we may very probably infer, that from thence are raised the *Exhalations*, which do Concrete the *Dew*; after such a Manner as the *Vapour* or *Exhalation* of *Lead* *Coagulates* *Quicksilver*.

An odd figured
Iris; by Dr. Lister.
n. 110.
p. 222.

LXI. I have not observed any Rock or sort of Stone, whether Metalline or more vulgar, which hath not its different sort of *Sparr* both for *Colour* and *Figure* shot in some part or other of its Bed or Seams. I have one of a very curious *Figure*, which is very common in our *Blew Lime-stone* Rocks, in *Yorkshire*, out of which Plenty of *Lead-Ore* is got. They are mostly of a *Black-Water*, like the *Black Flint* in *Chalk-Hills*; but there are of them, which have a *Purplish* or *Ametystine* Colour; and some there are as clear as *Crystal*. They adhere to the Seams of the *Rock*, be it betwixt Bed and bed, or wherever there are *Cross* and *Oblique Veins* through the very substance of the Bed. The smaller the *Veins*, the less the *Iris*. You will find of them as small as *Wheat Corns*, and others an *Hundred* times bigger. They shoot from both sides the *Seam*, and mutually receive one the other.

They are *Figured* thus, *viz.* a Column of 6 plains very unequal as to the Breadth; the End Adhering to the *Rock* is always *Rugged*, as a thing Broken off; the other End of the Column consists of three *Quinquangular* Plains, very little Raised in the middle: These Plains too are very unequal. Let them hug one another, or be any ways Streightned and Compressed in their shooting; yet the Number of Plains mentioned, both of the Column and Top, is most certain. The Places where Infinite of them may be had, are *Rainsborough Scarr* upon the *Ribble*; also in a stone Quarry near *Eshton Tarpe* in *Craven*.

Transparent
Pebbles; by Dr.
Lister. n. 201.
p. 778.

LXII. These *Transparent Stones* are of a Constant shape; and in some Antient Leases of *Royal Mines*, they are called *Rough* or *Mineral Pearl*, being Resplendent and bright, and figured like a drop of *Water*. Some of them are exactly *Spherical*, others like a *Half Globe*, others like a *half Oval*, with an Edge raised on the top. It was not without Reason that they were Esteem'd by the Antients: For their *Natural Polish* is not to be *Counterfeited*, but very easie to be Distinguisht with a *Microscope*, from the *Artificial Polish* of *Glass* and *Crystals*. Now *Gold*, *Silver*, *Diamonds* and *Pearl*, are for no other reason Estimable, but because they have certain indelible Characters, which all the Subtily and Wit of Man hath not yet been able to counterfeit, notwithstanding many pretences thereunto; as *Gold*, for example, that it will endure the drowning in *Antimony*; *Silver*,

ver, that it abides the *Test* of *Lead*; *Diamonds*, for that of themselves, even without a *Foil*, they cast a *Lustre*; *Pearl*, is Valued, because of its *Figures* and Peculiar brightness not to be Imitated.

These *Stones* are of the *Pebble-kind*, that is, not to be *Calcined* by Simple fire; whereas most other *Figured Stones* are *Calcinable* with a very easy Fire. They are very *Hard* and *Solid*, and do not consist within of *Laminæ* or *Flakes*, but break every way with great *Difficulty*, and *Naturally* throughout *Smooth*.

Their *Figure* comes nearest that of the *Ombriæ*; and many of them are very *Ombriæ* in Shape. Other *Transparent Ombriæ* I have seen, which yet are either very *Flints*, or of a *Flaky* and soft *Contexture*, of the nature of *Selenites*; and such are to be found about *Filo briggs*, a *Noted Set* of *Rocks* near *Scarborough*.

As these *Stones* are of a very *Different* nature and *Texture* from all other *Ombriæ*, I ever yet saw, and having no *Vestigia* of any *Spinæ* in any part of them, I may reasonably enough *Conclude* them to be *Stones* of *their own Kind*.

I am not *Adverse* to think, after so *Manifest* and *Considerable Discoveries* as *Augustino Scilla* hath made in *Sicily*, that most of the *Ombriæ* have been *Echini*; and yet some of the *Prickled*, which *Naturalists* have hitherto call'd *Lapides Judaici*, may have belonged to some of those *Ombriæ*. But there are only 2 or 3. *Echini* yet discovered, either in *Ours* or the *Mediterranean Sea*: Whereas of the *Ombriæ* of *Europe*, besides these present *Anomalous Stones*, there are at least 20 *Species* *Figur'd* and *Describ'd* by *Aldrovandus*, *Augustino Scilla*, *Dr. Plot*. &c. and in vast quantities in most *Counties* of *England*: And I doubt not many more *Species* will yet be found out. All which are to be accounted for; as to the *Natural places*, in what *Seas* they are to be found at this *Day*. And if not in the *European*, as I think they will not, how and whence they came hither into this *Island* in such *Plenty*.

LXIII. 1. Amongst the *Excellent Diamonds* brought from the *East-Indies* by *M. Tavernier*, there is one weighing $112\frac{3}{12}$ *Carats*, of a very *Fine Violet* colour, and *Two* of a *Rose-Pale* colour; all three of an *Adamantin Hardness*, and upon that account esteemed *Diamonds*.

Diamonds; by
n. 102. p. 26.

2. The *Parts* of the *World* known to contain *Diamonds*, are the *Island Borneo*, and the *Continent* of *India extra & intra Gangem*: *Pegu* is likewise *Reported* to have several, but the *King* contents himself with his *Mines* of *Rubies*, *Sapphires*, *Topasses*, *Emeralds*, *Gold*, *Silver*, *Brass*, *Tin*, and *Lead*.

By the *E. Mar-*
shall of Eng-
land. n. 136.
p. 907.

The *Diamond Mines* on the *Coast* of *Coromandel* (of which I have visited several) are generally adjacent to *Rocky Hills*, or *Mountains*, whereof begins a great *Ledge* or *Range* near *Cape Comorin*, extending in *Breadth* about 50 *English Miles*, some *Conjoyning*, others *Scattered*: and running thence in *Length* quite through *Bengala*. In, among, and near these *Hills*, in several places, are known to be (as it is believed most of them have) *Mines*.

The Kingdoms of *Golconda* and *Vijapore* Contain in them scope enough of Ground, known to have *Mines*, sufficient to furnish all the World plentifully with *Diamonds*; but their *Kings* permit digging only in some Places appointed, lest as it is Imagined, they should become too Common; and withal for fear of Tempting the Threatning Greatness of *Aurenge Zebe*; forbidding also those places that afford the Largest *Stones*, or else keeping Workmen in them for their Own Private uses.

1. In the Kingdom of *Golconda* (as near as I can gather from the best acquainted) are 23 *Mines* Now Employed, or that have been so lately.

Quolure was the First *Mine* made use of in this Kingdom. The Earth is somewhat Yellowish, not unlike the Colour of our Gravel dryed; but Whiter in some places where it abounds with Smooth Pebbles, much like those that come out of some of our Gravel-Pits in *England*. They Use to find great Quantities in the *Vein*, if it may properly be so call'd, the *Diamonds* not lying in Continued Clusters, as some imagine, but frequently so very Scattering, that sometimes in the space of $\frac{1}{4}$ of an Acre of ground, Digg'd between two or three Fathoms Deep, there hath been nothing found; especially in the *Mines* that afford *Great Stones*, lying near the Superficies of the Earth, and about three Fathoms Deep. The *Diamonds* found in these *Mines* are generally well shaped, many of them *Pointed*, and of a good Lively *White Water*; but it also produces some *Yellow* ones, some *Brown*, and of other Colours. They are of Ordinary Sizes, from about 6. in a *Mangelin* * (of which they find but Few) to 5 or 6. *Mangelins*, each; some of 10, 15, 20; they find but Rarely. They have frequently a Bright and *Transparent Skin* inclining to a *Greenish* colour, though the Heart of the Stone be purely *White*; but the *Veins* of these *Mines* are almost Worn out.

* A *Mangelin* is four grains in weight, saith *Linschoten*.

2. The *Mines* of *Codawillikul*, *Malabar*, and *Buttepallem*, consist of a Reddish Earth, inclining to an Orange Colour, (with which it stains the Cloaths of the Labourers that work in it;) they Dig about 4 fathom Deep. They afford *Stones* generally of an excellent *Water* and *Crystalline Skin*; smaller sizes than those of *Quolure*, *Ramiab*, *Gurem*, and *Muttampellee*; have a Yellowish Earth, like *Quolure*; their *Stones* like those of the Two Former *Mines*, but mixt with many of *Blew Water*. These 5. *Mines* being under the same Government with *Melwillee*, where the Governour Resides; He has lately Forbid their Use; and commanded all to Repair to his Residence.

Currure (the most Famous of them all and most Antient) has been under subjection of the King of *Golconda*; but about 25. Years ago was taken, with the Country of *Karnaticum*, from the *Hundue-Rajaes*, by the *Nabob Meer Jumla*. In it have been found *Diamonds* of a *Seize Weight*, which is about 9. *Ounces Troy* or $8\frac{1}{2}$ *Pago's* weight. It is only Employed by the King for his own Private use: The *Diamonds* that are found in it, are very well spred, Large stones (it yields few or none small,) they have generally a *Bright Skin*, which inclines to a pale *Greenish* colour, but within are purely *White*. The Soil is Reddish, as many of the others.

About

About 60. or 70. years ago, a *Portugueze* went thither from *Goa*, and having spent in Mining all that he had, even to what wearing Clothes he could spare, while the Miners were at work for the Last Days expence, he had prepared a Cup of Poyson, resolving if that Night he found nothing, to Drink his Last with the conclusion of his Mony; but in the Evening the Workmen brought him a very Fair spread Stone of 20 *Pago's* weight; in Commemoration whereof he caused a great stone to be Erected in the Place, with an Inscription engraven on it, in the *Hundues* or *Tellinga Tongue*, to the following effect, which remains to be seen till this Day;

*Your Wife and Children Sell, Sell what you have,
Spare not your Cloaths, nay, make your self a Slave.
But Money get; then to Currure make haste;
There Search the Mines, a Prize you'l find at last.*

Not far from *Currure* are the *Mines* of *Lattawaar* and *Ganjeconta*, which are in the same Soil as *Currure*, and afford stones not Unlike: But *Lattawaar* hath many Representing the great End of a Razor blade, Thin on one side and Thick on the other, very *White* and of an Excellent *Water*; but the best of the *Mine* is worn out, and *Ganjeconta* employed only to the *King's* Private use.

Fonagerre, *Pirai*, *Dugulle*, *Purwillee* and *Anuntapellee*, consisting also of Red Earth, are now Employed and Afford many Large stones; part of them of a *Greenish Water*; but the most absolute *Mines* are of *Wazzergerre* and *Munnemurg*, (the other rather Representing Pits than *Mines*;) for there they Sink through High Rocks till they go so far below their Basis, that they can go no further for Water, in some places 40. or 50. *Fathom* Deep. The superficies of the Rocks consists of Hard, Firm, White stone, into which they cut a Pit, like a Well, of about 4 or 5. in some places 6. *Foot* Deep, before they come to the Crust of a *Mineral Stone*, like the *Mineral* of *Iron*; then they fill the hole with Wood and keep as hot a Fire as they can there for 2 or 3. *Days*, till they think it sufficiently Heated; then they Pour in Water till they have Quench'd it, which also flakes and Mollifies both *Stone* and *Mineral*; both being Cold they Dig again, take out all the Crumbled stuff, and dig up what they can besides, before they Heat it a new; the Crust seldom is Thicker than 3 or 4 *Foot*, which ceasing they come to a *Vein* of *Earth*, that Usually runs under the Rock 2 or 3 furlong; sometimes much further: This they dig all out and search, and if their first attempt prove successful, they go to work again (digging after the same manner) as deep as they can till they come to Water; for the drawing whereof wanting the help of Engines known in *Europe*, they can go no deeper, although the *Vein* lie lower; all Lumps of the *Mineral* they break in Pieces, and frequently find *Diamonds* enclosed in them. The Earth is Red. Many large stones are found here; the smallest about Six in a *Mangelin*. They are *Mixt Waters*, but the greatest part Good, only of ill favoured shapes, many Cragged pieces of stones, some as if they had been Parts of very Great ones, others with pieces Broken off them; yet I never heard of any
that

that found two seeming Fellows, although they do those that look as if they had been Newly Broken.

In *Langumboot* they Dig as they do at *Wazzergerre* and *Munnemurg*; the Rock is not altogether so Solid, but the Earth and Stones it produces much alike.

Wootoor lyes near *Currure*, and affords stones of a like Magnitude, Shape and Waters; 'tis employed only to the Kings use: And singular, in that its *Diamonds* are found in Black Earth.

Muddemurg far Exceeds all the rest for *Diamonds* of a Delicate Shape, Water, and Bright Transparent *Skin*; yet it has store of Veiny ones, but those likewise of so Curious Shape and Water, that it is difficult to discover them from the Good especially the small ones. It produces stones of divers Magnitudes, from 10 and 12 in a *Mangelin*, to 6. or 7. *Mangelins* each; and besides, some Great ones. The Earth is Red: But it is seated in the Woods, and the Water so bad, that to all (except the People Bred there) it presently occasions Fevers, and Destroys abundance; in so much that most of the *Adventurers* have forsaken it; notwithstanding which it had been more Profitable than any of the rest, the *Vein* frequently lying near the superficies of the Earth, seldom running deep, and is better Furnished than any one yet discovered. The River *Kishna*, of excellent Waters, is but 9. Miles distant: but the Miners or Merchants will not be at the Charges of fetching their Water from thence. Divers are of the opinion, that, besides the Water, the Town lying in a bottom, environed with Hills and a Morass adjoining, the Air may be infected, and contribute to its Unhealthfulness.

Melwillee or the *New Mine*, so called, because it was but lately Found out (or at least Permitted to be made Use of) in the Year 1670; it had then a year Employed the Miners, but it was forbidden and lay Unoccupied till 1673, when Complaint being made at *Quollur*, that the *Vein* was Worn out, the King again Licensed its settlement. The Earth they Mine in is very Red, and many of the stones found there have of it sticking to them, as if it had Clung there while they were of a soft Glutinous substance, and had not attained their Hardness, maintaining its Colour on its Skin (seeming to be Roughned with it) that it cannot be Fetch'd out by Grinding on a Rough stone with Sand, which they make use of to Clean them. The Stones are generally well shaped, their size from 5. or 6. in a *Mangelleen* to those of 14 or 15 each, and of some Bigger; but greatest quantities of the Middle sorts: Most of them have a Thick Dull *Skin*, incline to a *Yellowish Water*, not altogether so strong and lively as of the other Mines; very few of them of a *Crystalline Water* and *Skin*. They are reported to be apt to *Flaw* in Splitting, which occasions those People to Esteem them something sester than the product of many of the other Mines: Several that Flatter by their seeming *Whiteness* when Rough, discover their Deceitfulness having past the *Mill*, and too often a *Yellowish Tincture*, to the disappointment and Loss of them that have cut them; but what they want in Goodness, is in part Supply'd by the Plenty they find, which, together with their Properties, make them the Cheaper.

21 *Visiapore* is known to contain *Mines* enclosing *Stones* as Large and Good as those of *Goleonda*; but the *King*, makes use but of the Meanest. There are 15. *Mines* employed in this Kingdom.

In *Ramulconeta-Mines*, in Red Earth, about 15 or 16. foot Deep, they seldom find a *Diamond* of a *Mangelleen* weight, but small to 20 or 30 in a *Mangelleen*. They are generally of an excellent *Crystalline Water*, have a bright clear *Skin*, inclining frequently to a pale *Greenish* colour, are well shaped, but few of them Pointed ones. There are also found amongst them several Broken pieces of *Diamonds*, by the Country people called *Shemboes*.

The *Mines* at *Banugunnappellee*, *Pendekull*, and *Moodawarum*; at *Cummervillee*, *Paulkul*, and *Workul*, which are not far distant from *Ramulconeta*, afford *Stones* much alike and in the same kind of Earth; but in the three last are very small ones even to 100 in a *Mangelleen*.

Lungepoleur Mines are of a *Yellowish* Earth (like these of *Quoleur*.) its *Diamonds* are generally well shaped, Globular, Few, Pointed, a very good *Crystalline Water* and Bright *Skins*; many of them have a thick dark *Grass-Green Skin*, some spotted also with Black, that they seem all Foul, yet are not so, but within purely *White* and Clean. Their sizes are from 2 or 3 *Mangelleens* downwards, but few very small. *Pootlock-Mines* are of a *Reddish* Earth, but afford *Stones* much like those of *Lungepoleur*, only smaller; under a *Mangelleen*; the general sizes are of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$ of a *Mangelleen*.

Punchelingul, *Sbingarrampent* and *Tondarpaar*, are also of Red Earth, their *Diamonds* not unlike those of *Quoleur*, only rarely or never any Large ones are found there.

Gundepellee hath the same Earth with the former, and Produces *Stones* of equal Magnitude; but frequently of a pure *Crystalline Water*, wherein they exceed the Former.

Donee, and *Gazerpellee*, dig both in Red Earth likewise, and afford *Stones* alike, the greatest part whereof are of good *Shapes* and *Waters*. They have also many *Shemboes*, and some of Bad *Waters*, some Brown which these People call soft or *Weak Water'd*, being esteemed of a softer and Weaker body than others, by reason they have not so much Life, when cut; and are subject to Flaw in splitting, and on the *Mill*. Their general product is in *Stones* of Middle Sizes. But *Gazerpellee* has besides many large ones; and is the only *Mine* Noted in the Kingdom of *Visiapore*.

The *Diamonds* (in all the *Mines*) are so scattered and Dispersed in the Earth, and lie so Thin, that in the most Plentiful *Mines* its rare to find One in Digging, or till they have Prepared the stuff, and do search purposely for them. They are also frequently enclosed in Clods; and some of those of *Melwillee* have the Earth so Fixt about them, that till they Grind them on a Rough stone with Sand, they cannot move it sufficiently, to discover they are Transparent; or, were it not for their shapes, to know them from other *Stones*. Sometimes the Unskilful Labourers, to try what they have found, lay them on a great stone, and striking on them with another, to their Costly experience discover, they had broken a *Diamond*.

Near the Place where they Dig, they make a Cistern about 2 Foot High, and 6 Foot Over, with a small Vent in one of the sides about 2 Inches from the bottom, by which it Empties it self into a little Pit, made in the Earth to receive *Small stones*, if by chance any should run through. The Vent being stopped, they fill the Cistern they have made with Water, soaking therein as much of the Earth they dig out of the *Mines*, as it can conveniently Receive at a time; Breaking the Clods, Picking out the greatest *Stones*, and stirring it with Shovels, till the Water is all Muddy, the Gravelly Stuff falling to the bottom: Then they open the Vent, letting out the foul Water, and supplying it with clean, till all the Earthy substance be washed away, and none but a Gravelly remains at the bottom. Thus they continue Washing till about 10 of the Clock before Noon, when they take the Gravelly Stuff they have Washed, and spread it on a Place made plain and smooth (like a Bowling-Alley) for the purpose, near the Cistern, which being soon dried by the Heat of the Sun at that time of the Day, they very curiously look it over, that the smallest bit of a Stone can hardly Escape them. If they find a *large Stone*, they deliver it not till they have done Work, and then very privately, least it should come to the Knowledge of the *Governour* of the Place, and he require a share, which in the Kingdom of *Golconda* is usually Practised, without Respect to any Agreement made with them.

The *Miners*, those that Employ them, and the Merchants that Buy the *Stones* of them, are generally *Ethnicks*; not a *Musleman*, that ever I heard of, followed the Employment. These Labourers and their Employers are *Tellinga's*, commonly Natives of or near the Place. The Merchants are the *Bani-ans* of *Guzzarat*, who, for some Generations, have forsaken their own Country to take up the Trade, in which they have had such success, that 'tis now solely Engrossed by them; who corresponding with their Country-men in *Surrat*, *Goa*, *Golconda*, *Visiapore*, *Agra* and *Dillee*, and other places in *India*, furnish them all with *Diamonds*.

* A Pagoda weight is 9 Mangellins.

The *Governours* of the *Mines* are also *Idolaters*: In the *King* of *Golconda's* Dominions a *Feulinga Brammee* Rents most of them, whose Agreement with the Adventurer is, that all the *stones* they find under a * *Pagoda* Weight, are to be their own; all of that Weight and above it, to be His for the *King's* use. Both Merchant and *Miner* go generally Naked, only a poor Clout about their Middle, and a Shash on their Heads; they dare not Wear a Coat, lest the *Governour* say they have Thriven much, are Rich, and so Enlarge his Demands on them. The Wisest, when they find a *Great Stone*, Conceal it till they have an opportunity, and then with Wife and Children Run all away into the *Visiapore* Country, where they are secure and Well used; by reason whereof Their *Mines* are much more Populous, and better Employed than those of *Golconda*.

It is observable, that notwithstanding of the Agreement with the Adventurers of the *Mines*, that all *Stones* above a certain Weight shall be for the *King's* Use; yet in the *Metropolis* of either Kingdom, as the Cities of *Golconda* and *Visiapore* are, there is no seizure, all *Stones* are free; and the late Deceased King, *Abdul Cutopshaw* of the Former, and *Edelshaw* of the Latter, would not

not

not only give very great Prizes for large Stones, but richly Vest, and Present the Merchant that sold them with Horses, or something else of Value, thereby encouraging others to bring the Like.

LXIV. 1. Mr. *Joh. Schefferus* conceives Amber to be a kind of *Fossil Pitch*, whose Veins lie at the bottom of the Sea; believing that it is Hardened in Tract of Time, and by the motion of the Sea cast on Shore. He adds, that hitherto, it hath been believed, not to be found but in *Borussia*: But he assures that it is also found in *Sweedon*, on the Shores of the Ile of *Biorckoo*, in the Lake *Melero*, whose Water is sweet. Of this he saith, he hath a fine piece by him, two Inches large and Thick, presented him by one that himself with his own Hands had gathered it and several other Pieces, on the Shore of the said Island; affirming withal from the Mouth of a Shepherd of that place, that it is thrown out by a strong Wind, bearing upon the Shore.

The Production of Amber; by Mr. Joh. Schefferus n. 19. p. 349.

2. I am almost of the same Mind with *M. Schefferus*, that Amber is a kind of *Fossil Pitch*, or *Bitumen*, seeing it is not only found on the Shore of the *Borussian* Sea, but also digged up in Subterraneous places, some *German Miles* distant from the Sea; and that not only in Sandy, but also in other Hills of firmer Earth; of which I have seen my self pretty big Pieces.

By Mr. Hevelius ib. p. 346.

3. *Succini Antiquissimis Temporibus cognita Virtus celebre ipsi, pluribus ante Christum natum Seculis, apud scriptores Græcos peperit Nomen. Postquam Romanis Admiracioni esse cæpit, & his Auctoribus Gemma reddita est Memorabilis: Præsertim cum Neronis Mores in Luxum Succino abuti docerent. Quantæunque vero Succinorum Vetusto Ævo fuerit Estimatio, Terræ Tamen, in quibus Generantur, incognitæ mansere; inde tot sententiarum Divortia; his in Africa, istis in Asia, aliis in Europa, Thesaurum reconditum memorantibus. Inter Europæas Ditiones, Italia, & in eadem Eridani vicinique Maris Adriatici ex succineis Divitiis præcipua Laus fuit; quam tamen fida magis Historia, Romanis latè per Germaniam Victricia Arma circumferentibus, Maris Germanici ac Baltici Insulis vendicat, Hispania & Britannia in partem aliquam Gloriæ admissis.*

An Account of Amber; by Mr. Phil. Jac. Hartman. n. 248. p. 5.

Verum ut Veteribus tot Regiones *Succiniferas* allegantibus ignosci posset, nescio an Proximo aut huic Nostro Ævo Venia sit danda, etiamnum ex *Africa* & *Asia*, quin ex novè detecto Orbe, *nativum succinum* afferenti, vulgato insuper *Orientalium Succinorum* Nomine. Quod enim cum Pace tantorum Virorum dixero, plerique Auctorum sunt intestabiles, Rumoribus plus justo Tribuentes: Oculatos Testes, fallere & falli nescios, vix produxeris. Per multos quidem qui in *Orientalibus* Partibus commemorati diutius, Rerumque Physicarum fuerint gnari, ipsemet atque Amici, coram & Literis, percontati sumus, neque incidimus in quempiam, qui certi quidpiam cum Fiducia edisserere nosset; majorque pars, quicquid de *Orientali Succino* Fama sparsit, aut scriptis prodidit, Incertitudinis aut Falsitatis condemnavit. Quin Nomen *Ambari* sive *Ambræ*, quod *Succino* cum Pretiosissimo & Fragantissimo *Orientali Bitumine* jam diu apud plurimas Nationes Commune esse cæpit, non paucos in Errorem induxit: *Succinum* enim crediderunt, quum *Ambram* in *Africa*, *Asia*, *Americæve* Partibus nasci acceperant. Si non alius Error *Succinum Orientale* progenuit, Resi-

nâ Copal, *Succinum* mentiri aptissimâ, hoc Nomine ab Officinis *Pharmaceuticis* adoptatâ.

Nec in *Europæ* memoratis omnibus Provinciis, *succinum* Generatur; Inanibus Auctorum de *Eridano*, *Mari Adriatico*, aliisque *Italia* locis *Succiniferis*, Commentis. Nec de *Hispano*, *Britannico*, *Pannonico* *Succino* graviora aut certiora prostant Documenta *Gagates Succini Nigri* Appellatione scriptoribus imposuisse videtur. De *Polonicis*, *Silesiacis*, *Bobemicis* *Succinis* effossis, quamvis Raros in Patriis Annalibus præcones nacta sint, indubitatâ *Experientiâ* constat. *Germanici succini* Crebrior & Evidentior est Memoria. In Litoribus Maris ad Insulas *Belgicas*, ad *Holsatiam Futiâ*, in Ripis etiam Fluviorum, Lectum; quin ex Interioribus Terræ visceribus erutum, gravissimi Auctores consignant. *Saxonia*, *Misnia*, *Islebia*, *Suevia*, ex Gremio Matris Telluris se hunc Fætum suscepisse, aliquoties attestantur: *Hallensesque* Carbonariæ Fodinæ, serenissimi *Frederici III.* Auspiciis non ita pridem detectæ, *succineas* viliores Glebas plus via simplici ostenderunt; Fidem faciente D. *Krug. S. Electoris Brandenb.* Archiatrorum Comite, & Consiliario, Rerumque Metallicarum Directore Gnarrissimo atque Meritissimo. Nec Ignobilia Testimonia inclyta *Marchia* perhibet: Superiori seculo *Jodochus Wilichius*, prope *Neomandram*, novam *Colbam* dictam, *Francofurto ad Oderam* Tria *Milliaria*, circiter *Distantem*, in Lacus ingentis Ripa *succinum Falernum* repertum; nostra Ætate in Ripa *Viadri* prope *Custrinum* juxta Pagum *Schaumberg* inventum, Cl. D. *Becmannus*; eque Fossa Insulæ *Pottamensis* regnante Magno *Friderico Wilhelmo* eductum, Cl. D. *Elsholtius*, memorarunt. Major autem *Succinorum* est proventus in locis *Mari Baltico* vicinis. *Suecia*, vel ex Lacus *Dulcis Meleri* Ripa Ejectum, sæpius legit, aut Effossum sustulit; *Dania* ex Fossa *Hafniensi* insignia *Succina* vidit, & admirata est, atque ex Collibus *Selandiæ* suæ *Mediterraneis* non contemnendâ Magnitudine ac Multitudine prodiisse, uniusque Colliculi Fossionem quinquaginta Libras erogasse, Vomereque ex Agris extracta, meminit; Testesque Cl. *Borrichii* adsunt Literæ, Insulas *Cimbriam Holsatiamque* allambentes [*Formœ Mandœ, Röm.*] ad Littora sua in Oceano pariter Copiosum *Succinum* expiscari. Liberalius tamen longè in *Samogitiæ*, *Curoniæ* & *Livoniæ* Contermina Maris *Baltici* Litora *Succineæ* Opes redundant; ut inter Algas Arenasque absconditæ à Rusticis confertim deprehendantur. Inter Arandum quoque, & inter Fodiendum, in Maritimis Jugeribus sese ultro, sine gravioris Laboris impendio, offerunt, Vili Pretio ab *Electrotorentis* ibi locorum quondam coempta.

Verum nulla Maritimarum Provinciarum, æque Opima spolia ex *Mari Baltico* legit, nulla ex sinu Telluris æque numerosam Prolem *Succineam* suscipit, ac *Prussia*; ut *Electrides* Antiquorum nullibi rectius collocaveris. Allata sunt mihi ex *Sambia*, ex *Natangia*, ex *Hockerlandia*, ex *Pomesania* fortuito inventa *succina*; & prope Oppida *Hollandiam*, *Liebstadium*, detecta; quæque ex *Electoralis Litvaniæ* Agris effossa, *Varmiensi* quoque & *Elbingensi* possideo. Olim Vir Consularis, mihi Amicissimus, annotarat, in Sylva quadam *Kerbswald Elbingensis* Ditionis An. 1641. intra modicum Temporis spatium, *Septingentas Libras* todiendo ex Terra erutas; frustumque Insigne Amicus nuperrimè dono dedit, cujus idem Natale fuerat solum. Et in Ripis Lacus *Recentis* ac *Curoniensis* Fluviorumque *Pregelæ*, *Vistulæ*, *Elmæ*, lecta adeptus sum. Adeoque

nullus

nullus dubito, totum *Prussiae* Fundum *Succineum* affirmare, praesertim cum scaurigo de repente An. 1666. circa Oppidum *Barthenstein* exundans, tantum vim *Succinorum* egefferit; ut *Fisci* Reditus augetet; quæ a *Terræ* visceribus avulsa, nec *Marè* vidisse unquam, certa est *Fides*.

Post *Prussiam*, *Pomerania Succinifera* nominari meretur, illo potissimum *Oræ* *Maritimæ* *Tractu*, qui per *Litora Electoralium* hinc & *Olivensium* ac *Gedanensium* *Ditionum* ad *Neriam* Recentem excurrit. Multum *Succini* cum *Decumanis* *Fluctibus* ad hanc *Oram* advolvitur, iisdem signis proventum manifestantibus, *Electrotoreutarum* *Gedanensium* *Quæstu* non spernendo, quia senatu justo prætio, quæcunque ad *Neriam* appellunt, redimerunt. Ad *Insulam Rugiam* usque *Maris Baltici* effusa est *Liberalitas*, siquidem & hæc *Succineis* *Glebis* potitur; juxta *Hiddensee* & *Lectas* & *Haustras* percepi. Nec *Mediterraneæ Pomeraniæ Succinorum* sunt vacua, quippe quod pariter bona *Fortuna* in eadem *Ruricolæ* aliud agentes incidant sæpius; *Curoniæque* & *Samogitiæ* inter *Succiniferas* *Palmam Pomerania* dubiam reddit.

Prussiam quaquaversum *Succiniferam* prædicavi, ut tamen præcipue *Litoris Sudavici* amore *Succina* detineantur; Situm est *Litus* in ista parte, quæ *Sambia* vocatur, a novo *Transitu* (*Nerve Tiff*) ad *Tabernam* (*Vrantz Vrug.*) decem *Milliarium* spatio. Regia hæc *Succinorum* sedes, *septem Recessibus* vulgato *Angulorum* vocabulo, Antiquitus distinguitur: *Krecke*, *Nodums* vel *Nodems*, *Lafsnicken*, *Kuckse*, sive *Kuyck*, *Palmenick*, *Nempe*, *Thierskeim*; *Nostra* *Ætate* non *Nempe*, sed *Kraydepellen*, sive *Crapellen* inter *Palmenig* & *Subenig*, tum *Bruster* magis quam *Dirschkeim*, & præter hos alii accensentur. *Litus* omne altis *Montibus* præcingitur, *Mari* *Vadoso*; a *Primo* *Ingressu* *Trium* *Quatuorve*, mox *Triginta* aut *Quadráginta* *Orygarum*, postquam progressus fueris *Profunditate* *minori*, pergendo longius rursus *Altissima*; ut *Brevia* sive *Syrtes* intelligas, quæ *Litus sudavicum*, hujusque *Recessum* *Brusteram* adprimè *Naufragiis* infamant. Prærupta & ardua *Recessum* *Juga*, quædam lentius attolluntur, versus *Pillarviam* in *Planitiem* desinunt. Solum minus firmum; alicubi latentium *Aquarum* *Commeata* fallax, in tantum ut quasi *Voragine* *Equi* & *Homines* absorpti memorentur; maximam partem *sabulo* tegitur, aliquot *Areolæ* *Herbis* investuntur, *Petasite*, *Eryngio*, *Lappa*; raris *Arbustis* aut *sentictis*, quæ tamen ad *Brusteram* silvescunt; eademque cum parte *Montis* aliquando subsidunt, *Rupes* nullæ, nec *saxa*, præterquam ad *Radices* *Montium*: *Aquæ* ex *summis* *jugis* passim dimanant, quæ *inferius* *Alveis* collectæ *Rivulos* imitantur. *Ista* *Exteriori* *facie* *Litoris Sudavici*, *Interranea* *Mineralibus* abundant: *Vitrioli* non una comparet species: *Alibi* *Niveis* *striis*, *Terra* *Nigra* interjecta, *stratum* super *stratum* alicubi *Fusum* *Vitrum*, *Lignis* *Fibris* hinc inde *interlucentibus*, præsentat; alibi *Terræ* *Micantium* *Pulvisculorum* *instar* est *admixtum*. Præter *Vitriolum* *Corticosa* *Terra*, qua *integri* *Colles* exsurgunt, & *Lignum* quod *Litoreos* *Montes* longo *tractu* *medios* dividit, sunt *conspicua*; tum *terra* *flavescens*, quæ *Ochram* æmulatur, & *Lutum* *Cæruleum*, certis *Intervallis* per *Litus* *expantum*. Ex *Lapidibus* memorabiles *dactyli fidei* (*Alpenschofs*) inter *saxa* & *Arenas* dispersi, sed & ex *Montibus* effodiuntur: *Saxa* *Mari* *vicina* *alia* *parte* *durissima*, *alia* *friabilia* visuntur: *Petrefacta* quoque *Ligna* *Lapidesque* *Alga Marina* *Tenui* *Folia* & *vesiculari* *luxuriantes* *inveni*: Mitto *varios* *Lusus* *Naturæ* in quos *incidi*. Præter *vulgares* *Lapides*, & *Adamantes*, & *Faspides* hoc *Litus* quandoque profert

profert. Camporum Vicinorum sterilitas summa; silvæ Raræ, Pineæ nullæ. Illud adjiciendum, quod *Phocarum* Greges apricantes, in Scopulis & Collibus vadosi Maris colludentes, sæpius se conspiciendos præbeant.

Litus hoc quidem inter Arenarum Lapidumve a cervos *Succina* monstrat, sed in his non Generari manifestum est: Multò minus ex Algâ Marinâ natales accersendi, licet huic involuta ad Litus propellantur. Et quum intra Viscera Montium Litoreorum ubique reperiuntur, in *Vitrioli* interstratis *Crystallis*, in Terræ Flavæ, in Sabuli, in Luti Cærulei intertexto opere; non tamen in his omnibus prima eorum statuenda Incunabula. In *Vitriolorum*, Terræ Flavæ & Sabuli partibus raro eventu *Succina*, eaque Minuta & ignobilia deprehenduntur. Cærulei Luti ductus nondum ita Experientia patuere, quod in accessi; quamvis Egregia & Numerosa *Succina* fovere à Colonis tradantur; mihi que diffractâ Luti Glebâ, Nativus Foetus *Succineus* animadversus, quem Tenui Cortice obductum, Colore Fulvo dilucidum, inter Cara Naturæ *Succinea* munuscula Musæum asservat.

Quum autem Corticosa Terra, & præter hanc Lignum Litus *Sudavicum* discriminent, Lignum quod Montes intersecat *Succiniferum* esse, ut quod maxime, multorum Annorum Experientia firmat. Hujusque Ductum Fossiles indagant & observant, nunquam irritò Successu, quousque instabile solum ipsorum operas progredi permittit. Terra Corticosa *Succina* exigua complectitur; minusque solida, & ingrati Coloris. Lignum autem minimè ab Arboribus est Arcessendum; siquidem tam vastos Truncos Arboreos, qui prostrati plurimarum Orgyarum Longitudine & Latitudine Fibras suas extenderent, nusquam Orbis vidit. Neque Arboreis Lignis simile est: quippe, quod nec Medullæ Intimæ, nec Corticis Extimi, ullum præbet indicium; Ramorum quoque Divaricationibus ac Nodis, Foliorumque Germinibus, prorsus destituitur; neque Fibras mutat, sed easdem quavis sui parte retinet: mitto quod Compagem Ligneam referens non tamen orbiculatim concrevisse cernitur, sed planiori specie.

Atque Curiosi jam diu Ligna *Subterranea* mirari desierunt, postquam plures *Europæ* Ditiones istiusmodi, è Terra eruta, ipsorum Censuræ submiserunt. Ducatus *Spoletani* silvæ *Umbriæ* fodinarum Lignum elegantissimum undulatum, in quo & Artificium ingenia se exercere poterant, *Franciscus Stellatus Lynceus* descripsit, inventore Duce & Principe *S. Angeli Friderico Cesio*; ejusdem & *P. Kircherus* meminit. Aliud *Germaniæ* Fossile Lignum, Solertia *D. Pillingen* in *Misnia* detexit, qui & Erudito Commentario Generationem illustravit. Transmissus mihi *Lunenbergenfis* Ditionis Subterraneus Fœtus Ligneus, *Prussico* Solidior & Ponderosior. Lignum vero quale Litus *Sudavicum* profert, & alibi locorum, in *Prussia* Interiori, una cum *Succinis* erutum, ex complurium Amicorum Literis fide Dignissimis rescivi: Gravesque mihi Actores *Bartholinus* & *Borrichius*, qui Cortices & Ligna ex Fossis *Hafniensibus* iisdem, ex quibus *Succina*, non exigua Quantitate educta attestantur; felixque Capturæ indicium in Litore *Neringæ* ex adnatantibus Fragmentis capitur.

Matricis autem hujus, Experientiâ Duce, ista indagavi Initia ac Rudimenta. Colliculi in Litore *Sudavico* hinc inde, imprimis an *Kraxteppelin*, procul Terra congesta, ubi propius accesseris Cumuli Coacervatorum Corticum videntur: Superior pars, sicubi a Sole ex siccata fuit Griseis, his autem remotis, piceæ Nigre-

Nigredinis, magnis & levibus nitidisque Crustis concretam offert Terram, quam si Cultro secueris, multorum mollissimorum Corticum Compagem conspicies: Ad Radicem istorum Colliculorum Uda Terra, Glutinoso ac Tenaci Liquore cohærens, Manuum Digitorumque impressorum Vestigia exacte refert, sed ut & Tangentes denigret. Talem Corticosam Pinguem Colliculorum Terram *Ligni Fossilis Prussici* judico Primordium: Neque Lignum nisi Siccitate, & qualicumque Soliditate, quâ magis compactum longiori Fibrarum Protensione, continuâ cohæret, a Corticibus istis differt. Corticosi enim Colliculi ab Uda Tenaci Terra nascendi Originem sortiuntur: Hanc postquam Maris Salsugo aliis *Subterraneis Salibus* admixta maceravit ac subegit, secedente Humore superfluo, Aer aut Calor Solis exsiccat; Siccitate verò à se invicem secedunt partes, quarum Pinguedo exhalavit, aut intus concessit; aliæ quæ Glutine hoc abundant, mutuo, licet in Crustas compactæ, cohærent, Speciemque Ligni referunt ubi justa Siccitas, qualicumque multarum Crustarum Cohæsioni Lignosam Formam conciliavit. Bituminosam verò Corticum & Ligni esse Naturam non solum Terrestris Pinguedo, sed & Examen ignis monstrat; accensa enim Fomitibus instar Serpentem Ignem propagant, Sulphurque Naribus afflant; & Destillationi exposita, uti inferias tradituri sumus, aliquot Oleosas particulas, *Olei Petræ* simili Odore, dimittunt, præterquam quod Liqueor Destillans *Succineum* Pingue quid exhalet. Post Bitumen Corticum & Ligni Generationem Salia Subterranea promovent; ab his enim Siccitas, & Crustarum Species deducenda intimè enim Lignis & Corticibus adhærent, *Vitriolum* superius differuimus, quomodo Cortices undique ambiat, atque cum illis concresecat. Aliorum Salium non ita manifesta est Demonstratio: Deprehendi tamen in Siccissimorum Lignorum Corticosæ Compagis Interstitiis, scintillantes salinas Stellulas & Fila splendens, quæ *Vitriolum* minimè referebant, insipidæ enim prorsus, aut subdulces, lenissimè adstringentes: Aquâ affusâ eduxi illas stellulas, *Lixiviumque Aluminis* aut magis *Martis* subdulcem saporem prætulit, ut tamen *Vitriolica* Virtus extremum perciperetur, quæ inspissato *Lixivio* evidentior, aliquo tamen Subdulcis *Aluminosi* aut *Martialis* Saporis sensu. *Nitrum* quoque sub hoc Ligno latens olim detexi, Forti *Lixivio vitriolicis* particulis segregatis; quamvis ipsi *Vitriolo Prussico Nitrum* videatur admixtum: forte & stellulæ ac Fila salina per intimas Ligni Fibras diducta, *Nitrosæ* sunt Naturæ. *Alumen* quoque in Crystallis *Vitrioli* latet, si non prorsus *Alumini* vindicandi, quos S S S componere asserimus, quique *Amiantho* aut *Alumini Plumoso*, similes conspiciuntur; Acidulus enim horum sapor, ad illum Salis *Succini* volatilis proximè accedens.

Matrice cognita, quibus *Bituminis* & *Salis* Virtutibus sit impregnata, facile est conjicere quomodo *Succineus* Fœtus *Prussicus* intra illam concipiatur. *Prussicæ* Solum undiquaque *Bituminosum* cogita; insignes enim Glebæ *Bituminis* condensati in abditis Terræ aut Luti aliquoties a Colonis casu deprehensæ; ipsemet aliquot *Librarum* Frustum non procul a *Regiomonto* ex Limo eductum conspexi, quin *Olei* rivos ex Terra dimanasse, non vanâ Famâ accepi. Cespites vero *Bituminosi* ex pluribus Locis effodiuntur. *Bituminoso* itaque Litoris *Sudarvici* Solo, Calor Subterraneus, quicumque iste fuerit, *Bituminis* exhalationes per interanea dispersas, undique consociat, & in Guttas cogit, præprimis ex Corticosa aut Lignosa Matrice eadem congregat; quod dum agit, simul vi-

cina *Salia* pervadit, ipsorumque Effluvia secum abducens *Bituminosis* Guttis immiscet; *Salina* spicula intra Matricem adacta Fluorem *Bituminosum* sistunt, & si nullæ Suppetiæ *Bituminosarum* Guttarum a Calore submittuntur, Gleba pro Modulo incunabili, quod intra *Lignum* ipsi concessum, formam subit, omnique Exhalationum motu sopito, Caloreque evanescente, *Salinæ* particulæ Rigorem recuperant, *Bituminosis* superfluum Humorem exhalantibus; Sociatæq; *Succineam* Gemmam producunt; Nitidiorem, Splendidiorem, Fragrantiolem, Firmiorem, ex Puritate & Proportione exhalationum *Bituminosarum* ac *Salinarum*. Hæc vera *Succini* est Generatio, quam ante nos nemo Erudito Orbi Perspicuam reddidit.

Aliquibus tamen is superest Scrupulus, an eadem *Succinorum* quæ Mare ejicit, Generatio statuenda? Verum cum in Vulgus hic locorum jam Notum sit, ex Collibus Marinis Tempestatum vi disjectis aut convulsis *Succina* prodire, quæ a Fluctibus ad Litus advolvuntur, Capturæ fructuosæ, aut inanis, ex Collium istorum Divulsione, leviori aut profundiori, sumpto Indicio; Qui, inquam, cum Haustilia *Succina* intra Colles Generari certum sit, alius Modus intra hos Generandi reddetur vero similis? Sane in Collibus *Submarinis* non minus quam in Littoris Naturæ Officina erit instructa: addo, quod inter Ejectamenta Maris & *Lignorum Fossilium* copia in Littore *Sudavico*, æque ac in *Neringiensi*, reperiatur: quid si Colles Alluvionibus obtekti, qui quondam Terræ Pars fuerunt? Si quoq; in Collibus submarinis reliquorum Mineralium eadem Generatio, cur non & *Succinorum*. Cæterum sicubi extra Matricem *Lignosam*, in Luto Cæruleo, in Terra Corticosa, Flava, Sabulosa, Vitriolica, *Succinum* nasci contigit, ne tunc quidem alia Ratio Generationis Suberit: pariter enim ex *Bituminosis* Exhalationibus in Guttas condensatis *Salium* justâ Miscelâ, istæ Glebæ pronatæ fuerint. Neque tamen ubicunque reperitur ibidem & *Nativa Succina* sedes illicò asserenda, per Maris enim vehementiam à Matrice avulsum in aliena loca sæpè rejicitur. Quin & Animalium ventriculis recondita *Succina* novi; visceribus patefactis exempta Amici Dono miserunt: nec tamen in Animalibus *Succina* Generata dicemus. Ex Accolis Litoris *Sudavici* addidici, omnis Generis Animalia, Terrestria, Aquatilia, Volatilia, avidè *Succineas* Glebas deglutire, adeoque intra Mactatorum Viscera non raro observari. Corvi & Cornices tanta Copia ingerunt, ut egerere rursus vesperi cogantur & Minutiæ complures sub Arboribus, in quibus confident, inter Excrementa reperiuntur. Ab *Asellis* (*Pomucheln*) deglutitæ plures mihi obvenere, insignior trium *Digitorum* Transversorum Longitudine, duorum Latitudine spectatur. Est ex Ove Globus *Succineus* Mirabilis, quem Crusta Gypsea Mucus Ventriculi obvelarat, quâ ab *Electrotoreuta*, imprudenter ab rasa, patuit ex pluribus Glebis, a Calore Animalis subactis, fuisse formatum.

Et Mare & Terra itaque in *Prussiam* *Succinea* Dona confert: sed Maris Dona partim in Littore leguntur, partim ex Aqua hauriuntur: *Vadoso Scil.* Mari, signis apparentibus, Coloni Reticulis Conto affixi Fundum verrunt, aut Fluctibus volventibus eadem adversa opponunt; hæc quæ Haustilia: reliqua, inter Ejectamenta, quæ natantia prædæ Indicium faciebant, Algarum, Samentorum, Lignorum, aut Arenarum, sedulò investigantur & feliguntur, lactaque audiunt.

Ex Terra vero, quæ fodiendo acquiruntur, Fossilia appellantur : Amam longiori Conto præfixam venæ in Montium Litoreorum jugis conspiciæ, admovent, tentando sicubi Glebam Ligno immersam offendant, qua animadversa Lignum leniter radunt, amaq; subjecta Glebas excipiunt, exceptasque adducunt saccoque a Collo pendulo indunt. Fossio vero ad Venarum ductum Priscis ignota Magni *Frid. Wilhelmi* auspiciis primum Montes Exercuit. Nec tamen ubique Fossioni patet Litus, sed certorum *Recessuum* juga ista opera fatigantur ; *Eross, Gubnicken, Ekross, Dirschkeim, Warnicken, Strobschnec, Palmnig* : & sicubi Matrix Lignea se conspiciendam præbet, atque ad eandem facilis ac tutus est Aditus.

Succinum uti ex Matrice producitur, quod in Fossorum operas intentus ipsemet expertus sum, Rigidum & durum tactu dignoscitur : Contingit aliquando Frangi dum protrahitur, sed vitio Glebæ ; *succinum* enim *succino* Duritie præstat. Non pauci tamen & Prisco & Nostro ævo *Mollia* ac Liquida, quidem ab altera parte Dura ab altera *Mollia Succina* sibi visa jactitarunt : Quæ mihi isto nomine Oblata, nec Fragrantia nec Sapore, nec Deflagratione, se *Succina* probarunt ; casui itaque inter *Hauustilia* reperta *Bitumina* istis Auctoribus in *Succineum* Censum referre placuit. Verum & *Picea* Gleba, & *Carbo* Fossilis, & Segmentum *Pice* navali abductum, aliaque plura una à *Fluctibus* Maris in Litus projecta, ista ratione *Succinei* Censu habenda forent. Opinio, quæ in Fundo Maris scaturigines *Liquidi Bituminis* commenta est, ut a *salugine* Maris Coagulatum *Succinum* haberet, *Mollia* istiusmodi *Succina* peperit : Neque Hauriendo, neque Fodiendo, neque Legendo, sibi *Mollia* cognita, illi qui *Rerum Succinearum* assiduam Curam gerunt, asseverarunt omnes. Ipse, Magnos *Succinorum* Rudium acervos perscrutatus sedulo, nullum *Molle* adverti, quod Virtutis Experimento *Succinei* Generis agnovissem. Vulgo persuasum est, Discrimen Fossilia & *Hauustilia* intercedere Duritiei potissimum, & Puritatis, ac *Crustæ* diversis Notis. Verum falluntur, qui istud in Animum inducunt ut Credunt : Evenit ut extra Matricem alienis in locis sepulcorum Robur aut Calor aliquid vitii contrahat, crassiori etiam *Crusta* superinducta ; hi tamen Casus *Nativorum* differentiam minime inferent : Æque intra Colles submarinos, ac intra *Litorea*, pro varia *Bituminis* & *salium* Copia ac Virtute Nobiliora & Ignobiliora *Succina* Generari certus sum.

In Glebis *Succineis* Formandis mirum Naturæ elucet Ingenium : ut in lucem eduntur, *Pira, Amygdalas, Cepas, Pisa*, aliasque Fructuum species, aut peregrinorum Corporum simulachra, vario Lusu referunt ; *Guttarum* his apud *Electrotoreutas* Nomen, quum Globosam Figuram maxima sui parte exprimant. Major Pigmentorum in *Crusta* denudatis admiratio. Literata Naturæ *Succina* plura vidi : Teneo in quo Albescens Linea Flexu suo concinne Literam S. *Latinorum* formavit, reliqua frusti facie flava : *Arabum* ac *Hebræorum* Characteres quædam ruditer exhibent. Præterea *Arbuscularum, Frondium, Nubium, Ruderum* aliarumque quarumcunque rerum Delineamento in *Succino* Variegato curiosus Oculus advertet. Est mihi Pectore tenus efficta senilis Imago, in ulna infantem reclivem monstrans ;

monstrans ; *Jesus* parvulus in *Simeonis* amplexu hærens animo obversabatur, quando primam hanc Naturæ Picturam intuebar.

Cæterum & quæ *succinis* Concreta adhærent, memoratu non indigna puto : Inter hæc Algæ visicularis & tenuis Foliæ Rami, radicibus firmiter infixis, ex *succineis* Glebis propullulantes inveniunt locum ; tum silex parvulus, eminentiori libera, latiori parte *succino* obvoluta : Alii Glebæ Lumina ferrea agglutinata est : Et Segmenta Lignorum, Conchyliæ, varique alia adnasci contingit.

Animalculorum *succinea* Funera, jam *Plinio* & *Martiali* celebrata, intentiorem Curam exposcunt ; ultra Triginta species Insectorum in meis *Succinis* numero ; Muscas, Araneas, Culices, Formicas, Papiliones, Apes, Millepedes, Teredines, Curculiones, Erucas, Scarabæos, & ex Cornutis & Deauratis aliquot ; & quorum nomina memoriam subterfugiunt. Sunt qui & perfectiora Animalia *Succino* condita memorant, Ranas, Lacertas, Pisciculos ; Quibus ut fidem habeam ægre a me impetro. *Hermano* decantata Ranæ & Lacertæ sepulchra non uno modo mihi suspecta redduntur. Pisciculos fraude Artis *succino* inclusos, jam aliis animadversum est. Nativa Animalculorum *succinea* faretra ab Arte elaboratis, illo maxime distinguis, quod in istis non procul a superficie, insecta implicita reperiuntur, in his vero meditullium occupant ; *scil.* Artem non ita feliciter occultarent *Electrotoreutæ*, si extimas partes excavarant, illisque Animalcula crederent, Translucida enim *succinea* Lamina fraudem proderet. Si quoque solidum, Purum, nullis Fissuris hians, nec Crustarem Compagē distinctum est *Succinum* in quo sepulta sunt, illud non a Natura fabrefactum scias monumentum ; Pleræque enim Glebæ *Succineæ*, quibus Animalculorum Exuviæ sunt repositæ, id quod Millies contuitus sum, corticatim cohærent, aut Fissuris hinc inde sunt intersectæ, ex quibus & pars Exuviarum aliquando exterius conspicienda prominet. Neque omnium intra *succinum* reconditorum Animalculorum par est Conditio : Alia situ obducta, alia nitida, quædam *succineo* fulgore splendentia intueor : Duas Apes & Erucam Nidumque Curculionis situs obtexit ; scarabæus fulget ; ex Muscis quædam nitent. Porro alia Vivacitatem, alia Languorem præ se ferre ; nonnulla quasi Evigilantia, cum Conatu vinculo isto se extricandi, conspicias. Quædam *Succina* Integrum Examen Insectorum, & ejusdem & diversi Generis, involutum, commonstrant.

Vexata hinc Curiosorum quæstio, quomodo *succinum* Animalcula oppresserit ? Non pauci Difficultate Quæstionis permoti Fœtum Arborei succi *Electrum* contendunt, quasi Resinis aut Gummi Arborum adrepentia Animalcula irretirentur facilius : Verum absque Experientiæ suffragio ; neque in Resinosis aut Gummosis Stillis hunc in modum, si recte memini, inclusa Insecta magno numero ; si modo ullo, Curiositas hæctenus detexit ; extrinsecus adhærentia conspeximus, non ita Fuso Liquore obtecta. Alios Gravitas Argumenti eo adegit ut negarent esse quæ in *Succinis* videntur Animalcula ; Phasmata Ludos istos dare. Sed Fractorum aut sectorum inspectio hos refellit, manifesta enim Insectorum supersunt Indicia ; licet enim Corpulcula Animalculorum vis *Bituminosa* ita subigat, ut Fibris *Succineis*,

cinis, intercurrentibus viscera condensata in Lapidem Indurescunt, quando facilis per Rariorum Texturam Insectorum Effluviis *succineis* est Commeatus, tamen Corporis alieni haxitum luculenter discernere datur; Apumque nostrarum Exuviæ, interaneis consumptis, istud ob Oculis egregie sistunt.

Funestos itaque Casus, quibus Insecta a *Succinis* sunt oppressa, ut rectius percipiamus, repetendum memoria, quod Insectis usu veniat, si quando Tempestatum aut Hiemis Injuria compelluntur, Cavernas & Latebras ubique quærere, inibique somno sepulta delitescere. Quare cum & Litorea Latibula non unum Genus Insectorum subintret, in illisque aliquando hæreat invitum, aut obdormiscat, Exhalationibus *Bituminosis* a Calore Subterraneo in la'icem collectis, ubi in Matricem *Succini*, quæ Latibulum ac Dormitorium interea præbuit, Liquor destillat, eadem implicat & obtegit, Gremioque suo suscepta, quando *Succinum* evasit, commonstrat. Contingit Bestiolas in Dormitoriis istis a Calore Subterraneo excitari; aut in vivas Fluor *Bituminosus* impingitur; sed cum nullum vigilantibus patet Effugium, eandem cum Dormientibus sortem subire coguntur, ut tamen fortis tunc suæ in Sepulchris *Succineis* relinquunt memoriam, Vivaciori, atque Animosiori corpusculorum Simulachro. Firmat Nostram Sententiam istud, quod *Succino* sepulta insecta pleraque sint ex illorum Genere, quæ Cavernas in Dormitorio eligunt: Majorem partem etiam languida ac somnolenta, aut mucosa transparent. Vivacia, quæ cum Nisu obluantur, aut Alas expandunt, abitumque parant, rariora puta sed tantam Vivacitatem, quæ Amoris Æstu in Coitum Animalcula concitarit, ut isto nexu cohærentia *Succineus* Latex involvisset, Hospitio huic Subterraneo minime convenire autumo; Quare quæ Culicum Muscarumve istos Hymenæos ostendunt faretra suspectis ad numero.

Speciosiora alia nunc depromam quæ Plantarum Germina sinu suo obvelant. Est mihi in quo explicata Algæ Vesicularis Folia Alas Aquilæ expansas & Pedes cum corpore utcunque adumbrant. Aliud Semen Tiliæ, stipitisque partem; aliud Folliculum, diductis Foliis hiantem, quatuorque Semina complexum, ex quibus Apex medius exsurgit, Cauliculo ad Superficiem protenso & prominente; est quod Muscum, in Pergule. S. Porticus Hortensis speciem, Fornicatis Operibus compositum obtutui sistit. In alio Flosculus minimus marcescens, in altero Rosmarini Sylvestris, *Prussis Korbl* dicti Ramulus tribus Foliis divisus Transparent; Rude aliud Algæ memoratæ Vesicularis Ramum majorem per Corticem non politum ostentat. Plura ex Musco villos disjectos obtinere: Nobile autem illud, in quo pars Albescens Convallem & Colliculum Musco investitum exhibet, sed per Speculum quasi, quando ex Flavo Ignei Coloris *Succino*, huic amenissimo Spectaculo mirabili Naturæ Artificio quasi Vitrum est Objectum, per quod Muscosi apparatus delicatior esset aspectus: Nec vile alterum Aqueo Lactescentis Coloris, quod Villorum Muscosorum crispata Congeries nobilitat. Spectabiliora hæc Herbarum *Succinea* Monumenta quam illa Animalculorum censeo. Major Copia Corticibus, Lignis, & Festucis intertextorum; Festucæ Pineæ videntur, specie istarum

rum quibus Formicæ acervos extruunt; Verum accuratiori Examini Fossili Ligni ac Corticis monumenta patuerunt.

Ex Minerali Regno quoque adducenda, quæ *Succinis* inclusa: *Vitriolum* sæpius saporè promptè dijudicandum; *Pyrites* quandoque, crebrius *Ferrum* de quo *Electrotoreutæ* conqueruntur, quod non nisi cum Detrimento Instrumentorum educatur: Armatura quoque *Aurea* & *Argentea*, divulsis coagmentatis partibus, in impuro conspicitur. Sed & *Aquæ* Guttas intro receptas diversis Alveis stagnantes *Succina* detinent: qui effluit Liquor Salsus aut Subsalsus, aliquando & insipidus, Non Exsiccari, ab aliis cum Luna Crescere & Decrescere Liquor traditur; habeo in quo Exsiccatus est; habeo in quo Perennat semper idem. Quæcunque autem ex *Plantis*, *Mineralibusve Succinum* complectitur, casu haud absimili, dum in Matricem illapsa sunt, a Fluore *Bituminoso* obsessa atque occupata intelligo. *Aquearum* Guttarum intra *Succinum* oclusarum singularis Ratio cogitanda: Udam Matricem calida *Bituminosa* Exhalatio obsepsit, intro compulsa *Aqua* à Calore Subterraneo consumi nequit, & ob Copiam Circumstantis *Bituminosi* Laticis nullam Rimam quâ diffueret invenit; præcluso itaque Exitu, captiva se includi passa est; Conatum elabendi, quando in Arctum coacta fuit Gutta, manifestis Indiciis quædam Glebæ produunt.

Fossile Succinum Declaravimus; *Metallis* tamen non esse accensendum, vel illud arguit, quod nec Ductile sit, nec Liquabile; sicubi enim in Fluo-rem deducitur soliditati ejus multum decedit, contra quam *Metallis* evenit. Fuerunt qui *Succinum* Fundendi, & parva frustra in unam Molem salva Firmitate uniendi Artem se tenere asseverarunt. Ego variis Experimentis, dum Fusioni *Succini* operam dedi, frustra istud tentare didici, siquidem salinum vis, à qua maximum *Succinorum* Robur, inter solvendum avolat; nec a Fuga retinetur, nisi addito aliquo; eo ipso tamen Soliditas corrumpitur. Quod si Calor tam Blandus admoveri posset, qualem Natura in Animalibus Humente Vapore miscet, non desperandum Arti putarem; Globus enim *Succineus* in Ovis Ventriculo repertus ex pluribus minutis coagmentatus est, relictis juncturæ ubique Vestigiis; quæ ipsa nec Fusorium, sed Tepidum Glutinandis commodum, ignem a Natura adhibitum fuisse indicant. Fusa *Succina*, quibus Sceleta obducta atque *Succinea* Funera venditata, Vernix sunt, uti Amicissimus D. *Vogeding* optime monuit. Solvi olim *Succinum* & Liquefeci, solo Ignis adminiculo, nulla alia re admixta, sed fragiliter justo comperi, imminuta Coloris Gratiæ, Salinis Minutiis quæ Lateribus Vasis ad hærebant causam reddentibus. Multo minus ad *Terrarum* aut *Salium* Classem *Succinum* referendum erit; quum *Terris* Arctius colæreat, & *Salibus* sit Pinguius, utriusque etiam humidius. Ad *Bitumina* & *Sulphura* propius accedit; Ut tamen Durities ipsum ab his discriminet, tam Dura enim ac Solida pura *Bitumina* aut *Sulphura* nemo indicabit.

Durities vero *Succinum* inter *Lapides*; Splendor inter *Gemmas* collocat; neque Fragilitas objiciatur; Fragilis & *Gagates*; *Gemmaeq;* *Gemmis* Solidiores, nec tamen propterea Loco moventur; *Electrotoreutæ* satis Dura *Succina* experiuntur, *Alba* in primis, ut *Ferri* aciem hebetent; Tormen-
taque

taque & Mortaria Ludicra, à Pulveris Pyrii Explosione illæsa, Soliditatem docent. Summa etiam *Succini* ex Duritie & Soliditate Gloria: faceffant itaque Friabilia ac Fragilia, quæ Ignobilitate contempta ab Arte rejiciuntur. Sed Virtutum, quæ *Succinum* à reliquis *Gemmis* discernunt, præcipua Antiquis visa *Attractiva*, ut *Electrica* ipsis vocarentur Corpora, quæ facultate Trahendi quidpiam ad se pollerent; & celebre hujus Virtutis Nomen *Platonis* etiam ingenium in explicando exercuit. Recentior ætas, quæ res Naturales intentiori *Experimentorum* Curâ explorat, aliis *Gemmis*, *Lapidibus*, *Vitris*, *Bituminosis*, *Resinosisque*, *Sulphuri*, *Asphalto*, *Laccæ*, communem vim *Attrahendi* advertit. Reliquis tamen *Gemmis* fortius *Succinum* attrahet, ut quod attritum pingua Effluvia eaque Tenacia copiosius emittit: Virtutem enim hanc Oleosis Particulis adscribendam persuasit *Experimentum*, quod de Colophonia gemina cepi; altera enim post Olei destillationem excepta pariter se *Electricam* adducendo levia probat; altera verò, quam post Balsami Nigri Liquorem exemi, licet Nitida & quasi Vitrea esset, nullam Vim *Attrahendi* exerebat: Nimirum illa, aliquid *Pinguedinis* retinuit, hæc vero *Capitis Mortui* instar omni *Bituminosâ* *Pinguedine* prorsus exuta fuit. Veteres quædam exceperunt, quæ non adduceret; *Sympathiæ* & *Antipathiæ* Miraculo: perperam admodum, siquidem & *Ocimum* & *Oleosa* & *Humida*, ipsasque *Aqueas Guttas* à *Succino* Attrahi pro lubitu demonstro, insigni & polita Gleba admota; eleganti spectaculo, quando Effluviis ingredientibus Gutta, in Bullam adsurgit, aut quando Pendula transfilit. Sed & in Corpus Humanum hæc Virtute *Succinum* agit: Frusto Cervici alligato partem, quam leviter attingit, leni Sudore Humectam Tactu percipies. II. *Boyle*, *Angliæ* imò *Europæ* Eruditæ maximum quondam Decus, enarrabat & incredulo mihi asseverabat, Illustris Profapiæ Virginem Globulorum Grandiorum lactei Albescentis Corollâ ita affectam, ut Os in Tremorem & quasi Spasmm ageretur, quoties Collo suspensam gestaret, remotâ verò Corollâ Tremorem cessasse & Convulsionem. Efficaciam autem *Attrahendi* Humores in *Fonticulis* quidam Globulis *Succineis* persensere.

Propria *Succino* est *Fragrantia*, qualem nulla *Gemmarum* exhalat; neque ex reliquis Naturæ Fætibus, *Aromaticæ* sortis quidquam parem Odorem spargit; non *Thus* non *Myrrha*, non *Camphora*, nec *Mastiche*; in resinarum intra Formicarum acervos abditarum Glebulis imitamentum habes Odoraminis, sed ut in Attritis & Accensis Discrimen se prodat illicò. Diversus est Flavorum sive Igneorum ab Albescentibus Odor; illorum Pingua, adeoque Blandiora, horum falsa & Acriora sunt Effluvia, quæ haud similiter Nares afficiunt. Peculiaris quoque inter *Gemmas Succinis* est Sapor; sed & hic variat, uti *Oleosarum* & *Salinarum* particularum variat Miscela; Alba Fibras Linguae pungunt, Flava non item. A plerisque *Gemmis* & Colorum varietate differunt: Nigrorem refugiunt; Opaca rara sunt reperta; superant inter Pura Pellucida. Denique levitate Parem vix nominabas Gemmam.

Princeps Virtus Corporibus Animalium mederi, ad quam Gloriam nulla Gemma æque accidit: Crudum citra Artis operam est Salutare, sive intus sive extus applicetur, *Indis* & *Chinensibus* suffitus in Delitiis habetur, ut in Luxum degeneret: Sed *Catarrhis* ex Pituita Suffimentum prodesse vulgus notavit; Exhalationibusque *Succineis Alexipharmacis* acceptum quondam tulerunt *Electroto-*

reutæ Regiomontani, quod ipse à Peste manserunt intacti: Certe non efficacior adversus *Contagiæ Suffitus*, quam ex *Succino*; Neque ulli ex *Folinis Litoris Sudavici Graves* aut *Pestilentes* erupere unquam Vapores. Fluxionibus Capitis Alba perpolita *Succina* sunt proficua, Cervici alligata Humores avellunt; Blanda quoque Oculis Flavorum affricatio; & Fonticulis *Succinei* Globi lenius induntur. In Pulverem contusum ad Urinam Ciendam, ad Calculum propellendum, ad Muliebris Sexus Menstruum Profluvium movendum, multum valere, si cætera sunt paria, quotidiana loquitur Experientia. Dono à Generosa Domina acceperam Calculum plurimum *Unciarum*, duos Articulos Digitorum & supra Latum, tres longum, quem carnificem Rustico in Sinu Pudoris tres Menses passa erat; dato *Succini Albi Pulvere*, Cochlearis Mensurâ, feliciter carnificinâ liberata est; ipsam Aniculum ad me adduci curavi, ut omnia exquirerem accuratius. Pariter *Succini Pulvis*, Vino infusus, hinc sub operculo incoctus, calido Vino epoto, & Urinæ & Calculo, & Mensibus trahendis inservit, quamvis minus efficaciter. In memoratos *Usus Medicos* præstat Album sumere; Salis enim maxima in his enitet Virtus.

Magisterium Resinosum salubriter Pilularum Formâ usurpatur, nec *Balsamo Copaitæ* cedit; sive Urina cienda, sive Pituita digerenda, sive Gonorrhæa temperanda: Idem Cephalicis Emplastris convenit. Colophonia Diaphoreticis quibusque & Stomachicis Emplastris Congruit; Commodo maximo si adversus *Paralysin*, *Apoplexiam*, aut *Epilepsiam*, aut etiam *Gangrænam* muniendæ sunt Partes; Sumptu minori: Debilitatos ab *Arthritide* Artus benignè fovet. Oleum *Succini Europæ & Asiæ* præclarum præbet Medicamen, sed imprudentiâ Medicastrosum Infamiam incurrit; siquidem in Gonorrhæa, Calculo & Mensibus Suppressis sæpe in exitium ægrotis cessit: Parca ejus sit Dosis Gutta una & altera aliquot *Drachmis* Sacchari vires impertit; Frigido Pituitoso Cerebro una Guttula Vertici aut Suturis illita medetur; Gossypio excepta Auribusque admota Flatus & Tinnitus discutit; ambustas Frigore partes restituit; Partui difficili fert Opem, quod vel Veterinariis in *Prussia* innotuit, quamvis his Pulvis magis in usu. Oleum autem eligendum quod Aërium, nullâ ab Igne notâ Empyreumatis impressâ, Albescens, Subtilissimum & Fragrantissimum. Salis Volatilis *Succinei* contra *Epilepsiam* aliosque Affectus Cephalicos à Pituita oriundos decantata est Medicina: Sed & Dieureticum insigne præstat. Essentia *Succini* est Olei subtilior portio, adeoque eadem de hâc tibi promittis Commoda, sed quæ *Spiritus Vini* Mixturâ diluta est largius in usum assumi potest: valet quoque ad arcendam Gangrænam extus. Sunt qui Phlegma Medicamentis adnumerant: Sed quodcunque ipsi in est Virium, Olei atque Salis reliquiis debetur, quibus si privatur Fatuum ac Fumosis Exhalationibus imbutum restat. Quod postremum Destillat crassum Oleum non nisi vulgo in Frigidorum Artum Medelam conveniet, Empyreuma enim graveolus reddit, ut satius estimem isto abstinere, & Colophoniam integris Viribus servare.

Illud unicum adjicio, me iusta *Analysi Ductu Naturæ Pura* ab Impuris sepe-
rando, blando in subsidium advocato Igne, vires *Succini* omnes ita coadunare,
ut salvâ *Fragrantiam Nativâ*, *Pinguium & Salinarum particularum* salvâ quoque
Efficaciâ, Externo Internoque usui idoneum Remedium evadat: *Balsamum*
Succineum voco, in quo remotis *Terrestribus Graveolentibus* partibus *Volati-*
liores

liores atque Delicatiores amicissimo Fluoris Nexu arctæ cohærent, nullo alieno in Societatem admisso. Quicquid à *Succino* Crudo aut Arte quomodocunque Præparato expectari potest, citius, tutius et jucundius à nostre *Balsamo* præstabitur. Internè formâ Pilularum commodissime assumitur, aut Boli; Externè Apoplectici, cujus & Colorem præ se fert, Balsami in modum applicatur; Gingivis, Linguae, Palato, in *Deliquiis*, in *Passionibus Hystericis*, *Epilepticis*, *Paralyticis*, cum fructu affricatur: Prophylaxeos ergò quavis Septimana bis terve *Grana* 5, 7, 10, imo 15, tuto usurpantur; similiter in Renum, Vesicæ, Genitalium certis Morbis, admixtis Anodynis; contra Tinnitum Aurium quam Oleum affert Medelam, at certiozem. Non malè apud *Hofmannum* & *Ettmullerum* *Balsami Peruviani* gratia Oleo *Succini* jungitur; Ast felicior *Peruviani* & nostri *Balsami Succinei*, adversus Gonorrhæam & Fluorem Album imprimis, societas erit.

Succini notior est Distillatio, quam ut describi opus habeat: Et XX & Retorta huic Negotio inservire valent; verum per Rimas multum Olei & Salis elabitur si XX adhibes, Vehementissimam enim Olei & Salis vim nullum *Lutum Philosophicum* coercebit; præstat igitur Retortæ operâ uti Attendum autem ut Alba si salis, si Olei copiam elicere Satagis, ut Flava eligas: ex ℥j. Albi recepti Salis volatilis ℥ss. quum ex Flavi ℥j. viz. ℥j. elicias. Felicius quoque & suavius Oleum proveniet, si polita Fragmenta, aut nitida, tenui Cortici lucida frustra, quam si impura, Crassâ Crustâ investita, aut vulgarem Rasuram adhibueris; nihil autem *Succino* est admiscendum, quamvis silices & Arenas addere olim fuit in usu. Absit Ignis Vehementia; ex Arena Calor leviter intenditur; atque justo Regimine mox cum Phlegmate ætherea Olei portio ascendit, quam Limpidam peculiari vase excipies; ubi Flavescens Oleum prodiit cum sale Volatili, cesset Destillatio.

Urgeri quidem potest *Succinum*, ut crassum Liquorem Nigrum fundat; parumque *Capitis Mortui* Nigri & Splendentis instar Colophonix erit residuum, sed hoc omni Virtute Olei & Salis est spoliatum; ex ℥ss. Albi restabat ℥i. hujus *Capitis Mortui*. Sed præstat aliquas Colophonix vires relinquere, quando gratior hujus præ Fætido Nigro Balsamo est usus. Sal Volatile, quod ad Rostrum Vasis evolavit, aut Lateribus adhæsit, calidâ Aquâ abluitur, atque ut ab admixtis Oleosis particulis separetur, Charta humefactata solutio percolatur, Transeunte sale, restitatur Oleum: à Solutione percolatâ postea Superfluous Humor abstrahitur, ut tertia pars relinquatur, quæ Frigori exponitur, atque singulare salis concrescunt Crytalli, Miliæ quasi sive Grandinosi. Alius est modus Sal Depurandi, si feculentum Vitro longioris Colli inditum Cinerum aut Arenarum Calori exponitur; Nives enim Floccis, sive Spiculis ad sublimiora Loca evolantibus, in Fundo impurior pars hæret: verum hæc Operatio cum jactura Vitri & Salis est conjuncta. Quidem & Phlegmati seperando student, verum rectius hoc cum Aquâ, quæ sal volatile imbibit, jungitur, ut pariter sale suo exuatur; neque reiterata Destillatio illi conciliabit Virtutem, nisi à sale Volatili illam acceperit; nec Gratus Phlegmatis Odor, ut in Salis Volatilis Conservationem commendari posset.

Accepi ex ꝑ̄ss. Albi Phlegmatis ꝑ̄ss. quod Salis *Succinei* sapore erat imbutum, repetita autem Destillatione Fumum solum sapiebat, cætera Fatuum & ingrati Odoris. In Colophonia, si non prorsus fuerit exulto, aliquid Salis latitat, quod ope Aquæ calidæ, morâ quâdam Macerationis educes: nonnullis hoc Sal Fixum *Succini* audit; non rectè, quia Parilis Volaticæ est Virtutis, Sapore & Odore eodem: Colophonix autem Virtutem hoc quodcunque est Salis intendit. Oleum omne, ut alia opera Depuretur non opus est, modo *Recipiens* vas justo tempore mutetur, atque ritè instituat Destillatio, purissimum statim accipies. Qualitates Olei *Succinei* ex Bitumine sive *Oleo Terræ* sunt derivandæ, qua in re Cl. *Borrichio* minimè refragor; sed quod idem omnes Virtutes *Succinei Petræ* Oleo vult communes, in hoc dissentio: alteratum enim *Succineum* Odor & Sapor ab illo Olei *Petræ* aut *Terræ* diversus demonstrat; at Olei ex *Ligni Fossilis* Destillatione, Odor Olei *Petræ*, non autem *Succinei* Odori congruit: Credo autem alterationem Olei *Terræ* in *Succino* Salium intimæ deberi Combinationi. Quænam vero ista sint salia determinare non licet, illa ipsa tamen erunt quæ *Succini* sal Volatile suâ misturâ progenerant. Nullum enim est *Succinum*, cujuscunque sit Coloris, quod sale Volatili destituatur; atque à Sale volatili omnis ista Peculiaris *Fragrantia*; quantoque Sale abundant, tanto in attritu *Fragrantiora* experieris. Ut autem temerarium Naturæ Arcana desinare, ex *Vitrioli* tamen *Martialis* Corpore sal istud *Succineum* majori ex parte componi citra Crimen Audaciæ assero; & enim in Albis Sale Volatili insigniter pollutibus, & Odore & Sapore *Chalcanthum* tale manifestò deprehenditur. Sed minime communi *Vitriolo* Sal *Succini* adscribimus; *Vitriolum* Alteratum sit oportet, quod tale Virtutis singularis Sal Volatile producit. Esse autem *Vitriolum Prussicum* ab aliarum Regionum *Chalcantho* diversæ Naturæ, Analysis inferius declarabit.

Certe ab Acido Originem trahere Sal Volatile, Acidus, isque non ingratus ferme Vinosus Sapor arguit; ad *Spiritum Vitrioli Philosophicum* proxime hæc gratia Acoris in Sale Volatili *Succini* accedit; pungit, minimè corrodens; affusque *Spiritu Vitrioli* non Effervescit, neque Ebullit, nec Consumitur, cum *Sp. Salis Armon*, commissum Bullulis excitatis cum stridore absorbetur. Subtilissimum hunc & gratissimum volaticum Salis *Succini* acorem moderationi Bituminosarum Exhalationum vindico; quemadmodum *Sp. Vini* cum *Spiritibus Nitri* aut *Salis* Combinatus, hos mitiores reddit, ut Dulces audiant. Siquidem dum *Bituminis* Particulas dispersas Calor subterraneus in unum cogit, fit ut hæc per Ditiones *Vitrioli* Transitum faciant, quas dum permeant, subtilissima *Vitrioli* Effluvia eodem Calore excitata secum rapiunt, minori, majorive Copiâ, atque in *Matricem Ligneam* auferunt, ut junctis seminiis *Succinea* pronascatur Proles.

Succini, quâ in Pollinem terendo redigitur, levior est Præparatio; equidem parùm interest, Pulverem contendendo an terendo minutum exhibeas; scilicet utroque modo prodest, vel Brutorum Exemplo, quæ avidè *Succinorum* Minutias devorare annotavimus. Verum tamen quod Divisio in Minima ad faciliorem Commissionem cum Succo nativo Animalis disponit, non inutilis in Medicina ista erit opera. Infusionem *Succini* aut Coctionem præterirem, nisi inter Euporista

Euporista Domestica meritò hæ Præparationes locum sibi dati poscerent: certum est, quod Virtus *Succini* Coquendo in Vinum transeat; sed Infundendo atque Digerendo Vinum *Succino* Medicatum impetrabis. Essentiam sive Tincturam affusus *Succino Sp. Vini* parat, qui tamen à Puris Albis Flavidine non tingitur; an *Sp. Vini* Igneus præstet, an Dilutus, in dubium vocaveris; illum enim Oleosæ hunc Salinæ partes deposcunt; verum cedit *Succinum* utrique & per Digestionis quamcunque moram necesse est ut *Sp. Vini* tandem reddatur Dilutior, præferendus itaque generosior. Felicius autem Tinctura proveniet, si Ramenta tenuissima cum *Sp. Vini* sociaveris: quidam *Ol. Tartari per delo* aut *Salis Fixati* addunt, aut his *Sp. Vini* acuunt, ut major Virtus & Ocyus in Spiritum transeat; non malè; nisi quod Alieni particeps hæc evadat Tinctura. Sed & Ebullitione in Vitro oblongi Colli *Succinum* Felicius dissolvitur, ut Virtus promptè suscipiatur, & Spiritus illà Saturetur penitus; id quod sola Digestio longissimà Morâ demum assequetur.

Majores Magisterium ex *Succini* Extracto per Acidum redigere sategerunt, nullo operæ pretio; si Acidum *Succini* Pulveris associare cupis, Terendo idem assequeris rectius. Præstantius Magisterium dabit Tinctura abstracto *Sp. Vini* Resinosum istud est, imò ipsa Resina sive Oleosa pars *Succini* qualemcunque mutationem passa; siquidem *Sp. Vini* quem Destillando recipis *Sucineis* Viribus impregnatus intimam sui cum *Succino* unionem indicat.

Ligni Fossilis Fragmenta contusa Aquâ Calidâ maceravi, Lixivium subdulcis *Aluminosi* aut *Martialis* potius erat Saporis, ut ægre tandem aliquid *Vitriolici* persentisceres; sed ad *Chrystallos Salinos* congregandos inspissatum, magis atque magis *Vitriolicum* saporem prodebat, ipsique *Crystalli* eundem referebant, nisi quod primum *Martialis* Dulcedo Linguam afficeret; id quod repetendo Solutionem & Corporationem in *Crystallos* denuò expertus sum. Exutum Sale *Lignum* Retortæ indidi; & Calore Arenæ intensissimo, ut intra Vitrum Fragmenta canderent, omnem Humorem elicui: Lacteus prorsus erat Liquor qui prodibat, specie Emulsionis Amygdalarum; quadam postea in Superficie Cuticula, & subsidentibus in fundo Particulis Calciformibus. Odor Gravissimus *Sulphureus*, qui totum Hypocaustum illicò pervadebat; sed propius admoto Liquore Nares *Sucineum* quid percipiebant, non quidem Fragrantis Glebæ aut Olei, sed Phlegmatis ut post Destillationem in Retorta Residui: Sapor quoque qualis Phlegmatis, Fumosus ab Emphyreumate, Salso aciduli quidpiam Gustui intermiscens. Lacteus Color in Liquore postea disparuit, Pinguiori relicta Cuticula. Denuo partem Igni feci exponi, si qua sal Volatile & Puriores Olei Guttas reiterata Destillatione exciperem: Verum Salis Volatilis nihil ascendit, Oleosæ autem Particulæ subtiliores innatabant, non amplius in modum Cuticulæ cohærentes; quædam etiam forma Globulorum Pellucidorum Fundum petierant, Igneo *Succini* Colore conspicuæ. Exigua portio Olei, aliquot Guttarum ex ꝥj. Liquoris; Sapore & Odore *Oleum Petræ* prorsus imitabatur; Globuli vero, ut in Fundo Resinosi apparerent,

levi concussione Liquori commiscebantur. Calciformes Particulæ tenuiori Terrestris Portioni adscribendæ erunt, Ignis visursum elatæ.

Lignum ex Retorta exemptum Brunno ferruginei erat Coloris; multum *Sulphuris* exhalabat; Accensum instar Fomitis Ignem alebat; Superficies ejus leviter Rubro Pulvisculo conspersa fuerit.

Crucibulo impositum per tres Horas ignis exercuit; refrigeratum pariter *Cinnabarino* quasi Pulvisculo obtectum fuit: Flammæ admotum minus prompte Ignem suscepit, neque diu detinuit, nedum ut Fomitis instar propagasset: spirabat autem *Sulphur* Auratum, hujusque saporem Commansum præbuit; accensum vero minus *Sulphuris* exhalabat quam quod in Retorta erat relictum: Colore etiam lucidiori. Denuo in Crucibulo ultra novem Horas detinuimus, neque Accendi amplius potuit, sed instar *Amianthi* Album post ignitionem comparebat, nullo *Sulphuris* Odore. Color post tam longam in Crucibulo moram ex *Griseo* partim Nigricans, partim Splendens: *Microscopii* ope aliæ partes instar Scoriarum, aliæ instar Chryfocollæ, aliæ instar Calcis efformatæ Dignoscebantur. Tostum atque Exustum satis *Lignum* Felle Vitri admixto, Igni Fusorio exposuimus; & facile coierunt in Massam, quæ Granulæ dispersa *Reguli Martialis* exhibuit postea. Dum vero in unum Corpus ista Granula fortiori igne cogere intendimus, Colliquata cum *Regulo* Massa, ex Nigro Splendens, Vitrea producta est.

Nativum Vitriolum, sive illud *Amianthi-Forme* sive *Fusum* alterum, attritu Chalybis prodit sibi non cum *Venere*, sed cum *Marte* Societatem innitam; nullam enim Cupri indicem Rubedinem relinquit. *Nativum Amiantha-Forme* solutum & in *Crystallos* redactum idem confirmat; subdulcis enim ac plane *Martialis* primo sensu percipitur sapor, qualis Salis sive Solutionis *Martis Crystalli* non ista Specie qua *Goslariense* concresecunt; Solutionum autem prius depurgavimus affusa Urina, atque semotis Fecibus concrevit Terra Foliacea; reliquus Liquor *Crystallos Sappharini* ferme Coloris inæqualibus Angulis exhibuit. Cæterum ex Solutione Inspissata hincque Filtrata, succedente Evaporatione, Album *Olum* prodiit, quod Furno Pistoris leviter Calcinatam Loricatæ Retortæ inditum *Sp. Vitrioli* intra 24 Horas fudit egregium, qualem ex *Olo Martis* alias Officinæ parare solent. In *Colchotare* multum Salis *Oli* adhuc latere, ope *Microscopii* exploravimus; ut pateat quomodo *Olum* in *Colchotare* Aeri exposito regenerari intelligendum.

Terram Corticosam ejusdem cum *Ligno Fossili* esse Naturæ Ignis Examen confirmavit; Leviori Tostione opus erat ut ex hac aliquid Metallici eliceremus, licet quod obtinuimus Exiguum esset. Ex *Luto Cæruleo* olim per Destillationem Spiritum Nactus sum Volatilem *Sulphurei* Odoris, & *Bituminosi* quid in Superficie comparebat. *Terram* vero *Flavum* ad *Martem* inclinare adverti; & *Vitriolici* aliquid traxisse ex Confinio Sapor arguit & Odor.

Inter *Regias Opes* antiquissimis Temporibus Thesaurus hic *Succinorum* repositus fuit *Regibus*, qui *Terras Succiniferas* tenuere jam olim *Succina* colligentibus,

colligentibus; ut Magnificentia Munerum aliis pares essent. Apud *Solinum*, Rex *Germaniæ*, (*Prussiae* intelligendus, quam *Germania* tantis Opibus *Succineis* nunquam gavisa sit) tredecim millia Librarum *Neroni* Donum misit; Non unius sed plurimorum Annorum congestus Acervus. *Prussia* inter Regalia *Crucigerorum* Ordini *Succina* vindicavit, aliquo in eadem Episcopi *Sambiensis* jure. Atque publicâ Autoritate Collectio est instituta, severis in Depeculatores Legibus. Seccessione Civitatum Ordinis *Ærarium* accisis *Succini* Reditibus non leve Detrimentum passum est, quam vis obnixè omnia ageret ut integro *Thesauro* solidè potiretur. Post *Crucigeros* Ducum *Prussiae* quæ fuerit in severandis *Fisco Succinis* Cura, *Annales* parcius eloquuntur: Destinati tamen operi memorantur *Litoris Sudarvici* Coloni, quibus ex *Capitaneatibus Schakensis & Fischusiano* additi sunt alii: *Servituti* non statim Dies, sed si quod *Capturae* Tempus commodum, diu noctuque, *Hieme* æque ac *Æstate*. *Stipendium* his, *Domus* instructa & *Agellus*, atque à *Tributis* *Immunitas*; *Hauftique* vel *Lecti Succini* *Modius Modio Salis* redhostitur. *Fossili* præsens *Pecunia* adjicit *Auctarium*. *Crucigeri* *Dominum Succinorum* vocabant qui *Succineis* *Rebus* præerat; alicubi & *Commendatoribus* ista Cura incumberebat. Sub *Divo Alberto* *Magistrorum* atque postea *Camerariorum* nomen frequentius fuit, *Equestris* *Dignitatis* *Viris* hoc *Munere* defungentibus: *Nostrâ* *Ætate* partem *Muneris* capit *Capitaneatus Fischusiani* *Præfectus*, partem *Feloniorum* *Director*, *Administratore* *Litoris* *peculiari*. *Administratori* *Custodes* *Litoris* *Equites* (*Dimond Keuten*) præsto sunt; *Equitibus* autem adjuncti sunt *servi* *Cameræ* (*Hunmer Musta*) qui *Pedestres* cum *Equitibus* *Munus* *Custodiendi* alternant, quandoque si opus est, & horum vices obeunt.

Administratoris *Officium* est ad *Operas* ordinandas *jussa* *edere*, *Succina* undique *recipere*, *congesta* *Regiomontum* *transmittere*, *Furta* præcavere, de *Inventis* *disceptare*, & *Regale* *Serenissimi* *ubique* *Inviolabile* præstare: *Hujus* *etiam* est *Sal* *Colonis* *distribuere*. *Equites* & *servi* *Cameræ* *Litus* de *Die* *obequitant* aut *circumeunt*, ne quis *Succina* *tollat*; *iidem* *Tempestates* *observant*, & *Colonos* si *Hauriendum* *Fodiendumque* *convocant*, *Fossiumque* & *Haustum* *recipiunt*. *Nulli* *Colonorum* *Succina* *detinere* *Domi* *licet*, sed ad *Equitem* aut *alium*, cui *istud* *Delegatum*, *deferunt*; quæ in *Pillarvia* & *Neringiæ* *Recentioris* *Litore* *leguntur*, *scriba Felonii* ab his *suscipit*. Si quando *Angustia* *Temporis*, *insigniori* *Copia*, in *Litore* *seligere* non *permittet*, *Domum* *asportandi* *Facultas* *concedetur*: *vi* *juramenti* *autem* *proximo* *Luce* *eadem* *reddunt*: *Inter* *Hauriendum* & *Fodiendum* *Operariis* *Sacculus* à *Collo* *pendet*, & *Furti* *Reus* *habetur* qui *Vestimento* *Glebam* *abdedit*. *Recepta* à *Colonis* *Administratori* *exhibentur*, à quo *Regiomonti* in *Succinorum* *Camera* *Reconduntur*, atque *præsentem* *Directore Feloniorum* *Discernuntur* & *Divenduntur*. *Olim* *plures* *Succinorum* *Cameræ* *erant*, *Lochsteti*, *Dirschkeimi*, *Memelæ*, *Germoviæ*, *singulisque* *sui* *præerant* *Magistri*.

Extra *Litora*, *Succina* in *prædiis* *Fisci* *reperta* *Præfectis* *sunt* *restituenda*; quæ in *privatorum* *Fundis*, si non *Privilegio* *Domino* *vendicari* *poterunt*, *Fisco* *neccesse* est *pariter* *cedant*; quamvis *hactenus* *privatis* *invidendas* *ex Succino* *Opes* *obtigisse* non *memini*.

Quondam *Privatis* *Succinorum* *Captura* *erat* *elocata*, ut *certa* *Annos* *Summa* *præsentis* *Pecuniæ* *10000* aut *12000* *Talerorum* *redimeretur*, *preterquam*

quod in Colonos impensæ erant faciendæ. Verum plus *Questus* ad *Fiscum* rediit, postquam publicâ *Autoritate* non solum *Curata*, sed & *Divendita* sunt. *Succina*, certo pretio cuilibet *Generi Succinorum* ad *Mensuram* statuto.

Succineæ *Rudes* *Glebæ* in *auctarium* præcii discernuntur, *Capitales* (*Haupt Stuck*) aliquot *Unciarum* pondere, carius veneunt; *Tornatiles* (*Dubly*) *Publæ* *Longitudine* ac *Latitudine*, minoris constant; *minimæ* (*Kraufs*) his cedunt. Illis autem, quæ aliquot *Librarum* pondera æquant, nulla certa est æstimatio. *Puritas*, *Dignitas* *Coloris*, *Pretium* adanger; *Vilissima* habentur *Impura* (*Dibluck*), *Pretiosissima* *Alba* *Lactea*.

Crusigeris *Dominis*, *Lubecenses* & *Stolpens* *Succinorum* *Commerciis* incla-ruere: Postea & *Gedanenses* atque *Regiomontani*. *Nostri* *Ætate* *Gedanensium* maximus ex *Succinis* est *Quæstus*, postquam *Mercatores* *Prussica* ad se traxere; *Electrotoreutarumque* *Collegium* quæ *Neringiæ* *Recentis* *Litus* offert, solide possidet. *Cruda* *Orientalibus* *Populis* magno *Pretio* venduntur; *Armenique* & *Persæ* olim *Regiomonto* asportari curarunt, *Lucro* *Civium* non contemnendo. *Cæterum* *As* *Electrotoreutarum* majorem *Quæstum* facit, *Sculptura* ac *Celatura* aut *Torno* varias *Figuras* inducendo, ut inter *Pretiosissima* habeantur ex *Succinis* *fabrefacta* *opera*. *Operibus* *pretium* intendit si ex *Eadem* *Massa* *integra* *confecta*, si *Nobilioribus* *Coloribus* sunt *conspicua*, si *Rariora* *Naturæ* *Pigmenta* monstrant.

Primus *Ego* *Persuasi*, ut *Italos* & *Gallos* invitentur, qui *Effigiem* *rerum* & *Animalium* *segmentis* aut *Tessellis* *Gemmarum* ingeniose componunt: Et succederet *Opus*, si *supremi* *Domini* *iussa* accederent, *Facultasque* daretur *seligendi*, quæ ad *Vermiculata* sive *Musiva* istiusmodi *Opera* requiruntur; etenim *Opaci* *Colores*, quibus *Ars* maxime indiget, in *Succinis* occurrunt *Rarissimi*. Neque solum *Arte* *Toreutica*, sed & *Pharmaceutica* ex *Succinis* *Lucrum* redigi potest; quum *Agyptæ* *Circumforanei* *Adulteratis* *Oleis* & *Balsamis* *Succinorum* tantum *Argentii* lucrentur. *Præterea* *Vernicis* & *Succino* magnus est *Uusus*; atque *Laccæ* non cedit *Succinum*, si recte preparatur. *Infectores* quoque *Hellium*, *Russi* imprimis ac *Judæi*, *Succinum* *Opere* adhibent; ut & *Horum* *ratione* ex *Succino* *Quæstus* promitti queat.

An Odd sort of Amber; by M. Hevelius. n. 64. p. 2061.

LXV. I lately received from one, that liveth on the side of the *Baltick* *Sea*, a piece of *Amber*, which is so *Soft*, that I Printed my Seal on it. It is *Yellowish* as most *Amber* is; *Transparent*, and *Burning* as *ot* *er* *Amber*; but its *Scent* stronger, as if it were a kind of *Glutinous* *Bitumen*; and yet it hath been cast up from the *Sea* this *Year*, and was found among other pieces. A very *Credible* *Person*, related at the same time, that he had been *Master* of a small piece of *Amber*, *Soft* on *One* *side*, and very *Hard* on the other, where n day *Buried* a *Fly*.

n. 66. p. 2028.

Succinum quod *Sigillo* cedit inter omnium *Rarissima* quæ apud nos reperiuntur, merito habetur; quippe dum vxi, si bina illa *Frusta*, quæ penes me habeo, excipias, ne unquam quidem vel *Minimum* *frustulum* vidi, ut ut tale à multis *Anis* sollicitè quæsserim. An unquam *frustulum*, altera parte *Molle* altera *durissimum*, possim impetrare, valde dubito.

LXVI. The

LXVI. The chief Fisher upon the *Inland Poysonous Sea* near *Dantzick*, informed me, that 2 or 3 Years ago Fishing in this Sea, his Net brought up a considerable large piéce of *White Amber*, which was a Rarity he presented to one of the chief Fathers of the *Olives Abby*, to which this *Sea* belongs. Now since this *Sea* lyes High, and about 3 *German Miles* distant from the *Ocean*; and since also the Neighbouring Woods, that bear none but highly Resinous Trees, cannot be reasonably said to furnish such *Amber*, that Conjecture, which imports that *Amber* is a *Bituminous Fluid Substance*, hardned by the *Aqua aerial* Particles upon it, may receive some Confirmation from this account.

White Amber;
by M. Kirkby.
n. 83. p. 4069.
Vid. Sup. Cap.
II. §. XXIII.

LXVII. Having occasion in *July 1674* to view certain *Fossils*, which I had disposed into divers Drawers in a Cabinet made of *Barbadoes Cedar*, I observed many of the *Stones* in Every Drawer (and some were lapped up in Papers) to be thick Covered over with a *Liquid Rosin* like *Venice Turpentine*; though after diligent Search there appeared no manner of Exudation in any part of the Cabinet.

The Electrical-
Power of Stones
in relation to a
Vegetable Rosin,
by Dr. Lister.
n. 110. p. 224.

Of the many sorts of *Stones* I there had, divers escaped, but not any of the *Hæmatites* kind; having therein *Manganes*, *Scistos*, *Botryades*, &c. which were all deeply concerned: and amongst perhaps 500 pieces of the *Astroites* here and there one or two in an apartment, and sometimes more were seized, and the rest Dry; as it fares with People in the time of the *Plague* in one and the same House. I further observed, that *Stones* of a Soft and Open Grain, as well as those of a Hard and Polih'd Superficies, were concerned in a manner alike.

'Tis certain, that the whole Body of the *Turpentine* of the *Cedar-Wood* was carried forth into the Air, and floating therein was again Condensed into its own proper form upon these *Stones*. This makes it more than probable, that *Odoriferous* bodies Emit and Spend their very Substance. Thus *Camphir* is said if not well Secured, totally to Fly away. Again it is hence Evident, that there is great Difference betwixt the *Distillation* of *Vegetable Juices*, and the Emission of *Effluvioms* or this *Natural Distillation*: That really Separating and Dividing the Substance into different parts; but this carrying out the Whole entirely and Unaltered in its Nature.

LXVIII. Non solum *Succinum* & *Gagates* Allectant Corpuscula, sed & *Adamas*, *Sapphirus*, *Carbunculus*, *Iris Gemma*, *Opalus*, *Amethystus*, *Pseudo-adaneas Bristolensis*, *Berillus* & *Christallus*: Item *Hyacinthus*, *Granatus Bohemicus*, *Vitrum*, & ex *Vitro* sive *Chrystallo Gemmæ Adulteratæ*, *Vitrum Antimonii* & *Saturni*, *Omnes Fluores ex Fodinis*, *Belemnites*, *Sulphur*, *Mastix*, *Cera Sigillaris* ex *Lacca*, *Resina Durior*, *Arsenicum* sed imbecillius, & *Cælo Sicco Sal Gemmæ*, *Lapis Specularis*, & *Alumen Rupeum*.

A Catalogue of
Electrical Bo-
dies; by Dr.
Rob. Plot.
n. 245. p. 384.

Ambergreece, a Vegetable Production; by ... Communicated by Mr. R. Boyle. n. 97. p. 6113.

LXIX. 1. The several Trials and Observations of my own about *Ambergreece* having long kept me from acquiescing either in the Vulgar Opinions, or those of some Learned Men concerning it; yet I confess, my Experiments did much less discover what it is, than the following Paper has done, in case we may safely and intirely give Credit to its Information, and that it reach to all kinds of *Ambergreece*. And probably you will be invited to look upon this Account, though not as Compleat, yet as very Sincere, and on that score Credible, if you consider, that this was not written by a *Philosopher* to broach a Paradox, or serve an Hypothesis, but by a *Merchant* or Factor for his Superiours, to give them an Account of a Matter of Fact; and that this Passage is Extant in an *Authentick Journal*, wherein the Affairs of the *Dutch and India Company* were by Publick Order from time to time Register'd at their chief Colony *Batavia*, which was lately taken in a *Dutch East-Indian Prize*. And it appears by the Paper it self, that the Relation was not looked upon as a Doubtful thing, but as a thing from which a Practical way may be deduced to make this Discovery easily *Lucriferous* to the *Dutch Company*.

“*Ambergreece* (says the *Journalist* Mar. 1. 1672.) is not the Scum or Excrement of the *Whale*, &c. but it issues out of the *Root* of a *Tree*, which *Tree* how far soever it stands on the Land, always shoots forth its *Roots* towards the *Sea*, seeking the Warmth of it, thereby to Deliver the *Fattest Gum* that comes out of it: Which *Tree* otherwise by its Copious *Fatness* might be Burnt and Destroyed: Wherever that *Fat Gum* is shot into the *Sea*, it is so Tough, that it is not easily broken from the *Root*, unless its own Weight and the Working of the *Warm Sea* doth it, and so it *Floats* on the *Sea*.

“There was found by a Souldier $\frac{7}{8}$ of a pound, and by the Chief, Two pieces weighing 5 Pounds. If you plant the *Trees* where the stream Sets to the Shoar, then the stream will cast it up to a great Advantage.

An Animal Production; by Mr. Rob. Tredway. n. 232. 711.

2. An Ignorant Fellow in *Jamaica*, about 2. years ago, found 150 pound Weight of *Ambergreece* Dash'd on the Shoar at a Place in these Parts call'd *Ambergreece Point*, where the *Spaniards* come usually once a Year to look for it. This vast Quantity was Divided into two Parts; supposed by Rolling and Tumbling in the *Sea*. This Man tells me that 'tis Produced from a Creature, as *Honey* or *Silk*: And I saw in sundry Places of this Body, the *Beaks*, *Wings*, and part of the *Body* of the Creature, which I preserved some time by me. He adds, that he has seen the Creatures alive, and believes they Swarm as *Bees*, on the *Sea-shore* or in the *Sea*.

The Production of Coral; by S. Paulo Boccone. n. 99. p. 6158.

LXX. 1. *S. Boccone* having been present at the *Coral Fishing* in the Channel of *Messina*, which separates *Calabria* from *Sicily*, relates in a Letter of his, written on that Subject to Signor *Marchetti* at *Pisa*, that before the *Coral Fishers* drew their Nets out of the Water, he immersed his Hand and Arm into the *Sea* to Feet, whether the *Coral* was Soft under the Water, before it was drawn up in the Air, and found it altogether *Hard*, except the Round

Round End, which having been Bruised with his Nails, he found it made up of 5. or 6. little Cells, full of a White and somewhat Mucilaginous Liquor, resembling that Milky Juice, found in Summer in the long Cods of the Herb, call'd *Fluvialis Pistana foliis Denticulatis*, spoken of by *Joh. Baubinus*.

This *Corallin Juice* he calls *Leven*, because having Tasted it himself, as well as the Mariners did, they always found it of a *Sharp and Adstringent Taste*, in such pieces as came Recently out of the Sea; those that are Dried losing that part of the Taste which is *Acrimonious*, and retaining only that which is *Adstringent*: Which Change of Taste he affirms to be made in about 6 *Hours* after the *Coral* hath been drawn up; in which time also the said *Leven*, that is inclosed in the Pores, is Dried, and hath changed its *Colour*. He inclines strongly to the Opinion of those who Conceive, that the Long Concoction of the *Ferment* Fixes the parts, and produces the *Red-Colour*, especially being near to the *Hard Coral*, and the *Red Vermillion*, which Surrounds it.

2. *M. Guifony* is of Opinion, that *Coral* is so far from being a *Plant*, that 'tis a meer *Mineral*, composed of Much *Salt* and a little *Earth*; and that 'tis Formed into that Substance by a *Precipitation* of divers *Salts*, that ensues upon the encounter of the *Earth* with those *Salts*; after the manner of the known *Metallick Tree*, which in a very little time is form'd and Increas'd by the Settling and Combination of *Mercury* and *Silver*, Dissolv'd in *Aqua-Fortis*, and afterwards cast into common *Water*; the parts of this *Mineral* and *Metal* joyning themselves one to another. Which thing also happens in some *Subterraneous Grotto's*, where by a continual and long Fall of *Water Drops* many sorts of *Figures*, and, amongst them Shapes of little *Trees* are Form'd. This Sentiment he confirms by alledging, that he can shew a *Salt of Coral*, which, being Cast into *Water*, and there Dissolv'd, upon the Evaporation of that *Water* by a gentle Heat, is presently *Coagulated*, and Converted into store of small Sticks, resembling a little *Forrest*.

By *M. Guifony*.
ib. p. 6159.

LXXI. 1. The *Stones* Figured like *Plants*, which *Agricola* calls *Trochitæ*, and the Compound ones *Entrochi*; we in *English*, *St. Cutberd's Beads* are (like the *Lapides Judaici*) of an *Opaque* and *Dark Coloured Sparr*; though I have of them from some parts of *England* of a *White Sparr* or *Cawke*, as our *Miners* call it. They all break like *Flint*, Polished and Shining.

Trochitæ and Entrochi describ'd; by Dr. Lister. n. 100. p. 6181.

Vinegar as a *Menstruum* will corrode and dissolve them (as well as all *Fossiles* of what *Figure* soever) provided they be Broken into indifferent small grains, and if the bottom of the *Vessel* hinder not, they will be moved from place to place by it.

The *Figure* of the *Trochitæ* is *Cylindrical*; the utmost round or *Circle* (we speak of one Single *Joynt*, which *Agricola* calls *Trochites*) is in general *Smooth* both the *Flat sides* are *Thick* drawn with fine and small *Rays*, from a certain hole in the *Middle* to the *Circumference*. Two, Three, or more of these *Trochitæ* Joyned

Fig. 93.

together make up that other Stone, which is called *Entrochos*. The *Trochitæ* or single Joints are so set together, that the Rays of the one enter into the others Furrows, as in the *Sutures* of the *Skull*.

They are found very plentifully in the *Scarrs* at *Braughton* and *Stock*, little Villages in *Craven*. I never met with any much above two *Inches* about; others there are as small as the smallest *Pin*, and of all *Magnitudes* betwixt those proportions. They are all *Broken Bodies*; some shorter pieces, some Longer, and some of them indeed *Trochitæ*, that is, but single Joints. I never found one Intire piece much above 2 *Inches* long, and that very rarely too; in some of which long pieces, I have reckoned above 30 Joints. And as they are all broken Bodies, so are they found Dejected and Lying confusedly in the Rock, which in some places, where they are to be had, is as hard as *Marble*, in other places soft and Shelly (as they call it) that is, Rotten and Perished with the Wet and Air. And though in some places they are but sprinkled here and there in the Rock, yet there are Whole Beds of Rock of vast extent, which are made up for the most part of These, and other figured Stones, as *Bivalve*, *Serpentine*, *Turbinate*, &c. as at *Braughton*.

Fig. 92.

As to the *Injuries* they have received in their Removal from the Natural Posture, if not Place of their Growth and Formation, they are manifest; for, besides their being all *Broken Bodies*, we find many of them *depressed* and *Crushed*, as if the Joint of a Hollow Cane should be trod under Foot: These *Crushes* being also real Cracks as of a Stone or Glas. Again, these Stones consisting of many *Vertebræ* or Joints, they are many of them strangely *Dislocated*; sometimes two, three, or more of the Joints in a piece are slipped out of Order, or Rank, and sometimes a whole Series of Joints, as when a pack of Crown pieces leans obliquely upon a Table. Further, others I have that are twisted like a Cord; if this possibly may be reckoned among the *Injuries*. Lastly, some have their Joints, indeed, Even and in File, but are yet stuffed with a Foreign matter, as when Bricks are laid in Morter.

There is great *Variety* as to the Thickness of the *Trochitæ* or single joints: Some are so Thin, that they are scarce the full of the 24th part of an *Inch*; others are a full *quarter* of an *Inch* Thick; of these latter I only found at *Stock*: Betwixt these Extreams there are Joints of all Measures in Diverse pieces, but in one and the same piece they are mostly of an equal Thickness. And there are slender and small *Entrochi*, or pieces, which have as Thick Joints, as the Biggest and Fairest Pieces.

There is also some Difference in the *Seams*, or closing of the Joints. Some are but seemingly Jointed; which appears by this, that if they be eaten down a while in *Distill'd Vinegar*, the seeming *Sutures* will Vanish, as in some I had out of *Staffordshire*, from about *Beresford* upon the *Dove*: Others, and all here at *Braughton* and *Stock* are really Jointed, and the *Sutures* Indented; which Indentures being from the Terminating of the Rayes, they are more fair or Large, according to the Difference of the Rayes, but Even, Equal and Regular.

We have said that the Utmost Circle is generally Flat and Smooth, yet are there many other Differences to be Noted; very probably because they are parts of *Different Species*.

1. Their Joints are of different Thickneses.
2. On some *Entrochi*, betwixt Suture and Suture, in the middle of each Joint, are certain Knots in a Circle; the Joints thus distinguished are very Deep and Large, and are very frequent of *Stock*.
3. There are likewise of these with a Circle of Knots, which have many Knots besides on each Joint and look Rugged.
4. Some with much Thinner Joints, which yet have a Circle of Knots in the middle of each Joint; and this also looks as though it were all over Knotted; and these are found at *Braughton* only, as far as I know.
5. As some have but one Circle of Knots, others are Knotted all over the Joint and Rough; so are there some others, which have a Circle of Larger Knots in the middle of each Joint, and a Circle of Lesser on each side close adjoining to the Border or Verge of the Suture. This is huge Pretty, and they are found at *Stock*.
6. Others betwixt Suture and Suture in the middle of each Joint, rise with a Circular Edge.
7. A smooth *Entrochos* with a large or much risen Edge on the middle of one of the joints, and a much smaller on the middle of another joint, and that Alternately.
8. The same Alternate Difference, the Joints only much Rounder and Blunt, and here the Joints are visibly one Thicker than the other.
9. The same with Alternate Edges Knotted.
10. A Double Edge in the Middle of every Joint; this makes the Joints look as though they were exceeding Thin, and Numerous, but indeed they are not so.
11. A Double Edge in the middle of every Joint Knotted by intervals, or as it were, Serrate Edges.

Some of the Pieces of most, if not all, of the Differences of these *Entrochi*, are Ramous, having less Branches Deduced from the Greater, and that without Order. These Branches are deep inserted within the Stemm, and by being seperated, leave great Holes in the sides of it. The Rayes in the Joints of the Branches, run cross to the Rayes of the Stemm. On thick Stemms are sometimes very small Branches, but mostly the Bigger the Stem the Thicker the Branches. Some of these Branches are branched again: Yet I find not any of them above one *Inch* intire, and yet adhering and inserted into its Stock or Bole, and for the most part not above a Joint or Two. The Branches are known from the Stemm, by being a little Crooked and something Tapering or Conic.

We meet but with few Pieces (besides the Branches) that are not exactly Cylindrical, setting aside the *Injuries* above mentioned. And amongst those Few, some Tapering at both ends, and much swelled in the middle; others figured like a kind of Fruit, or *Lapis Judaicus*; yet truly *Entrochi*, and jointed, notwithstanding this shape: Upon a small Stalk of two or three Joints is suddenly

Fig. 99.

Fig. 93.

Fig. 94.

suddenly Raised an Oval Bottom, Broken off also at both Ends.

Fig. 95.

To these we shall add, what seems to have been *Summitates* or *Fastigia*; Long and Slender pieces with a little Button, Hollow on the very Top; which Top seems not to have been divided or broken off from any thing else.

These Hollows are sometimes filled with Earth, and sometimes another *Entrochos* is inclosed, like a pair of Screws, and which is, (as it were) Pith to the other.

Fig. 91.

Of these Inward *Entrochi*, some I have which are Transparent. These Hollows or Piths are of different Bores, but most are Round. And yet there are of them in great plenty at *Stock*, whose Hollow in the middle is in the Elegant Fashion of a *Cinque-foil*; and the Rayes of the Joints of these *Entrochi*, are much deeper and Fewer in number, than of any other yet observed by me. These also are Smooth jointed. This is most surprizing, and I know not any *Vegetable* whose Pith is *Perforated* in such a manner.

Fig. 96, 97, 98.

Lastly, We, in these Rocks, find certain *Rude Stones*, of the bigness of *Walnuts*, which have many Impressions of *Trochitæ* upon them, as though they had been the *Roots* of them. And when these have been a little Cleaned in *Vinegar*, these Impressions appear more than Casual; for, the Substance that Covers them (if not the Stones themselves) is *Sparr*, and the Impressions are Round Holes with Rays, like those Holes which we said above the Branches, made in the sides of the *Stock*, when Broken out from them. I have found some of them most Elegantly figured, Intire and Compleat at *Stock*, amongst very many others strangely Shattered and Defaced. One is in the fashion of a *Pine Apple* or *Cone*, with a Hollow Bottom, about the half of an *Inch* deep, and as much over at the Bottom: On the very top is the round figure of an *Entrochos* broken off; round about the Bottom or Basis are five single Feet at equal distances, in the Figure of Crescents. This Stone is Incrustate or made up of Angular Plates; viz. the bottom is composed of 5 Plates, which we call Feet; the middle of the Stone of 5 other Plates, all of a *Sexangular* figure; and the Top Stone. All other Plates are smooth on the outside.

Another is much after the same *Pyramidal* fashion; the Bottom Convex, about one *Inch* and a quarter over; on the Top is the lively Impression of an *Entrochos* Broken off; or rather a *Trochites* yet remaining; Round the Basis are 5 double points or Feet at equal distances, all Broken off and somewhat in the Figure of Crescents. This Stone is also Incrustate or Covered with *Sexangular Plates*, which are Rough.

Of these *Figured Plates* I find great variety in the Rocks, Broken off, and Heaped together in great Confusion, which yet manifestly belong to the above describ'd Stones. Some of the fairest of them at *Broughton* and *Stock*, are *Pentagonous* and as broad as my Thumb Nail, Hollow on the one side like a Dish; Convex on the other side, where are certain Eminent Knots, about the bigness of a small Fin's Head, set in a kind of square Order: This Plate is somewhat Thin at the Edges and yet Elunt. Others are *Pentagonous* and some-
what

what Convex Above, but not Hollow Underneath, and without these eminent Knots; the Edges as Thin as of a Knife and Sharp. Others of these *Pentagonous* Plates are Convex on one side, and somewhat Hollow on the other; Thick Edged; one of the 5 sides only is Indented; the Indented side is ever the Thinnest, and the Stone is most sloped towards that side. *Note*, That there are many amongst these last Indented sorts of Plates, which are Channelled on the Concave side and otherwise Notched. One of these *Pentagonous Plates* from *Wansford-Bridge* in *Northamptonshire*, has one of the 5 sides Thick Indented; the Convex part has in the middle a Raised *Umbo*, like some Antient Shields, and round about the sides a List of smaller *Studds*; and some from *Bugthorp*, under the *Woolds* in *Yorkshire* are much like this.

The *Sexangular Plates* are small, save here and there one. Some of them are a little Hollow on the one side, and Convex on the other, having the Convex side most elegantly wrought with Raised or Embossed Work; that is, with an Equilateral Triangle bestriding each Corner, and a single Right Line in the Midst; or, if you will, Two Triangles one within another. These we found at *Broughton Scar* only. Others (which are most common in these Rocks) are a little Hollow on the one side, and Convex on the other: They are for the most part smooth on the Convex side or Scabrous only; some are much Thicker than others; some being as Thick as Broad, but most are Plate like; the Sides are very Unequal, as in *Crystals*; sometimes 5 Broader sides and one very small; again Two sides Broad and 4 much Narrower; and infinite other Differences as to the inequality of sides.

2. 'Tis strange that these Main *Stemms* should be of Equal bigness from the Top to the Bottom, and not at all Tapering, if they be indeed the Bodies of *Rock-Plants*. There are found in *Malta* certain Stones called *St. Paul's Batoons*, which I suppose were originally a sort of *Rock Plants*, like small snagged Sticks, but without any Joints; the Trunks whereof Diminish according to the proportion of other Plants, after the putting forth of their Branches. Those *Roots* which you have observed, are a good Argument, that these Stones were Originally pieces of *Vegetables*. Who knows but there may be such Bodies growing on the *Submarine Rocks* at this Day, and that the *Fishers* for *Coral* may find of them; though being of no use, they Neglect and Cast them away. Certain it is, there is a sort of *Coral jointed*.

3. All the *Trochitæ* and *Entrochi* describ'd by *Dr. Lister* are found in *Mendip Hills*; except that Figured like a *Fruit*, and my Observations generally agree with His. But I may add that I find even the Joints of some of those *Entrochi* which *Swell in the Middle*, to be of that Make: So that such an *Entrochos* Shews like a parcel of little Barrels, set one on the other.

Their *Hollows* are of all bignesses, from a Central point to the taking up of more than a Thrd part of the Stone. Some of these *Entrochi* are so *Hollow*, that there is only a Thin Shell left, smooth within and without: Others have only a Thin Shell left, but with Screws within and without; and sometimes Both these are one entire piece, with seeming Sutures. Those *Hollows* like a *Cinquefoil* seem most natural to the *Radix*, having 5 Hollow Stirts or Feet issuing side-ways from it: And I find in some pieces of *Radix's* that a little furrow passes inwardly from each Foot to the Top of the Stone with a Ridge on the

outside of it. Besides these, I have a new species of *Trochites* and *Entrochi*, which has 6 Inlets in the *Hollow*, as the latter has but 5; but with this Difference, that these Inlets terminate in Angles, so that it is a *Sexangular* Hollow, whereas the *Cinquefoil* Inlets are Round as the Leaf is, and not pointed, though I have seen even of these with sharp Angles.

The *Rays* shooting from a Center, must of necessity leave considerable *Widenesses* betwixt them, as they pass towards the circumference; according to the bigness thereof; to fill up those *Widenesses*, I find that in some, betwixt two *Rays*, issuing from the Center, a *Third Ray* rises about half way on the Stone from the Center, and shoots to the Circumference; some have their *Rays* gently widening from the Center to the Circumference; some have a *Trunk* rising from the Center, which grows *Forked* towards the Circumference; sometimes betwixt those *Forks*, there rises a little *Ray* near the *Trunk* where the *Forks* join, which shoots to the Circumference; (but note that these Differences are scarce discernable where the *Rays* are fine, but with the help of a *Glass*.) Some again are *Ramous*, having a *Trunk* rising from the Center, with 3, 4, or 5 *Branches* shooting to the Circumference; some are *Smooth* Half way on the Stone from the Center, and have a *Circle* of small *Rays* near the Circumference; some are smooth without any *Rays*; these are commonly pretty *Thick*, and are joined in an *Entrochos* after this manner: One *Trochite* a little within the *Outward Circle*, in the upper and lower parts, where the *Rays* use to be, has *Round Inlets* or *Sockets*, pretty deep, so that only a thin *Tympanum* hinders, but the *Trochite* would be *Hollow* at this wideness all through; and in the *Middle* of this *Tympanum* there is a *Hole*, as in other *Trochites*, which is sometimes *Round*, sometimes like a *Cinquefoil*: The *Trochites* that answer this on both sides, have smooth joints, (I cannot properly call them *Screws*, having no *Ridges*) which enter into these *Sockets*; those *Joints* being *Hollow* also, and so other *Trochites* with *Sockets* come on upon those again to make up the *Entrochos*. Some of the e have both *Sockets* and *Rays*, some have a *Socket* on the one side, and *Rays* on the other without a *Socket*; some are all smooth, only a small *Ridge* runs round them a little within the *outward Circle*, which enters into a small *furrow* answering to it; some are all smooth and joined only *per harmoniam*, as Mr. *Lister* calls it; some *Trochites* hold of an equal *Thickness* of Substance from the Center to the Circumference; some are pretty *Thick* in the Circumference, and grow *Thinner* towards the Center; so that they have *Concavities* on both sides, to which *Convexities* in other *Trochites* answer. Some hold of an equal *Thickness* half way on the Stone from the *outward Circle*, and then grow *Concave* toward the Center. I have also found some *Entrochi*, as well as *Trochites* of an *Oval* Figure, and their *Bore* is also *Oval*. Some *Trochites* of this kind have no *Rays*, but are joined together only by one *Ridge* which passes directly along the middle of the Stone the long way, there being a *Furrow* in the other answering to it; these have also a small *Speck* in the middle, making but a very little *Impression* in the Stone, and seldome passing through it, though I have of this sort with indifferent *Holes* as the other *Trochites*, but such are commonly *Pointed* at the *Ends*, and not carried out with an *Oval* Round as the others. There are some *Single Joints* which are shaped with a *Double Oval*; that is, the *Oval* in the

Upper part of them stands clean contrary to the *Oval* in their lower part. In some again the *Ovals* do not stand so extremely opposite to each other, but only the *Oval* in the Upper part of the *Trochite* seems a little Wrested from the Direct line of the *Oval* in the Lower part, so that they stand Bend-ways to each other, like a *St. Andrew's Cross*; there are *Entrochi* too made up after this manner; and I find most of the *Oval Entrochi* grow Crooked and Twisted.

I have One Perfect *Radix* without any Impression of a *Trochite* on it; the Top of it, indeed is a little Flat with a Hole in it, but it is withal very smooth, without the least sign of a *Ray*; yet I find another with the *Rays* there; At the Middle of the Broad End there is another Hole, just Opposite to this. At the Ends of the 5. *Stirts* or Feet, where the *Hollows* should shew themselves, there grows after a very Artificial manner a pretty large Seam of the same Stone just over the middle of the Hollow, from the upper part of the *stirt* to the lower part of it, parting the Hollow in the middle, and covering about a 3d part of it; not that this seam enters farther into the Hollow than the mouth of it; so that the Hollow of each *stirt* presents it self with two Eyes: Hence it appears, that those *stirts* or feet were never longer than they are, and that no stone ever Grew to them. These Fore seams, being very obnoxious to the Least Injury, were broken off from *Dr. Lister's*. The stone is composed of *Trigonal, Tetragonal, Pentagonal* and *Hexagonal Plates*. The upper part of the Conical End is wrought round with six large *Hexagonal Plates*, and these reach half way the stone; then follows a second Round, made up of *Pentagonal Plates*, pretty large, and these reach almost to the Broad Bottom, which is a little Convex; the Bottom it self and Feet contain *Plates* of all Makes, but most of them are very small. This stone is in substance a Whitish Opaque *Fluor*, of the same nature with the *Trochites*; it has outwardly a Rusty coat, and is Blewish within like some *Sea-Shells*. When 'twas first found, 'twas full of a sort of Ash coloured gristy-Clay, which is the evident Material Cause of it, it being found in a bed of the same

Fig. 96.

Fig. 97.

I easily pick'd out the Clay with a Needle, so that 'tis now all Hollow; the Shell-like and *Sparry* substance being scarce as thick as half a Crown. I have one *Sexangular Plate*, whose Convex part has on it a star consisting of 6 Embost *Rays*, which shoot from the Center directly to the middle part of the sides betwixt the Angles, and betwixt every Two *Rays* there grows a little stud after a very Elegant manner.

I find the *Trochites* sticking to Rake-Mold stones, and in the Crannies of Rocks, at all Depths from the Grass to 20 Fathom; and doubtless there are of them Deeper: But I find them most plenteously in certain beds of an Ash coloured gristy-Clay, and particularly at one place within a Yard or two of the Grass. I found here a *Fruit* with them like a *Lapis Judaicus* (though somewhat defac'd) if not a *Species* thereof; its about the bigness of an Acorn, with Ridges and Furrows running the long way; it differs from those describ'd by *Dr. Lister*, being rather less in the middle than at the Ends, and the Ridges not knotted or Purl'd. It is in Substance a Whitish Opaque *Spar* like the *Trochites*, though (as *Mr. Lister* says) some *Trochites* are of a Dark-Coloured *Spar*;

Fig. 94.

and I find some of a White Cawky substance, and some have a Tincture of Red; but these differences proceed from the Clay of which they are made; for though an Ash colour be the chief in it, yet there are some Veins of Red in it, some of White, some of a Light Blew, some of a Dark Blew, &c; which cause these Varieties in the Stones. I find some *Trochites* and *Entrochi* Shaped in a *Raw Clay*, before they have attained the Consistency of a *Stone*; and these, if laid in the Sun, become Light and Spungy like a *Pumex*. I took up there a piece of another strange *Stone*, of the like *Sparry* substance; it is about the bigness of a Walnut, Hollow, and Fill'd with the said *Clay*; it somewhat resembles a *Helmet*; the fore part of it is Smooth, the Upper part, which has a large Ridge in the middle, is all wrought with little Rings, Three at a place, encircled within each other. The stone call'd *Cornu Ammonis*, shap'd like a *Ram's-Horn*, is very frequent in this *Clay*; the largest I have is 7 inches in length, 4 inches in compass at the Broad end, and $2\frac{1}{2}$ at the small end; the Top being broken off. Tracing its Original, I find some of the first Bud-dings out of it about the bigness of a young *Cocks-spur*, and very much like it. I have some in *Raw-Clay*, and one growing of a white *Cawky Stone*. They generally become at last a *Whitish Spar*, and some Milk White as some of the *Trochites* are:

There are of all intermediate proportions betwixt these two, though very few of any bigness are to be found Entire, but all Broken and imperfect pieces: And I take the seeming *Summitates* of Mr. *Lifter* to be only little Essays of Nature towards the production of this *Stone*, the Alliance being evidently nearer than betwixt them and the *Trochites*. The texture of these stones is thus: Some have *Massy Spar* in their insides, which takes up three parts of the *Stone* then from the sharp Top there grow thin flat Cells, or small pipes of *Spar*, set Edgeways one close to the other, all round the stone, which shoot towards the Broad end, and appear outwardly like small Ridges or Seams; and many of these Pipes running down thus after the *Stone*, shew their Hollows, some at one place of it, some at another, and some not till they come to the Broad End: And this is the Texture of the Great stone, which has Rings also, though somewhat Defaced, running round it, tending likewise in their growth towards the Broad end as in a *Ram's Horn*. Most of the lesser *Stones* have very little *Massy Spar* within them, and some have none, but appear somewhat Hollow at the Broad End, with Cells coming down inwardly from the Top of the stone, resembling those in the *Flowers* of *Coral*, which Terminate its Branches; and doubtless, if taken from their Beds in a seasonable time, would yield the like *Milky-juice*; for I find in the Cells of some Broken pieces of these *Stones* an evident Concretion of such a *Milky-juice*. And I may here acquaint you, that I have a Piece of *Branchy Spar*, which I found at a Mine on these Hills, growing like *Coral*, and Terminated with Buttons or *Flowers* like it. I find very few of the lesser *Cornua Ammonis*, whose Cells do any way appear or shew their Hollows Outwardly, as in the Great stone, whose outward surface is wholly made up (as I said) of those Cells, or thin Flat Pipes, set close the one to the other, many of which shew their Hollows at several places in the stone, whereas the Cells in the smaller ones appear only Inwardly, having

one Coat Outwardly which covers them all, and this Coat in some is Smooth, in others it is all wrought with little Rings like the *Helmet stone* before mentioned; and some Out sides have Ridges or Rings round them as a *Ram's-horn*.

These stones generally *Move* in *Vinegar*, *Juice of Lemons*, &c, sending forth Bubbles, as I find *Cawk* will very freely, and most of our *Mineral Stones*. This Motion seems to proceed from the Contest betwixt the *Acid Spirit* of the *Vinegar* and the *Mineral Salt*; so that the *Spirits* by Fermentation breaking forth Under the stone produce that Effect.

4. After Diligent search I have at last found a Mine, where well near all the *Entrochi*, (so called hitherto) or bodies of *Rock-Plants*, grew Tapering and Ramous, some of them having Branches issuing from them near 2 inches in Length, and other small Branches issuing from those, and upon a nearer search I discovered an entire Plant, though small, growing up after the side of a Stone I found also, that all the clifts in some Mines are made up of these *Stone Plants*; whereof some as appears, were converted into the nature of those *Limestone Rocks*, whilst they were in their first Tender Growth; others being become *Spar* compose Rocks of that substance.

Ib. p. 732.
Fig. 100.

Considering that all the Clifts for a very large circumference in some places are made up of these Plants, we may truly say, that there have been, and are whole Fields or Forrests of these in the Earth, as there are of *Coral* in the *Red-Sea*. In the *Courses*, (or *Loads* as some call them) betwixt the Clifts I find of these *Plants* growing up in the Gristy Clay, mentioned above, being Rooted on the *Rake mold Stones*; many of them being above a foot in Height, and about the bigness of the Stem of a Tobacco Pipe: All I have yet seen of this Length, are either Raw Clay; or of the Consistency of a *Lime-stone*, and some of them have outwardly evident Beginnings of *Circles* and *Sutures*. The small *Plant* which is Entire, and the *Branched bodies* of many others, have attained their full Term of Growth; being become Perfect *Spar*. If these had ever a Height answerable to their Bigness, (some of them being near 3 inches about,) they must have been much Higher than those before mentioned. The *Branches* are all joynted, and have the same *Bore* with the Trunks, and are terminated with Round and Blunt joynts, but very small. I find the *Bores* or *Hollows* of such as are found to be commonly fill'd with a *Milky* Crudled substance, which probably in their time of Growth was Fluid, like that in *Coral*. As it cannot be Doubted but many of these *Plants* Grow on those admirable *Radixes* of which we have given an account, and whereof I have at present some pieces which have a *Cinquefoil Bore* on the *Top*, others with the Impressions of *Oval* Joynts there; and many other Differences; so I am now fully satisfied that many of them Grow from *Plain Roots*, that is from *Plain Spar*, or *Lime-stone*, without any such Figure, as the *Entire Plant* does, and many other Trunks which I have noted.

These *Plants* do not always Grow up with One Trunk or Body: but sometimes 5 or 6 Sprouts, near of an equal bigness, shoot up together from the same Root; as it usually happens with *Coral*. I have met with some of them which have only 4 *Inlets* in their *Hollows*, and others with *Seven*. Some have

have a *Circular Edge* on every other Joynt, the Intermittent Joynt being *Smooth* without Edge or Knot. Some Trunks have Circular Edges on the middle of every Joynt, but so that the *First* and *Fifth* Edges are the Highest; the *Second* and *Fourth* the lowest; the *Third* is Higher than the Latter, and Lower than the Former; the Joynts themselves being Great and Small accordingly; and this Order holds all along the *Plant*. Some Trunks have Edges according to the same Order, only the Edges on the 2^d and 4th Joynts are Round and Blunt, the other 3 being sharp; some have Edges after the same Order, which are all Round and Blunt. There are some Trunks wrought after the same manner, only the *First* and *Fifth* Joynts have a Circle of Knots round them, the other *Three* have Edges: Some Trunks have no Circles, nor Knots, but are only a little Scabrous like the *Plates* which compose some *Roots*. But notwithstanding these Diversities of *Figures*, the Texture of their substance appears to be wholly the same: And therefore since we find no Qualities either by the smell or taste which manifest any Specifical Distinction, it may perhaps be as hard to make them out to be Distinct *Species*, as to shew a Specifical Difference betwixt several *Snow Blossoms*.

Fig. 101.

The Reason of that strange *Disorder* which these *Plants* usually lye in, and of those *Injuries* they have received, perhaps may be this; whilst they were Growing, the *Clay* wherein they Grew was soft as a *Quagmire*, these probably requiring such a substance to support their Growth, as *Coral* does *Sea Water*: Afterwards as they began to settle to a stony Consistency, and as part of the *Clay* became of a Rocky Nature, the whole Mass sunk from its Position, and the Moisture passing away made some Concavities, washing down some Broken pieces of those *Stones* with it; and Lumps of *Clay* and other stones, falling down through those Crannies, added to their *Confusion*, being very apt to be Disordered by the least Concussion, either whilst they were in their First Growth, or after they were become *Spar*, their Joynts being very Tenderly set together; and Hence these stones are generally found in *Leirey* places (as they call it) that is, *Cavernous*.

These *Rock Plants* begin their Growth from the Finest Parts of *Clay*, being commonly White, Soft, and smooth at first, and by Degrees come to have Ridges; Knots, and Sutures, as they grow towards a *Stony*, and so to a *Sparry* Nature.

The *Pith* continues still soft and White, as the whole is at first, and it is continually Refresh'd by the Mineral Steams and Moisture, which have free Access to it through the 5 Hollow *Stirts* or Feet, in the *Figured Roots*, or through the Mass of *Clay* which commonly lies under the *Plain Roots*. Nor can it be said but these *Stone Plants* have True *Life* and *Growth*; for since in the Curiosity of their Make they may Contend with the greatest part of the *Vegetable Kingdom*, and are shap'd like them, having inward *Pith* or *Sap*, and likewise *Joints* and *Runnings* in their Grit, and sometimes *Cells*, which may very well supply the Place of *Veins* and *Fibres*, I know not why they may not be allowed as proper a *Vegetation* as any *Plant* whatsoever.

Vid. Sup.
§. LXX. 2.

And though a *Salt* of *Coral* after Dissolution, will upon Coagulation shoot into a little Grove of *Plants*, as it were, Resembling the *Growth* of *Coral*, yet

yet this cannot Disprove its *Vegetation*; for its well known, that all *Plants* may be so Prepared, that from their *Ashes* they will Rise again in their Proper *Species* after such a manner.

But I am enclined to the Opinion, that these *Rock Plants* are *Lapides sui generis*, and not *Parts of Plants* or *Animals Petrified*. Indeed the *Figured Roots* on which these *Rock Plants* sometimes Grow (as appears by the Impression of *Rays* on the *Tops* of some answering to those in the *Joynts* of the *Plants*, and by the impression of *Oval Joynts* there) may give us some Suspicion that they once belonged to an *Animal*, whether it were a species of the *Stella Arborefscens*, or some other: But the *Trunks* of these *Stone Plants* cannot be looked upon as *Parts of Animals*, with the least shew of Probability. And I think them almost as hardly Reducible to any known *Species of Vegetables*; considering that, besides the *Bores* of some of these with 4, 5, 6, and 7, inlets in them, and besides their admirably Diversified *Joyntings*, scarce either of them to be match'd in any *Vegetable*, I have by me above 20, if not 30, *Species* of these *Rock Plants*, Differing Outwardly from each other in their *Joynts*, *Knots*, and *Sutures*, all observing a wonderful Regularity, and not one of them to be parallel'd by any *Vegetable* that I know of in Nature. And we cannot well imagine, how so many *Species*, Diffused through many parts of the whole Earth, should all happen to be *Lost* together. So that upon the whole, this seems to me a considerable objection, against those who maintain that all *Figured Stones* in the Earth, are *Petrefactions* of *Plants* or *Animals*, to which Opinion *Steno*, in his *Dissertation concerning Solids naturally contained within Solids*, adheres.

LXXII. 1. I have procured a good quantity of the *Astroites* from *Bugthorp* and *Leppington* at the Foot of the *Yorkshire Woolds*: At the former place I have seen them Dug out of a certain Blew Clay on the Banks of a small Rivulet, betwixt the Town and the foot of the *Woolds*. There are plenty of them washed into the Brook; but the most Fair and solid are those we get out of the Clay.

The Astroites;
by Dr. Lister.
n: 112. p. 274.

Fig. 103.

The Matter and substance of these *Stones*, if Broken, is *Flint-like*, of a Dark Shining Politure; but much softer, and easily Corroded by an *Acid Menstruum*. *Vinegar* indeed makes them Creep; but a stronger Spirit, as of *Nitre* Tosses them. I doubt not, but they will readily Calcine, as the *Belemnites* to a very strong and white Lime.

These *Stones* (as we now find them) are all *Fragments*; either one *Single Joynt*, or 2, 3, or more *Joynts* set together, making a *Pentagonous* or *Five sided*, Column. I have not yet had any Piece much above one *inch* long, which consisted of 18 *Joynts*; but I have seen one Piece, somewhat shorter than the former, which had 25 *Joynts*. These last *Thin Joynted* pieces are quite of a Different Make, as to all Circumstances, from the Other.

Every *Joynt* consists of 5 Angles, which are either Drawn out and sharp, and consequently the sides of Pieces made up of such *Joynts* are Deep *Channell'd*; (and this is the condition of some of the *Thick Joynted* pieces, as well as of all the *Thin Joynted* ones; or the Angles are Blunt and Round, and the sides Plain

Plain or very little hollowed. There are as Big, and as small pieces of this sort, as of any other more Sharp angled.

Where the *Joints* are *Thin* or *Deep*, they are so equally throughout the Whole piece; yet are there some, but very few pieces, which consist of *Joints* of Unequal Thickness. Many of the *Thick-jointed* pieces have certain *Joints* a thought Broader, or a very little standing out at the Angles, and thereby the *Joints* are distinguisht into certain Conjugations of 2, 3, or more *Joints*: And these Conjugations are very observable in the *Thin-jointed Stones*, and are marked out with a set of *Wyers*.

The Thickest piece, which hath yet come to my Hands, is not above *one Inch* and a *half* about, and those very rare too: From which size to that of a small Pin, I have all the Intermediate proportions; and these so exceeding small pieces are as Exactly Shaped as the Greatest. Most pieces, if not all, of any considerable Length, are not Streight, but visibly Bent and Inclining.

All the pieces, of any sort, are much of an Equal Thickness or but little Tapering; yet one of the ends, by reason of a *Top Joint*, is visibly the Thickest.

This *Top-Joint* hath 5 Blunt Angles, and is not *Hatched* or *Engraven*, or but very faintly, on the Outside. Every Joint else of a piece (save the *Top-Joint*) is an *Intaglia*, and Deeply Engraven on both sides alike; and will accordingly serve for a Seal. The Middle of each Angle is Hollow, and the Edges of the Angles are Thick Furrowed: The Terminations of these *Hatchings* are the Indented Sutures by which the *Joints* are set together; the Ridges of one Joint being alternately let into the Furrows of the other next it. The *Hatchings* of the Flat-sided pieces are in Circular Lines; but of the other two *Species*, they are straight Lines or near the matter.

In the very Center of the 5 Angles, is a small *Hole*, conspicuous for most *Joints*. Note also, that in the Middle of each *Joint*, betwixt Angle and Angle, in the very Suture, is another such like small Pin Hole very Apparent, if the Stones be first well scoured.

In the *Deep jointed* pieces, just under the *Top-joint* above described, the Vestigia of certain *Wyers* rather than Branches; and sometimes 2, 3, or more of the *Joints* of the *Wyers* yet adhering. These *Wyers* are ever 5 in number, *viz.* One in the Middle or Hollow part betwixt Angle and Angle. Again in *Thin Jointed* pieces there are 5 of these *Wyers*, or a *Set* of them Inserted into every Conjugation of *Joints*; so that it were some Representation of the thing, to Imagine the Stalk of *Asperula* or *Equisetum*: Also I have seen, but that very rarely, (not in one piece among 500) a *Set* of *Wyers* in the Middle of a *Deep-jointed* piece. One *Thin-jointed* piece I have by me, where a *Wyer* of 20 *Joints* and upwards (and how much longer they may be I know not) lies Double within the Hollow side, and by that accident was preserved in its natural place. Further, some Lumps of Quarry I have from the Place abovenamed, where the *Wyers*, as well as the *Stones* themselves, are seen in Long pieces. It is no wonder, that these *Wyers* are knock'd off, and but very rarely found adhering to the stones they belong to, being very small and Slender, of a Round Figure

Fig. 104.

105.

Fig. 106.

figure and *Smooth-Joynted*, being set together *per Harmoniam* and not *Indented Sutures*. Nothing that I can think of, is so like these *Wiers*, as the *Antennæ* of *Lobsters*. Lastly some of these *Wiers* are *Knotted*, and others of them fairly subdivided or *Branched*.

2. If you can allow the *Trochites* and *Eutrochi* to have been *Fragments* of *Rock plants*, I see not why you should make any *Difficulty* of admitting these to have been so too; the several *Internodia* being alike *Thin* in both, and the *Commissures* not much *Different*; only the external *Figure* doth not *Correspond*. The *Wiers* springing out of the *Furrows* or *Concave Angles* of some of the *Internodia*, and *Encircling* the *Stalk* like the leaves of *Asperula* or *Equisetum* seems to me to *Argue* these bodies to belong to the *Genus* of *Vegetables*; no less than *Coral*, *Coralline*, and the several sorts of *Pori*; some of which are also *Joynted*: But no *Vegetable* either of *Land* or *Sea*, that I know of, hath such frequent *Joynts* and *short* or *Thin Internodia*; and so they are things of their *Own kind*, whose *Species* is, for ought we know, *Lost*. If they were *Vegetables*, I guess they were never *Soft*; but grew upon the *Rocks* like *Coral*, and the other *Stone Plants*, just as they are.

By Mr. Ray.
ib. p. 278.

The *Leaves* of some sort of *Equisetum* are *Joynted*, as well as the *Stalk*: Else I know no *Plant* that hath *Joynted Leaves*; except some sorts of *Rush-grass*.

I have found on the *Banks* of the *River Tanar* in *Piedmont*, plenty of the *Fragments* of the stalks of *Equisetum* perfectly *Petrified*, with little or no *Increase* of *Bulk*, so exactly like the *Plant*, that all the *Striæ*, did all along clearly *Appear*. The colour of these *Petrified Stalks* was *White*.

LXXIII. We have plenty of *Stones* called *Dactili Idæi* and *Lapides Judæi* (for *kind*) in the *Stone Quarries* at *Newton* near *Hemesley*, and at *Hellingley* by *Malton*. There is some *Variety* in the *Figure* of them; but the most common one in these *Rocks* is after the fashion of *Date stone*, *Round* and *Long* about an *Inch*, and sometimes *Longer*. They are a little *swell'd* in the *Middle*, and *Narrower* towards each end: They are *Channelled* the length way, and upon the *Ridge* *Knotted* or *Purled* all over with *small Knots*, set in a *Quincunx order*. The *inward substance* is a *White Opaque Sparr* and breaks *Smooth* like a *Flint*; not at all *Hollow* in the *Middle*, as are the *Belleminites*.

Lapides Judæi;
by Dr. Lister. n. 110.
p. 224.
Fig. 107.

LXXIV. 1. Dr. *Home* of *Berwick* tells me that he never used the *Ostracites* to any that he knew to be troubled with a *Confirmed Stone* (being persuaded that no *Medicine* can *Break a Large Stone*) but only to such as were afflicted with *Gravel* or *small Stones*; that some of his *Patients* were *Cured* without *Evacuating* any *Gravel* or *Stones* at all; that others *Evacuated* both: That it never does its work suddenly, (being not remarkably *Diuretick*) but that it rather *Dissolved* the *little Stones* than *Forced* them. That none that he ever gave this *Medicine* to, however *Grievously* and *Frequently* *Afflicted* before, have ever been troubled with *Nephritick Pains* since; that his *Manner* of giving it, is in *Fine Powder* mixed with about a *third part* of *Flores Chamomeli*.

Vertues of the
Ostracites; by
Dr. Cay. n. 250.
p. 81.

Dose from *Half a Dram* to *One Dram* in White Wine; That the greatest Dose is often apt to offend and Nauseate the Stomack; that he once gave it alone, with a weak Infusion of *Chamomil Flowers* in White Wine after it, but this did not so well.

I can say little of my Own Knowledge of this Medicine, having had it but a short while, and not Used it yet to any but one Gentlewoman, whose Frequent and Violent Fits of the *Gravel*, made her lead a Life uneasy enough. I gave her this Medicine mixt with poudred *Semina Saxifrag.* I cannot say, that since she Used this Medicine she never had any Returns of her *Pains*, but she neither has them so Violent, nor so Frequently; and whenever she is Threatned with them, she most certainly finds Ease by that time she has taken 3 Doses of her Powder. And she has, since the use of this Medicine, *Voided* a great many *small Stones*. But the Reason perhaps why she is still Threatned with the Return of her *Nephritick Pains*, is, that she has never Follow'd her Medicine throughly, but upon the third Dose, finding such certain Ease, she gives it over, till a New Fit forces her to Use it again.

I take this *Shell* to be what Dr. *Lister* calls *Ostracites Maximus Rugosus & Asper*. It burns to a *Lime* as other *Shells* do, and as the *Selenites* (tho' weakly) does. It yields no *Volatile Salt*, tho' I tryed it in a Naked Fire; nor does Common *Oyster Shells*, Fresh taken and used, afford above *Half a Scruple* of a Liquor somewhat moderately *Urinous*, from 4 *Ounces* of *Shells*. And it may be, if they were long *Dryed* and *Exposed* to the Weather, they would lose even that, and yield no more *Volatile Salt* than the *Ostracites*. I confess I was somewhat surpriz'd at this matter; since there are who say, that even the other *Shells*, that are commonly call'd *Petrify'd*, yield a *Volatile Salt*: and I had my self from the *Shells* of *Crustaceous Fishes*, (particularly of *Lobsters*) had a *Volatile Salt* and *Fætid Oyl* in no inconsiderable Quantity, even in a *Sand-Furnace*. But these sort of *Shells* differ from other *Shells* (as Dr. *Lister* has exactly observ'd) in this too, *Quod in his Umbo ad Cardinem leviter Rostratus est, qui tamen in Ostreis paulum aliter est*. They Differ too in their *Specifick Gravity*, these being more *Ponderous* than Common *Oyster Shells*, and somewhat near the *Specifick Gravity* of the *Selenites*. But indeed they Differ one from another in *Gravity*, as well as from other *Shells*, as they partake more or less of a *Taphaceous* substance that Coats many of them on the inside, and which perhaps may be somewhat a kin to the *Selenites*. I have observ'd some such Differences among the *Cornua Ammonis*, having had one or two small ones from our *Coal-Pits* here, that had a considerable Mixture of the *Pyrites*; whereas these that are found about *Whitby*, approach, I think, more to the Nature of the *Alum stone*; and perhaps the *Cornua Ammonis* of the Antients were found in Beds of somewhat yet more Valuable, since *Pliny* says they were of a *Golden* colour, and were reckoned *inter Sacratissimas Æthiopiæ Gemmas*. I know *Agricola De Ortu & Causis Subterranean*, *Lib. 4.*, accounts for this *Golden Colour* after another Manner: *Cornua Ammonis, inquit, Succo Aluminis infecta Aurei Coloris sunt*. And I am ready enough to think, that there is some Truth not only in this Observation, but in what he immediately adds; *Idem inquit, & aliis quibusdam Lapidibus accidit*: For I cannot but attribute the extraordinary

extraordinary Appearance of Colours in the Peacock Tail-Coal, to its being infected with the *Succus Aluminis*, having seen some Pieces of this pretty sort of coal shoot into True and Genuine *Alum*.

I shall only add concerning these *Shells* that if they be *Real Shells*, their being found in such Different Parts of the World, and at such great Distance from any Sea, may serve for a Fair and Convincing Argument of the Universality of the *Deluge*. And if they be not *Shells*, but only *Stones* Form'd by (what some People call) *Fanciful* and *Sporting* Nature, we may at least conclude thus much from it, That since even these *Lusus Naturæ*, these *Freaks*, and *Random Strokes* of Nature, have not only a Beauty, but a Real Use, nothing in Nature is made in Vain: And that many other *Fossils* that we now contemn as *Toyes* and *Trifles*, fit only for furnishing out a *Musæum*, may have other Remarkable Virtues, that may in Time bring even them to be taken Notice of, and Valu'd, as well as the long Neglected and Despised *Ostracites*.

2. The Golden Colour is from its being a *Pyrites*, that is *Iron Stone*. A gain, all the *Conchitæ* Kind, but more particularly the *Belemnitæ* and *Lapidæ Judaici*, were known to the Antients for *Specificks* in *Gravel*. By Dr. Lister. ib. p. 85.

LXXV. *Siliquastrum* (quantum nobis innotuit) toto genere Novus est idemque Rarissimus, nec Inelegans Lapis. *Siliquastrum*, autem appellare placuit, quod *Siliquæ Lupini* vel alterius cujusdam Leguminis, *Valvulum alterum* (Cavitate tamen Repletâ) non parum referat. *Siliquastrum* Notæ Genericæ sunt, quod sit *Lapis figura plerique ad Siliquæ Valvulum (Sublato Concavo) accedenti*; ex parte altera semper *Convexior*; & (si *Marmoris instar fortuito expositis excipias*) *minute admodum Rigosus*, seu, ut explicatius loquar, *Crebro & Eleganter Malleolatus*: *Facie quasi Oleo Obductus, Resplendenti*: *Textura si comminuitur Belemnitis fere ad instar Striata*. Hujus *Lapidis* plures dantur *Varietates* quarum præcipuas solum modo nunc vacat recensere. Several Regularly Figur'd Stones; by Mr. Edw. Lhwyd. n. 200. p. 746.

1. *Siliquastrum ad Phaseoli Valvulum quodammodo accedens*; seu *Siliquastrum Phaseolatum*. *Figuram Titulus* indicat; *Magnitudinem* quod attinet, *Sescunciali* est *Longitudine*, *Dimidium Unciæ* *Latum*, vix *Quadrantem* *crassum*. *Quoad Periferiam*, aliud *Latus quodammodo Falcatum* est, aliud (quod etiam magis acclive est) *Rectum*: *Extremum alterum* *linea Obliqua cum Duobus Angulis clausum*; alterum non item. *Ex parte pronâ superficies rectilineis Striata* est, cæterum *leviter Rugosa*; & *color Anthracinus*, nisi quod ad utrumque *Extremum*, paululum *virescat*. *Ex parte supina, Accretione* *quam lapidea sædatur*, *Coloris Rubiginosi*. *Inveni in Lapidina Witneiensis*, septimo ab urbe *Oxon. Lapide*; sed *Rarissime* occurrit. *Triplo aut Quadruplo* *minores aliquot*, in quibusdam à jam descripto *differentes*, habeo, è *fodina Stunsfeldensi*, in hac *Provincia*. Fig. 108.

2. *Siliquastrum Lupini*, *Siliquam nonnihil referens*: *Seu veniam dabis sic loqui, Siliquastrum lupinatum*. *Phaseolato* *subinde Brevior* est, at *Semper Latior*: *Colore incerto*, sed ut plurimum à *Prona parte Nigro*, vel ad *Nigredinem* *accedenti*; à *Supina Rubiginoso*. *Sed & utrinque variat quoad Colorem & Superficiem*. *A parte Gibbosa Lineolis Albis & Maculis nescio quibus distinctum* *vidimus*; quod & *Bufoniis Lapidibus*, & *Glossopetris* quibuscunque aliquando Fig. 109.

liquando accidit. Sed & inveni unum aut alterum cui à parte averfa nescio quid Appendicis adnasceretur; in qua Virgulæ aliquot Transversæ conspiciatur, quasi amissi cujusdam ignoti Vestigia. Differt hic Lapis à præcedente præcipue, quod sit Latior, magisque Rectus, à neutro latere Falcatus. In *Anglia Mediterranea* non admodum Rarus est hic Lapis. Vidimus in *Latomia Garvordiensis* in *Bercheria, Witneia & Charltonia* apud *Oxonenses*, ad *Pagum Rance* in *Comitatu Northamptonia*, *Honey-comb Lash* apud *Waltonenses, &c.*

Dantur etiam in hoc Genere Lapides, quos *Pisi vulgaris & Vicia Siliquas* æmulari dixeris.

Fig. 110.

3. *Siliquastrum Minus, Triangulum*; seu *Minus, Conchæ ad instar Rostellatum*. Colore & Superficie cum reliquis convenit: at *Tellinam* aliquam, vel (*mavis*) *Concham parvam Anglicanam Listeri*, magis refert quam *Siliquam*. Verum ex Facie, cum Externa tum Interiori, *Siliquastrum* se prodit. *Stunfeldia* habuimus in *Agro Oxoniensi*.

Fig. 111.

4. *Siliquastrum*, *Officulum* è capite *Affelli Minoris* referens.

Fig. 112.

5. *Siliquaastro congener Punctularia Gibbosa*, quandoque *Tortilis*, superficie *Marmorea*: seu *Siliquastrum Gibbosum, Marmoreum*, argute admodum plerumque *Punctulatum*. Superioribus magis Tersum & Expolitum est hoc *Siliquastrum*: ex Prona parte nunc magis, nunc minus *Gibbosum*; & Colore ut plurimum *Nigricanti*, alias *Subviridi, Exalbido, &c.* Ex parte Averfa seu Interiori, nescio qua Ossea Appendice munitur, Coloris *Nigri* vel *Rubescantis* sed hoc in plerisque desideratur. Utrunque in Mucronem magis Obtusum definit quam priora. In multis quæ videre contigit Exemplaribus, pars *Gibbosa* Soli obversa, minutula admodum & creberrima ostendit *Punctula*. Passim Occurrit in *Comitatu Bercheriano & Oxoniensi*. Inveni in *Lapidinis* ad pagos *Marcham Garvord & Stunfeld*.

Fig. 113.

Fig. 114.

6. Ejusdem Lapidis major Varietas.

7. *Siliquaastro accedens Ricinus*; seu *Siliquastrum Minimum instar Seminis Phaseoli, Ricinus Lapis Siliquastrum* est omnium, quotquot hætenus videre contigit, Minimum; quod *Ricini* Herbae, vel etiam *Phaseoli* cujusdam Minoris Semen quadantenus exprimat. Superne scaber est, plane ut *Siliquastra* proprie sic dicta; Colore aut *Fusco* aut *Atro nitenti*. Infra vero Decolor est, & informis. *Witneia* inveni, instar *Scarabæi Atro nitentes*; *Stunfeldia* autem, & ex *Atro-nitentes, & Fuscos*.

Conjicio quod hos *Lapides* quos nos *Siliquastra* diximus, Posterius ad minimum (si non hujus seculi) Philosophi *Piscium Dentes & Officula*, tuto appellarint. Certe quod ad *Siliquastrum Minus Triangulum* attinet, vidimus aliquot Specimina, *Officulis* istis vulgo notis ex *Afellorum Capitibus* non parum consimilia.

Fig. 115.

8. *Busonites Majusculus Atro rubens instar Capsulæ Glandis Quercinæ*. Colore est undique ex *Atro Subrubente*; quoad cætera omnino convenit cum *Figura Boetii*. Inveni in *Lapidina Faringdonensi* apud *Bercherianos*; sed rarius occurrit.

Fig. 116.

9. *Busonites Medius Rotularis* Alveolo utrinque donatus. Color in ambitu

bitu *Subpallidus* est; Alveolus ab utraque parte *Rubiginosus*. Cum priore habuimus.

10. *Bufonites Medius Orbiculatus*, seu *Bufonites Vulgatiore Anglicus*. *Majusculo* Atro rubenti triplo aut quadruplo Minor est. Colore insigniter Variat; alias *Anthracino*, alias *Fusco* sive *Hepatico*, alias alio: Sed & nonnunquam *Cæruleis* maculis, & lineolis notatum vidimus. Unicum habeo *Crassiusculum*, & cæteris minus *Depressum*, Colore *Pallido* aut *Exalbido*; *Atro* limbo aut *Fasciola* fimbriatum.

Fig. 117.

In Latomiis & sabuletis *Angliæ Mediterranea*, passim obviam habuimus: at Specimen novissime dictum, in *Lapidina Farringdonensi*. Passim inveniuntur & *Minores* & *Minimi Orbiculati*, & forma quasi in plano *Ovata*.

11. *Bufonites Minimus a convexiori parte Rugosus*. In Agro *Glocestrensi* & *Oxonensi* cum reliquis, sed *Rarius*.

Fig. 118.

12. *Bufonites Minor, Trochili ad instar Fastigiatus*, seu *Bufonites Trochilus* dictus. Coloris est ex *Anthracino Subcærulei*, & *fimbria Nigra* donatus. E *sabuleto Faringdonensi*.

Fig. 119.

13. *Bufonites Minimus Trochilo affinis Calyculo Striato longiusculo donatus*. *Caliculus Striatus Castanei* Coloris est: *Umbo* idem fere Color ac præcedentis. In *Sabuleto Faringdonensi* aliquoties observavimus.

Fig. 120.

14. *Bufonites Scaphoides extremo altero latiore*. In *Lapidinis Marchamiæ* & *Garvordiae*, & ad *Faringdoniam* non admodum *rarus*.

Fig. 121.

Omnes *Bufonites* ut id semel dicam, variant Colore; at *Anglicani* ut plurimum ad *Nigrum Fuscum*, & *Hepatiem* accedunt. Hos *Lapides Angliæ*, antehac inveniri non constat: nam *Bufonites D. Plot in historia Oxoniensi*, hujus loci non est. *Bufonites D. Christopheri Meret* (si locum memini) *Lapides* non erant, sed ipsissimi *Lupi Piscis Dentes*, &c. Quod quidem satis feliciter, sive ab ipso sive a quovis alio, excogitatum: Quippe hi *Lapides* aliud non sunt, me iudice, quam *Luporum* aliorumque *Piscium Dentes*, *Habitu* & *Vestitu Lapidum* personati. In *fodina Garvordiensis* septimo ab *Academia* milliari, (ob *Rariores* quos habet *Lapides*, diutius a me frequentata) tandem incidi in *Maxillæ Piscis* ut videtur fragmentum, cui *Tres Bufonites*, *Triangulato* quodam ordine, arcte inhærebant; *Bini* scilicet *Orbiculati Minores*, & *Minimus Tertius*. Sed de *Bufonitibus* hæc dicta sufficiant; quos, si id magis placeat, *Ichthyodontes Scutellatos* in posterum jure merito appellare poteris.

Fig. 122.

15. *Plectronites lævis Mucrone paulo acutiore*. *Plectronites* non aliud est quam *Ichthyodos* quidam tereti formis, *Plectrum Gallinaceum* referens, *radice Bufonitis* instar, *excavata*. Colore, *Superficie* & *Magnitudine*, ut reliqui, *Ichthyodontes* variant. Passim in *Lapidinis Berberianis*, cum *Bufonitibus* & *Glossopetris* inveniuntur. *Striato Periosteo* denudatos suspicor quotquot *Marmoris* ad instar *Politos* cernimus.

Fig. 123.

16. *Plectronites Major altiusculè Striatus, Mucrone magis obtuso*. Hujus *Lapidis* non nisi *Duo Exemplaria* hætenus videre contigit. E *Fodina Stunsfeldiensis*.

Fig. 124.

17. *Rhombus Minor* sive *Medius*, quem *Rhombum* appellare placuit; *Compressior* est quidam *Lapis*; præter-propter *Cucumerini Seminis* magnitudine, forma

Fig. 125.

forma ad *Rhomboidem* accedenti. Ab uno latere Convexior est, & Colore ut plurimum *Nigro*: ex altero Planior, & Testacea quadam lamella obductus; quæ mirè splendet, Colore *Anthracino* vel ex *Atro Rubenti*, Hæc Testula, sive Testacea Lamella, Figuram *Rhomboidalem* constituit, Margine quandoque leviter inclinato; & quod materiæ elegantiam, elimatum *Testudinis* Exuvium quam proxime similat. Invenimus in Lapidinis *Marchamensibus* & *Charletoniæ*. Dantur etiam & *Majores* & *Minimi*, & quidam figura à *Rhomboidali* multum discrepantes. *Rhombum* quoad Materiæ & Coloris elegantiam excipit.

Fig. 126.

18. *Scalpellus*. Est autem *Scalpellus*, Lapis figura ab omnibus hucusque notis prorsus aliena. Quod ad Magnitudinem spectat & Colorem, cum *Rhomb* aliquatenus convenit. At Figura est omnino sibi propria. *Scalpellum* nominare volui, quoniam *Cultelli* Mucronem quodammodo mentitur. Nam Lamellatus est Lapillus; Figura tamen Trigonalis, cum alio quodam Angulo minus eminenti. Facies altera omnino Plana est et Sessilis; sed altera ob demissum Marginem, seu mavis Transversas quasdam Lineas eminentes, undiquaque leviter Acclivis. *Charletoniæ* habui cum priore.

Fig. 127.

19. *Bufoniti* Congener *Gibbus* Lapis: seu *Bufonites Gibbus* cognominatus. *Gibbus* autem lapis ex Re Nomen habet; nam *Bufonites* est non ut reliqui plane sessilis, sed omnino Arcuatus: adeo ut si in Plano posueris, lucem subtus recipiat. Atque hinc a Dorso Elatiori, apud nos *Gibbi* nomen sortitus est. In parte *Gibbosa*, foramen obtinet ad Basin latiore; ei prorsus simile quo cæteri donantur *Bufonites* minores. In Arenosis *Marchamiæ* Lapidinis invenit optimæ spei Juvenis D. *Joannes Archer* è Collegio *Reginensi*: qui inter alios Lapides aliquam multos, ejusdem Duo vel Tria habet Specimina. Nos postea in Sabuleto *Faringdonensi* observavimus.

Hactenus dictos *Lapides* ut et alios aliquam multos, quos in *Anglia Mediterranea* inveni, pro *Piscium Dentibus* aliisque *Capitum Officulis* aut habeo, aut vehementer suspicor. Cæterum & eorundem *Vertebras* non paucas undiquaque in Agris *Glocestriæ Bercheriæ* & *Oxonii* sparsas, observare licuit; quos omnes generali nomine.

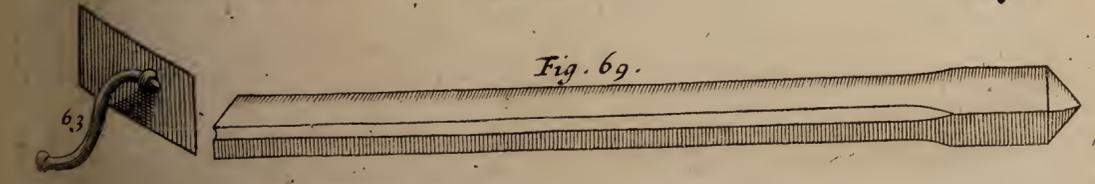
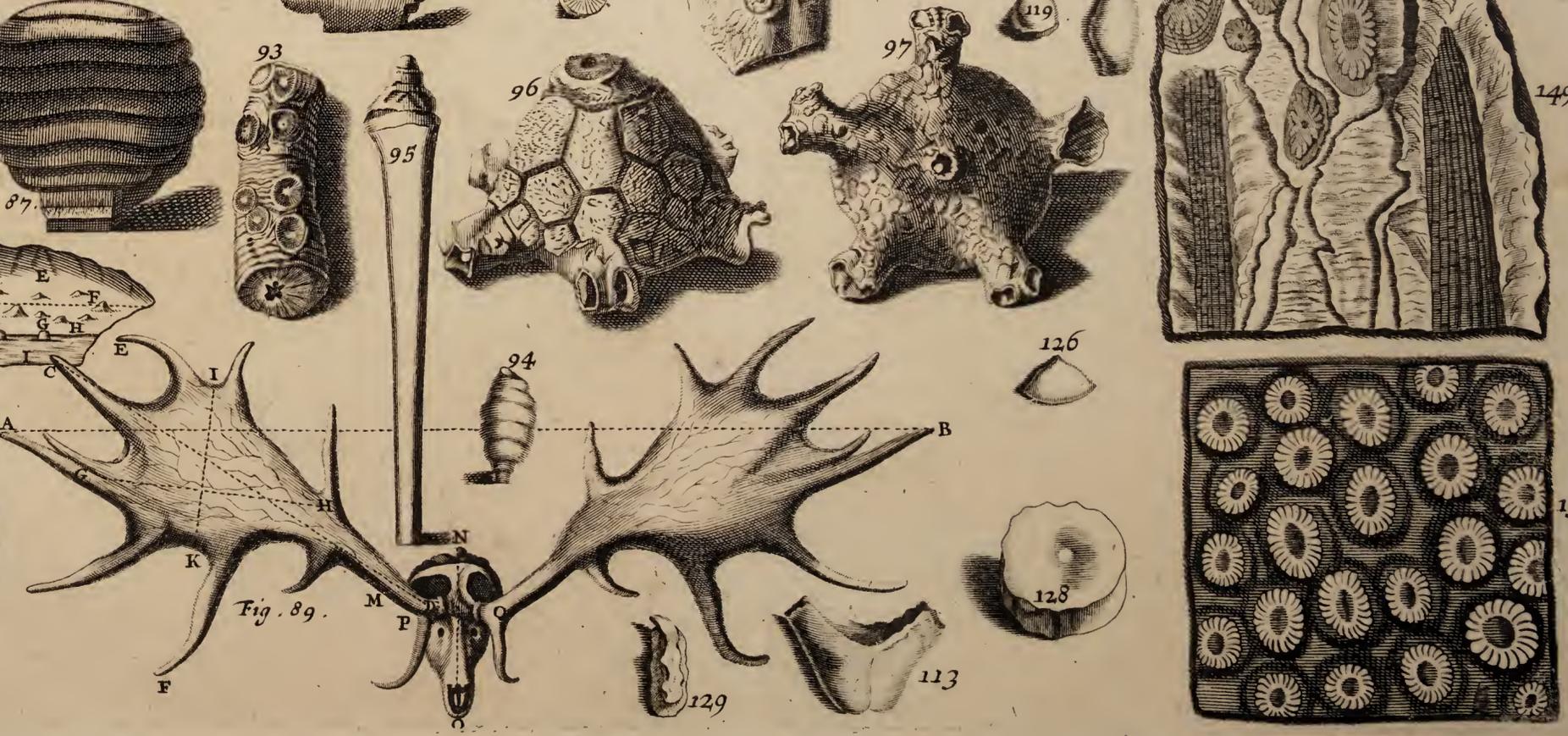
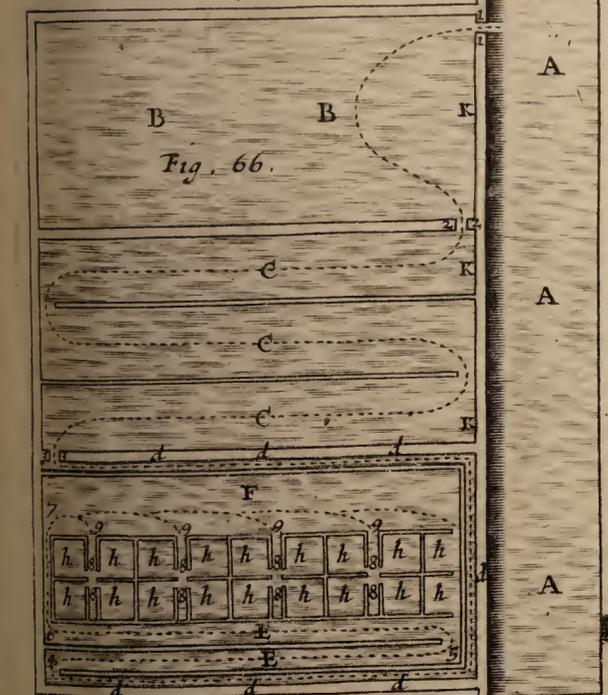
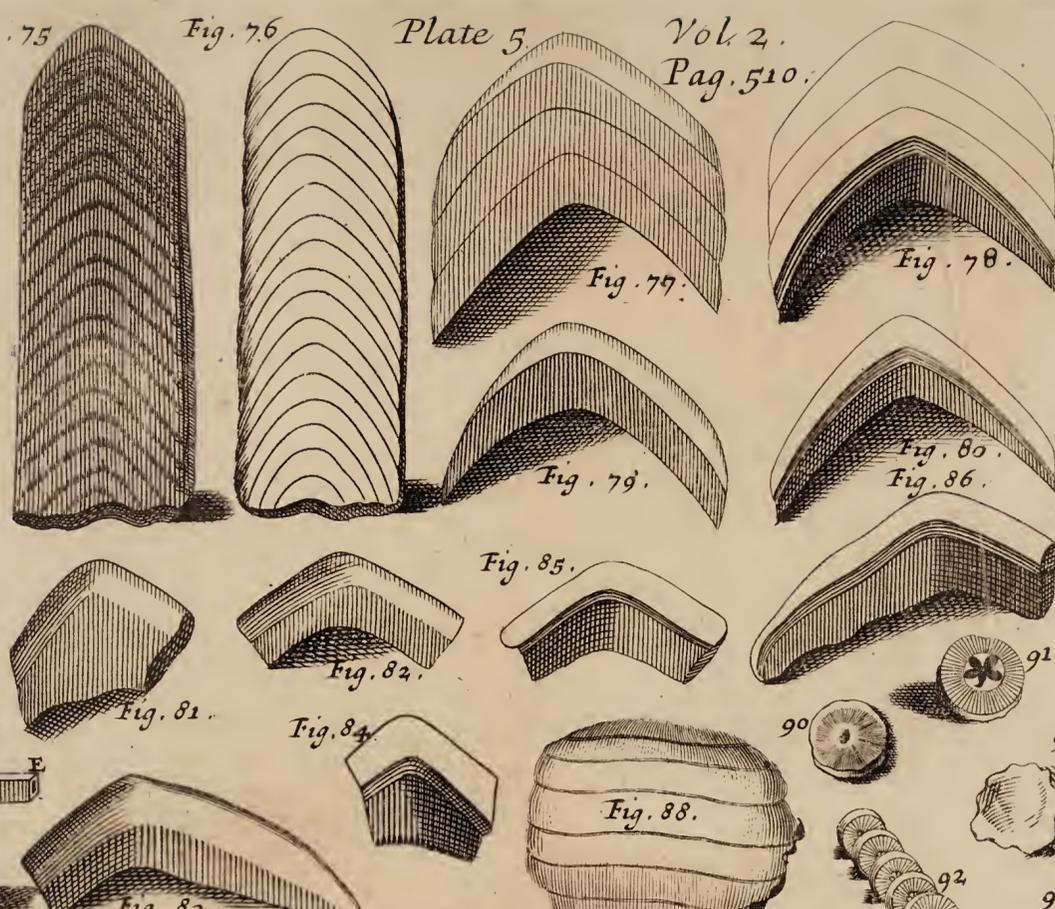
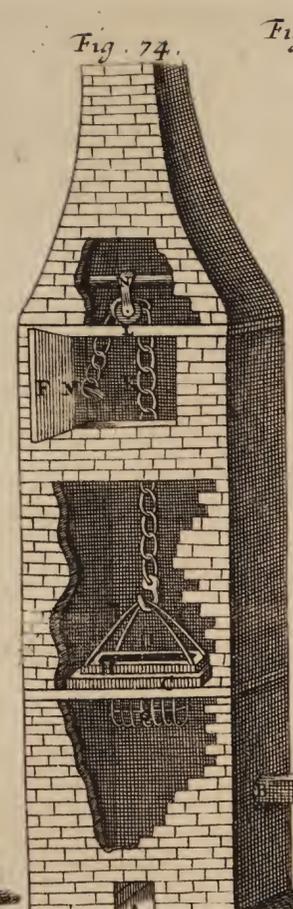
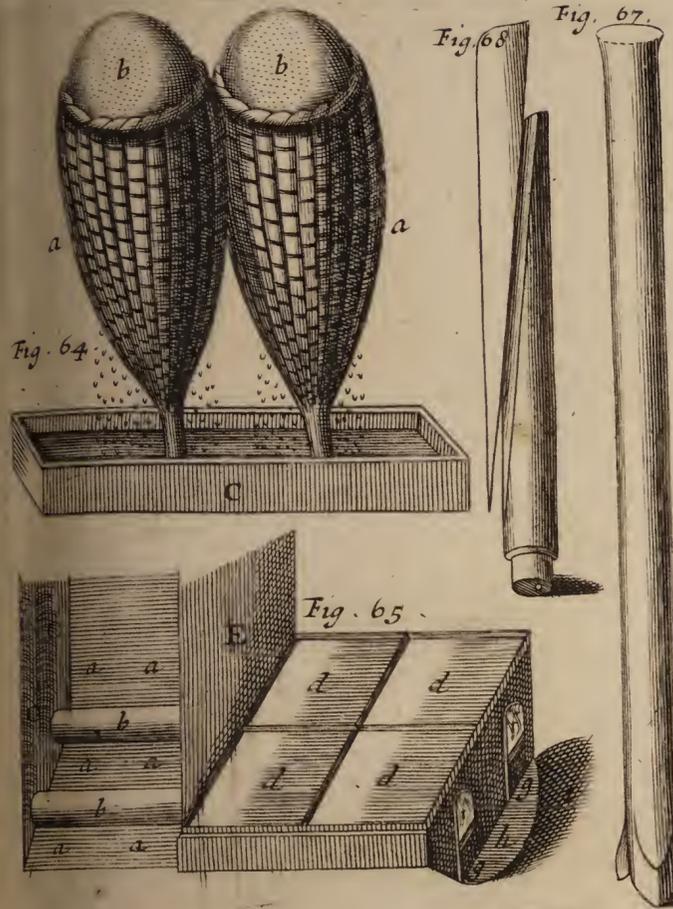
Fig. 128.

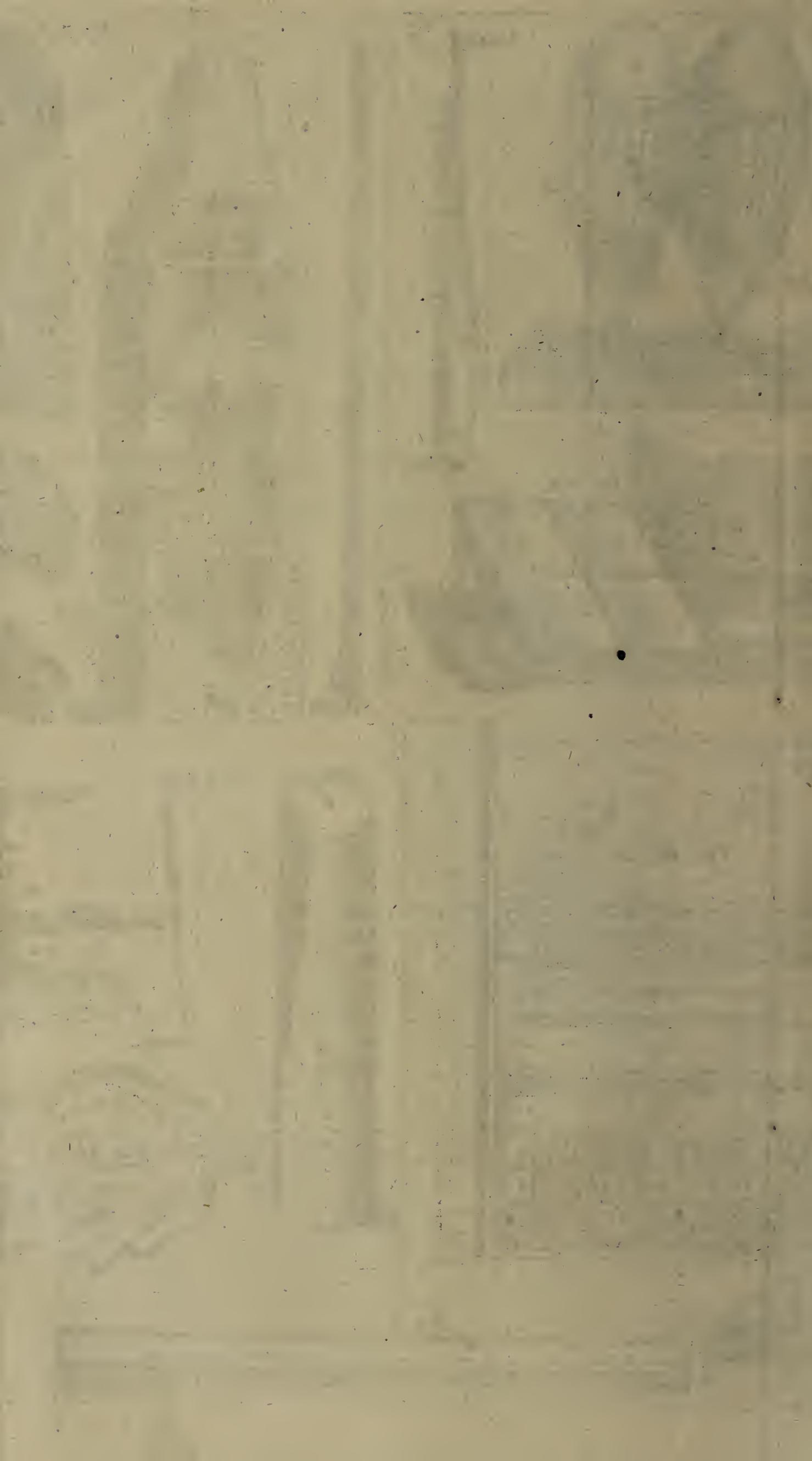
20. *Ichthyospondylos* appellare consuevimus. Sunt autem ii vario pro conditione loci, *Tincti*; alii *Nigri*, *Fusci* alii; quidam *Subletei* aut *Cinerei*. Magnitudine etiam & Forma non minus Varia sunt quam *Ichthyostea*, superius dicta. Invenimus qui Latrunculos Lusorios Magnitudine exsuperent; atque etiam *Viciæ Semine* Minores. In Arenosis Fodinis *Marchamensibus*, sine ulla fere (ut mihi visum est) materiæ *Offeæ* jactura conservatos vidimus. Porro *Ichthyospondyli* aut raro aut nunquam inveniuntur pluribus simul junctis, ut *Piscium Vertebræ*: Magno quidem Indicio, me Judice, has non esse *Lapides* Spontaneos, ad imaginem (cognatæ quantumvis materiæ) *Offium* formatos. Nam si Natura Subterranea, quod Marina perficit, prestare conatur quidni eodem opere ac labore, quo Singularem *Piscis Vertebrarum*, integrum saltem *Skeleton*, ut cætera nequeat, conficeret?

Fig. 122.

21. *Maxillæ Piscis* fragmentum *Lapideum*, cum adnati *Bufonitibus*. *Garvordix* inventum.

2. *Glossopetra*





22 *Glossopetra Exigua cum Mandibulæ fragmento Lapideo adnato.* Fa- ringdon. Fig. 129.

23, 24, 25, We found near *Lhan Deilo* in *Caermardhinshire*; 26, 27, 28, 29. on the *Severn Shore* in *Glocestershire*; 30 at *Gold Cliff* in *Monmouthshire*; and all the rest in the *Isle of Caldey*, in *Pembrokeshire*. The 25th. Fig. 132. whereof we found great Plenty, must Doubtless be referr'd to the *Skeleton* of some *Flat-Fish*; the 23d. and 24th I know not at all what to make of; The rest are *Modioli*, or *Vertebræ* of *Sea-Stars*; for I have been long since fully satisfied that all sorts of *Entrochi* and *Asteriæ* must be referr'd thither; not that I conclude that either these, or any other *Marine Terrestrial Bodies*, were ever really, either *Parts* or *Exuvia* of *Animals*; but that they bear the same Relation to the *Sea-Stars*, that *Glossopetræ* do to the *Teeth* of *Sharks*; the *Fossil Shells* to the *Marine Ones*; &c.

Fig. 149, 150. Represent a *Limestone Marble*, we have lately discover'd in *Wales* when Polish'd. We have Plenty of it; but few pieces exceed 6, 9, or 12 *Inches* Diameter; for 'tis only a sort of *Alcyonium*, incorporated in several small Blocks of the *Limestone*; whereof Fig. 149. Represents a piece Polish'd Perpendicularly, and Fig. 150. Horizontally. 'Tis to me more Beautiful than the *Florentine Marble*, but much more Hard and Substantial.

N. B. This stone is a sort of *Coral*, and the *Lapis Astroitidis* five *Stellaris Primum Genus*. Boet. de Bodt; or *Astroites*, *Worm. Mus.* It grows in the Seas adjoining to *Jamaica*. It is frequently found Fossile in *England*. I have some of it that will Polish as well as *Agar*, which was many years since found out by Mr. *Beaumont*.

LXXVI. 1. This Description of the *Giants Causeway* I received from a Scholar and a Traveller, who went on purpose the last summer 1692 with the Bishop of *Derry* to see it. It is in the County of *Antrim*, about 7 miles East of *Colrain*, and 31 miles to the East of the Mouth of the River *Derry*. The Coast there is a very great Height from the Sea: And from the Foot of the Precipice, there runs out Northward, into the Main Ocean, a Raised *Causway* of about 80. Foot Broad, and about 20 foot High above the rest of the Strand; its sides are Perpendicular; it was about 200 Foot in View to the Sea-Water.

This whole *Causway* consists all of *Pillars* of Perpendicular *Cylinders*, *Hexagones*, and *Pentagones*, of about 18 and 20 *Inches* Diameter but so justly shov one by another, that not any thing thicker than a Knife will enter between the Sides of the *Pillars*. When one Walks upon the Sand below it, the side of this *Causway* has its Face all in *Angles*, the several *Cylinders* (pardon the *Impropriety* of the word) having some *Two*, some *Three* of their sides open to View. The very vast High Precipice does also consist all of *Cylinders*; tho' some Shorter and some Longer: And all the stones that one sees on that Coast, whether single, or in Clusters, or that Rise up any where out of the Sand, are all *Cylinders*, tho' of never so Different *Angles*; for there are also *Four Squared* upon the same Shore.

2. The

By Dr. Sim.
Foley. n. 212.
p. 170.

2. The *Giants Causeway* is somewhat more than 8 *English Miles* North East from the Town of *Colerain*, and about 3 from the *Bush Mills*, almost directly North. It runs from the bottom of an high Hill into the Sea, no Man can tell how Far, but at Low Water the Length of it is about 600 *Foot*, and the Breadth of it, in the Broadest place 240 *Foot*, in the Narrowest, 120 *Foot*. It is very unequal likewise in the Height, in some places it is about 36 *Foot* High from the Level of the Strand, and in other places about 15 *Foot*.

It consists of many thousand Pillars, which stand most of them perpendicular to the plain of the Horizon close to one another, but we could not discern whether they do run down under Ground like a Quarry or no. Some of them are very Long, and Higher than the rest; Others Short and Broke; some for a pretty large space of an Equal Height, so that their Tops make an Even Plain Surface; many of them imperfect, Crack'd and Irregular, others Entire Uniform, and Handsome, and these of Different shapes and Sizes. We found them almost all *Pentagonal*, or *Hexagonal*, only we observed that a few had 7 *Sides*; and many more *Pentagons* than *Hexagons*, but they were all Irregular: For none that we could observe had their sides of Equal Breadth; the Pillars are some of them 15 some 18 *inches*, some 2 *Foot* in Diameter, none of them are one Entire stone, but every Pillar consists of several *Joynts*, or Pieces, as we may call them, of which some are 6, some 12, some 18 *inches*, some 2 *Foot* Deep.

These Pieces lye as Close upon one another as 'tis possible for one stone to lye upon another; not *Joynting* with Flat surfaces, for when you force one off the other, one of them is always *Concave* in the Middle, the other *Convex*. There are many of this kind of *Joynts*, which lye loose upon some part of the *Causway*, and on the Strand, which were blown or washed off the Pillars. These *Joynts* are not always Placed alike, for in some Pillars the *Convexity* is always Upwards, and in others it stands always Downwards. When you force them asunder, both the *Concave* and *Convex* Superficies are very *Smooth*, as are also the *Sides* of the Pillars which touch one another, being of a *Whitish Free stone* Colour, but a Finer Closer grit; whereas when we broke some pieces off them, the inside appear'd like *Dark Marble*.

The *Pillars* stand very *Close* to one another: And though some have 5 *Sides* and others of them 6 yet the Contextures of them are so adapted, that there is no Vacuity between them; the Inequality of the Numbers of the sides of the Pillars being often in a very surprising and Wonderful manner, throughout the whole *Causway*, compensated by the inequality of the Breadths and Angles of those sides. So that the Whole at a little distance looks very Regular: And every single Pillar does retain its own Thickness, and Angles, and sides, from Top to Bottom.

Those *Pillars* which seem to be Entire as they were Originally, are at the Top *Flat* and *Rough*, without any Graving or *Striate* Lines; those which lye Low to the Sea are washed *Smooth*; and others that seem to have their Natural Tops blown or Washed off, are some *Concave*; and others *Convex*.

The High Bank hanging over the *Causway* on that side which lyes next it, and towards the Sea, seems to be for the most part composed of the common
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Fig. 136.

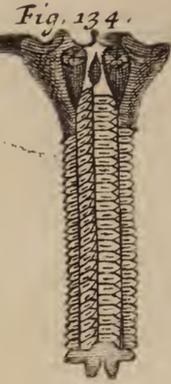


Fig. 134.

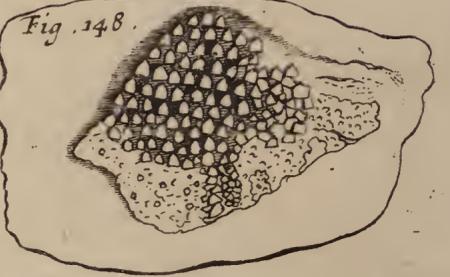


Fig. 148.



Fig. 147.

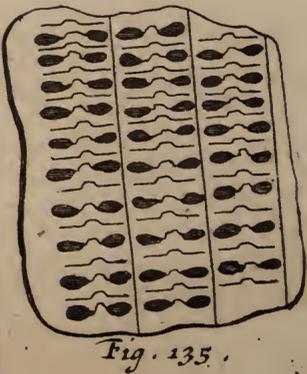


Fig. 135.



Fig. 145.

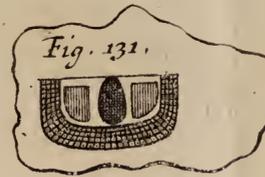


Fig. 131.

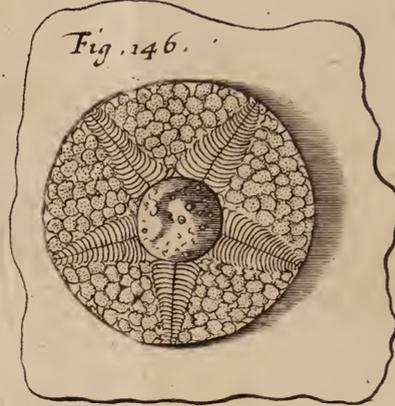


Fig. 146.

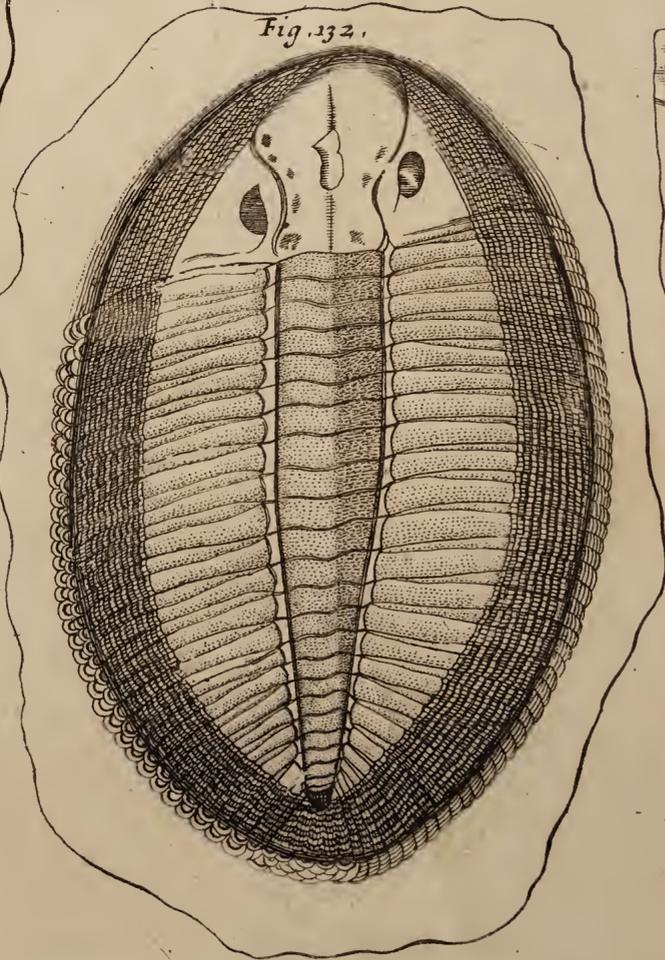


Fig. 132.

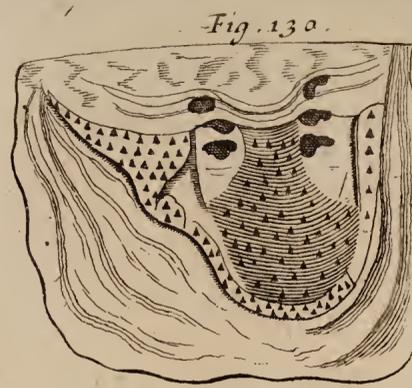


Fig. 130.

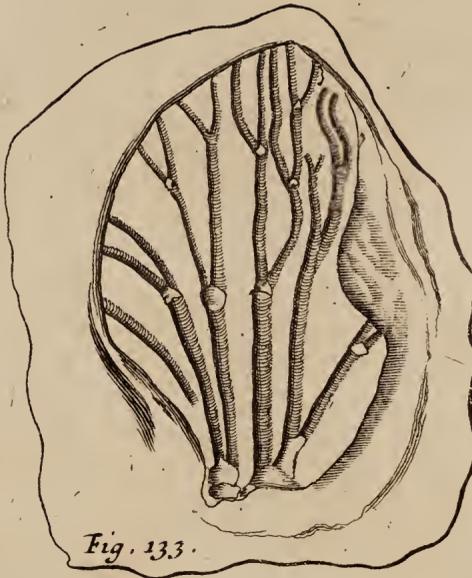


Fig. 133.

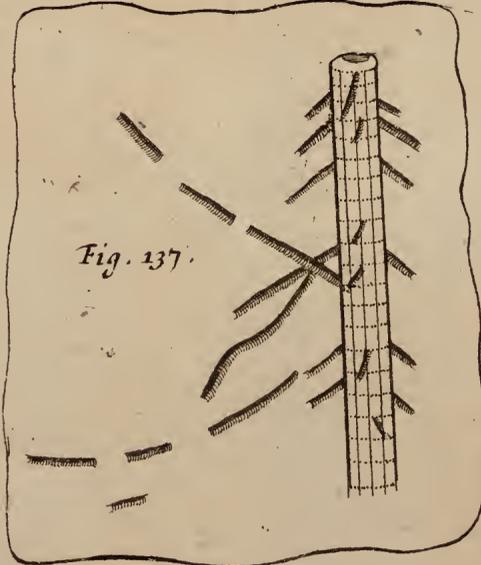


Fig. 137.



Fig. 139.

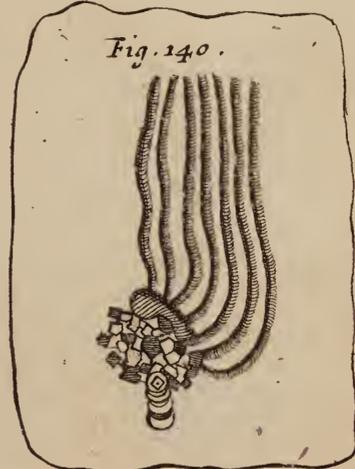


Fig. 140.

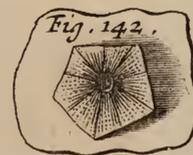


Fig. 142.

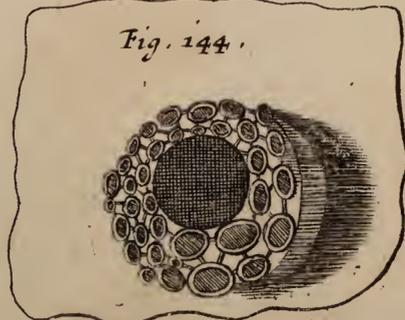


Fig. 144.

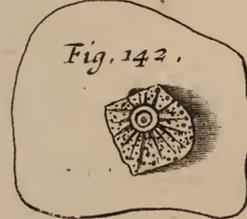


Fig. 142.

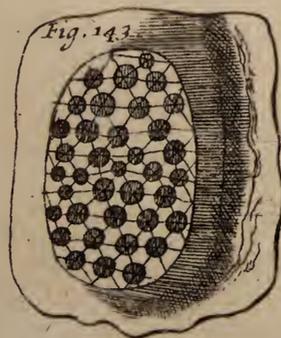


Fig. 143.



Fig. 138.

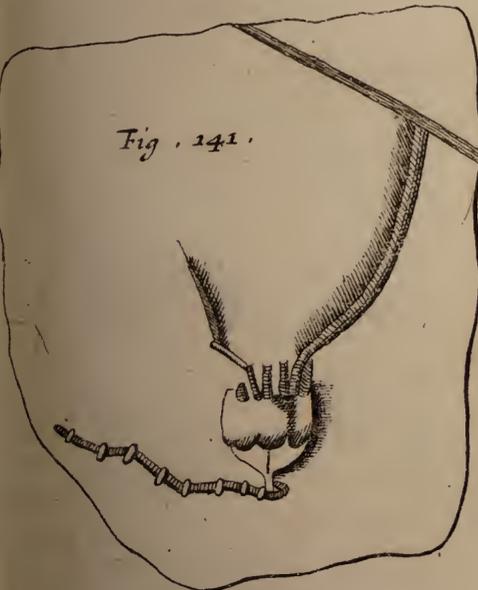


Fig. 141.

fort of Craggy Rock: Only we saw a few Irregular Pillars on the East side, and some farther on the North, which they call the *Looms*, or *Organs*, standing in the side of a Hill; the *Pillars* in the Middle being the Longest and those on each side of them still shorter and shorter: But just over the *Causway*, we saw as it were the Tops of some *Pillars* appearing out of the sides of the Hill, not standing, nor lying Flat, but Sloping.

We suppose each *Pillar*, throughout the *Causway*, to Continue the same to the very Bottom, because all that we saw on the sides were so.

N. The several sides of One and the same *Pillar* are as in the Planes of *Crystals*, of very Unequal Breadths or Lengths, call it either, when you Measure them Horizontally; and that in such as are *Hexagonal* a broader side always subtends, or is opposite to, a narrower, which sort of *Geometry* Nature likewise observes in the *Formation* of *Crystals*. *ib. p. 174.*

3. Among the several *Figur'd Stones* already Described by Authors, I find none that has more Agreement with those which compose our *Giants Causway* than the *Entrochos*, the *Astroites*, or *Lapis Stellaris*, and the *Lapis Basanus* or *Basaltes*: And yet for all the great Resemblance they have in some particulars, they Differ very much in Others. By Dr. Tho. Molyneux. *ib. p. 175.*

The *Entrochos* Agrees with the *Pillars* of our *Causway* in that it is a stony substance, formed by Nature *Column wise*, and consisting of 20 or 30 several *Internodia*, or *Foynts*, set one a top of another; but then it Differs in that its Outward shape is Round and *Cylindrical*; in its having a *Hole*, or *Pith*, run from Top to Bottom through all the *Foynts*; in the setting on, or Way of Fitting one *Foynt* to another; and in its size and Magnitude.

The *Astroites* or *Lapis Stellaris* is not only shap'd *Column wise*, as the *Entrochos*; and *Foynted* with several *Internodia* closely adjusted to one another, but its sides are *angular*. But then it must be observ'd that the sides of the *Astroites* are always *Sulcated*, or a little Furrowed, and are constantly *Pentagons*; whereas the *Irish Stone* has its sides perfectly smooth, and *Plane*, and sometimes in *Hexagons* and *Heptagons*, as well as *Pentagons*. Moreover the *Astroites* has Furrow'd and Protuberant *Rays* striking from its Center, somewhat as they draw a Star. Whence it has its Name, that adapting the *Concavities* and *Convexities* together, cause the Cohælion of the *Foynts* to one another; whereas the Internal Superficies of the *Internodia* in our *Irish Stone* sends forth no sort of *Rays* from its Center, and unite to one another by a quite different *Articulation*. For besides what Dr. *Foley* remarks of the Bottom or Top of each *Foynt*, having a large round *Concavity* or *Convexity* that extends it self from the Center of the Stone within an inch or two of the Angular Circumference; Examining two *Foynts* that were sent up from the place hither to *Dublin*, I observ'd likewise, that the Bottom or Top of each *Foynt* round this *Concavity* or *Convexity* either Rises with an eminent *Verge*, or *Ridge*, if it be *Concave* in the Middle or if it be *Convex*, is Hollowed with such a sort of Groove, as to receive closely into it all the Eminent Ridge of the next *Foynt* either above or below it; so that each Superficies in the *Articulations* adapt themselves on all sides so exactly one to

U u u

t'other,

other, as 'tis possible for two Bodies, that are only Contiguous, and not Cohæring.

The *Astroites* also as well as the *Entrochos*, Differs extremely from our stone in its *Size*, or *Magnitude*; for the Largest that is found of either of those kinds, do not much exceed the Thickness of a Man's Thumb, whereas our *Columns* are some of them 2 Foot in Diameter. Yet this Disproportion of bulk is not so considerable a Difference, since we observe that Nature Affects the like Disparity in other of her Works, and those too neerly allied, and evidently of the same Tribe, or Family. Our small *Joynted Rushes* or *Reeds*, and the Largest *East Indian Bambon*, one of which I remember to have seen in *Holland* above 26 foot high and as thick as a Man's Middle, are yet *Plants* of the same Species and Class.

But nothing among all the *Fossil* Tribe that I have seen or read of; comes so nigh in all respects, in its Formation, Substance, Size, Way of Growth, or manner of standing, &c. to the *Columns* whereof this *Causway* is Composed, as the *Lapis Basaltis Misenus*, described by *Kentmannus* in *Gesner de Figuris Lapidum*, whereof he says there is a great large Bed within 3 Miles of *Dresden* in *Saxony*. He gives the following account of it thus in his own words. — *Lapides Angulosi plures coagmentati Basalten representat, qui crescit formâ & magnitudine Figni mediocris, Singularis quidem sed Copiosus atque ita Junctus Coaptatusque, veluti ab Arculario arte commissus esset; septem, sex, quinque, nonnunquam sed rarius quatuor Angulorum: Omnino Figura Trabis erectæ, foris Lævis, & Tactu minime Asper, Ferrugineus Ponderosus, Duritie velut Adamantis; Hi Lapides sic Coagmentati in terra Ulmas decem & septem extant; Quanto spatio intra Terram condantur, nemini adhuc exploratum est.* But, I find this Difference between these and the *Misnean Basaltis*, that its *Columns* were one Entire piece from top to bottom, whereas our *Irish Basaltis* is composed of *Columns* Divided into many *Joynts*. So that I think it may not Improperly be called, to Distinguish it from this and all other *Fossils*.

Lapis Basaltis vel Basanos Maximus Hibernicus Angulis minimum Tribus plurimum Octo constans; crebris Articulis sibi invicem affabre conjunctis, sed facile separabilibus, Genuculatus.

Whether our *Irish Basaltis* can pretend to the Name *Basanos*, on the same account the *Misnean* does, from the Greek word *Βασανίζω*, *Exploro*, because it has the property of the *Touch Stone*, that shews by Lines drawn with Metals on its Smooth Surface, which are Genuine, and which Adulterate, I cannot positively say; because those *Pieces* I have, are so Rough, that unless some part of the Superficies were Artificially Polished, the Experiment cannot be made: Yet I have reason to believe it would Succeed, were the Stone Polished; because I find *Black Marble* in general, so it be of a Close Texture and Hard, as this is, always partakes of that Property.

4. To have a Just Idea of this *Wonderful Production*, I proposed the last Summer 1697. to some Philosophical Gentlemen here in *Dublin*, that we should

should Employ, at our common Charge, one Mr. *Sandys*, a good Master in Designing and Drawing of *Prospects*, to go into the North of *Ireland*, and upon the Place take the Genuine and Accurate *Figure* of the Whole Rock, with the Natural Posture of the Hills and Country about it for some distance; accordingly we sent him away with such Instructions as I drew up for him, and he Returned soon after with a Fair and Beautiful Draught, very expressive of each Particular we desired.

A. The *Great Causway*; which is from B. to C. 135. *Yards*; from D. to E. 120 *Yards*; and from F. to G. 64 *Yards*.

Fig. 151.

H. The *Imperfect Causway*, which is 120 *Yards* Long.

I. *Stones*, the same as those of the *Causway*, which lye on their sides in the *Hill*.

K. *Rocks* in the *Sea*, which appear to be the same sort of *Stone*.

L. The *Organs*, which are *Pillars*, the same with the *Causway*.

M. The *Chimneys*, which are *stone* and make that *Figure*.

The *Prick d Line* in the *Causway*, shews how far the *Sea Flows* at *High-Water*.

Fig. 152. The *Prospect* of the *East side* of the *Causway*.

Fig. 152.

There are also several of these *Kind of Stones* seen in the *sides* of the *Rocks*.

But the most instructive part of the *Scheme* is that which expresses all the *Various Figures* of the several *Foynts* and *Columns* that have been found by careful *Observation* to make up the *Causway*,

N. A *Foynt* but of *Three Sides*.

O. A *Foynt* of 4 *Sides*.

P. A *Foynt* of 5 *Sides*.

Q. A *Foynt* of 6 *Sides*.

R. A *Foynt* of 7 *Sides*.

S. A *Foynt* of 8 *Sides*.

Fig. 153.

Fig. 154. A *Piece* of a *Column* of 6 *Sides*, *Transversly* divided in the *Middle*, the *Uppermost* part *a*. laid close by the *Lower* part *b*. that the *Manner* may the better and more plainy appear, how the *Convexity* or *Rising* of the *Foynt* below, mark'd *c*. was let into the *Hollow* of the *Foynt* above, mark'd *d*. when that was in it's *Native Posture*, standing a top and *Covering* it. By this sort of *Articulation* the several *Foynts* of the *Columns*, whether they consist of 3, 4, 5, 6, 7, or 8, *Sides*, *Adapt* and *Unite* themselves to one another: and observe, in all the rest of the *Figures*, *c*. denotes a *Convexity* or *Rising*; *d*. a *Cavity* or *Hollowness*, in the *Stone*.

Fig. 154.

Fig. 155. Is a *Collection* of 7. *Columns* as they stand together in the *Causway*; and shew that though the *Pillars* Differ from one another in their *Shape* and *Angles*, yet they *Adjust* their *Sides* in such a *Manner* to the next immediate adjoining *Columns*, that there remains no *Vacuity* between them: For the *Pillars* are of such *Various Figures*, that all sort of *Interstices*, of what *Shape* soever, are entirely fill'd up by one or other of them. e e e e the *Sides* of the *Pillars* which shew by their *Outward Surface*, that each *Column* consists of many *Foynts* placed one above another, from *Top* to *Bottom*; and these *Foynts*

Fig. 155.

so Closely Contiguous, that only a small Crevice or Line seems to sever them; some with their *Convexities* Uppermost, as those mark'd *c.* others with their *Concavities*, as those mark'd *d.*

The *Triangular, Quadrangular, and Octangular Pillars* are much Fewer in Number than those *Other Figur'd Columns*: So that they do not come Readily in sight, except they be carefully searched after.

But this sort of stone is not more Remarkable for being Cut thus Naturally into *Regular Geometrical Figures*, than for being found in such *Plenty* and vast *Abundance* in many parts of this Country, for 4 or 5 *Miles* about. For, besides what goes under the Vulgar Name of the *Giant's Causway*, which it self alone is of a great Extent, and how far it may run into the Sea none can tell, there are many other Collections of the same Kind of *Pillars*, situated in and about this Place; as two Lesser but more imperfect and Broken *Causways* as we may call them, that both lie at some Distance o'the Left Hand of the *Great one*, as you face the North; and a little farther into the Sea, some *Rocks* shew themselves above Water, when the Tide is Low, that seem all made still of the same stone. And if you Ascend towards the Land in the Hill above the *Causway* next and immediately adjoining to it, you meet with more of the same sort of *Pillars*, but in a Different Situation, not Perpendicular and Erect, but Lying as 'twere on their sides, in a *Slanting Posture*.

Beyond this Hill Eastward, at several Distances, stand many sets of Straight and *Upright Columns* Ranged in Curious Order along the sides of the Hills: That Parcel of them which is most Conspicuous and nearest the *Causway*, the Country People call the *Looms* or *Organs*, from its Formal Shape; which is so very *Regular*, that all its several *Pillars* may be Distinctly Counted, and they are just 50 in Number; the *Largest* and *Tallest*, at least 40 Foot High, consists of 44 Distinct *Foynts*, and stands Directly in the Middle of all the rest, they Gradually Decreasing in Length on both sides of it, like *Organ Pipes*.

Four *Miles* Westward of the *Giant's Causway*, a *Mile* and a *half* Distant from the Sea, 3 *Miles* from the Town of *Coleraine*, and about 2 from *Dunluce*, an old Seat of the *Marquesses* of *Antrim*, several Ranges of Tall *Pillars* shew themselves, along the side of a Rock, for about 300 *Paces* together: a *Church* within a *Quarter* of a *Mile* of them, called *Ballywillan-Church*, I am told, was Built for the most part with Stone taken from those *Pillars*, which are all of the same sort of Stone with the *Columns* of the *Giant's Causway*, (as I find by carefully Examining and comparing together Pieces of them both I have now by me) and like those too, Consist of *Regularly* Cut, loose and Distinct *Foynts*, placed one upon the Top of t'other; but in these Respects they Differ.

1. That some of these *Inland Pillars* are of much Larger Size than any in the *Causway*, being *two Foot* and a *half* in Diameter.

2. That there are only found among these, such as have 3, 4, 5 and 6, *Sides*, and none that have 7, and 8, like some of the *Giant's Causway*.

3. That the *Foynts* of these do not observe that kind of *Articulation*, by *Cavities* and *Convexities*, as those of the *Causway* do; but their Upper and Lower

Lower Surfaces Touch only in *Planes*, and they stand United by means of their Weight and Pressure alone: so that a Small Force will sever them.

But I find by observing the Manner of the *Commissure*, or way of *Articulation*, in Six Couple of the several sorts of *Foynts* of 3, 4, 5, 6, 7, and 8, *Sides*, which I had raised on purpose, and taken out of the *Causway*, as they were naturally fellow'd in *Pairs*, that some of the *Foynts* actually want this *Cavity* and *Rising*, as those of 4 and 6 *Sides* I have now in my House, and are only United to one another by Superficies touching close in *Plains* that run a little Slanting and not Parallel to the Horizon. Yet this may be only a Chance Formation, since the Universal *Foynting* of the Whole *Causway*, is certainly otherwise. But I must take notice, that the *Hollows* and *Convexities* are not constantly form'd and moulded in the Stone with all that Accuracy and Circular Exactness, the Artist has pleased to express them in the *Figures*.

These *Cavities* in such *Foynts* as are Uppermost, and lye exposed to the Open Air on the Surface of the *Causway*, afford no small use and Advantage to the Poorer sort of the People in the Neighbouring Country, with whom it is a common Practice in the Summer Time, when they want *Salt*, to fill these natural Basons with *Sea-Water*, which by Reason of their Shallowness are of so Commodious a shape, that in the space of 4 *Tides* they find all the Water that was left in them Exhaled, and the *Salt* remaining Dry in the Bottom of the *Hollows*.

But there is another Irregularity I must take Notice of, which is, that one of the *Foynts* of the *Causway*, a *Pentagon*, sent me hither to Town is *Cavous* both at Top and Bottom: But the General Formation is this, that if a *Foynt* be *Concave* at one End, the other End is *Convex*.

The vast Towering Height of those Strait *Foynted Pillars*, especially of those that are most slender and the perfectest among them, is truly very surprising. There are in the *Causway*, some of 32 others of 36 *Foot* High above the Strand, and as I said before, some among the *Organs* equal 40 *Foot* in Height. How far these may be continued under Ground is not yet discovered: But a Gentleman of my Acquaintance Trac'd one of the Tall-est *Pillars* of the *Causway* by Digging into the Strand, and it continued still of the same Make and Figure, *Foynted* as it was above, for the Depth of 8 *Foot* together, and he found no Reason to doubt but he might have trac'd it much farther.

This is Observable, that Commonly the *Foynts*, as well of the *In-land Pillars*, as those of the *Causway*, as they have their Situation nigher the Earth, are Longer and Taller than those towards the Top of the *Column*; but no Difference is Observed in the *Cavities* or *Risings* of the *Foynts*, as they are placed Higher or Lower in the same *Pillar*, they continue much the same as to their Depth or Protuberance from Top to Bottom: Yet the Utmost Top of such of the *Pillars* that seem Compleat and Entire, always Terminates with a *Foynt* that's *Flat* on the Up-
per

per side, and no way either *Concave* or *Convex* like all the rest below it.

As to the *Internal Substance* of this stone, 'tis of an Extraordinary Hard, Close, and Compact Texture: Its *Greet*, or *Grain*, so very Even and Fine that it hardly Appears, unless viewed near the Eye, and when the stone is newly Broke: Then it shews it self on its Surface like a very minute small Glisning Sand thickly interspersed with the rest of the Solid; which by Reason its parts are so Firmly Combin'd together, has something more of Gravity, in Proportion to its Bulk, than most other sorts of Stone, unless such as partake of the *Marchasite* or *Pyrites* and are more Ponderous than usual from a *Metal-line* Principle, being an Ingredient in their Composition; of which this does not at all Participate, or at least not in any considerable Quantity that I can discover.

It seems as if it were one Plain Homogeneous Body, without any Mixture of *Cochlite*, *Belemnite*, *Veins* of *Spar*, or such like Extraneous Matter, so commonly met with in most other stony Concretes: Nor can there be Observed *Rays*, *Farrows*, *Striæ*, or any Manner of *Lines* running along its Superficies; so that it is Capable of a good *Polish*, and I find has in Perfection that Quality of the *Lapis Lydius*, *Basanus* or *Touchstone*, so much Celebrated of Old, for shewing the various Impressions Different Metals make upon it when Rub'd or Drawn along its Surface; but being a Stone naturally Divided into small Pieces or *Joynts*, and of so Hard a Body, that it Turns or Breaks the Edges of the best Tools, when they offer to Cut it, it seems Unfit for the imbellishing of Houses, and all the other greater Uses of *Architecture* and *Statuary*.

Its Rough and Natural Outside that's exposed to the Open Air, and Beating of the Weather, is of a *Whitish Colour*, much the same with that we see on Common Rocks, and Lime-stone; but the inside, when you sever one piece from another, is of a *Blackish Iron-Grey*, like that of the best *Black Marble* before 'tis Polished, but somewhat of a Darker Shade. And indeed I can discover but Little, if any, Difference between the Substance of this Stone and that of *Marble*. 'Tis true, the most Common sort of *Marble* is not near so Hard and close a Body; yet that does not Import much, since 'tis known that several Kinds of *Marble* vary extreamly from one another in *Hardness*.

Georgius Agricola, in his Book *de Natura Fossilium*, has a Passage (and which I find confirmed too, by a Later Author living in that Country, *Lachmande Fossilibus*, &c.) wherein he mentions a sort of *Marble* found in the District of *Hildesheim* in *Germany*, that seems to bear in several Respects, a great Analogy or Agreement with this stone of the *Giants Causeway*. In *Hildesheim* quoque e regione *Arcis Marieburgi Collis est plenus Lapideis Trabibus quarum Capita interdum eminent, sunt vero Perlongæ acervatim positæ, inque medio earum Terra est Colore Nigro, Ferro aut altero Lapide percussæ non aliter ac Marmor Hildesheimum Cornu Usti virus olent, omninoque ex eadem Materia sunt.* He does not indeed tell us the precise Figure of these *Marble Beams*,

Fig 152

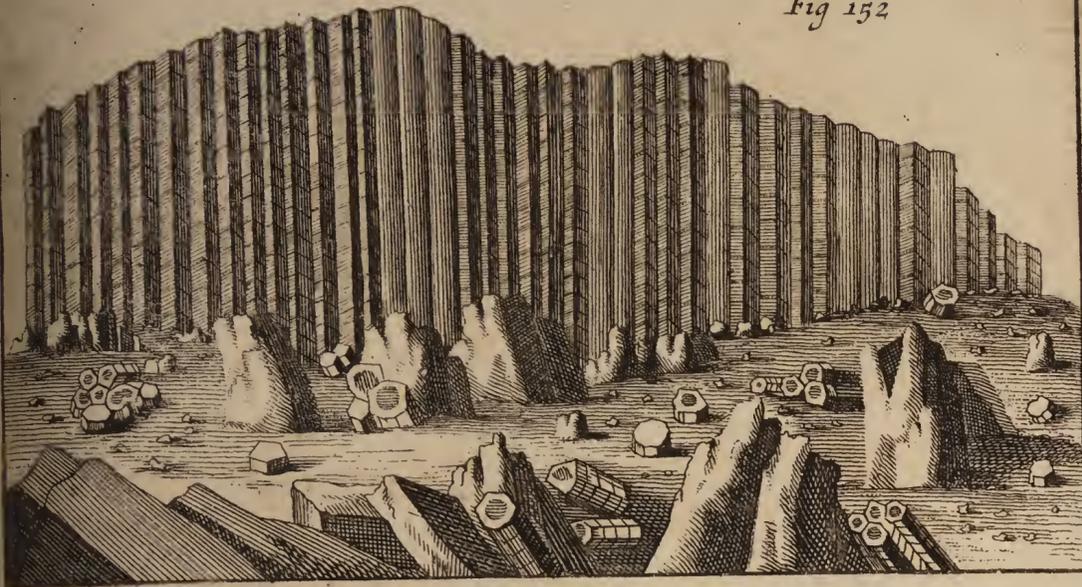


Fig. 156.

Fig. 154.

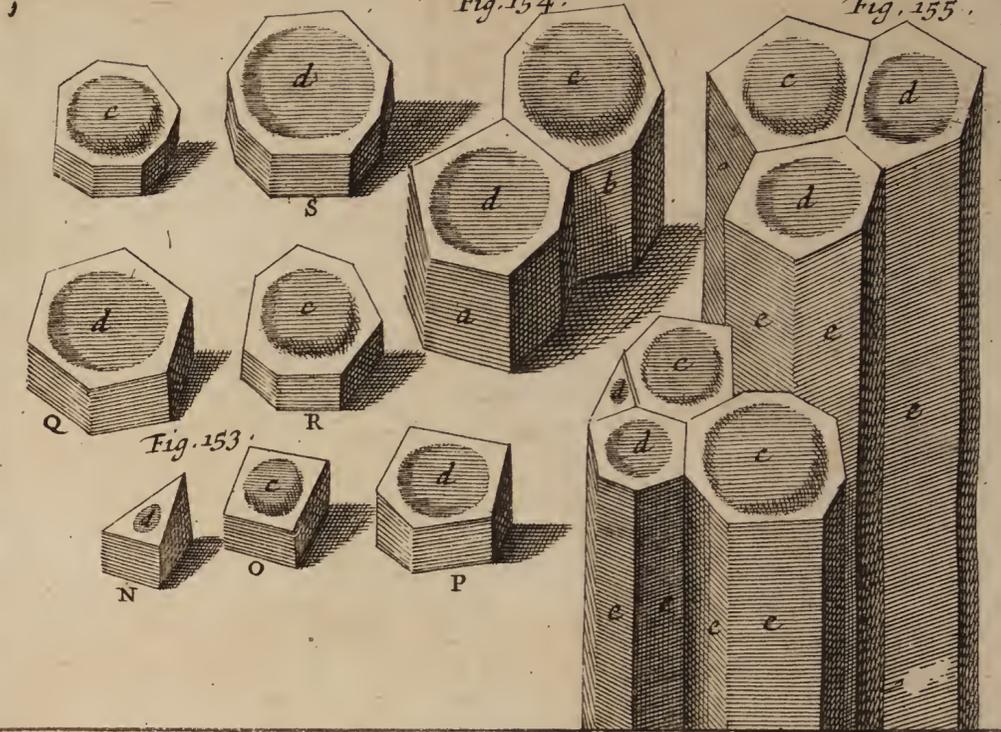


Fig. 155.

Fig. 153.



Fig. 151.

Beams, yet it seems probable at least that some were *Square*, which makes him call them, *Trabes Lapideæ*. But however that might be, this I'm assur'd of from frequent Experiments, that the *Marble* of the *Giant's Causeway*, like these *Stony Beams*, when forcibly struck with another stone or a Bar of Iron, sends forth a strong offensive Scent like *Burnt Horn*.

LXXVII. The best way to explicate the *Vegetation* of *Rock-Plants* is, *first*, to Represent the several ways of the *Growth* of *Spar*, which (to pass by the Account from *Helvetia*, that *Snow* by long lying and continual *Frosts* is Hardened into *Spar*) I observe to be three; *Either* 1. it takes a Being from *Stearns* alone; or 2 from *Stearns Coagulating*, either *Dew* as it falls on the Ground, or *Waters* issuing from the joints of *Rocks* under ground; or 3 it Grows from *Earths* and *Clays*. We have an instance of the *first* in many *Grotto's*, where some *Spars*, produced from *Stearns* alone, Hang from the *Roofs* like *Icicles*; *Lead-Ore* often growing in the same Manner: And as this *Spar* grows *Downwards*, so in many places from the sides of it there issue little *Plants* of *Spar*, which shoot *Upwards* contrary to the *Growth* of the other. Thus *Spars* grow from *Stearns* about the *Baths* at *Buda* in *Hungary*, according to the Relation of *Dr. Brown*. An Example of the 2^d is given above; where 'tis said, that at a certain place in *Italy*, *Crystals* (which are a sort of *Spars*) are Produced in Clear Evenings by a *Coagulation* of *Dew* falling on *Nitrous Stearns*. We have some, of the like Rise, on *Mendip Hills*, our *Miners* finding sometimes in *Roads*, where the *Earth* is bare, *Triangular Crystals* about 2 *Inches* in Length and an *Inch* over, not with Sharp Angles, like the *Triangular Glass*, but with Round and Blunt Angles, and carried up Round at the Ends like a *Coco Nut*; none of these being ever found in *Digging*. I have also seen of the same sort which were taken up in *Glocestershire*. So again its commonly seen in *Grotto's*, that *Stearns Coagulating Waters* issuing from the Joints of the *Clefts*, Produce *Spars* of all *Colours*. As to their 3^d way of *Generation*, to wit, from *Earths* and *Clays*, because I do not remember to have met, in any Author, with a Satisfactory Account thereof, I shall briefly relate to you what I have Observed herein.

There are in *Mendip Hills*, and generally where *Mines* are, *Subterraneous Vaults* or *Grotto's*, whereof some, which are pretty Deep, and admit not Air too freely, and have other Conditions required, are said by our *Miners* to be *Quick*, having often *Ore* in them, and still Lively Coloured *Earths*, with some Moisture and Lively *Spars*: Others, admitting Air 2 or 3 ways and having in them Black and Moist Rocks, and Dry and Rotten Shelly *Stones*, Dark *Earths*, Barren Sands, and the like, being said to be *Dead*. I have often Searched both, and in some of the Former, particularly in one of them, which is 35 *Fathom* Deep, by a perpendicular Line (though the Oblique Descent of it makes it above 50 *Fathoms* to those that go into it,) I Discover'd this process of Nature in the *Formation* of *Spar*. There are in the bottom of this *Grotto* some Beds of *Clay*, and others of a Liver Coloured *Earth* which I take to be as good a *Bole* as any now in Use; it is insipid to the taste,

but

The Growth of Spar, and Formation of Rock-Plants; by Mr. J. Beaumont. n. 129. p. 734. Vid. Sup. §. LIX.

Vid. Sup. Cap. II. §. XXXIX. Vid. Sup. §. LX.

Vid. Sup. §. II.

Smells well, especially when Dried; for, as it lies, it is Moist and like Paste, made so partly by the Distilling Waters, and partly by a *Steam* incumbent on the place Raised from those *Waters* by the *Mineral Ferments*. This *Earth* and *Clay* there Shoots up every where in *Spires* in all proportions in Height, from the First Buddings out of it, till it comes almost as High as a Man's Finger; the Biggest of them being in Thickness about an *Inch* Diameter. These *Spires* are all Ruled up with Irregular *Ridges* and *Furrows*, and some sooner some later, begin on the Top to be Congealed into *Spar*, and so gathering a *Crust* Downward by Degrees, are all at last Turned into an Absolute *White Spar*, with some *Diaphaneity*. I Discovered the same *Earth* in some places there growing *Spherical*, which whilst it is *Earth* it is still sticking to its *Bed*; but afterwards, as it comes to be *Crusted* over and at last to be Turn'd into *Spar* like the other, it Grows clear off from its *Root*, as Fruit falls from the Tree when Ripe. I have by me of these *Spherical Stones*, from the Bigness of an ordinary Bullet, to that of a Great Pins-head, some Turning to *Spar* sooner than others: I found some quite Grown off, some Half Grown, some *White Spar* Outwardly, and *Raw Earth* in the Middle, so that the Process was as Plain to me as I could wish. I saw the same *Earth* in some places there growing in an exact *Oval* Form, and Turning into *Spar* not *Oval*, but Raised on both sides with an *Edge* round it like *Apricock Stones*: And as these *Spherical* and *Oval Stones* are most exact in their Figure; so, notwithstanding the Rector fails in this *Vault* to give a true *Sexangular Figure* to those which I said shoot up *Pyramidally*; yet there is a certain place on these *Hills*, where the *Spars* Grow all *Sexangular*, both Points of them Terminating into a *Pyramidal Figure*, *Sexangular* likewise, as the *Veins* of *Chrystal* found in *Italy*, produced by a *Coagulation* of *Dew*; these with us probably having the same Rise, Lying also on the Surface of the *Earth*. Here I may acquaint you, that I find *Talc* on these *Hills* growing *Sexangular*; the *Rust*, which oftentimes lies over *Veins* of *Lead-Ore*, in many places Shoots up *Pyramidally*, and is bounded round with 6 *Angles*, and sometimes with 5; *Lead Ore* it self often Shoots up *Pyramidally* with rough Irregular Lines round it, and in some places I find it bounded round very Regularly with 4 *Angles*; in other places it Grows Branched like a *Plant*, as I have seen in a Mine where the *Stone Plants* grow.

As to that Opinion which generally solves those various *Phænomena* of the several *Figured Stones*, which we find in *Mines* and elsewhere, by saying, That they are part of *Plants* and *Animals*, or Whole ones, *Petrified*; it seems not to be grounded on Practical Knowledge. Thus when we find several sorts of *Shell-fish* in *Mines*, as there are some in the *Clay* where those *Stone Plants* grow, we must not flie to *Petrification* as though they had been brought there by the *Sea*, or otherwise, and so *Petrified*; but we must take that to be (as it is truly) the Natural Place of their *Birth*; some of them being *Raw Clay*, others of the same Texture with the *Rock* where they grow, and others of as absolute a *Shelly substance* as any in the *Sea*; these being only different gradations of Nature, which can as well produce *Shells* in *Mines* as in the *Sea*, there

there being no want of *Saline* or *Earthly* Particles. Nor is there any great Difference betwixt some sorts of *Spars*, and *Sea-shells*; neither do I know, why *Shells* might not as well be produced in *Mines*, as any sorts of *Spars* are in the *Sea*; for Instance, the *Fungi Marini*, which are of a *Sparry* substance, some of them having their Surface all wrought with Flowers, as it were, which are only the *Terminations* of *Sparry Cells*, as in *Coral*; and *Coral* it self is a sort of *Spar*, which so well resembles our *Stone-Plants* in its growth, especially if some of it be jointed, as Mr. Ray informs us, that I know not a more apt Name for these than to call them *Mineral Coral*; unless some haply will rather say, they are *Fluores Arborescentes internodiis distincti*; and as I find the Bodies and Branches of some *Coral* are all Ruled up with *Lines*, so are many of these in some *Mines*, and are terminated with *Cells* like it.

Mr. Lister Judges that *Shells* found in *Stone-Quarries* were never any Part of an *Animal*; and gives this probable Reason for it, because *Quarries* of Different *Stone* yields us quite different *Species* of *Shells*, not only one from another, but from any thing in Nature besides, which either the *Land*, *Salt*, or *Fresh Water*, does yield. I have Observed the same thing some Years since, and have now by me several *Species* of *Stone* resembling *Shell Fish*, which I gathered from Plowed Fields and Quarries, that are scarce to be Parallel'd, as I judge by all the *Collections* of *Sea Shells* extant.

To examine this Opinion of *Petrification* further; I only find, that the Thing supposed to be *Petrified* becomes first *Crusted* over with a *Stony* Concretion, and afterwards, as it Rots away Inwardly, the *Lapidescent* Juyce insinuates it self by degrees into its room, and makes, at last a *firm Stone*; Resembling the Thing in *Shape*; which may lead some to believe it really *Petrify'd*. But, though a *Real Petrification* were Allowed in some Cases, it would not be rational to plead this in all the *Figured Stones* we see, in regard of those many grounds we have for the contrary. But I take these to be the Chief Reasons which make some so ready to Embrace so generally this Conceit of *Petrification*, because they are Prepossess'd with an Opinion against the *Vegetation* of all *Stones*, and for that they think it Impossible for Nature to express the *Shapes* of *Plants* and *Animals* where the *Vegetative Life* is wanting, this being a Faculty peculiarly belonging to the *Soul*; whereas they seem to Err in both; For, as what hath been laid concerning our *Stone Plants*, may suffice to prove their *Vegetation*, so it will be as ealie to shew, that Nature can and does work the *Shapes* of *Plants* and *Animals* without the Help of a *Vegetative Soul*, at least, as it is shut up in *Common Seeds* and *Organs*. To be satisfied of this, let them view the *Figurations* in *Snow*; let them view those delicate *Landskips* which are frequently (at least in this Country) found depicted on *Stones*, carrying the resemblance of whole *Groves* of *Trees*, *Mountains*, and *Valleys*, &c. let them Descend into *Coal-Mines*, where generally with us the *Clifts* near the *Coal* are all wrought with Curious Representations of several sorts of *Herbs*, some exactly resembling *Fern-Branches*, and therefore by our *Miners* call'd the *Fern-Branch Clift*; some resembling the *Leaves* of *Sorrel*, and several strange *Herbs*, which haply the known *Vegetable Kingdom* cannot Parallel; and though it could, here can be no Colour for a *Petrification*, it being only a *superficial*

Vid. Sup.
Sect. XXX.

Superficial Delineation. The like may be said of *Animals*, which are often found *Depicted* on *Stones*; as all *Mineral Histories* will sufficiently inform them. Now since here is no Place for *Petrification*, or a *vegetative Soul*, we can only say, That here is that *seminal Root* (though hindered by the Unaptness of the Place to proceed to give these things a *Principle of Life* in themselves) which in the First Generation of things made all *Plants*, and, I may say, *Animals* Rise up in their *Distinct Species*; God Commanding the *Earth* and *Waters* to Produce both, as some *Plants* and *Animals* Rise up still in certain places, without any *Common Seed*.

It is a thing of very difficult Search, to find what this *Seminal Root* is, which is the *Efficient cause* of these *Figures*: But it seems to me not very Unapt to Explicate it according to the Saying of *Heraclitus*; *Lux Sicca, Anima Sapientissima*, that is, where there is a strong *Internal Light* to Expand the *Ideas*, and a *Drought* to Terminate them, the Vertue of a *Soul* is still Present which *Imprints* them in the Matter. Hence we find Nature is most Busie in the Kind where her *Intentions* are highly raised by the Presence of her chief *Principles*, *Salts*, *Sulphurs*, and *Mercuries*, promoting her *Ferments*, which cause some *Internal Light* and *Drought*, the *Ignes Fatui* being only shadowy Results from them: Thus we see Over and in Beds of *Clays* and *Marles*, which have strong *Ferments*, being well Impregnated with *Salts*, there often lie Beds of *Marchasites* full of *Luminous Particles*, and there we frequently find great numbers of *Lapides Serpentarii*, and *Marchasites* resembling *Snakes*; and so several other *Figur'd Stones*, as the *Belemnites*, &c. And in the Joints of the *Lias Stones*, growing over Beds of *Clay*, we often meet with a great plenty of *Elegant Landskips*. In *Coal-Mines*, where the *Sulphurs* are strong, we find great Lumps of very Bright *Marchasites*, and great Varieties of *Herbs* *Depicted* as is said before. In *Mines of Metals*, where the *Mercuries* are generally Predominant, there are *Landskips* and *Representations* both of *Land* and *Sea Animals*, whereof some carry a Bulk, others are only Superficially Delineated. Those who endeavour to Explicate those *Figurations* Mechanically, seem to have a harder Task; for, if they say with *Hippocrates*, *Spiritu Distenta omnia pro Generis Affinitate distant*; as though, when the *Mineral Spirits* had Extended the Matter, it fell into those *Figures* upon a Spontaneous Recess, according to its proper Weight, which gives Order and Measure to things; as he Mechanically shews by a *Bladder*, into which, if *Earth*, *Sand*, and *Filings* of *Lead* be put, and *Water* be added to them, and we give them Motion by Blowing in the *Bladder* through a *Reed*, first they are Mixt together with the *Water*, but in a while continuing in a gentle Motion they separate themselves and retire each to its like, the *Lead* to the *Lead*, &c. I say, if it be Explicated thus, it seems difficult to Conceive, how the matter should come to have such a Determinate Weight to run into such *Figures*, without a *Specifical Rector* to Intend and dispose it, unless a General one be Admitted, in whose Vertue all *Known* and *Possible species* are, which, first Introducing Dispositions in the Matter, he Intentionally works; and, as sometimes he gives that Weight to the Matter, not Endowing it with a *Principle of Life*, so he often disposes it to Receive *Life* and introduces it; which Position I conceive will Hold good, notwithstanding some late Industrious Essays to prove that there is

●● *Equivocal Birth.*

Lib. de Nat.
Pueri.

LXXVIII. Here is lately found in *Cheeshire*, a *Rock of Natural Salt*, from which issues a *Vigorous Sharp Brine*, beyond any of the Springs made use of in our *Salt-Works*. There runs near it (at least in the Winter Season) a small Rindl (or Gutter rather;) but it is wholly free from all Danger of Overflowing, which threatens all other *Salt-Pits* in this Country every great Shower, through the Vicinity of Rivers. The *Rock of Salt*, by the relation of the Workmen, is between 33 and 34 *Yards* distant from the Surface of the Earth. That parcel of it which the Augur brought up was as Hard as *Allom*, and as Pure, and when Pulverized became an Excellent, Fine, and Sharp Salt. The first Discoverer of it was one *John Jackson* of *Halton*, about *Lady-Day* last, (1670) as he was Searching for *Coals* on the behalf of the Lord of the Soil, *William Marbury* of *Marbury* Esquire.

A Rock of Natural Salt in Cheeshire; by Mr. Adam Martindale. n. 66. p. 2015.

LXXIX. There are two Kinds of *Transylvanian Stone Salt*: The *Salt Gemma*, and that which is commonly used at *Table*. The Latter is found in most of the *Salt-Mines*; and is brought in great Quantities down the River *Tibiscus*, and the Rivers running into it: Some of which is afterwards sent Down the *Danube*, and Up the *Morava* to furnish *Servia*, and the adjacent Provinces; and a great part of it Up the *Danube* into *Hungary*. But they bring it no Higher; Stone Salt being Prohibited by the Emperour, in *Austria* who hath a considerable Profit upon the *Boyled Salt* brought from *Hall-stadt* in that Province.

The Salt-Mines in Transylvania and Hungary; by Dr. Brown. n. 58. p. 1191.

I have also received an Account, that half an Hour's going from the City *Eperies*, there is a *Salt-Mine* of great Note; from the first place of Descent unto the Bottom, it is about 180. *Fathoms* Deep: Into this the Miners Descend first by *Ropes*, and at last by *Ladders*, unto the Lower parts. The *Mine* is for the most part in an *Earthy*, and not a *Rocky* Ground.

The *Veins* of *Salt* are Large, and there are Pieces to be found of 10000 *pound* Weight. They commonly Hew out the *Salt* into long square pieces of 2 *Foot* in Length, and one in Thickness; and for use, it is Broken and Grinded between two Grind Stones.

The *Mine* is Cold and Damp, but the *Salt* being a *Stone-Salt*, is not easily Dissolved, or at least in any great Quantity, by Dampness or Moisture: Yet the Water of the *Mine* is Impregnated with *Salt* in such sort, that being Drawn out in large Buckets, and afterwards Boyl'd up, it affords a *Blackish Salt*, which they give to their Cattle in the Country.

The Colour of the Ordinary *Stone-Salt* of this *Mine* is not very *White*, but somewhat *Grey*; yet being Broken and Grinded to Powder, it becomes as *White* as if it were Refin'd. This *Salt* consists of *Pointed* Parts, or *Fossils*: Another sort of *Salt* there is, which consists of *Squares* and *Tables*; and a Third, to be found of somewhat *Stirious* or *Long shoots*.

Nor is all the *Salt* of this *Mine* of one Colour, but of Divers; that which is found grossly Mixt with the *Earth*, receives some Colour from it: And e-

ven that, which is most Pure, and resembleth *Chrystal*, doth often receive Tinctures of several Colours. In the middle of a *Chrystal Salt* with *Long Shoots*, I have seen a *Delicate Blew*; and *Count Rothal* hath a *Large piece*, of a *Fair Yellow*. There are also some pieces very Clear and Transparent, so Hard that they Carve them into divers Figures, as *Crosses*, *Crucifixes*, and others.

I cannot omit to Advertise you, that whereas these *Salts*, though kept without Care, Remain'd *Dry* for many Months in other Countries, yet they began somewhat to *Relent* soon after I came into *England*, and if they be kept in a *Stove*, or very *Hot Place*, they will be apt to lose their *Transparency*.

Sal-Gemme
Mines in Po-
land; by
n. 61. p. 1099.

LXXX. The *Mines of Sal Gemme* in *Poland*, a mile distant from *Cracovia*, near the small Town of *Wilizka*, which (the Church excepted) is altogether digged Hollow under Ground, hath 4 *Descents*: Of which the two Chief being in the Town it self, are those through which the *Salt* is drawn up; the other two do serve for letting down *Timber* and other *Necessaries*. These *Descents*, or *Holes*, are square, 4 or 5 *Foot* long, and as broad, lin'd downwards thorough with *Timber*. Above, is a great *Wheel*, with a *Strong Rope*, of the thickness of a *Lusty Arm*, drawn about by a *Horse*, like as in a *Horse Mill*.

He that will *Descend*, must cover himself with a *Frock*, and have another man that fastens another *Rope* to the aforesaid *Big Rope*, and having so tyed it about himself as to sit in it, takes one in his lap and holds him fast about; whereupon the *Big Rope* being let somewhat down, another fastens likewise a piece of *Rope* to the other *Thick Rope* and does like the former, seating himself in it and taking and clasping another *Man* in his *Lap*; and being also let down a little way gives place to others to do the like; in which manner, 30, 40, and more *Persons* may be let down all at once; of whom the *First* having toucht the *Ground* steps out and goes aside, the rest following him and doing the like. And thus they *Descend* to the depth of 100 *Fathoms*. But then they take a *Lamp* and lead *People* about by strange *Passages* and *Meanders*, still more and more *Descending*, till they come to certain *Ladders* by which they go down 100 *Fathoms* deeper, where there are double *Passages* and *Holes* one above another, in abundance; for the *Mine men* dig on still, and cut out every where and on all sides, as long as the *Salt Vein* lasteth. The great *Holes*, to secure both the *Town* above, and the *Work* below from falling in, are very carefully filled out, and supported by *strong* and well compacted *Timber*.

Out of these *Mines* they digg and cut out 3 sorts of *Salt*; one is *Common*, *Course* and *Black*; the *Second* somewhat *Finer* and *Whiter*; the *3d* very *White*, and *Clear* like *Crystal*. The *Course* and *Black Salt* is cut out in great pieces, *Roundish* and 3 *Polonian Ells* long, and one *Ell* thick, which costs from 50 to 70 *Polonian Florins*.

Mean time the *Inhabitants* of *Cracow* have a *Privilege*, whereby a certain *Number* of pieces is to be *Delivered* to them, at 8 such *Florins* the *Piece*.

The

The greatest Pieces lye before their doors, where the Cattle passing to and fro, lick of those *Salt Stones*; which afterwards by Mills and other Engines are Ground and Beaten small for use. The Colour of these *Salt Stones* is *Darkish Gray*, with some Mixture of *Yellow*.

When this *Salt Work* was first found, (which is now above 400 years ago) the *Mine men* which first began to work in it were *Germans*; whence the *Poles* have retained the *German Names* of the *Tools*, but given them *Polish Terminations*. These *Salt Works* belong to the *King of Poland*, who appoints and maintains the Officers of them; and 'tis one of his best *Royal Revenues*, amounting to a considerable Sum of Money. There is no less than 1000 Men, that are constantly employed in these *Mines*; and there was then a Provision of *Salt* valued at 2 *Millions*.

There are in these *Works* three *Horses*, that stay always below, having their *Stable* and other *Necessaries* there: They Carry the *Salt* from the places, where 'tis Cut and Digg'd out, to those whence 'tis, by the above mentioned *Wheel* and *Ropes*, drawn up by a *Horse* above *Ground* going round about. The *Horses*, after they have been a while under *Ground*, grow *Blind* from the Sharpness of the *Salt*; and one of them that had been longest in those *Mines*, had the *Hoof* of his *Feet* grown as long again, as they are usually; so that each *Hoof* was near a *Span* long. This *Salt Work* hath also beneath it certain *Salt Springs*, whence the *Salt Water* is by *Channels* convey'd to several places, where 'tis *Boyl'd* to *Salt*.

But there is yet another *Mineral Salt Work* in *Poland* viz. at *Bochna*; but not so well Ordered, as the former. Besides, there are divers other Places in *Poland*, and in *Russia* also, which yield *Salt*; as at *Holitz*, *Colomeja*, *Solum*, *Pintz*, *Osventz*, &c. In the *Podolian Desert*, near the River *Boristhenes*, is a *Salt-Lake* whose *Water* is by the Heat of the *Sun* Wasted, and turned to *Salt*, like unto *Ice*, so that the *People* there ride into it with *Horses* and *Waggon*s, and cut it into pieces and carry it away; as the *Polish Historian Cramerus* at large relateth; who also affirms, that in the aforesaid *Salt-work* at *Bochna* they find a *Frozen Substance*, which by them is call'd *Carbuncle*, used by the *People* to Purge their *Bodies*, by *Grating* and *Drinking* it in a convenient *Vehicle*.

LXXXI. 1. The *Natron* of *Egypt* is an *Alkali Salt* perforated like a *Sponge*, and of a *Lixivial Taste*; and thus I find it describ'd by *Pliny*, *Mathioli*, and *Agricola*.

Its Principles I take to be chiefly two; viz. a *Sal-Marine* and an *Urinous Salt*.

That it contains a *Sal-Marine* seems manifest by these Experiments; first, because a *Solution* of the *Natron* has the same *Taste* that a *Solution* of *Sal-Marine* hath; 2dly in *Evaporation* the *Particles* of the *Natron* incrustated upon the *Surface* of the *Water* as the *Particles* of *Sea-Salt* do in *Evaporation*. 3dly because the *Natron* is *Perforated*, which proceeds (as I suppose) from a *Sal-Marine*, for that, when it *Crystallizeth*, shoots with little *Cavities*. 4ly if the *Natron* be *Mixt* with *Salt* of *Tartar*, it emits the same *Spirit*, as *Sal Armoniack* when *Mixt* with the same *Salt*. And lastly, that it contains a *Sea Salt* seems plain from

The *Natron* of *Egypt*, and *Nitri-
trian Water*,
Examined; by
Dr. Ch. Leigh.
n. 160. p. 609.

from *Cesalpinus*, says he, *Efflorescit etiam sponte non solum in Salinis ad similitudinem Lanuginis Canescentis; sed etiam in Vasis in quibus Sal continetur.*

But here it is to be noted, that though the *Nitrian Water* is of a Blushy Colour, and makes a Brisk *Fermentation* with an *Acid*; yet a Solution of *Natron* looks Clear, and will not *Ferment* with an *Acid*. The Reason why a Solution of the *Natron* looks Clear, though the *Nitrian Water*, which is but a Solution of the same *Salt*, is of a Blushy Colour, may perhaps be this; I suppose that the *Water* of *Natron* receives its Redness from a Red Clammy Substance, which serves chiefly to Cement the two *Salts* together: and this I take to be rather a Conjecture, because after a Solution of the *Natron* had pass'd through a *Filtre*, there stuck to it a Red Clammy Matter, and the Solution was Clear. And the Reason why a Solution of the *Natron* will not *Ferment* with an *Acid*, I conceive to be this; because that in a Perfect Dissolution, its Parts being Separated one from another by the Parts of the *Water*, their Strugglings are too Weak to make an *Effervescency* with an *Acid*, and in this I was further confirm'd by these Two Experiments. I found that if into a Solution of the *Natron*, I pour'd an *Acid*, while the *Water* look'd Whitish or Disturb'd the *Salt* not being perfectly Dissolv'd, it made a Brisk *Fermentation*: But when the *Water* came to be Clear, the *Salt* then being perfectly Dissolved, if I then poured an *Acid* upon it, it would not *Ferment*. I likewise found that this Solution being Evaporated to a Third part would *Ferment* again.

Its *Second Principle* I take to be an *Urinous Salt*; first, because if Mixt with *Salt* of *Tartar*, it smells like *Sal Armoniack* when mixt with the same *Salt*. Lastly when it was *Distill'd* with *Salt* of *Tartar* in a *Retort*, it afforded an *Urinous Spirit* as Piercing as the *Spirit* of *Sal Armoniack*.

The *Sal Marine* (being a *Fossile Salt*) I take for granted it Receives from the Earth, but it seems to have its *Volatile Alkaly* from the Air; first, because its said by *Pliny*, *Spumam Nitri* (which is the *Natron* here spoke of) *Antiqui negabant fieri nisi cum Ros cecidisset.* By *M. de la Chambre* it is affirmed, that 3. or 4. Days before the *Nile* begins to Overflow, there falls a certain Dew which hath a *Fermenting Vertue*, and Leavens a *Past* expos'd to the Air, and at that time saith *Pliny*, and *M. de la Chambre* the *Nitre Pits* grow full of *Nitre*. And *Sands*, *Vanslebius*, and several say, that though 500 in a Day Die in *Grand Cairo* of the *Plague* before the beginning of the *Inundation* of the *Nile*, yet the very Day After, there does not One Die; which doubtless could not proceed from any other Reason, than because at that time, the Air was impregnated with this *Volatile Alkaly*; for at that time the *Nitre Pits* grow Full and this Dew falls. This (I think) may sufficiently Hint to us the great use of its *Volatile Spirit*, especially in *Pestilential Distempers*. Lastly, about that time that the *Nile*, begins to O'erflow, those *Specimens* which we had here at *Oxford* Grew Heavier by being Exposed to the Air.

Here it is to be noted, that this *Alkaly* is not made so by *Fire*: I cannot therefore Conclude with *Helmont* that all *Alkalies* are made such by that Element.

The Learned Dr. *Huntington* (who was at *Nitria*;) gives this Account of its separation from the *Water* in *Latron*.

There is a Town in *Egypt* called *Nitria*, which gives Name to the *Nitrian Desert*, where there is a *Lake* called *Latron* taking up an Area of 6 or 7 *Acres*. situate about 30 *Miles* W. b. S. from *Terana*, a Town lower upon the *Nile* than *Grand Cairo*, and about the same Distance N. W. from the *Pyramids*; from the Bottom of this *Lake*, this sort of *Nitre* call'd *Natron*, ariseth to the Top (as they do apprehend), and there by the heat of the *Sun* Condenses into this kind of substance. That all the *Nitre* comes from the Bottom to the Top, I dare not affirm, and shall therefore premise some *Phænomena* which it afforded in Evaporation, before I give you my Conjecture about it.

I took an *Evaporating Glass* which held about 4 *Ounces*, and poured into it 2 *Ounces* of the *Nitrean Water*, this I set upon a *Sand Furnace*, giving it Fire by Degrees; as soon as the *Water* was warm, the *Particles* of the *Nitre* began to swim upon its surface in stragling and uneven Numbers, these, after a while, United, and at last there arose *Salt* sufficient to cover the whole *Superficies* of the *Water*; I took then a *Thin Glass* and Skim'd off this *Ice*, but could scarce take it all off, before it was seconded by another, and thus the *Salt* did rise successively in *Films*, as long as there was any *Water* in the *Glass*; these *Films* had the Colour and Taste of the *Nitre* which came from *Nitria*, and did like it Ferment with an *Acid*. And these are they which by *Pliny* are called *Flos Salis*, and if I mistake not the same with that which *Herodotus* says, they make their *Mummy* with. If therefore by the Languishing Heat of a *Digesting Furnace*, the *Nitrous Particles* could Separate themselves from the *Water*, and over that spread themselves in an *Ice*, it may be as probable, that by the greater Heat of the *Sun*, the *Nitre* of *Latron* is separated from the *Water* after the same Manner. And as in the Evaporation of other *Mineral Waters*, when the *Water* is not strong enough for to hold up the *Salt*, it is generally cover'd with a thin *Film*. So I suppose in Evaporation of the *Natron*, some Parts of the *Water* being flown away, the *Particles* of the *Sal Marine* branch one into another, and so Incrustate upon the Surface of the *Water*.

In this *Hypothesis* I was the farther Confirm'd by this Experiment; I took some of the *Natron* and dissolv'd it in *Water*, and set it to Evaporate: And I found that the *Salt* did not incrustate upon the *Water*, till 3 Parts of the *Water* was Evaporated. It did not therefore seem probable that the *Nitre* came all from the Bottom to the Top, and so was Condensed by the Heat of the *Sun*; but that they Incrustated, when the *Saline Particles* Brancht one into another, some of the *Aqueous Parts* being Exhaled.

The Reason why its *Volatile Alkaly*, in Evaporation, does not fly quite away, is because it is held there by the *Sal Marine*.

By the Testimony of *Hippocrates*, *Gallen*, *Mathiolus*, *Diascorides*, *Pliny*, and *Agricola*, it appears to have been of great Use in *Physick*. But here it is to be Noted, that when *Nitre* is Prescribed by them, that *Nitre* which is an Ingredient of *Gun-Powder*, is not to be understood.

Amongst

Amongst the *Moderns* we have this Account of it; *M. de Clos* is of the Opinion that most of the *Mineral Waters* in *France* are Impregnated with this sort of *Nitre*, and that all their *Cures* are done by it.

Molenbrochius affirms a *Tincture* of *Aphronitrum* to be of Wonderful Efficacy in *Stone*. This I rather Credit, because it's said by *Funken*, in his *Medicus*, the *Niter* of *Nitria* is of so piercing a *Spirit*, that it doth not permit either *Stone* or *Rock* to be thereabout.

In Treating of its Use in *Agriculture*, I think it convenient to Premise one *Phænomenon* which it afforded in *Evaporation*; when the *Salts* had spread themselves over the *Water* in an *Ice*, those *Thin Plates* after a while would Break and Ascend in Perpendicular Lines to the very Top of the *Glass*; I do therefore conjecture, that *Nitre* may be said to *Fertilize* the *Ground* after this Manner; it's *Volatile* Particles being *Heated* by some *Subterraneous Fire*, or else by the *Warmth* of the *Sun*, they do quickly *Ascend* in the small *Tubes* of the *Plant*, and so by their *Elastick* Nature, Carry along with them, or force before them, those Particles which as they differently *Convene* together, *Constitute* the different parts of the *Plant*.

Mund. Subter.
Cap. de Nitro.

But this Conjecture will be made something the more probable, by an Experiment in *Kircher*; where he says, if you take a *Wooden Tube*, and put into it *Tartar*, *Quick lime*, *Salt*, and the *Urine* of a *Wine-Drinker*, reduced into one *Mass*, which is to be *Hardned* in the *Sun*; and after that set it in a *Cold Cellar*, by the Help of *Salt-Petre* from the before mentioned *Mass*, you will, not without *Admiration*, see *Flowers* Branch out of it. Yea such is the Force of *Nitre*, that if in a *Glass* kept close shut, you put the *Juices* of some *Nitrous Herbs* on the before mention'd *Mass*, the *Nitre* contain'd within it, being *Pregnant* with *Spirit*, will Force it self through the very *Pores* of the *Glass*.

M. De la Chambre says, *Plants* do grow in *Egypt* in such *Abundance*, that they would *Choak* one another, if they were not *Hindred* by throwing *Sand* upon the *Fields*: insomuch that the *Egyptians* must take as much *Pains* to lessen the *Fatness* of their *Land*, as other *Nations* do to *Encrease* the *Fatness* of it.

Cap. de Vitri.
Juvent.

In *Mechanicks* we have this Account of it: It's said by *Pliny*, that a *Company* of *Merchants* being thrown upon a *Shore* where there were not any *Stones* to be found, were forced to take great *Pieces* of *Egyptian Nitre* out of their *Ships*, and make *Walls*, upon which they heng their *Boyling Kettle*: the *Nitre*, being *Heated* by the *Fire*, *Mixt* with the *Sand*, and ran into several *Streams* of *Glass*, which afterwards *Hinted* the way of *Making Glass*. It is likewise of Use in *Dying*, for *Pliny* and *Vitruvius* affirm, that by the Help of this, the *True Azure* is made; and that without this, there cannot be a *True Shadow*.

This *Nitre* is distinguish'd from *Salt Petre*; *First*, by its *Fermenting*: it will *Ferment* with any *Acid*, but *Salt-Petre* will not. I found that it would *Ferment* with *V. negar* as the *Old-Commentators* observe in their *Comments* upon *Jeremiah* and the *Proverbs*, but *Salt Petre* will not: Which gave *Occasion* to some, in those *Texts*, to alter the *Word Nitre*.

2. It may be distinguisht from *Salt Petre* in its *Taste*; for *Natron* hath a *Lixivial Taste*, but the other not.

3. By the *Volatile Spirit* which it affords: For from the one comes over a *Volatile Alkaly*, but from the other a *Corrosive Acid*.

4. The *Natron* affords a *Red Clammy Substance*, *Inspid*, but the other not. This *Clammy Substance* (if I mistake not) is that which by *Pliny* is call'd *Ærugo Salis*: This it hath from the *Earth*, and therefore it is again said by *Pliny*, *Sunt ibi Nitrarix in quibus & Rufum exit a Colore Terræ*.

5. Like *Salt Petre* it will not *Crystallize*.

6. In the *Fire*, it makes no *Detonation*.

But in this it resembles *Salt Petre*; as that by the *Flowers* of *Sulphur* is made into a *Sal Prunellæ*, so this, if you Drop *Spirit* of *Sulphur* upon it, Shoots into *Pyramidal Salt*, that is not by the *Taste* distinguishable from *Sal Prunellæ*, though its *Taste* before was *Lixivial*.

From *Sal Armoniac* it may be Distinguish'd; *First*, by its *Colour*, for the *Natron* is *Reddish*, the other not. *Secondly*, by the *Texture* of its Parts: In *Sal Armoniac* the Parts seem *Close* and *firmly knit together*, but the *Natron* is *Spongy* and *Perforated*. *Thirdly*, If mixt with *Sal Armoniack*, the *Sal Armoniack* Emits the same *Spirit*, as it doth when Mixt with *Quick-Lime*.

But I think it comes much nearer to the Nature of *Sal Armoniack*, than *Salt Petre*; *First*, Because it is compos'd of a *Sea-Salt* and an *Urinous Alkaly*; *Secondly*, Like *Sal Armoniack*, when Dissolved in *Water*, it makes it extremely *Cold*: And, as *Franciscus Hernandez* says, It produces the same Effect when Dissolved in *Wine*.

Hist. of Mexico.
co.

2. The *Nitre* of *Egypt*, by the Experiments made about it at *Oxford*, plainly appears to be little Different from *Sal Armoniack*: And Considering, that it *Rains* little or nothing, comparatively to the great Heats, in *Egypt*: and that the *Lakes* there are only once a Year furnisht with fresh *Water* from the *Overflowings* of the *Nile*; also that Vast Tracts of Land there, and all over *Asia*, are naturally cover'd with *Fossile Salt*; again, that those *Lakes* are furnisht with vast Animals, as *Crocodiles*, *Hippopotami*, and without doubt great variety of other lesser *Vermine*; these things, I say, well consider'd, it is easie to think, that in a Years Time, most of the *Salt Water* of those *Lakes* has past through the Bodies of those Animals, and consequently is become *Urinous*, or *Saline Urinous*, as is the Nature and Composition of *Factitious Sal Armoniack*.

The Original of the Nitre of Egypt; by Dr Lister. n. 167. p. 837.

LXXXII. I am convinced that *Sulphur* is sublimed from the *Pyrites* according to the Opinion of *Dr. Lister*, especially that gathered upon Mount *Ætna*, *Vesuvius*, the *Solfatara*, and in the Stoves of *St. Gennaro*, not far from thence, for most of the Stones and Cynders, thrown out of those mighty Furnaces, do manifestly contain *Iron*, if we may believe the *Magnet*. As to the *Salt* (taken by many Writers to be a sort of *Sal Armoniack*) found together with the *Sulphur* in the foremention'd Places, it appeared to me to be a kind of *Nitrum Calcarium*; for, as I remember, it had not any *Urinous Qualities*, that I

The Pyrites and Lapis Calcarius, consider'd; by Dr. Tanc. Robinson. n. 169. p. 924.

could perceive by Slight Tryals of Mixture ; and I was the more confirmed in my Opinion after I had seen, and consider'd, the great Quantity of *Limestone* round about *Naples*; many Beds of it lying up and down the *Terra di Lavoro*, or *Campania Felice*.

The Spontaneous Firing of the Pyrites; by Dr. Fred. Slare. n. 213. p. 218.

LXXXIII. The Master of a *Copperas* Work at *Whitstable* in *Kent*, having Engross'd all the *Pyrites* or *Copperas Stones* to himself, laid up Two or Three Hundred Tun in a Heap, and Built a Shed over it to keep off the Rain: But in the space of 6 or 7 Months it first Smoked, and then took Fire, and Burnt for a Week. Some of it looked like Melted Metal, and other parts like Red hot Stones ; and it discharged so Fætid, Sulphurous, or Stinking Exhalations, that the People in the Neighbourhood were miserably Afflicted, and forced to use all their Endeavours to Extinguish it.

A Mineral at Liege, yielding Brimstone and Vitriol, by Sir Rob. Moray. n. 3. p. 45

LXXXIV. The *Mineral* out of which *Brimstone* and *Vitriol* are Extracted is one and the same, not much unlike *Lead Ore*, having also oftentimes *Lead* mingled with it, which is separated from it by picking it out of the rest. The *Mines* resemble our *English Coal Mines*, dug according to the depth of the *Mineral*, 15, 20, or more *Fathoms*, as the *Vein* leads the Workmen, or the *Subterranean Waters* will give them leave.

To make *Brimstone*, they break the *Stone* or *Ore* into small Pieces, which they put into *Crucibles*, made of Earth 5 Foot Long, Square and Pyramide-wise: The Entry is near a Foot Square. These *Crucibles* are laid Sloping, eight undermost, and seven above them, as it were betwixt them, that the Fire may come at them all, each having its particular Furnace or Oven. The *Brimstone* being Dissolved, by the violence of the Heat, drops out at the small end of the *Crucible*, and falls into a *Leaden Trough* or *Receptacle*, Common to all the said *Crucibles*, through which there runs a continual Rivulet of Cold Water, conveyed thither by Pipes, for the Cooling of the Dissolved *Sulphur*, which is ordinarily 4 Hours in Melting. This done, the *Ashes* are drawn out with a Crooked Iron, and being put into an Iron Wheelbarrow, are carried out of the Hutt, and being laid in an Heap, are covered with their other *Elixed* or *drained Ashes*, the better to keep them Warm ; which is Reiterated, as long as they make *Brimstone*.

To make *Copperas* or *Vitriol*, they take a quantity of the said *Ashes*, and throwing them into a square planked Pit in the Earth, some four Foot Deep, and Eight Foot Square, they Cover the same with Ordinary Water, and let it lie 24 Hours, or until an *Egg* will swim upon the Liquor, which is a sign that it is strong enough. When they will Boil this, they let it run through Pipes into the Kettles, adding to it half as much *Mother-Water*, which is that Water that remains after the Boiling of the *Hardned Copperas*. The Kettles are made of *Lead*, $4\frac{1}{2}$ Foot High, six Foot Long, and three Foot Broad, standing upon thick Iron Bars or Grates. In these the Liquor is Boiled with a strong Coal Fire twenty four Hours, or more ; according to the strength or weakness of the *Lee* or *Water*. When it is come to a just Consistence, the Fire is taken away and

and the Boil'd Liquor suffered to Cool somewhat, and then 'tis Tapp'd out of the said Kettles through Holes beneath in the sides of them, and Conveyed through Wooden Conduits into several *Receptacles*, 3 Foot Deep and 4 Foot Long (made and ranged not unlike our Tan-Pitts), where it remains 14 or 15 days, or so long till the *Copperas* Separates it self from the *Water*, and becomes *Icy* and *Hard*. The Remaining *Water* is the above mentioned *Mother Water*; and the *Elixed* or *Drained Ashes* are the Dregs or *Caput Mortuum*, which the *Lee*, whereof the *Vitriol* is made, leaves behind it in the Planked Pits.

LXXXV. 1. There is a *Stone* in *Sweden* of a *Yellow* Colour intermixed with streaks of *White*, (as if composed of *Gold* and *Silver*) and Heavy withal. It is found in Firm Rocks, and runs in *Veins*, upon which they Lay Wood, and set it on Fire. When the *stone* is thus Heated, they cast Water upon it, to make it Rend, and then Dig it up with Mattocks. This done they break it into smaller pieces, and put it into Iron Pots, of the Shape Represented by *Fig. 153*. the Mouth of the one going into the other. These they place, the One in the Oven upon an Iron Fork sloping, so that the *stone* being Melted, it may run into the Other, which stands at the Mouth of the Oven, supported upon an Iron. The first Running of the *stone* is *Sulphur*.

Sulphur, Vitriol, Allum, and Minium, from a Stone in Sweden; by Sir Gilb. Talbot. n. 21. p. 375.

Fig. 153.

The Remainder of the *Burned stone* is carried out, and laid upon a High Hill, where it lyes exposed to the Sun and Air for the Space of two *Years*; and then *Taketh Fire of it self*, Casting forth a Thin Blew Flame, scarce Discernable in the Day-time. This being Consumed, leaveth a Blew Dult behind it; which the Workmen Observe, and Mark with Wooden pins. This they Dig up, and carry into the work house, and put it into great Tubs of *Water*, where it infuseth 24 *hours*, or more. The *Water* they afterward *Boyl* in Kettles, as we do *Salt-Peter*, and put it into Cooling Tubs, where in they place Cross Sticks, and on them the *Vitriol* fastens, as *Sugar-Candy* doth.

The *Water* that Remains, after the Extraction of the *Vitriol*, they Mix with an 8th part of *Urine* and the *Lees* of Wood Ashes, which is again *Boyled* very strong, and being set to Cool in Tubs, Cross Sticks are likewise fastened and thereon the *Allum* fastens.

In the *Water*, which Remains after the *Allum*, is found a *Sediment*, which being separated from the *Water*, is put into an Oven, and Wood laid upon it and Fired, till it become *Red*, which makes the *Minium*, wherewith they Paint their Houses, and make Plaister.

2. There is a Kind of *stone* in the North of *England*, yielding the Same Substances, except *Minium*.

The same in England; by . . . ib. p. 376.

LXXXVI. *Copperas Stones*, which some call *Gold-stones*, are found on the Sea shore in *Essex*, *Hampshire*, and so *Westward*. There are great Quantities in the Cliffs; but not so Good as those on the Shore, where the *Tides* Ebb and flow over them.

Green-Copperas Works; by Mr. Daniel Colwal. n. 142, p. 1056.

The Best of them are of a Bright Shining *Silver Colour*; the Next, such as are of a Rusty deep *Yellow*; the Worst such as have Gravel and Dirt in them, of a Sadder *Umber Colour*.

In the midst of these *Stones*, are sometime found the *Shells* of *Cockles*, and other small *Shell-Fishes*; small Pieces of the Planks of Ships, and Pieces of Sea-coal.

In order to the making of *Copperas*, they make *Beds* according as the ground will permit; those at *Deptford*, are about 100 *Feet* long, 15 *Feet* broad at the Top, and 12 *Feet* Deep, Shelving all the way to the Bottom.

They *Ram* the *Bed* very well, first with strong *Clay*, and then with the Rubbish of *Chalk*, whereby the Liquor, which Drains out of the Dissolution of the *Stones*, is Conveyed into a Wooden Shallow Trough, laid in the middle of the *Bed*, and Covered with a board; being also boarded on all sides, and laid Lower at One End than the Other, whereby the Liquor is Conveyed into a Cistern under the Boiling House.

When the *Beds* are indifferently well Dryed, they lay on the *Stones* about 2 *Feet* Thick.

These *Stones* will be 5. or 6. *Years*, before they yield any Considerable Quantity of *Liquor*; and before that, the *Liquor* which they Yield is but Weak.

They Ripen by the *Sun* and *Rain*: Yet *Experience* proves, that Watering the *Stones*, although with Water Prepared by Lying in the Sun, and poured through very small Holes of a Watering-Pot, doth Retard the Work.

In Time these *Stones* Turn into a kind of *Vitriolick Earth*, which will swell and Ferment like Leavened Dough.

When the *Bed* is come to *Perfection*, then once in 4 *Years* they Refresh it, by laying New *Stones* on the Top.

When they make a New *Bed*, they take a good quantity of the Old *Fermented Earth*, and mingle it with New stones, whereby the Work is Hastened. Thus the *Old Earth* never becomes Useless.

The Cistern before mentioned is made of strong Oaken Boards, well Joyned and Calked. That at *Deptford* will Contain 700 *Tuns* of *Liquor*. Great Care is to be taken, that the *Liquor* doth not Drain through the *Beds*, or out of the Cistern. The best way to Prevent the same, is to divide the Cistern in the middle, by Oaken Boards, Calked as before; whereby One of them may be Mended in case of a Defect.

The more Rain falls, the More, but the Weaker will be the *Liquor*: The Goodness whereof is tryed by Weights prepared for that purpose; *Fourteen-Penny Weight*, is Rich: Or an Egg being put into the *Liquor*, the Higher it swims above the *Liquor*, the stronger it is. Some times the Egg will Swim near Half above the *Liquor*.

Within *one Minute* after an Egg is put in, the ambient *Liquor* will Boil and Froth; and in *three Minutes* the *Shell* will be quite Worn off.

A Drop of this *Liquor* falling on the Manufactures of *Hemp*, *Flax* or *Cotton Wooll*, will presently *Burn* a Hole through it. As also in *Woollen* and *Leather*.

Out of the aforesaid Cistern, the *Liquor* is Pumped into a *Boiler of Lead* about 8 *Feet* Square, containing about 12 *Tuns*, which is thus ordered. *First* they lay Long Pieces of *Cast Iron*, 12 *inches* square, as Long as the Breadth of the *Boiler*, about 12 *inches* one from another, and 24 *inches* above the Surface of the *Fire*. *Then* Cross-wi e they lay ordinary Flat *Iron* *Barrs*, as close as they can lye, the sides being made up with *Brick* work. In the middle of the *Bottom* of this *Boiler* is laid a *Trough* of *Lead*; wherein they put at first 100 *pound* *Weight* of *Old Iron*.

The *Fewel* for *Boiling* is *Newcastle Coals*. By degrees, in the *Boiling*, they put in more *Iron*, amounting in all to 1500 *pound* *Weight* in a *Boiling*. As the *Liquor* *Wastes* in *Boiling*, they Pump in *Fresh Liquor* into the *Boiler*: Whereby, and by a *Defect* in *Ordering* the *Fire*, they were *Wont* to be above 20 *dayes* before it was *Enough*; When that is, they *Try*, by taking up a small *Quantity* of *Liquor*, into a *Shallow Earthen Pan*, and observing how soon it will *Gather* and *Crust* about the sides thereof. But now of *Late* by the *Ingenious Contrivance* of *Sir Nicholas Crisp*, the work is much *Facilitated*. For at his *Work* at *Deptford*, they *Boil* off 3 *Boilers* of *Ordinary Liquor* in *One Week*; Which is done, *first* by *Ordering* the *Furnace* so, as that the *Heat* is *Conveyed* to all *Parts* of the *Bottom* and sides of the *Furnace*.

Then, whereas they were *Wont* to Pump *Cold Liquor* into the *Boiler* to *Supply* the *Waste* in *Boiling*, whereby the *Boiler* was *Checked* sometimes 10 *hours*, *Sir Nicolas* hath now a *Vessel* of *Lead*, which he calls a *Heater*, *Placed* at the *End* of the *Boiler*, and a little *Higher*, supported by *barrs* of *Iron* as before, and *Fill'd* with *Liquor*, which by a *Conveyance* of *Heat* from the *Furnace*, is kept near *Boiling Hot*; and so continually *Supplies* the *Waste* of the *Boiler*, without *Hindring* the *Boiling*. *Thirdly*, by putting due *Proportions* of *Iron* from time to time, into the *Boiler*; As soon as they perceive the *Liquor* to *Boil* slowly, they put in more *Iron*, which will soon *Quicken* it. Besides, if they do not continually *supply* the *Boiling Liquor* with *Iron*, the *Copperas* will *Gather* to the *Bottom* of the *Boiler* and *Melt* it; And so it will do if the *Liquor* be not *Presently* drawn off from the *Boiler* into a *Cooler*, so soon as it is *Enough*.

The *Cooler* is *Oblong*, 20 *Feet* Long, 9 *Feet* Over at the *Top*, 5 *Feet* Deep, *Taper'd* towards the *Bottom*, made of *Tarras*. Into this, they *Let* the *Liquor* run, so soon as it is *Boil'd* *Enough*. The *Copperas* herein will be *Gathering* or *Shooting* 14 or 15 *dayes*: And *Gathers* as much on the sides as in the *Bottom*; *sc.* above 5 *Inches* *Thick*. Some put *Bushes* into the *Cooler*, about which the *Copperas* will *Gather*: But at *Deptford* they make no use of any.

That which sticks to the sides, and to the *Bushes*, is of a *Bright Green*, that in the *Bottom* of a *Foul* and *Dirty Colour*.

In the end of 14 *Dayes*, they *Convey* the *Liquor* into another *Cooler*, and *Reserve* it to be *Boiled* again with *New Liquor*.

The *Copperas* they *Shovel* on a *Floor* adjoining: So that the *Liquor* may *Drain* from it into a *Cooler*.

The *Steam*, which comes from the *Boiling*, is of an *Acrimonious* smell.

Copperas

Copperas may be Boiled without *Iron*, but with Difficulty; without it the Boiler will be in danger of Melting.

Sometimes in stirring the *Earth* upon the *Beds*, they find pieces of *Copperas*, Produced by lying in the Sun.

Oyl of Vitriol
Increasing in
Weight; by Dr.
Wil. Gold.
n. 156. p. 496.

LXXXVII. Some Druggists have accidentally taken notice of an Increase of Weight in Oyl of Vitriol Exposed to the Air (and perhaps have Improv'd it to their own Gain, though to the Detriment of the Buyer.) And the Industrious Chymist Mr. White, the University Operator at Oxford, had a Viol of that Liquor Unstopt and Constantly running over: But since from thence no true Estimate of the *Just Increase* could be Collected, I shall here give you what has Occur'd more particularly on this Subject.

Vid. Sup. Cap. I.
§. XVI.

Nov. 4. 1683. Three Drams of Oyl of Vitriol, so far Dephlegm'd as to Burn or Corrode a strong Packthred assunder, was Exposed to the Air in a Marmalade Glass of three Inches Diameter, and placed in a Nice pair of Scales, in a Room where no Fire nor Sun came; it's Increase for seven Natural Days, divided by less Portions of Time, was according to the following Table.

Nov. 1683		Gain.	Space of Time.	Weather.	Wind.	Sum of Gain.	Natural Day.	
D.	H	3	∅.	gr	H.	3	∅.	gr.
9	5 p. m.	3	0	0	Moist	3	∅.	gr.
10	11 p. m.	0	0	19	6 h. Moist and Windy.			
	8 m.	0	1	12	9 Southerly N. Westerly.			1st.
	11 m.	0	0	08	3 Rainy Morn.	1	0	8
	5 p. m.	0	0	09	6 Clear.			
11	11 p. m.	0	0	18	6 Star lig. Cold. Bright Morn.			
	8 m.	0	1	07	9 Mild. N. W.	0	2	18
	11 m.	0	0	04	3 Mild, Dry Weather.			
	5 p. m.	0	0	09	6			
12	11 p. m.	fere	0	10	6 Mild, Dry, Clear Morn.			
	8 m.	0	0	17	9 Frosty. N. more.	0	1	19
	11 m.	0	0	05	3 Overcast. W.			
	5 p. m.	0	0	07	6			
13	11 p. m.	0	0	06	6 Cloudy Rain. Westerly.			
	8 m.	0	0	09	9 Cloudy. S. W.	0	1	3½
	11 m.	0	0	03	3 Mild.			
	5 p. m.	0	0	05½	6			

14	11 p. m.	0 0 06	6	Cloudy. Moist.	S. E.	0 0 18	5th.
	8 m.	0 0 08	9	Cloudy Misty.			
	11 m.	0 0 02½	3	Misty.	Southerly.		
	5 p. m.	0 0 01½	6	Very Warm.			
15	11 p. m.	0 0 02	6	Cloudy, unusu- ally Warm.	More S.	0 0 15	6th.
	8 m.	0 0 06	9	Cloudy.	S. E.		
	11 m.	0 0 03	3	Cloudy Moist	more S.		
	5 p. m.	0 0 04	6	Clear Coldish.	Easterly		
16	11 p. m.	0 0 04½	6	Dry Star light.	Easterly.	0 0 17	7th.
	9 m.	0 0 9	10	Cold. Cloudy but Cold.			
	11 m.	0 0 2	2	Cloudy Windy.	S. E.		
	5 p. m.	0 0 2	6	Cl. very Mild.			

From the 16th. in the successive Spaces of 24 Hours, each Gain'd one of the Number of Grains following; as the 8th. Natural Day Gained $13\frac{1}{2}$. The Next, 12. 9. 7. 6. 5. 5. $4\frac{1}{2}$. 3. 3. 3. 3. 4. 3. (Decem.) 4. $4\frac{1}{2}$. 4. 3. 3. &c. still irregularly Decreasing, till the Liquor was satiated. The Diary was continued to Jan. 4. 1684 when the Increase, in 24 Hours, amounted scarce to Half a Grain, and probably had the Weather been then Dry, it might have been none at all; or rather the Liquor might have lost what before it had Gained.

Hence 'tis Obvious that the more our Liquor was Saturated, the less was its daily Increase, though not Gradually less by an Even Descent each Day, but sometimes two or more Natural Days together, it was exactly the same, a Day or two after less, and then again More the next Day following, according as the Liquor stood Affected by the Heat and Cold, Dryness or Moisture of the Weather, the Differing time of the Day, and Quarter of the Wind. Thus upon the view of the whole Diary of almost two Months, it appear'd, the Increase was more in a Moist, Rainy, Misty, and Snowy, but less in a Frosty, Clear, and Dry Season; as also it was more in a Cold than in a Warm Air. When the Wind was Northerly or Easterly the Gain was less *cæteris paribus*, than when Southerly or Westerly, and was less in the Day than in the Night. The Primary Cause of this Phænomenon seems to be the Moisture of the Air, which our Liquor (a Potential Fire) imbibes as greedily, as Actual Fire does the Pabulum of Nitre, yet we must allow that all the other Circumstances of Season just now mention'd have each their particular influences in Diversifying the Quantity of the Increase. Thus it appears in the Table, that Heat alters the Progress of Increasing: For on the 14 of Nov. from 11 m. to 11 p. m. (at which time, specially towards Night) a very Unusual and Troublesome Heat in the Air was complained of by several here in Oxford; in 12 Hours the Gain was only $3\frac{1}{2}$ gr. whereas in the like Time preceding, it was $10\frac{1}{2}$ Grains, and in that just following 9 Grains.

Neither.

Neither indeed can any thing otherwise be expected from *Heat*, since there- by the *Moisture* might rather be Exhal'd; or at least might be Suspended, Agitated and intimately mixt with the Substance of the *Air*, and consequently not so easily be Arrested and Entangled by the Surface of the *Liquor*, as when the *Air* is Less *Hot*. However, allowing the Effect of this *Anomalous* Accident at a Time of the *Year* when least expected, and considering that most commonly *Heat* keeps even Pace with the Season of the *Year*, depending as to its Temper for the most part on the *Nearness* or *Remoteness* of the *Sun*, we may safely Conclude *Moisture* the chief and only Cause of the Increase of Weight in *Oyl* of *Vitriol*, since in *Dry, Clear Weather*, it constantly *Increases* less than in *Moist and Cloudy*; the Circumstance of *Heat* or *Cold* remaining the same in both.

But this will be clearly Evinc'd by an Inquiry made into the *Nature* of the Substance *Gain'd*, with the *Increase* of *Weight*: For by the Ordinary ways of Tryal it appear'd, the *Atmosphere* afforded our *Liquor* nothing besides some of its *Watry Particles*, wherewith it always abounds; but more especially is ready to part with in *Moist Weather*.

The *Air*, without doubt, has great Variety of Different Substances floating in it, whereof some Particles do Adhere to this, some other sort to that Body, according as either is Peculiarly Dispos'd to receive one sort rather than another. Thus the *Mortar* in the Joynts of *Old Walls* and *Vaults*, from *Corpuscles* attracted from the *Air*, *Sprouts* out and Frames a peculiar kind of *Salt*. I have known a *Deal Shelf*, *Meisten'd* only with the *Liquor* of *Fixt Nitre*, *Frosted* over with *Crystals* of a perfect *Inflammable Nitre* by Regaining the Proper *Acids* from the *Air*, all one as if so much *Spirit* of *Nitre* had been pour'd on the said *Liquor*. I have seen a *Viol* Half Fill'd with *Oyl* of *Tartar per Deliquium* (by being left open to the *Air*) beset above the *Liquor* with Peculiarly *Figur'd Crystals*, and at the Bottom were *Flat Chrystalliz'd Plates* of a *Salt* which without *Flame* Crackled on a live *Coal*, and left behind a *Calx* much like *Dr. Lister's Nitrum Calcarium*. And 'tis well known *Colcothar* of *Vitriol* Reimpregnated by the *Air*, will by a fresh *Distillation* give you its Proper *Acid* as at first. Now upon such Hints as these, some (Fond of the Doctrine of *Alcali* and *Acid*) might perhaps expect, since Differing Bodies of an *Alcalizate* Nature do thus Regain their Proper *Acids*, that *Vice versa* even this most *Acid* *Liquor*, *Oyl* of *Vitriol*, also might find its *Alcalizate* Associate in the *Air*, from which the Violence of *Fire* had before Driven it: But we could Discover no such Matter; the *Tast* of our Augmented *Liquor* was Still purely *Acid* and only Weaker than before, whereas it would have been *Saltish* had an *Alcali* been Combin'd with it; and its *Colour* from a *Deep Reddish*, became *Limpid*, all one as if the like Quantity of Fair *Water* had been Mixt. But to be more Certain in this Point, I *Distill'd* off the New *Gain'd* Substance: At first it came over as *Inspid* as *Clear Water*; and urging the *Fire* farther, the Drops prov'd *Sower*, and the Remaining *Oyl* in the *Retort* was altogether as *Corrosive* as at first. Whence we may Infer, its Edge was not at all Blunted by any adjoynd *Alcali*: So that what the *Air* Afforded was nothing else but mere *Water* only.

As to the Quantity of the Whole Increase it can't be Determined by any General Rule, since it Varies according to the Different Strength of the Oyl of Vitriol: For it appears by the Table, the more Diluted the Liquor the Less Attractive it prov'd. This here employ'd (as highly Depblegm'd, I presume, as any usually is) gave a Triple and more than $\frac{1}{2}$ of its First Weight, amounting in all from 3 to 9 Drams, and 30 gr. before it come to a Stand.

Which Proportion of Increase I found confirmed in Lesser Quantities also; as, 3 gr. Increas'd to more than 9 gr. and one Grain gave the Weight of something more than 3 Grains. But besides the Strength of the Liquor, there are other Circumstances, as the Season of the Year, and Position of the Place, which will certainly something Alter this Point; thus our Liquor will Gain more in Winter than in Summer; more in a Cellar and Sunless Room, than in a Room not so Qualify'd.

All these Circumstances, which relate to the Quantity will also Influence very much the Time of the Encrease: But that which makes the most Peculiar and Principal Variation in this point, is the Proportion of the Surface to the Bulk of the Liquor. For I find the Greater or less the Surface is, the Quicker or Slower the Encrease. Thus 3 Grains Dropt and Diffus'd to near $\frac{3}{4}$ Inch Breadth on a piece of Glass, Gain'd 3 Gr. in 6 Hours; one Gr. in 6 more; one Gr. and $\frac{1}{2}$ in 12 Hours more; in the next 12 Hours it gain'd $\frac{1}{2}$ a Gr. and in the last 12 Hours it gain'd very little Observable, so that in Less than 48 Hours, having more than Triple its First Weight, it was for some Time fully Satiated, till Rainy Weather added something more.

But to discover more Nicely what interest the Proportion of Surface has in Hastening or Retarding the Increase of Weight, I expos'd in the same Room, and to the same Temper of the Air (as near as I could guess) 3 Drams of the same Oyl of Vitriol in an Open Flat Glass One Inch broad, being only $\frac{1}{3}$ of the Diameter of that Glass used at first with the like Quantity. The Result was this; that whereas the other Surface of 3 inches Diameter gain'd (as in the Table) near 19 Gr. the first 6 Hours, this Less Surface gain'd a very little, perceivable, more than 2. Grains in the same space of Time. Now since the Area's of Circles are to one another as the Squares of their Respective Diameters; as One, the Square of the Less, is to 9, the Square of the Greater Glasses Diameter, so was the Weight of a little more than 2 Grains, Gain'd in the Narrower Glass, to near 19 Gr. gain'd in the Broader: Wherefore the Time of Increasing bears, as near as can be expected, an Exact Proportion to the Surface of the Liquor Expos'd; and the Liquor in the lesser Glass having but $\frac{1}{9}$ part of the Surface of the Greater, could not be Satiated under 9 times as many Days as the Greater.

LXXXVIII. All I can find of the Origine of White Vitriol is out of *Borrichius de Docimastice Metallica*, that it is Produced from a certain Lead Ore boil'd Raw. (*Plumbi Nigri Vena Vitriolum Album producit, etiam non Cremata*) None, that I know of, of our English Lead Ores gives us any suspicion of any such Vitriol. It is True I have by me some sorts of White Lead-Ore, Spar-like, plentifully yielding Lead: But I cannot say, that either those,

White Vitriol;
by Dr. Lister.
n. 256. p. 331.

or any *Colour'd Lead-Ores*, did give me any Reason to Suspect, after diverse Experiments upon them, that they yielded *White Vitriol*.

As to the *Crystals of White Vitriol*, they are very Difficult to Describe: and seem to me to be a Congeries of Infinite small *Needles*; for which Reason it is of a most *Speedy Operation*, and Irritates the Stomack *Suddenly*, before they can be well dissolv'd or Broken.

Allum-Works;
by Mr. Dan.
Colwall. n. 142.
p. 1052.

LXXXIX. Allum is made of a *Stone*, of *Sea-weed* and *Urine*.

The *Stone* is found in most of the Hills between *Scarborough* and the River of *Tees* in the County of *York* As also near *Preston* in *Lancashire*. It is of a Blewish colour, and will cleave like *Cornish Slate*.

The *Mine* which lies Deep in the Earth, and is indifferently well Moistned with Springs, is the Best. The Dry *Mine* is not good: And too much Moisture Cankers and Corrupts the *Stone*; making it *Nitrous*.

In this *Mine* are found several Veins of *Stone* called *Doggers*; of the same Colour, but not so Good. Here are also found those that are commonly called *Snake-stones*. The People have a Tradition, that the Country thereabouts being very much annoyed with *Snakes*, by the prayers of *St. Hilda*, there inhabiting, they were all turned into *Stones*, and that no *Snake* hath ever since been seen in those Parts.

For the more convenient working of the *Mine*, which sometimes lies 20 *Yards* under a Surface or Cap of Earth, (which must be taken off and barrowed away) they begin their Work on the Declining of a Hill, where they may be also well furnished with *Water*. They digg down the *Mine* by Stages, to save Carriage; and so throw it down near the places where they *Calcine* it.

The *Mine* before it is *Calcined* being exposed to the Air, will Moulder in pieces, and yield a Liquor whereof *Copperas* may be made: But being *Calcined* its fit for *Allum*. As long as it continues in the Earth, or in *Water*, it remains a Hard stone.

Sometimes a Liquor will issue out of the side of the *Mine*, which by the Heat of the *Sun* is turned into Natural *Allum*.

The *Mine* is *Calcined* with *Cinders* of *New Castle-Coal*, *Wood*, and *Furzes*. The *Fire* made about 2 feet and an half Thick, 2 *Yards* Broad, and 10 *Yards* long. Betwixt every *Fire*, are stops made with Wet Rubbish; so that any one or more of them may be Kindled, without prejudice to the rest.

After there are 8 or 10 *Yards* Thickness of broken *Mine* laid on this Fewel, and 5 or 6 of them so covered: Then they begin to Kindle the *Fires*: And as the *Fires* Rise towards the Top, they still lay on Fresh *Mine*. So that to what Height you can Raise the Heap, which is often times about 20 *Yards*, the *Fires* without any further help of Fewel will Burn to the Top, stronger than at the first Kindling; so long as any *Sulphur* Remains in the *Stones*.

In *Calcining* these *Stones*, the Wind many times does hurt, by forcing the *Fire* in some places too Quickly through the *Mine*, leaving it Black and Half Burnt; and in others, Burning the *Mine* too much, leaving it Red. But where the *Fire* passeth softly and of its own accord, it leaves the *Mine* White; which yields the best and Greatest quantity of Liquor.

The

The *Mine* thus *Calcin'd* is put into *Pits* of *Water*, supported with *Frames* of *Wood*, and *Rammed* on all sides with *Clay*: About 10 *Yards* long, 5 *Yards* Broad, and 5 *Feet* Deep, set with a *Current* that Turneth the *Liquor* into a *Receptory*, from whence it is *Pumped* into another *Pit* of *Mine*. So that every *Pit* of *Liquor*, before it comes to *Boiling*, is *Pumped* into 4 several *Pits* of *Mine*; and every *Pit* of *Mine* is steeped in 4 several *Liquors*, before it be *Thrown* away; the last *Pit* being always *Fresh Mine*.

This *Mine* thus steep'd in each of the several *Liquors* 24 *hours*, or there about, is of course 4 *Days* in passing the 4 several *Pits*, from whence the *Liquors* pass to the *Boiling House*.

The *Water*, or *Virgin Liquor*, oft times *Gains*, in the *first Pit*, 2 *pound* *Weight*. In the 2^d it encreaseth to 5 *pound* *Weight*; in the 3^d to 8 *pound* *Weight*; and in the *Last Pit*, which is always *Fresh Mine*, to 12 *pound* *Weight*; and so in this proportion, according to the goodnes of the *Mine* and the well *Calcinig* thereof. For sometimes the *Liquors* passing the 4 several *Pits*, will not be above 6 or 7 *pound* *Weight*: At other times above 12 *pound* *Weight*, seldom holding a *Constant* *Weight*, one week together. Yet many times *Liquor* of 7 or 8 *pound* *Weight* produceth more *Allum*, than that of 10 or 12 *pound* *Weight*, either through the *Illness* of the *Mine*, or, as usually, the *Bad Calcinig* thereof. And if by passing the *Weak Liquor* through another *Pit* of *Fresh Mine*, you bring it to 10 or 12 *pound* *Weight*: Yet you shall make less *Allum* with it, than when it was but 8 *pound* *Weight*. For what it gains from the *Last Pit* of *Mine*, will be most of it *Nitre*, and *Slam*, which *Poysons* the *Good Liquors*, and *Disorders* the whole *House*, until the *Slam* be *Wrought* out.

That which they call *Slam*, is first perceived by the *Redness* of the *Liquor* when it comes from the *Pit*, occasioned either by the *Illness* of the *Mine*, or, as commonly, the *Over* or *Under Calcinig* it, as abovesaid; which in the *Settler* sinks to the *Bottom*, and there becomes of a *Muddy* substance, and of a *Dark* *Colour*. That *Liquor* which comes *Whitest* from the *Pits*, is the *Best*.

When a work is first begun, they make *Alum* of the *Liquor* only that comes from the *Pits* of *Mine*, without any other *Ingredients*. And so might continue, but that it would Spend so much *Liquor* as not to quit *Cost*.

Kelp is made of a *Sea-weed*, called *Tangle*, such as comes to *London* on *Oysters*. It grows on *Rocks* by the *Sea-side*, between *High-Water* and *Low-Water* *Mark*. Being *Dryed*, it will *Burn*, and *Run* like *Pitch*; when *Cold* and *Hard* 'tis beaten to *Ashes*, steeped in *Water*, and the *Lees* *Drawn* off to 2 *pound* *Weight*, or thereabout.

Because the *Country* *People*, who furnish the work with *Urine*, do sometimes *Mingle* it with *Sea-water* which cannot be discovered by *Weight*: They try it, by putting some of it to the *Boiling Liquor*. For so, if the *Urine* be good, it will *Work* like *Yest* put to *Beer* or *Ale*, but if *Mingled*, it will *Stir* no more than so much *Water*.

It is *Observed*, that the best *Urine* is that which comes from *Poor* *Labouring* people, who drink little *Strong Drink*.

The *Boiling Pans* are made of *Lead*, 9 *feet* long, 5 *feet* Broad, and 2 and

a *half* Deep: Set upon Iron Plates about 2 *inches* Thick; which *Pans* are commonly new Cast, and the Plates Repaired 5 times in 2 *Years*.

When the work is begun and *Alum* once made, then they save the Liquor which comes from the *Alum*, or wherein the *Alum* shoots, which they call *Mothers*. With this they Fill two Third parts of the *Boilers*, and put in one third part of Fresh Liquor which comes from the *Pits*. Being thus Filled up with Cold Liquor; the *Fires* having never been drawn out, will *Boil* again in less than 2 *hours* time. And in every 2 *hours* time the Liquor will Waste 4 *Inches*, and the *Boylers* are Filled up again with Green Liquor.

The Liquor if Good, will in *Boiling*, be Greasy, as it were, at the Top: if *Nitrous*, it will be Thick, Muddy and Red. In *Boiling* 24 *hours*, it will be 36 *pound* Weight. Then is put into the *Boiler* about a Hoghead of the *Lees* of *Kelp*, of about two *Penny* Weight, which will Reduce the whole *Boylers* to about 27 *pound* Weight.

If the Liquor is Good, as soon as the *Lees* of *Kelp* are put into the *Boiler*, they will Work like *Yest* put to *Beer*: But if the Liquor in the *Boiler* be *Nitrous*, the *Kelp Lees* will stir it but very little; and in that case, the workmen must put in the more and stronger *Lees*.

Presently after the *Kelp Lees* are put into the *Boiler*, all the Liquor together is drawn into a *Setler*, as big as the *Boiler*, made of *Lead*, in which it stands about 2 *hours*; in which time most of the *Nitre* and *Slam* sink to the Bottom.

This *Separation* is made by means of the *Kelp Lees*. For when the whole *Boiler* consists of Green Liquor, drawn from the *Pits*, it is of Power strong enough to cast off the *Slam* and *Nitre*: But when *Mothers* are used, the *Kelp Lees* are needful to make the said *Separation*.

Then the said Liquor is Scooped out of the *Setler*, into a *Cooler*, made of Deal Boards, and Rammed with Clay. Into this is put 20 *Gallons*, or more of *Urine*, more or less according to the goodness or badness of the Liquor. For if the Liquor be Red, and consequently *Nitrous*, the more *Urine* is required.

In the *Cooler* the Liquor in Temperate Weather, stands 4 *days*. The 2d *day* the *Alum* begins to strike, gather and Harden about the sides, and at the Bottom of the *Cooler*.

If the Liquor should stand in the *Cooler* above 4 *days*, it would as they say Turn to *Copperas*.

The Use of *Urine*, is as well to cast off the *Slam*, as to keep the *Kelp Lees* from Hardning the *Alum* too much.

In Hot weather, the Liquors will be One *day* longer in *Cooling* and the *Alum* in gathering, than when the weather is Temperate. In Frosty weather the Cold strikes the *Alum* too soon, not giving time for the *Nitre* and *Slam* for to sink to the Bottom, whereby they are Mingled with the *Alum*. This produceth double the Quantity: But being Foul, is consumed in the *Washing*.

When the Liquor hath stood 4 *Days* in the *Cooler*, then that called *Mothers* is scooped into a *Cistern*, the *Alum* Remaining on the sides and at the Bottom; and from thence the *Mothers* are Pumped back into the *Boiler* again: So that every 5 *Days*, the Liquor is *Boiled* again, until it Evaporate or Turn into *Alum* or *Slam*.

The *Alum* taken from the sides and Bottom of the *Cooler*, is put into a *Cistern* and *Washed* with *Water* that hath been Used for the same purpose; being about *Twelve Pound* weight. After which it is *Roached* as followeth.

Being *Washed* it is put into another *Pan* with a quantity of *Water*, where it *Melts* and *Boils* a little. Then it is *Scooped* into a great *Cask*, where it commonly stands *10 Days*, and is then fit to take down for the *Market*.

The *Liquors* are *Weighed* by the *Troy Weight*; so that *Half a Pint* of *Liquor* must *Weigh* more than so much *Water*, by so many *Penny Weight*.

XC. Vitriol is of several *Kinds*, being for *Colour*, *White*, *Yellow*, *Green*, or *Blew*; usually of the two last mentioned: And is made either of *Mineral Waters*, Boiled up to a convenient *Consistence*; then set to *Crystallize*: Or *Extracted* by *Common Water* out of *Earths* impregnated therewith. 'Tis also afforded by many sorts of *Stones*, commonly called *Pyrites* and *Marcafites*, which exposed some *Months* to *Aerial Influences*, are resolved into *Powder*, and the *Saline Part* Dissolved in *Rain* or other *Water*; then *Boil'd* and set to *Shoot*, yield store of *Vitriol*, especially with the *Addition* of *Copper* or *Iron*: It is often *Associated* with *Earth* and *Stones*, wherein *Metals* are *Contained*; and with many *Natural Recrements* of *Metals*, such as *M. sy*, *Sory*, *Chalcitis*; from which 'tis usually *seperable* by the *Common Method* with *Water*; sometimes not to Be *Extricated* until the *Mineral* be first *Calcined* or *Burnt*. It is also frequently found *Pure* and *Perfect* in the *Caverns* of the *Earth*, being an *Efflorescence* of several *Minerals*; and this is accounted by all *Naturalists*, the *Best*, both for *Medicinal* and *Spagyric* uses. Lastly, it is *Copiously Contained* in common *Mineral Sulphur*.

Experiments about Vitriol, Sulphur, and Alum; by
n. 103. p. 41.

Vitriol consists of *Inspid Phlegm*, *Earth* or *Oker*, some *Metal*, *Mineral Sulphur*, an *Acid Salt* or *Spirit*, together with some small *Portion* of the *Volatile Aerial Salt*. That it contains *Water*, needs no great *Proof*, since no *Saline Substance* can *Crystallize* without it; and *Distillation* will *Convince* any *Person*, that it exceeds in *Quantity* any of the other *Principles*.

The *Earth* or *Oker* may be thus *seperated*. Dissolve *Vitriol* in fair *Water*; immediately a *Yellow Powder* will *seperate*, and in a short time *Subside*. The greater the *Quantity* of *Water* imployed, the *More Oker* *Precipitates*: The *Weaker* the *Lixivium*, the less able to support *Bodies* more *Ponderous* than *Common Water*; And the *Lighter* the *Water* (as if *Distilled Rain-Water*, or *Phlegm* of *Vinous Spirits*;) the more *Earthy Parts* *Subside*, upon the same *Hydrostatical Principle*. I have above *20 times* repeated this *Dissolution*, *Secoded* by *Filtration* and *Coagulation*, and each time *seperated* some *Quantity* of this *Earth*: And I am *perswaded*, had I long continued the *Operation*, the *Success* would have been the same; only I observed the *Quantity* *seperated* each time, *sensibly* to *Diminish*. But I have found a more *Easie* and *Expedite* way of *Effecting* this *Seperation*. Take a good *quantity* of the *Common Dantzick*, or *Hungarian Vitriol*; having *Powder'd* it, put it into a slender *Cucurbite*; Place it in *Water*; keep under it an *Equal Constant Fire* *3 or 4 Days*: The *Vitriol* will, without *Addittament*, become *Fluid*, as if *Dissolved*

Dissolved in Water, and the Oker with most of the *Metalline* parts, with the *Gross Sulphur*, will Subside, and become a Hard Cake at the bottom, the *Vitriol* being fluid about it, which in the Cold again *Crystallizeth*; excepting a small quantity of *Liquamen* of the same nature with that we shall hereafter Mention: This Repeated once or twice, the *Vitriol* attains unto a High Degree of Purity, and is easily capable of many Alterations, whereunto it was not subject before this Purification. This Operation will not succeed in a Dry Digestion; I mean, *Ashes, Sand, Filings* of Iron or Steel, *Open Fire*, or even *Flame of Lamps*, whether fed with Oil or Spirit of Wine. This *Earth* may be also Obtained in a great Proportion, though in another Form, if after a long and Intense *Calcination*, the *Vitriol* is freed from its Remaining Salt, by frequent *Ablutions* with warm Water: The far greatest part of this *Dulcify'd Colcothar* is *Insipid Earth* with some small proportion of *Metal*. The same may be *Precipitated* by *Salt of Tartar*, or any other *Alcalies*, or *Filings* of Zink, or other Immature *Minerals*, out of a Solution of *Vitriol* in Common Water. It being also *seperated* from *Metalline* and *Saline* parts, by a Method I shall hereafter mention, there remains a great quantity of an *Insipid* Substance nearly resembling *Burnt Allom*. Besides, whereas *Salt, Nitre, &c.* require in *Distillation* a large quantity of *Earthy* Substance, to Disjoin the *Saline* Parts, and prevent *Fusion*: *Vitriol* and *Allom* need it not; an unquestionable Proof, that *Earthy* Parts abound therein.

That *Vitriol* contains *Sulphur*, is Evinced by the *Sulphureous* Smell it emits in *Distillation*, especially if urged with a strong Fire from the beginning; and the *Spirit* thus drawn being *Rectified*, the *Liquor*, which first arises, hath a Highly *Sulphureous* Smell; as hath also that we shall hereafter mention, Distilled from *Vitriol* deprived of its *Metallick* parts. The *Colcothar Dulcify'd*, or *Metallick* parts *Precipitated* by an *Alkali*, or *Immature Mineral*, *Sublimed* with *Sal Armoniack*, an *Inflamable* Sulphur may be many ways separated, both from the *Sublimate* and *Caput Mortuum*. The Common Oyl of *Vitriol* digested on *Antimony*, then Distilled, yields a much greater quantity of *Sulphur*, than would have been produced, had any other *Acid* Liquor been Employed; and the same Oyl of *Vitriol* digested with *Spirit of Wine*, and Distilled, yields an Oil, and at the latter end, store of *Sulphureous* Inflamable Flowers.

As for the *Acid Saline* Principle, I suppose no Person who hath Tasted of the *Spirit of Vitriol*, and, that abusively called, its Oil, will Question its abounding in that Subject.

In order to the Resolution of some Enquiries about this *Saline* Principle, I made these Experiments. I took 4 or 5 Gallons of the *Vitriolate* Water, which was conveyed by Artificial Channels at *Deptford*, from the Beds of *Pyrites* or *Marcasites* into the Great Cistern. I Distilled therefrom, in Glass Vessels, two Thirds of *Insipid Water*, letting the Glasses Cool, the Water let fall a *Vitriol* of a lovely Dilute Colour, together with a great Quantity of that Yellow Sediment which we formerly call'd *Oker*. Then Evaporating a Third part of the remaining Liquor, I received more *Vitriol* of a Paler Colour than the former, and *Oker* as before, though less. The 5th time this

Operation was repeated, instead of *Vitriol* it afforded a *Yellow*, and ever after a *White Salt*, which did differ exceedingly from *Vitriol*, not only in Colour, but also Taste; being Fiery and Pungent; and did partake little of that Abominable Rough Astringent Smack which is Peculiar to *Vitriol*. It was also *Unctuous*, like *Salt* of *Tartar*; made the Hands soft and Supple, cleansing like a *Sapo*; whereas Common *Vitriol* renders them Rough and Harsh: Being Dissolved in Water, it appeared to the very Eye very *Fatty* and *Oleaginous*.

From 5 Pounds and an half of *Lixivium*, I received 4 Pounds of this Fiery *White-Salt*, besides half a pound of *Liquamen*, which remained Fluid, and would not *Coagulate*. I do the rather mention this; for that it is one of the most eminent Instances, I ever met withal, of so great a quantity of *Salt* kept fluid in the Cold, by so small a Quantity of *Water*.

The remaining *Liquamen* was very Fiery, Acidly Pungent, and extremely Ponderous; no whit Inferiour, in my Opinion, in any of these respects to Common Oil of *Vitriol*; it seeming to me strange, and Unusual, that so strong a Liquor should be obtained without any considerable degree of Fire.

This *Liquamen* being exposed unto the *Air*, soon Attracted double its Quantity of *Moisture*; I cannot recollect, that I did ever observe any Fluid Body, which approached near unto it for this Property: Though I am not ignorant, that all *Corrosive Saline* Liquors will borrow considerably from their neighbouring Element. I always observed this *Liquamen* to acquire more or less *Moisture*, according to the Constitution of the Season, Rising sensibly in Moist Weather, and little in *Dry*.

The *White Salt*, last mentioned, was Distilled in a *Sand Furnace*, and the far greater part came over in the Form of a *Spirit* highly *Acid*, especially that which came last in small Drops. This Liquor *Rectified* in a very Tall Body, immediately upon the Approach of the Smallest Degree of *Heat*, a *Volatile Sulphureous* Spirit did arise, Clear as Rock Water, almost, nay I think altogether *Inspid*; yet the *Smell* so Subtile and Penetrating, that 'twas Insupportable: And such it continued many *Years*, not Letting fall any Sediment, and thereby losing its strength, as doth the *Volatile Spirit* made out of common *Vitriol*. The *Spirit* which remained after the Separation of the more *Volatile*, was in all respects like that of *London Vitriol*; only seemed more Gratefully *Acid*, and might, like it, be seperated into *Spirit* and *Oil*, corruptly so stiled.

Vitriol freed, as is before declared, from its *Earthy* and *Metallick* parts, by *Zink*, or other *Imperfect Minerals*, is much of the same nature, and yields its *Spirit* in *Sand*, as this we have now mentioned; is also *White*, and more *Unctuous*; hath a grain more like *Nitre* than *Vitriol*; as hath also the *Goslar Vitriol* which is *White*, and comparatively *Unctuous*, because it hath little *Metal*, and less *Mineral Sulphur* than the *Common*; whose *Metalline* part detains the *Saline*, and will not dismiss it until long Urged by a very intense degree of *Heat*. What remained in the *Retort*, after this *Distillation* was not Red or Purple, like the *Caput Mervuum* of the common *Vitriol*, but *White*, *Light*, and *Spongious*, like *Burnt Alam*, and altogether as *Inspid*; although, after it was some time Exposed unto the *Air*, it received many strange Impressions and Alterations.

n. 104. p. 66.

I cannot but take notice here of the great Affinity that is between *Vitriol*, *Alum*, and *Mineral Sulphur*; the *Saline* Principle, which is in each of them by far the Chief, both in Quantity and Energy, having One Nature and the same Properties. This will appear Evident to those who will Compare with the common *Spirit*, or *Oyl* of *Vitriol*, the *Acidity* of *Sulphur* afforded by *Brimstone* Inflam'd under a Glass Bell; which being *Rectify'd*, is not to be Distinguish'd, by any sensible Property, from the well *Rectified Acidity* or *Oyl* of good *Vitriol*; and they may, I am confident, be safely substituted for each other, producing in *Men* and *Metalls* the very same Effects, being in my Apprehension, no less alike in their *Internal* and secret, than in their *External* sensible Qualities.

The Quantity indeed of *Acidity*, which is obtained in the ordinary ways of Operation, is very small, a pound of *Brimstone* not yielding above one Ounce or 10 *Drachms*; the far greater part being by the rapid motion of the Flame *Sublimed* in the form of *Flores*, which differ not from the common *Flowers*. I have been often assured by a Kinsman of that admirable Mechanist *Cornelius Drebbel*, that his Uncle did, by the means of conveniently shaped Vessels, ordinarily obtain out of a pound of good *Brimstone*, 8, and in a very *Moist* Season, 10 Ounces of *Acidity*; and was confident, he could, by improving the Contrivance, recover the entire weight of the *Sulphur*; the *Moisture* of the *Air* acquired, making abundant recompence for the Avolation of what is *Incoagulable*. I have my self, by the Means of several *Menstrua*, reduced common *Brimstone* into the form of an highly *Acid Corrosive* Liquor; and even *Spirit* of *Nitre*, or *Aqua-fortis* well *Rectified*, being *Digested* on the *Flowers* of *Brimstone*; then *Distilled* in *Ashes*, this Repeated 5 or 6 times, after the last *Cohobation* there will remain with the *Flowers* near their Weight of an *Acid Spirit*, like that made by a *Bell*; the *Spirit* of *Nitre* being scarcely changed from what it was before the Operation. And I suppose, that being Reiterated frequently, especially if Fresh Spirit be employed, the whole may be *Transmuted*, abating some few Earthly and Metallick particles; the *Sulphureous* being capable of a Fluid form, and are copious in *Oyl* of *Vitriol*, *Aqua-fortis*, and many other *Acid Menstrua*, especially if any Imperfect *Sulphureous* Minerals were employed with the other Ingredients in their Production.

I once made out of *Vitriol*, *Common Salt*, and *Antimony*, a Liquor Clear as any Fountain Water; yet the *Smell* intolerably *Sulphureous*, continuing so many Years: And True Inflammable *Sulphur* may several ways be Recovered out of *Oyl* of *Vitriol*, or *Sulphur*, many times *Rectified*, and in appearance Free from such Mixture. We formerly mentioned its *Separation* by means of *Vinous Spirits*. Also, if Mixt with *Oyl* of *Turpentine*, and *Distilled*, at the latter end store of *Brimstone* will *Sublime*: I suppose, none will Ascribe this to the *Vegetable Oyl*, which is only the Means of its *Seperation*, being an appropriate *Menstruum* or Dissolvent of *Sulphureous* bodies. This recalls into my Mind what I have often observed, (and I suppose it always Happens) in the Preparations of *Balsom* of *Sulphur* with the said *Oyl* of *Turpentine*: After the *Oyl* is Satiated with *Sulphur*, it lets fall store of fair *Crystals*: an evident

dent Proof of its *Saline* Nature: For, although these *Crystals* Broken, within appear full of *Sulphur*, their Outward parts or Superficies seem perfect *Salt*, by Vertue whereof they are disposed to *Crystallization*. It may indeed be Objected, that *Crystallization* is not a sufficient Proof of a *Saline* Nature, the *Essential Oyles* (as they are called) of *Aniseeds*, *Fennel seeds*, and of many other Substances being very Prone to *Crystallize*. But most *Essential Oyles* abound no less with *Salt* than Common *Sulphur*, into which I have often Converted them without Additament or Suspicion of *Transmutation*.

The *Affinity*, I had almost said *Identity* of the *Saline* Principle in *Sulphur* and *Vitriol*, further appears by the Following Experiment. Take thin plates of *Copper*, Cement them carefully with common *Brimstone*, *Stratum super Stratum*, Repeat the Operation 4 or 5 times with Fresh *Sulphur*; most of the *Copper* will be converted into *Vitriol*. which Dissolved in Water, and most of that Evaporated, yields very Beautiful *Azure Crystals*. The same may be Effected with *Iron*. Or, take the *Acidity* of *Sulphur* (corruptly called its *Oyl*) Moisten therewith Filings of *Copper* or *Iron*; then free them by Fire or Air from Superfluous moisture; Repeat this twice or thrice; and afterwards with common Water you may Extract a Fair *Vitriol*, which by the *Chymists* is called *Vitriolum Martis* or *Veneris*, according as the one or other Metal was employed in order to its Production; which same Metals being Dissolved in any *Acid Menstrua*, and *Crystallized*, are Converted into *Vitriol*. This is signified unto us by the common name of *Vitriol*, Vulgarly stiled *Cuperosum*, *quasi Cuprum Erosum*; that being the Metal wherewith 'tis usually Associated, *Sulphur* indeed is found mixt with most Metals and Minerals, *Gold* and *Silver* not being Excepted; the most expert Mineralists in *Peru* accounting abundance of *Sulphur* an especial *Sign* of Rich Ore: And among the Richest Ore of the Mountain of *Potosi* are such Quantities of *Brimstone*, that the Cavities and Hollow places are presently filled with *Flame* if a Candle touch or come near their sides. Yet they do not ordinarily find *Vitriol* in Mines of *Gold* and *Silver* (unless Mixed with other *Metals*) because those Bodies are something too Compact for the *Sulphureous Spirit* to Dissolve assisted with a small degree of Heat; whereas all Ores, which touch on *Copper* or *Pyrites* abounding in *Sulphur* do also afford *Vitriol*; *Copper* being an Open Body, and more easie Soluble than any other Metal, For it will presently, though Crude, Dissolve in, and give a deep Tincture to common *Volatile Urinous Spirits*: Which cannot be affirmed of any other Metal, howsoever Prepared; and therefore no wonder if it be not by the Steam of *Sulphur* so easily converted into *Vitriol*. And in the Bowels of the *Earth* it is, I do conjecture, mostly produced after this manner; An *Acid Salino Sulphureous* steam (such we have Proved that of common *Sulphur* to be) insinuating it self into a Vein of *Copper*, Corrodes it, and Uniting therewith becomes *Vitriol*, So it doth by mixture with *Iron* and other *Minerals*; whence being Washed with Water, it Produces *Acidulae* of divers kinds, according to the Nature of the *Minerals*, wherewith the *Acid* is United. And that *Vitriol* and *Vitriolate Waters* are thus Produced, is hereby confirmed, that many Ores and *Pyrites* being Distilled *per Descensum*, yield abundance of common *Sulphur*: The Remainder there after affords store

Alonso Barba's
Art of Metals.
Lib. I.

of *Vitriol*, although before *Calcination* it would have yielded none; the Fire enabling the *Sulphur* to Corrode, and Associate with the *Metallick* parts, that which is without Mixture of *Metal*, or which hath thereof a very small Proportion, continuing under the form of *Brimstone*.

This to me seems the Reason, why *Vitriol* and *Brimstone* are usually found together: Those *Minerals* and *Pyrites* that abound with one, being usually impregnated with the other; *Vitriol* not being a distinct Principle, but the Genuine offspring of *Sulphur* its Material Cause, and Fire and Air the Efficient causes of its Production.

I speak of *Vitriol* Generated in the Bowels of the Earth; for it may be, and is often, Produced above Ground, by the *Aerial Salt* United with *Mineral* substances copiously contained in *Marcasites*, which it Extricates, and Coagulating therewith becomes a *Vitriol*. This *Aerial Salt*, which I have many ways procured, whilst in the *Air*, is altogether Unspecificate, I mean Freed from all Union with, or Determination by, any *Seminal* Principle, (the *Primordials* of all *Species* in the Universe being in my Opinion *Spermatical*; but being once at the Command of the *Architectonick* Power of any *Species*, whatsoever that be, it is by it, with other Matter, Determined in order to the Formation and Augmentation of the *Individuum*, and Propagation of the *Species*, and upon the Dissolution of its Dwelling, returns whence it Descended. Besides this there is also in the *Air* an *Acidity*, as is Evident in *Iron Bars*, whose Superficies is thereby Resolved into a Subtile *Crocus*; also in the Tarnishing of *Polish'd Metals*, where *Pit-Coal* is much Burnt, near unto and on the *Sea*, and where Exposed to certain *Winds*.

This *Acid Spirit* with the *Salt* last mentioned, are Instruments by Nature employed in almost every Operation; especially the *Salt*, without which no Perfect *Animal* can subsist a Minute and all *Vegetables* Deprived thereof, do immediately Decay. Its well known that several *Minerals* and *Pyrites*, which are to the Taste altogether insipid and Elixivated, and would yield not a Grain of *Salt*, being exposed unto the *Air* are Resolved into a Powder, and Afford some *Allum*, others *Vitriol* Copiously. Sometimes the *Minerals* require Previous *Calcination*, which Opens and Relaxes the Compages of the Bodies: So that the *Air* may have more easie ingress. And it is, I think, by most allowed, that after all the *Salt* is Extracted out of *Earth* Impregnated with *Vitriol*, *Allom* or *Nitre*, the said *Earth* being Exposed a sufficient time unto the *Air*, acquires Fresh Supplies: Which must be Derived from the *Air*. And it is particularly Remarkable in *Vitriol* and *Allum* that their *Spirit* being put into a Commotion or *Fermentation* by either Heat or Contrary-Natur'd *Spirits*, the Glasses which contain them being well Closed, although Large and Strong, will be Crack'd or Broken in pieces; which seems to proceed from the Expansion of some of those prodigiously Active *Springy* particles, wherewith the *Air* abounds, which together with the *Aerial Salt* were Arrested by the *Vitriolifying* Principle, and set at Liberty by the Tumultuating.

ruating Liquor, the Change of whose Contexture might occasion their Dismission, the unbending of their Springs, and the Effects which thereupon ensue.

The Affinity between *Vitriol* and *Natural*, not *Factitious*, *Allum*, thus appears: *Vitriol* not only in *England*, but in several other Parts of the World, is ordinarily found in the same *Vein*, and sometimes in the same Parcel, which Yields the *Allum*: Which may by several Methods be separated from each other. The *Mineral* of *Allum*, if Mature, *Elixiviated* yields its *Salt* presently; if less Mature, it requires Previous *Calcination*; if very immature, it must not only be *Burnt*, but long Exposed unto the *Air*.

The Cause whereof seems the very same, with that we lately mentioned in our account of the Production of *Vitriol*; the *Allum*, as that is, being Produced by the *Sulphurs* Acting on, Corroding of, and Coagulating with, some *Mineral* substance, which usually partakes more of *Terrene* and *Stony*, than *Metallick*, Nature: Although yet *Metal* is often found to be Contained in the *Allum-Stone* or *Ore*. And that the *Sulphur* is the chief Efficient and Material Cause of its Production, appears from hence, that many *Allum-Stones* (as the *Vitriolate*) *Distill'd per Descensum*, Yield good *Brimstone*; and all *Allum-Stones* or *Ore*, during *Calcination* Emit a *Sulphureous* steam. An inquisitive Naturalist of my acquaintance did gather from the very same *Rock*, and that within a Few *Inches* of each other, *Vitriol*, *Allum*, and *Sulphur*, all of them Excellent and Perfect in their Kind. Indeed they are so nearly Allied, that I can by some pretty Artifices (too long to be here described) Convert *Allum* into *Vitriol*, or *Vitriol* into *Allum*, which shall be the Same, to all intents and purposes, (as we commonly speak) with the *Natural*.

Allum Distilled into an *Acid Spirit* with *Copper* or *Iron*, becomes good *Vitriol*; and *Vitriol* freed from its *Metallick* parts becomes *Alluminous*; and Distill'd; yields a *Spirit* scarcely to be Distinguish'd not only by Taste, but even by the Nice and Accurate scrutiny, from that of *Allum*. And (which doth in some measure Illustrate this Affinity) I have often Observed Rectified *Oyl* of *Vitriol* and *Spirit* of *Sulphur* to Coagulate, and become Solid Transparent Concretions, exactly resembling *Allum Crystallized*, with which Compared, I am confident, the most Judicious Eye, without the Assistance of the *Palate*, would find little Difference.

The *Salt* in *Brimstone* is thus Derived. *Brimstone* consists of *Mineral Sulphur* and an *Acid Salt*, which being United it is no Difficult matter to Conceive how it should become *Volatile*, if we Reflect on *Cinnabar* and *Sublimate* In one; *Mercury* is so Disguised by a little *Sulphur*, that it seems a *Mineral* substance of another Nature, and abating the Colour, not unlike *Antimony*: In the other, *Salts* very *Acid* and *Fixt* are Rendered sufficiently *Volatile*. Now whence the *Brimstone* should Derive its *Sulphureous* Particles, will appear very Obvious to them, who have observed how much the Bowels of the Earth abound with *Bituminous* Substances. What else Feed all the *Subterraneous Fires*? What an Immense Quantity thereof is lodged in the Earth, will be attested by our Large and Numerous *Coal-Mines*, and by those Eruptions of *Bituminous* Substances in many Quarters of the World; among which that

call'd *Naphtha*, is so purely *Sulphureous*, so Free from Mixture with any other Materials, that upon the very approach of Fire or Flame it is immediately *Inflamed*, and scarcely to be Extinguish'd until wholly Consumed. As for the *Saline* Principle of *Sulphur*, I conclude it to be *Common Salt*, which, together with the *Aerial Salt* before mentioned, is the Foundation of all *Saline* Substances in the Universe. And I assure you I can with *Common Salt* make both *Vitriol* and *Allum*, hardly Distinguishable from the *Natural*.

The Efflorescence of certain Mineral Glebes; by Dr. Lister. n. 110. p. 221.

XCI. I kept by me certain big pieces of *Crude Allom-Mines*, such as it was taken out of the *Rock*. I had also in the same Cabinet like pieces of the Ordinary *Fire-Stone* or *Marcasite* of the *Coal-Pits*, which here we call *Brass-Lumps*.

In process of Time, both the *Glebes* shot forth *Tufts* of long and slender *Fibres* or *Threads*: Some of them half an *Inch* long, Bended and Curled like *Hairs*. In both these *Glebes* these *Tufts* were in some measure *Transparent* and *Crystalline*. These *Tufts* did as often *Repullulat*, as they were struck and wiped clean off.

The *Alluminous Fibres* were of a *Taste* very *Allomy* and Pleasantly *Pungent*: The *Vitriolique*, *Steptique* and *Odious*. Again, the *Allom* ones, being Dissolved in Fair Water, raised a small *Ebullition*: Whereas the *Vitriolick Fibres* Dissolved *Quietly*. The *Allom-Fibres* were generally smaller, and more *Opaque*, *Snow-like*: The *Vitriolick* larger, many *Fibres* equalling an *Horse-Hair* in *Thickness*, and more *Crystalline*. The Water wherein the the *Allom-Fibres* were dissolv'd, did give no *Red Tincture* with *Gall*; not by all the means I could devise to Assist them: the *Vitriolick* did immediately give a *Purple Tincture* with *Gall*.

Having laid pieces of the same *Marcasite* in a *Cellar*, they were, in a few *Months* covered over with *Green Copperas*; which was these *Fibres* shot and again Dissolved, by the *Moist Air*, *Clodder'd* and *Run* together: Exposing other pieces of the same *Vitriolick Glebe* in my *Window*, where the *Sun* came, they were Covered over with a *White Farinaceous* matter; that is, with these *Fibres* *Calcined* by the *Rays* of the *Sun* and *Warm Air*, beating upon them.

I take these *Fibrous* and *Thread like* Shootings of *Allum* and *Vitriol* to be most *Genuine* and *Natural*: And their *Angular* Shootings, after *Solution*, into *Cubes* and *Rhomboides*, to be *Forc'd* and *Accidental*; *Salts* of very *Different* *Natures*, as well *Vegetable* as *Fossile*, by a like *Process* in *Crystallizing* of them, being *Observed* to shoot into like *Figures*.

Amianthus; by n. 72. p. 2167.

XCII. I. Signior *Marco Antonio Castagna*, superintendant of some *Mines* in *Italy*, hath lighted, in one of them, upon a great *Quantity* of that *Lanuginous Stone*, call'd *Amianthus*: Which he knows so to Prepare as to render it like either to a very *White Skin*, or to a very *White Paper*; both which Resists the most *Violent Fire*. The *Skin* was Covered with *Kindled Coals*, whence it took *Flame*, but being taken out, after it had been left there a while,

while, the Fiery Colour Presently disappear'd, and it became *Cold* and *White* again as before; the Fire, it seems, palling only thorough, without Wasting or Altering any thing of it: Whereas some of the Hardest and Solideft *Mé-tals*, as *Iron* and *Copper*, reduced to very thin Plates, and kept as long in the Fire as this Substance was, would cast Scales. Again, this *Skin* being made as Thin as *Paper*, doth not only yield that *Antient* and so much Admired *Amiantbus*: But is also Perfecter than that which comes from *Cyprus*; and not inferior to that which sometimes, though but seldom, comes out of *China*. This *Paper* was also try'd in the *Fire*, and there it remain'd likewise without any Visible Detriments, or without the least *Change* of its first Whiteness, Fineness, or Softness. Of the same matter this Artist hath wrought a *Week*, never to be consumed as long as 'tis fed, nor altering its Quality after the *A-liment* is Wasted away.

2. The *Lapis Amiantbus*, or *Linum Fossile Asbestinum*, is found in no small quantity in *Llan Fair yng Hornwy* in the Northern part of *Anglesey*; where it runs in *Veins* through a Rock of *Stone*, in Hardness and Colour not unlike *Flint*. These *Veins* are generally about $\frac{1}{4}$ of an *inch* Deep; which is the length of the *Amiantbus*, and is seldom longer, but often Shorter. It is composed of a *Lanuginous* matter, exactly resembling that of *Pappous Plants*: But so closely Compact, that till you draw a Pin, or any such sharp thing, cross the Grain of it, it appears only a Shining *Stone*; there being not the least Filment of *Lint* to be perceived in it. In its Natural Form, some of it looks Whitish, and some straw-coloured, but all Shining: But if Pounded in a Mortar, the Brightness disappears, and the whole becomes Whitish. Note that Above and beneath the *Veins* there's a very thin *Septum* of Terrene matter, betwixt the *Amiantbus* and the *Stone* whereto it adheres. I put a small Quantity of the *Lint* in the *Fire*, which grew Red Hot: But though it Remained there $\frac{1}{4}$ of an *hour*, I could not perceive that it was any thing Consumed. I Twisted also some of it in the form of a *Week*, and dipping it in *Oyl* it gave as good a *Flame* as other *Weeks*, till the *Oyl* was Consumed; the *Week* remaining of the same Proportion as at first. Being satisfied it was *Incombustible*, I pounded some quantity of it in a *Stone* Mortar, till it became a *Downy* substance: Then I sifted it through a fine *Searce*, by which means the Terrene parts (being reduced to a Powder) came through the *Searce*, the *Linum* remaining. I then brought it to a *Paper Mill*: and putting it in *Water* in a Vessel just Capacious enough to make *Paper* with such a Quantity, I stirred it pretty much, and desired the Workmen to proceed with it in their usual method of making *Paper*, with their *Writing Paper-Mould*; only to stir it about ever before they put their *Mould* in, considering it as a far more Ponderous substance than what they Used, and that consequently if not immediately taken up after it was Agitated, it would Subside. *Paper* thus made of it proved but very *Course*, and too apt to Tear: But this being the first Tryal, I have some reasons to believe it may be much Improved.

By Mr. Edw. Lloyd. n. 166. p. 823.

XCIII. I here send you the account of the *Incombustible Linnen Cloath*, which I received of it from one *Corco*, a Natural *Chinese*, resident in the City

Incombustible Cloth; by Mr. Nich. Waite. Of n. 172. p. 1049.

of *Batavia* in the North-East parts of *India*: Who, by means of *Keay arear Sukradana* (likewise a *Chinese*, and formerly Chief customer to the old *Sultans* of *Bantam*) did after several Years diligence, procure from a great *Mandarin* in *Lanquin* (a province of *China*,) near $\frac{3}{4}$ of a *Yard* of the said *Cloth*; and declared that he was credibly informed, that the Princes of *Tartary*, and others adjoining to them, did use it in *Burning* their *Dead*; and that it was said and believed by them, to be made of the Under part of the *Root* of a *Tree* growing in the Province of *Sutan*, and was supposed, in like manner to be made of the *Todda trees* in *India*; and that, of the Upper part of the said *Root*, near the Surface of the Ground, was made a *Finer* sort, which in 3 or 4 times *Burning* I have seen Diminish almost half. They Report also, that out of the said *Tree* there Distills a *Liquor*, which not Consuming, is used with a *Wick* made of the same Material with the *Cloth*, to Burn in their *Temples* to Posterity.

By
ib p. 1050.

2. A *Hankerchief*, or *Pattern* of this *Incombustible Linnen*, which was shewn the *Royal Society*, was a foot long and just $\frac{1}{2}$ a foot broad.

There were two *Proofs* of its *Resisting Fire*, given at *London*: one, before some of the Members of the *Royal Society*, privately, *Aug. 20. 1684*; when *Oyl* was permitted to be Poured on it whilst *Red-Hot*, to Enforce the Violence of the *Fire*. Before it was put into the *Fire* this first trial, it Weighed 1 Ounce, 6 Drams, 16 Grains: And Lost in the *Burning* 2 drams 5 grains.

The second Experiment of it was publick before the *Society*, *Novem. 12* following, when it Weighed (as appears by the *Journal* of the *Society*) Before it was put into the *Fire*, 1 Ounce, 3 Drams, 18 Grains. Being put into a *Clear Char-coal Fire*, it was permitted to continue *Red Hot* in it for several *Minutes*: When taken out (though *Red-Hot*) it did not Consume a piece of *White Paper* on which it was laid: It was presently *Cool*, and upon Weighing it again, was found to have lost 1 *Dram*, 6 Grains.

Decem. 3. Mr. *Arthur Baily*, one of the *Fellows* of the *R. S.* Presented them with a piece of this *Linnen* in the Name of Mr. *Waie*. At the same time, the same Mr. *Baily* Presented Dr. *Plot* with another piece of it: which being brought to *Oxford*, the Experiment was again Repeated on it, *Decem. 16* it being put into a strong *Char-coal-Fire* in the *Natural History School*, in a full meeting of the *Philosophical Society* of that *University*; where after it had continued *Red Hot* for some Considerable Time, it was taken forth again little Altered when *Cold*, saving that it seemed a little *Whiter* and *Cleaner* than before.

By Dr. Rob. Plot. ib p. 1051.

3. This kind of *Linnen-Cloth* was esteemed by the Antients, though then more common, and perhaps better known; than 'tis yet amongst us; equally Pretious with the best of *Pearls*.

Nor is it now of Mean Value even in the Country where made, a *China Covet* (i. e. a Piece 23 inches and $\frac{3}{4}$ long.) being worth 80 *Tale*. i. e. 36 l. 13 s. 4 d.

The *Reality* of such a Being has been Doubted, or Deny'd by very good Authors: Who though they Owned such a *Mineral* as *Amianthus*, out of the *Woolly* part whereof this, sort of *Linnen* was always Antiently said to be made, yet Questioned the Possibility of its having been actually done. But *Pliny* says Expressly (and I Dare believe him in any thing he speaks of his own Knowledge) that he himself had seen *Napkins* thereof; which being taken Foul from the Board at a great Feast, were Cast into the *Fire*, by which means they were better Scoured, and looked Fairer and Cleaner, than if they had been Wash'd in Water.

And besides the Testimony of several Curious Persons in all Ages, we have Now seen a piece of this *Linnen*, pass the *Fiery Trial* both at *London* and *Oxford*.

This *Lanuginous Mineral* is call'd from its strange Qualities) sometimes *Amiantus*, quod in Ignem injectus non mutaverat; the *Fire* being so far from Defiling it, that it rather gives it a Lustre. 2. It is called *Albestos*. and 3. *Salamandra*, in English, *Salamanders-wool*: I suppose from the *Thryallides*, or *Candle-Wicks*, said to be Antiently made of it, which being put into *Lamps* of *Inconsumable Oyl*, would never Wast, or go out; which I take to be the True Reason of the imposition of these Names upon it, whether there ever were any such *Lamps* or no.

4. From a *Pungent Quality* *Agricola* says it has on the *Tongue* without *Astringency*, it is call'd *Alumen*: Having the Distinguishing Epithet *Plumeum* added to it, taken from its *Downy Filaments*, to Discriminate it from all the rest of them *Allums*.

5. From the *Light Gray Colour* of its *Lanuginous* parts, it is called by some *Polia*; by others, *Corfoides*; and from its likeness to the *Hoary Fibres* of some sort of *Mat-Weed*; *Spartapolia*.

6. From the Capacity it has of being Spun into Thred, it is also call'd *Linum*, with some Distinguishing Epithet taken either from its Quality, such as *Asbestinum*, or *Vivum*; or from the Place where found in General or Particular: It being called in General *Linum Fossile*; in English, *Earth Flax*, and in Particular: *Linum Indicum*; *Creticum*; *Cypricum* & *Carpasium*, or *Carystium*. But beside the Places that have given these Epithets to the Head made of it, it is also found in *Tartary*; at *Namur* in the *Low Countries*; at *Eisfield* in *Thuringia*; amongst the *Mines* in the old *Noricum*; some where in *Aegypt*; and in the Mountains of *Arcadia*; also at *Puteoli*; and lately in some *Mines* in *Italy*; and it has been yet latelier met with in a small Island belonging to *William Robinsón Esquire*, called *Ynis Molroniad*, i. e. the Island of *Sea Calves*, in the parish of *Llan Fair Yng Hornwy* in *Anglesea* in *Wales*.

It is commonly by the *Lithographers* reckoned among *Stones*: But I rather should Judge it a *Terra Lapidosa*, or Middle substance between a Stone and an Earth. But whether the one or the other, it is made of a Mixture (I guess) of some *Salt* or other, a Pure *Earth* without *Sulphur*, Coagulated in the Winter, and Hardned to Perfection by the Heats in Summer; Which *Salvatorius Hesus* proves by a very Cogent Argument to be *Alumen Liquidum*

dum, describing it as *Matthiolus* also does, to be of a Whitish Lacteous substance, some what inclining to Yellow, that sweats out of the *Earth*, and smells like *Rotten Cheese*; whereof having gathered a quantity at *Puteoli*, together with the other Species's of *Alum*, and kept it a while by him, when he came to look on it again, he found it to have lost the *Smell*, and a great part of it changed into *Alumen Plumeum*, the *Saline* part (I suppose) Shooting into *Threads*, and the *Pure Earth* Uniting them, as found in the Places wherever Generated; whether sweating from the *Earth*, as *Pliny* and *Matthiolus* would have it, or Percolated through *Rocks*, as we find it in *Wales*, the *Veins* of it there Running through a *Rock of Stone* in *Hardness* and colour not Unlike *Flint*.

And yet seems to be made of such an *Alum*, as that of *John Hesus* at *Puteoli* was, some of it being *Straw coloured*, as if it still retained the *Yellowness* that his *Liquid Bitumen* was said to have: Which is a Colour not given to it by any Author, most of it being said to be *White*, or *Cinereous*; some of it *Red*; and some of an *Iron Colour*, as *Agricola* tells us; and I have some of the *Cyprian* by me, sent from *Aleppo* by *Dr. Rob. Huntington* whereof some is of a *Light Blue*, or *Pearl Colour*, and some of it has a *Cast of Sea-Green*.

But however the whole *Mineral* substances found at several Places may Differ in *Colour*, yet I do not find but the *Woolly* part of them all seems to be much the same, viz. of a *White-Silver Colour*, the *Threads* very *Fine* and *Slender*, yet very *Ponderous*, the smallest particles of them thoroughly *Wet*, Sinking in water, as I also found a very slender *Thrumm* of the *Incombustible Linnen* given me by *Mr. Baily*, which *Mr. Waite* brought from *India*, would also do: Which Renders it very Probable that it is not a *Vegetable*, but a *Mineral* substance, notwithstanding the Informations of *Conco* and *Keay*. *arear Sukradana* mentioned in *Mr. Waites* Letter. I say Renders it Probable, there being several *Woods*, such as *Box*, *Red Wood*, *Persian Wood*, &c. that will Sink in Water.

De Region Ori-
entalibus.

Marcus Paulus Venetus acquaints us, that it is found in *Tartary* in a certain Mountain in the Province of *Chinchinthalas*, and made into *Cloth*, as he was informed by one *Curficar* a *Turk*, who was superintendent of the *Mines* in that Country, after this manner; The *Lanuginous Mineral*, or *Amiantus* being first *Dryed* in the *Sun*, is next *Pounded* in a *Brass Mortar*, and the *Earthy* part Separated from the *Woolly*, which is afterward *Washed* from all filth whatever that may stick to it; and so, being thus *Purged*, is *Spun* into *Thread* like other *Wool*, and after *Wove* into *Cloth*: Which if *Foul*, or *Spotted*, they *Cleanse* he says, by *Throwing* it into the *Fire* for an *hours* time, whence it will come forth *Unhurt*, as *White as Snow*. Which very Method (sa *Strabo* describes it) seems also to have been *Used* in ordering the *Cretan Amiantus*: Only with this Addition, that after it was *pounded*, and the *Earthy* part shook from the *Woolly*, he says it was *Combed*; and so does *Agricola*, which argues there was some of a *Greater Length* than any I have yet seen.

Of this *Linnen* (as *Pliny* informs us) Shrouds were Antiently used, at the *Royal Obsequies*, to Wrap up the Corps in, so as that the *Ashes* of their *Bodies* might be preserved Distinct from those of the *Wood*, which made the *Funeral Pile*: And the Princes of *Tartary*, as *Keay-arear Sukradana* was credibly informed (and I have it well Confirmed from other Hands) do use such at this Day, for *Burning* their *Dead*. It must be acknowledged, it does Diminish every time it undergoes the Violence of the *Fire*: Yet this hinders not, but it may, and will, do that Service Divers Times, before it be Rendred altogether Useless. Some of the Ancients are said to have made themselves *Cloths* of it; particularly the *Brachmans* amongst the *Indians*. The *Wicks* for the *Perpetual Lamps* of the *Antients* were also made of this Substance: And we are told, that *Septalla*, Canon of *Millan*, had *Thread*, *Ropes*, *Net works*, and *Paper* of it. *Marco Antonio Castagna*, who lately found this *Mineral* some where in *Italy*, knows how to Prepare, and Render it Tractable and Soft: Which he can Thicken and make Thin to what degree he pleaseth, and maketh it thereby, like either to a very *White Skin*, or a very *White Paper*. We have also made *Paper* of our *Welsh Amiantus* but lately here at *Oxford*, which will both bear *Fire* and *Ink* well enough, the *Ink* only turning *Red* by the Violence of the *Fire*.

To shew the Reason whence it is that this substance should be so Strangely Privileged by nature, we must consider, that the Qualities and Power of the *Fire*, according to *Aristotle*, are Διακρίνειν τὰ μὴ ὁμόφυλα συνκρίνειν δὲ τὰ ὁμόφυλα; to *Separate* things of a *Different*, and *Unite* those of a *like Nature*. Hence it is that the Subjects most apt to take *Fire*, and be Dissolved by it, we find to be such *Heterogeneous* bodies, in whose Pores the most *Sulphurous*, *Bituminous*, and *Aqueous* particles are Lodged: Which being Seized by *Fire*, are quickly put into Motion, Dilated and Separated; and being thus made capable of Flying away, are at last Consumed; and Dissolve the Frame of those bodies whose Parts before were United by them. When these are Fled and gone, the *Fire* naturally goes out, as having nothing now Left to Work upon; nothing remaining, but the *Salts* and *Earth* in the form of *Ashes*: Which in all sorts of *Compounds* are the things that Resist this Element most, and will Remain after the most Exalted Operation it can be forced to. Nor do the *Salts* only of *Mixt Bodies* thus Baffle the force of *Fire*: But the *Simple* ones much more, as being more *Homogeneous*, as we see in the *Decrepitation* of *Common Salt*, and *Exsiccation* of *Vitriol*, which when the *Aqueous* parts are once Evaporated, are now a *Pure Simple Homogeneous Body*, no more Sensible of the *Fire*, the *Decrepitation* Ceasing, and nothing Remaining that can be Dilated any further to break the Corns of *Salt*. Now whatever the *Fire* cannot Dilate, it cannot *Separate*, nor consequently *Destroy*, or Carry any thing from it, but what is *Heterogeneous* and accidentally Adhering to the outside of it: Which is perfectly the Case of our *Incombustible Linnen*, whose Threads being altogether *Homogeneous*, and nothing else but the *Pure Striæ* of *Liquid Allum*, as was shewn above, holding nothing of *Sulphur*, *Bitumen* or *Water*, or any thing that is *Different* or *Heterogeneous* to it self, that can be Dilated or Separated, it is in no Possibility of being liable to the *Fire*: Which may indeed

pass through it, as we see it does when it is made *Red-Hot*, but can carry nothing from it, but such Accidental Filth as has been put upon it, or Accrued by Using.

Lapis Calaminaris; by Mr. Giles Pooley. n. 198. p. 672.

XCIV. The *Lapis Calaminaris*, or *Calamine*, which is digg'd and prepared near *Wrington* in *Somersetshire*, is found sometimes in Meadows, sometimes in Arable, sometimes in Pasture; and as I have observed, most commonly in Barren and Rocky ground. The *Waters* thereabouts are much of the same Colour, Taste, Clearness, and Wholesomness with other Water. The *Grass* upon the Ground, and the *Leaves* of the *Trees*, are as Fresh where *Calamine* lyes as in any other place. But this I observe that the *Groowers* always Dig for it upon, or near *Hills*; for they expect none in those Grounds which have no Communication with *Hills*.

To Find out a *Vein* they digg a Trench till they come to the Rocks, where they expect it Lies; which Trench they generally digg from the North to South, or near upon that Point, the *Courses* usually lying from East to West, or at 6 a Clock, as their Term is, but sometimes the *Courses*, *Seams*, or *Rakes* as they call them, lie at 9 a Clock, and sometimes are *Perpendicular* which they call the High time of the Day, or 12 a Clock; and these *Courses* they esteem the Best. These *Seams* or *Courses* run between the Rocks generally Wider than those of *Lead-Ore*, unless they are inclosed in very Hard Cliffs, and then they are Narrow as the *Veins* of *Lead*. The Colour of the *Earth* where *Calamine* liss, is generally a *Yellow Grit*, but sometimes *Black*; for all *Countries*, as they term their Under-ground Works, are not alike.

The *Calamine* it self is of several Colours, some White, some Reddish, some Greyish, some Blackish which is counted the best, and when this is broken it is of several Colours.

In Working for it below in the *Countries*, they use the same Way and Instruments, as they do in *Lead-Mines*; and sometimes they Light upon a good quantity of *Lead*, but always find some *Eyes* of *Lead* among the *Calamine*: Though I think in *Lead-Mines* they do not always find *Calamine*. In Lading of the *Calamine* some pieces are Bigger than others, and Mixt with a gritty *Earth*; I have been informed that they have found one Entire Piece of 8 or 10 *Tun*, which by reason of its Bigness was forced to be broken in the *Groove* before it could be Landed: But generally it Riseth in small Particles; some about the bigness of a Nut, they call a small *Calamine*. In Ancient Works *Damps* and *Staunches* sometimes arise, but never in New-Works.

When they have Landed a good quantity of the *Calamine*, they Wash, Clean, or Buddle it as their Term is, which they perform after this manner. They Enclose a small piece of Ground with Boards or Turfs, through which a Clear Stream of Water runs; within this Enclosure they Shovel and often Turn their *Calamine*, and the impure and Earthy parts the Running Water carries away; and leaves the *Lead*, and the *Calamine*, and the other Heavier Stony and Sparry parts behind. When they have thus Washed the *Calamine*,

as *Clean* as they can, having Rak'd up the Bigger Pieces both of the *Lead* and *Calamine*, they put the smaller Parts into *Sieves*, made of Strong Wire at the bottom: And these they often Dip and Shake up and Down in a great Tub of Water, whereby the parts of the *Lead* which are mixt amongst the *Calamine* Sink to the Bottom of the *Sieves*, the *Calamine* remains in the Middle, and the other Sparry and Trashy parts Rise up to the Top; which they Skim off and Throw away, then they take off the *Calamine*, and after that the *Lead*. When they have thus Cleansed the *Calamine*, they are forced to Spread it abroad, and so Pick out with their Hands the Trash and Stones that remain. But all of it does not require so much Trouble; for some Riseth Big enough out of the Works to be Cleansed and Picked fit for the *Calcining Oven* without all this Charge and Pains: And I have seen several Loads of this Great *Calamine*, which had no Mixture of Earth or Trash in it.

Their *Calamine* being thus Prepared they carry it to the *Oven*, which, at least that which I saw, is much Bigger than any *Baker's-Oven*, and made much in the same Fashion: Only they Cast in their Coals into a *Hearth* made on one side of the *Oven*, which is Divided from the *Oven* it self by a Hem or Partition made open at the Top, whereby the *Flame* of the *Fire* passeth over, and so Heats and Bakes the *Calamine*. They let it lie in the *Oven* for the space of 4 or 5 hours, (the *Fire* burning all the while) according to the Strength of the *Calamine*, some being much Stronger than other, and so Requiring longer time; and while it continues in the *Oven*, they turn it several times with long Iron Coal-rakes; when it is sufficiently Burned, Baked, and Dried, they Beat it to a Powder with long Iron-Hammers, like Mallets, upon a thick Planck, picking out what Stones they find amongst it; so that at last the *Calamine* is reduced to *Dust*, and then it is fit for the Merchant.

I have been credibly informed that the *Dust* of *Calamine* conduces much to the curing of *Sore-Eyes* of Men: And that its Frequently made use of, for the taking off *Films* from the *Eyes* of *Horses* and other Beasts.

XCV. 1. Take of *Antimony* 1 pound; Flux it Clear: Have 1 Ounce or 2 of the *Cawk Stone* (by and by to be described) in a Lump Red Hot in readiness. Put it into the Crucible to the *Antimony*; continue the Flux a few minutes: Cast it into a Clean and not Greased Mortar, *Decanting* the Melted Liquor from the *Cawk*.

To Vitrify Antimony with *Cawk*; by Dr: Mart. Lister. n. 110. p. 225.

This process gives us above 15 Ounces of *Vitrum* of *Antimony*, like polisht Steel, and as bright as the most Refined *Quicksilver*. The *Cawk* seems not to be Diminished in its Weight but rather Increased; nor will be brought to Incorporate with the *Antimony*, though Fluxt in a strong Blast.

This *Cawk-Stone* is a very Odd *Mineral*, much a kin to the *White Milky Mineral Juices* of the *Lead-Mines*, which *Vitrifies* in like manner. Besides these I could never Light upon any One *Mineral* Substance, which had any such Effect upon *Antimony*.

Vid. Sup. §. XLVI.

Cawk is a Ponderous White Stone, found in the *Lead Mines*; it will draw a White Line like *Chalk* or the *Gallacites*; but it is more Fine and hath a smooth and Shining grain, *Sparr-like*, yet not at all Transparent.

The Vertue of
Antimony; by
.....n.39.p.774.

2. I Try'd that a *Boar*, to whom I had given an Ounce of *Crude Antimony* at a time, putting him into the *Sty*, would be Fat a fortnight before another, having no *Antimony*, upon the like feeding. *Antimony* will Recover a *Pig* of the *Measles*; by which it appears to be a great *Purifyer* of the *Blood*. I knew a *Horse* that was very Lean and Scabbed, and could not be fatted by any Keeping, to whom *Antimony* was given for 2 *Months* together every morning, and that upon the same Keeping he became exceeding Fat. One of my own *Horses* having had the *Fashions*, and being cured, had notwithstanding extream running Legs; so that after he had passed the Course of *Farryers* Twice, to be Cured, it was not done; but upon my giving him *Antimony* one week, he was presently Healed.

The manner of using it, is this. Take one *drachm* of *Crude Antimony* Powder'd for one *Horse*, and when you give him his *Oats* in a Morning, shake it out amongst his *Oats*: or make it in *Balls*.

A Black Shining Sand from Virginia, Examined by Dr. All. Moulen. n. 197. p. 624.

XCVI. A small Vial fill'd with Ordinary White Sand, and containing only 3. i. gr. xi. being fill'd with the *Virginia Sand* was found to contain 3 ij, 3 ij. gr. i.

This *Sand* did Apply to the *Magnet* both before and after *Calcination*: but the latter did Apply better to it than the former.

A Parcel of this *Sand* Mixed and *Calcin'd* with powder'd Charcoal, and kept in a Melting-Furnace for about an *Hour*, yielded no *Regulus*: but Apply'd more Vigorously to the *Loadstone* than either of the former.

I flux'd a Parcel of this *Sand* with *Fix'd-Nitre*, in a Melting Furnace for above an *Hour*, but could obtain no *Regulus*; nor any Substance that would Apply to the *Magnet*, excepting a Thin Crust that stuck firmly to a piece of Charcoal that Dropt into the *Crucible* when the Matter was in *Fusion*.

I Flux'd it also with *Salt Petre* and Powder'd Charcoal, dropping pieces of Charcoal afterwards into the *Crucible*. It continued about an *Hour* in the Melting Furnace in *Fusion*, and that without producing a *Regulus*, or a Substance that would Apply to the *Magnet*, excepting only what stuck to the Charcoal, as in the former Experiment.

I Flux'd another Parcel of it with *Salt-Petre* and *Flowers* of *Brimstone*, without being able to procure any *Regulus*.

I pour'd good *Spirit* of *Salt* on a Parcel of this *Sand*, but could observe no *Luftation* thereby produced.

I pour'd *Spirit* of *Nitre*, both strong and Weakned with Water, on Parcels of the same *Sand*, without being able to discover any *Conflict*.

I pour'd *Single Aqua Fortis* upon another Parcel of it, without being able to perceive any *Ebullition* worth noting.

I pour'd *Double Aqua-Fortis* upon another Parcel of it, which, for ought I could Discover, had no more Effect on it than the Former.

I pour'd also some *Aqua Regia* on a Parcel of it, without discovering any sensible effect. I pour'd good Oil of *Vitriol* upon another Parcel of this *Sand*, but seeing no *Bubbles* thereby produc'd, I weaken'd the Oil with Water, but without any sensible Effect.

I repeated all the former Experiments with the *Menstruums* upon this *Sand* after *Calcination per se* in a *Crucible*, but cou'd scarce observe a *Bubble* produc'd by any of them.

I pour'd some of each of the Liquors upon Parcels of the *Powder* of this *Sand Calcin'd*, without any Success.

Note, That I made these Experiments both in the *Cold*, and upon a *Sand-Furnace*. So that to me there seems to be but little wanting to Discover any *Metal* known to us, if it contained any such: for there is no *Metal* nor *Oar* that some of these *Menstruums* will not work on.

I Powder'd a Fragment of a *Loadstone*, and pour'd some of these *Menstruums* upon it, without being able to find that they in the least prey'd upon it, any more than they did upon the *Sand*.

I pour'd some of the afore mention'd *Menstruums* upon ordinary *Sand* taken out of a *Sand-Furnace*, where it must have suffer'd some *Calcination*, but could find no more *Bubbles* produced thereby, than what might rationally be suppos'd to be produc'd from *Lime*, and other *Dirt* mixt with the *Sand*.

XCVII. The *Black Sand*, which in *Italy* they use instead of *Dust* to their Letters, is found 6 Miles from *Genes* near *St. Piere d' Araine* on the Sea-Shore. It hath the Properties of the *Loadstone*, and I do believe that it is *Loadstone*, or *Powder* of *Loadstone*, for it followeth the *Loadstone*; it sticketh to a *Knife* that is touch'd with the *Loadstone*; it Draweth a *Magnetick Needle*; it doth not *Ferment* with *Aqua-Fortis*, as *Iron-Dust* doth; it doth not *Rust* with any *Acid* that can be put to it; it doth not *Sparkle* in the *Flame* of a *Candle*, as *Steel-Dust* doth, when it is thrown into the *Flame*. It is commonly found on the *Sea-Shoar* after *Great Storms*.

A Black Sand from Italy; by Mr. Butterfield. n. 244. p. 336.

XCVIII. A Certain *Powder* lately invented in *Germany* maketh *Metal* so *Close* and *Smooth*, that it leaves not the least *Pit* in the *Piece*; A *Gun* so *Cast* needs no *Boaring*, and one third of the *Metal* may be spared. Such *Guns* remain *Clean* and *Neat* a long while. *July 9. 1672.* there was *Cast* a *Demy-Cannon*, Weighing 34 Hundred, which was *Tryed* with a *Bullet* of 34. lb . and the *first* time 12. lb . of strong *Powder*, the *second* time as much, the *third* time 15. lb . and the *fourth* time 24. lb . all which it endur'd very well. With a small *Petard*, of 2. lb . of this *Metal*, I broke in pieces a beam of a *Rhine-foot* square, the *Petard* remaining *Entire* and *Perfect*.

To make Metal Run Smooth and Close; by ... at Franckfort on the Main. n. 94. p. 6040.

This *Powder* is not only easie to *Make*, but also of small *Expence*.

Iron-Works, in
Glocestershire;
by Mr. Hen.
Powle. n. 137.
p. 931.

XCIX. 1. The *Forest of Dean* (lying betwixt the *Wye* and *Severn*) consists generally of a *Stiff Clay*. The Country is full of Hills, but they are no where High: Betwixt them run great store of little *Springs*, of a more *Brownish Colour* than ordinary Waters, and often leave in their Passage *Tinctures of Rust*. The Ground is naturally inclin'd to *Wood*, especially *Hassle* and *Oak*: but 'tis now almost Devoured by the Increase of the *Iron-Works*. Upon the Surface of the Earth, in many places, lie an abundance of *Rough Stones*, some of them of a vast Bulk; but where they Sink their *Mines*, they rather meet with *Veins of Scaly Stone*, than *Hard and Solid Rocks*. Within the *Forest* they find great plenty of *Coal* and *Iron-Ore*; and in some places *Red* and *Yellow Oker*.

The *Iron-Ore* is found in great abundance in most parts of the *Forest*; Differing both in *Colour*, *Weight*, and *Goodness*. The Best, which they call their *Brush-Ore*, is of a *Blewish Colour*, very *Ponderous* and full of little shining specks like *Grains of Silver*. This affords the greatest quantity of *Iron*: but being Melted alone produceth a *Metal* very *Short* and *Brittle*. To Remedy this inconveniency, they make use of *Cynder*, which is found in great Quantities through all parts of the Country, where any former *Works* have stood; For in former Times, their *Bellows* being mov'd only by the strength of Men, their *Fires* were much less Intense than in the *Furnaces* they now Employ: So that they Melted down only the *Principal part* of the *Ore*, and Rejected the rest as *useless*. This is call'd *Cynder*, and being Mingled with the *Ore* in a *Due Quantity*, gives it that *Excellent Temper* of *Toughness*, for which this *Iron* is *Preserr'd* before any that is brought from *Foreign Parts*.

The *Ore* is first *Calcined* in *Kilns*, much after the Fashion of *Ordinary Lime Kilns*; which they fill up to the *Top* with *Coal* and *Ore*, *Stratum super Stratum*: Then putting *Fire* to the bottom, they let it *Burn* till the *Coal* be *Wasted*. This is done without *Fusion* of the *Metal*; and serves to consume the more *Drossy* parts of the *Ore*, and to make it *friable*. From hence they carry it to their *Furnaces*, which are built of *Brick* or *Stone*, about *24 foot* square on the out side, and near *30 Foot* in *Height*. Within not above *8* or *10 foot* over in the middle, the *Top* and *Bottom* having a *Narrower Compass*, much like the shape of an *Egg*. Behind the *Furnace* are placed *Two Huge Pair* of *Bellows*, whose *Noses* meet at a little *Hole* near the *Bottom*. These are *Compressed* together by certain *Buttons*, placed on the *Axis* of a very *Large Overshot Wheel*.

The *Furnaces* are at first filled with *Ore* and *Cynder* intermixt with *Fuel*, which in these works is always of *Charcoal*; laying them *Hollow* at the *Bottom*, that they may more easily take *fire*: But after they are once *Kindled*, the *Materials* run together in a *hard Cake* or *Lump*, which is sustained by the Fashion of the *Furnace*, and through this the *Metal*, as it *Melts* *Trickles* down into the *Receivers*, where there is a *Passage* open, by which they take away the *Scum* and *Dross*. Before this lies a great *Bed* of *Sand*, wherein they make *furrows* of what *Fashion* they please; into these they let in their *Metal*; which is made so very *fluid* by the violence of the *Fire*, that it conti-

nues Boiling for a good while. The *Furnaces* are kept at work Night and Day for many *Months*; still supplying the Waste of the *Fewel* and other Materials with Fresh, poured in at the Top.

From these *Furnaces*, they bring their *Sows* and *Pigs* of *Iron* (as they call them) to their *Forges*. These are of two sorts, though standing together under the same Roof: one they call their *Finery*, the other the *Chafery*. Both of them are upon Hearths, on which they place great Heaps of *Sea-Coal*, and behind them *Bellows*, like to those of the *Furnaces*, but nothing near so large. Into their *Finery*, they first put their *Pigs* of *Iron*, placing 3 or 4 of them together behind the *Fire*, with a little of one End thrust into it; Where softening, by degrees, they Stir and Work them with long Bars of *Iron*, till the *Metal* Runs together into a Round *Mass* or *Lump*, which they call a *Half-bloom*. This they take out, and giving it a few Strokes with their *Sledges*, they carry it to a great Weighty *Hammer*, raised likewise by the motion of a *Water-wheel*: where applying it Dexterously to the Blows, they presently Beat it out into a Thick Short Square. This they put into the *Finery* again, and Heating it Red Hot, they work it out under the same *Hammer*, till it comes to be the shape of a Bar in the Middle, with two square Knobs on the Ends. Last of all they give it other Heatings in the *Chafery*, and more Workings under the *Hammer* till they have brought their *Iron* into *Bars* of several Shapes and Sizes. If they Omit any One Process it will be sure to want some part of its Toughness, which they esteem its Perfection.

For the *Backs* of *Chimneys*, *Hearths* of *Ovens*, or the like, they take the Melted *Metal* out of the *Receivers* in great *Ladles*, and pour it into *Moulds* of Fine and.

2. 1. At *Milthrop-Forge* in *Lancashire*, they have several sorts of *Iron Stone*; In Lancashire; by Mr. John Sturdy. n. 199. p. 695. some of it making *Colashire Iron*, that is such as is Brittle, when it is *Cold*; another sort makes *Redshire*, that is such as is apt to Break if it be Hammered, when it is of a *Dark Red Heat*; and therefore they are never melted down but in Mixture, and so they Yield an indifferent Good sort of *Iron*. They have of late made it much better than heretofore, by Melting the *Sow-Metal* over again, as likewise by using *Turf* and *Charcoal*, whereas formerly their fuel was only *Charcoal*. They first Burn the *Iron Stone*; and then for every 17 *Baskets* of this Burnt Stone they put in one of *Limestone* Unburnt to make it Melt freely, and Cast the Cinder; which they always take off from the Melted *Iron*, before they let it Run.

The Bottom of the *Furnace* is about 2 *Yards* Square, and so rises Perpendicular for a *Yard* or more, which is also Lined within with a Wall of the best *Fire-Stone*, to keep off the force of the *Fire* from the Walls of the *Furnace*. The *Bellows* (which are very Large, and played with *Water*) enter about the Middle of the *Focus*. The rest of the *Furnace* is Raised upon this, 6 or 7 *Yards*, Square-wise, but Tapering; so that the Top Hole (where they throw in *Baskets* of *Stone* and *Fewel*) is but $\frac{1}{2}$ a *Yard* Square. When they find it to have Subsided about a *Yard* and $\frac{1}{2}$ then they fill the *Furnace* again.

The *Oar* is got in *Furness* (a Division of *Lancashire*) at least 15 *Miles* from *Milthrop*. Some of it is Hard, but feels Soft and Smooth on the outside, like Velvet. Some is soft as *Clay*; but all is Red; and one sort seems to be good *Hæmatites*

Ib. p. 697.

2. The *Forge* is very much like that of a Common Black smiths, about 1 $\frac{1}{2}$ *Yard* over, and the same Height. The *Hearth* is all of *Sow-Iron*, much of the Shape of a Broad-brim'd Hat, with the Crown Downwards. This Hollow Place they fill and Upheap with *Charcoal*, and lay the *Ore* (first broken into pieces as big as a Pigeons Egg) all round about the *Charcoal* upon the flat *Hearth* to Bake it, as it were, or Neal it, and thrust it in by little and little into the Hollow, and keep Blowing for some 12 *Hours*. Then they pull out a *Stopple* at the Bottom of the *Wall*, and out comes all the *Glassie Cynder* being very Liquid, leaving the *Iron* (which is never in a perfect *Fusion*) in a *Lump* at the Bottom. This they take out with great *Tongs*, and turn it under heavy *Hammers* (played with *Water*) which at the same time Beat off, or rather squeeze out, the fluid *Scoriæ* (especially at first taking out of the *Furnace*) and Form it after several Heats into *Barrs*. They use no *Limestone* or other thing to promote the *Flux*. They get about an *Hundred* weight of *Metal* at one *Melting*, which is the Product of about 3 times so much *Ore*.

Ib. p. 699.

Steel is not made from that they call *Steel-Ore*, but *Iron*, such as is made from the rest.

The several sorts of *Ores* lye in one *Vein*, which is sometimes an *Inch*, sometimes a *Foot*, and sometimes 3 or 4 *Yards* Broad, and many *Fathoms* Deep, between *Grey Limestone* Rocks: but the *Hard Ores* lye usually next the Rocks on each side, and the *Soft Ore* in the Midst. They use the *Soft Ore* frequently and with good Success, as a *Medicine* for the *Murrain* in *Cattle*, and for all *Diseases* in *Swine*, to which last they will give a good Handful or Two in *Milk*.

By Dr. Lister. *ib.*

3. This *Clay Hæmatites* is as Good, if not Better, than that which is brought from the *East-Indies*; Witness the *Tea-pots* made of it in *Staffordshire*.

The True Way of Making of Steel. by Dr. Mart. Lister. n. 203. p. 865.

Vid. inf. Vol. III. par. II. Cap. II. §. XLIV.

C. Those Famous and Stupendious Monuments of *Antiquity*, the *Ægyptian Obelisks* are all of *Porphyry*, and most of them curiously Carved with a vast number of *Figures*; one way of *Writing* of the *Ancient Egyptians*: These Witness the Facility that Nation had of *Graving* in *Porphyrie*; a Stone which no *Tool* will now Touch, nor nothing less Affect, than *Emery* or *Diamant-Powder*

Mr. *Ray* assures us, that all the *Obelisks* of *Rome*, that are Graven with *Hieroglyphicks*, are of one and the same kind of Stone, viz a *Marble* of a Mingled Colour, *Red* and *White*, very *Hard*, and hath not in so many Ages Suffered the least by the *Weather*.

Something there is certainly Lost in this Age, as to the manner of *Steeling* of *Tools*: And the *Processes* now used by most Nations, are *Fraudulent*, and

a Poisoning of Iron, by certain Mineral Salts, rather than a True Making of Steel.

Aristotle tells us, That wrought Iron it self may be Cast so as to be made *Meteor. L. 4. c. 6.*
 " Liquid, and to Harden again: And they are wont to make Steel thus:
 " For the Scoria of Iron subsides, and is purged off by the bottom. And
 " when it hath been often Defecated, and made Clean, this is Steel. But this
 " they do not often, because of the much Waste, and for that it loses much
 " Weight in Fining. But Iron is so much the more Excellent, the less Ex-
 " crement it hath. This Account is a little Confused, and not well Under-
 stood: It is indeed True, that Iron is still better, the more it is Purged. It
 is as true that even wrought Iron may be Melted as often as you please; and
 as oft as it is Melted and Purged, it loseth much of its Weight. But after all,
 Iron of it self, how oft soever it is Purged and Refined, will never become
 Steel; yet of this so Purged, the Best Steel doubtless may be made.

The manner of making True Steel, is thus faithfully described by *Agricola. De re Metal.*
 And this way by *Kircher* is said to be now in use in the Island of *Ilva*, a Place *l. 9.*
 famous from all Ages, even from the Times of the Romans, for that Metal a-
 lone, down to our Days.

" Make Choice of Iron which is apt to Melt, and yet Hard, and yet which
 " may easily be wrought with the Hammer, for although Iron which is made
 " of Vitriolick Ore, may melt; yet it is Soft, or Fragil, or Eager. Let a Par-
 " cel of such Iron be Heated Red Hot, and let it be cut into small Pieces, and
 " then be mixt with that sort of Stone, which easily melts; then set in the
 " Smith's Forge or Hearth, a Crucible or Dish of Crucible Metal, a Foot and an
 " half Broad, and a Foot Deep; fill the Dish with good Charcoal, and Com-
 " pass the Dish about with loose Stones, which may keep in the Mixture of
 " Stone, and Pieces of Iron put thereon.

" As soon as the Coal is throughly Kindled, and the Dish is Red Hot, give
 " the Blast, and let the Work man put on by Little and Little, all the Mix-
 " ture of Iron and Stone he purposes.

" When it is Melted, let him thrust into the middle of it, three or four, or
 " more pieces of Iron, and Boil them therein 5 or 6 Hours, with a sharp Fire;
 " and putting in his Rod, stir often the Melted Iron, that the Pieces of Iron
 " may imbibe the smaller Particles of the Melted Iron, which Particles Con-
 " sume, and Thin the more gross Particles of the Iron Pieces; and are as it
 " were, a Ferment to them, and make them Tender.

" Let the Work man now take one of the pieces out of the Fire, and put
 " it under the Great Hammer to be drawn out into Bars, and wrought, and
 " then, Hot as it is, forthwith plunge it into Cold Water.

" Thus Tempered, let him again Work it upon the Anvill and Break it;
 " and looking upon the Fragments, let him consider whether it look like Iron
 " in any part of it, or be wholly Condensed, and turned into Steel.

" Then let the Pieces be all Wrought into Bars; which done, give a fresh
 " Blast to the mixture, adding a little fresh Matter to it, in the room of that
 " which had been Drunk up by the Pieces of Iron; which will Refresh and
 " Strengthen the Remainder, and make yet Purer the Pieces of Iron again put

“ into the Dish: Every one of which let him, as soon as it is Red Hot, Beat
 “ into a Bar, upon the Anvil, and Cast it Hot as it is into Cold Water. And
 “ thus Iron is made into Steel; which is much Harder and Whiter than I-
 “ ron.

Lib. 34. c. 14.

Pliny, speaking of Iron, says, *Fornacum maxima Differentia est: in iis equi-
 dem Nucleus Ferri excoquitur ad Indurandam Aciem, alioque modo ad Densan-
 das Incudes Malleorumve Rostra.* From this Passage it should seem, that the
Ancients had one way to make Steel, and another way to Harden or Temper their
Tools, particularly such as *Picks* and *Anvils*. And it is plain that the *Nucleus
 Ferri* (by which must be meant well purged Iron; the same which *Aristotle*
 calls *εἰσπαυῖν* & *σέδνε*) was melted down in both. But in my Opinion
 with this difference, in Making Steel, they not only Boil'd their Iron in its own
Sow-Metal, or *Liquid Iron*, but Hammer it also, and after Quench it in Cold
Water.

And this Opinion those other words of *Pliny* in the next Chapter favour;
*Ferrum accensum Igni, nisi Duretur Ictibus, corrumpitur: And again, Aqua-
 rum summa Differentia est, cui subinde Candens immergitur.* And this way
 was sufficient for *Sword-Blades*, and *Knives*, *Razours*, &c. Whereas in
Steeling their *Tools*, they Boiled their *Tools* in *Sow-Metal*, to such a Degree
 of *Hardness* or *Temper*, as was Requisite, and did not afterwards Hammer
 them. For *Iron* this way made into *Steel*, becomes a kind of *Electrum*, and
 is filled with an exceeding Brittle and Hard Body; for which purpose the
 Word *Densare* is, by *Pliny*, aptly and Elegantly used. And this way was u-
 sed when the strongest *Temper* and *Hardness* was required; as to *Picks* and *An-
 vils*: For it is Certain that *Steel*, as well as *Iron*, by *Ignition*, is Spoiled or
 Corrupted. Hence it was that the *Ancients* well knowing that in making
 their *Tools* out of *Steel*, they could not but considerably Lose and abate of
 their *Temper*; they first shaped them, and then gave them a strong Body of
Steel and *Temper* together, and so had nothing else to do but to Finish them
 on the *Grindstone* and *Hone*, to set the Point or Edge.

Copper-Mines
 in Hungary;
 by Dr. Edward
 Brown. n. 59.
 p. 1042.

Cl. I. *Herrn Ground* is a little Town in *Hungary*, seated very high be-
 tween two Hills, upon a part of Land of the same Name, an *Hungarian*
Mile distant from *Newsol*. In this Town is the Entrance into a Large Cop-
 per Mine, very much Digged.

I went in through a *Cuniculus* call'd *Tach stoln*. The steep Descents are
 made by *Ladders* or *Trees* set Upright, with deep Notches or Stairs cut in
 them to stay the Foot upon. They are not troubled with *Water*, the *Mine*
 lying High in the *Hill*: But they are molested with *Dust* and *Damps*.

The *Veins* of this *Mine* are Large, many of them Cumulate, and the Ore
 very Rich; in an hundred Pounds of Ore, they ordinarily find twenty Pounds
 of *Copper*; sometimes thirty or forty, half *Copper*, and even to sixty in the
Hundred. Much of the Ore is joined so fast to the Rock, that it is separated
 with much Difficulty. There are diverse sorts of Ore; but the chief difference
 is between the *Yellow* and the *Black*; the *Yellow* is pure *Copper Ore*, the *Black*
 contains also a Proportion of *Silver*.

They

They find no *Quicksilver* here: The Mother of the Ore is *Yellow*; and the *Copper Ore* heated and Cast into *Water*, maketh it become like that of some *Sulphureous Baths*.

They separate the *Metal* from the Ore with great Difficulty. The Ore commonly passes 14 times through the Furnaces: Sometimes it is Burned, and other times Melted, sometimes by it self, and sometimes mixt with other Minerals and its own Dross.

There are diverse sorts of *Vitriol* found in this Mine; *Green, Blew, Reddish* and *White*. There is also a *Green Earth*, or sediment of a *Green Water*, called *Berg-grun*. There are likewise *Stones* found of a beautiful *Green* and *Blew* colour, and one sort, on which *Turcoises* have been found; therefore called the *Mother* of the *Turcois*.

There are also two Springs of a *Vitriolate Water*, which are affirmed to turn *Iron* into *Copper*. They are called the *Old* and the *New Ziment*. These Springs lie deep in the Mine. The *Iron* is ordinarily left in the *Water* 14 Days. I took diverse pieces formerly *Iron*, now appearing to be *Copper*, out of the *Old Ziment*. They are hard within the *Water*, and do not totally lose their Figure, and fall into Powder; they will easily Melt, without the Addition of any other Substancc.

They make Handsome Cups and Vessels out of this sort of *Copper*.

2. There is a Heap of *Copper Ore* by *Darwent* near *Keswick*, but I suppose the Weather hath eaten out all the *Copper* that was in it. It is reported, that the Thickness of the *Vein* at *Gouldscope* in *Newlands* was 6 Foot. There is no *Shafts* now in being either at *Newlands* or *Caldbeck*. There are diverse *Adits*; but they are useless, the Workmen having wrought down the Ore far below them. There is part of an *Adit* wrought at *Caldbeck*; but it is uncertain what it may cost finishing; for some Stone may be wrought for 20 *Shillings* a *Fathom*, and some of it may prove so Hard, that it may cost 10 *Pound* a *Fathom*.

In Lancashire and Cumberland, by Mr. Dav. Davies, to Dr. Lister. n. 200. p. 737.

A Thousand *Pound* Stock will be enough to begin with, to get Ore at *Caldbeck-Mines*, and then there must be *Smelting-Houses* built, which cost 500 *Pound* or more. And before *Copper* be made ready for sale at the Market, and the Work come to pay it self, it will be 6 or 7 Years at least, and by that time 10000 *Pound* will be *Stock* little enough.

3. The *First Work* that was found, and Wrought in by the *Dutch-men*, in *Coniston Fells*, is called *Low-Work*. It hath a *Stulm* or *Shaft* to draw *Water* from the Mine. This Work was left good, and had been Wrought from the Day to the Evening End of the said Work 40 *Fathoms*, or thereabouts. The *Seam* or *Vein* of *Copper Ore* then Left, was above 3 quarters of a *Yard* Thick of Good Ore: Which *Seam* or *Vein* did go from the Evening-End to the Morning-End of the said Work, and was esteemed 200 *Fathoms* betwixt, Wrought as the *Vein* went; and was, when Left, all near of a Breadth or Thickness. The *Copper Ore* in this Work was Mixt with some *Silver*, or *Lead Ore*.

By to Dr Lister. ib. p. 741

The *Second Work* is called *White Work* or *New Work*, about 40 *Fathom* from the

the First ; was wrought about 10 *Fathom* deep. The *Seam* then left was about 22 *Inches* of Good Copper Ore.

The *Third*, is called *Toung-Brow*, a little distant from the last ; being Wrought about 30 *Fathom*, and the *Seam* about two *Foot* thick of the like Ore.

The *Fourth*, is called *God's Blessing*, or *Thurdlehead* ; being Wrought about 20 *Fathom*, and being from the Last Mine about a *Mile* ; the Thickness of the *Seam* of Ore above a *Yard*, when Left off, and thought to be much of it Gold Ore.

The *Fifth*, called *Hen-Cragg*, is a *Mile* from the Last, Wrought about 2 *Fathoms* ; a small *Seam*, but excellent Ore.

The *Sixth* Work is called *Sumy-Work* at *Levers-Water*, at the Water side, and a little above that, *Hanch Clockers-work* ; a little above that, *George Towers* and *William Dixson's work* ; *Bartle Clocker's Work* ; near the last, *Kichard Tower's Work* ; then *John Saclock's Work*, and *Hanch Mire's Work* ; being all, *Seven Works*, and lie altogether, and about a *Mile* from the *Fifth Work* abovesaid ; and Wrought about 10 or 12 *Fathom* ; the *Seam* of Ore about 16 *Inches* Thick ; the Stone very soft, and the Ore very Rich, and much of the said Ore Green. If the *Tarn* was drained (its thought) that all these 7 *Works* would come into One, and that it would be the Best Work that ever was in these Parts.

The *Seventh* Work is called *Gray-Cragg-Beck*, wrought hut a little, the *Seam* about 18 *Inches* Thick, of as Good Ore as any of the other Works.

The *Eighth* is called *John Dixon's Work* in *Brumsell*, was wrought about 2 *Fathom*, the *Seam* about 24 *Inches* Thick, and esteemed the Best Ore, except *God's Blessing*. It is about Half a *Mile* from the last Work.

The *Ninth* Work is called the *Wide Work*, or *Thomas Hirn's Work*, wrought about 60 *Fathom*, and left a *Seam* above 26 *Inches* Thick, when the Work was given over, of very good Ore. It has a *Shaft* or *Pump* to Draw the water away, and it is from the last Work about 2 *Miles*.

The *Tenth* Work is called *Three Kings* in *Tilburthwait*, being 3 *Works*, and wrought above 40 *Fathoms* a piece, the *Seam* being above 14 *Inches* of very Good Ore.

These are all the works that have been wrought in *Coniston-Fells* : Most of them have small *Seams* near the Copper, of a Grey sort of Ore in small Threads.

There are lately Discover'd 3 *Veins* in *Torverwell*, and about 10 in other Places, and all within *Two Miles* of the *First work* in *Coniston-Fells*, and as Hopeful as those that have been Wrought in.

When the Ore which was got at *Conistone*, came to be smelted at *Keswick*, they found it so much to exceed the Copper Ore of either *Caldbeck* or *Newlands*, that they let fall these works, and sent the Workmen to *Coniston-Fells* ; so that there was one Hundred forty Men kept constantly at the Works there ; and the Ore that they got, did sufficiently furnish and supply the *Smelt Houses* at *Keswick*.

The Rate that was given for getting of Copper Ore was according to its Goodness, from 8 Shillings a Kibble to 2 Shillings and six pence, every Kibble being near a Horse Load in Weight, it being first Beaten very small, washed, and sifted thro' an Iron Sieve, then Measured or Weighed.

There was near the First Work a Stamp-House, which went by Water, and several Persons were employed to bring the Refuse from Each Work, that the Miners did Throw away, to the Stamp house, where it was Stamped, washed, and Order'd, and they had 2 Shillings and six pence for their Pains.

CII. Calamine is Digged out of several Mines in the West of England (as about Mendipp, &c.) about 20 Foot deep. It is Burned or Calcined in a Kiln or Oven made Red Hot, then Ground to Powder, and sifted into the fineness of Flower, then mix'd with Ground Charcoal, because the Calamine is apt to be Clammy, to Clodd, and not so apt or Capable of Incorporating. Then they put about 7 Pound of Calamine into a Melting Pot, of about a Gallon content, and about 5 Pound of Copper uppermost; the Calamine must be Mixt with as many Coals as will fill the Pot. This is let down with Tongs into a Wind Furnace 8 Foot deep, and remains 11 Hours therein; they cast off not above Twice in 24 Hours. One Furnace holds 8 Pots. After Melting it is Cast into Plates or Lumps.

45 Pound of Raw Calamine produces 30 Pound Burnt or Calcin'd.

Brass Shruff serves instead of so much Copper; but this cannot always be Procured in Quantities, because it is a Collection of Pieces of Old Brass, which is usually Procur'd in small Parcels.

The Best Guns are not made of Malleable Metal, and cannot be made of Pure Copper or Brass; but it is necessary to put in Courser Metals to make it Run Closer and Sounder, as Lead and Pot-Metal; Bell Metal being Copper and Tin; and Pot Metal, Copper and Lead. About 20 Pound of Lead is usually put into a 100 Pound of Pot-Metal: But about 6 Pound is sufficient to put into 100 Pound of Gun-Metal.

The Calamine Stones were heretofore fetched from Poland; but since fetched from Hence by the Dutch.

The Manufacture of Brass was Privately kept in Germany for many Hundred Years; wherein many Thousands were Employed, and all were maintained; some having thereby raised themselves to Great Estates.

CIII. It is supposed by the Miners, That there was a great Concussion of the Waters in that separation of the Waters from the Waters at the Creation, when the Dry Land first Appeared, or at Noah's Flood; or at both times: Whereby the Waters Moved and Removed the (then) Surface of the Earth. That till then the Uppermost surface of Mineral Veins, or Loads, did (in most Places) lie even with the (then Real, but now Imaginary) Surface of the Earth, which is now call'd the Shelf, or Fast Country, or Ground that was never Moved. But at this Concussion of the Waters, the Surface of the Earth, together with the Uppermost of those Mineral Veins, were loos'd, and torn off, and by the Descending of the Waters into the Valleys, both the Earth, or

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Grewt,

Grewt, and those *Mineral Stones* or Fragments, so torn off from their *Loads* (which are constantly Termed *Sboad*) were, together with, and by the Force of the Waters carried beneath their proper Places, and from some Hills even to the Bottoms of the Neighbouring Valleys; and from thence by Land Floods many *Miles* down the Rivers.

Trayning a
Load.

1. Upon these Suppositions we proceed in Trayning a Load, thus ;
 1. Where we suspect any *Mine* to be, we diligently search that Hill and Country, that we may the better know the *Grewt*, and *Stones*, when we meet with them at a Distance in the neighbouring Valley.
 2. Then we observe the *Frets* in the Banks of Rivers that are newly made by any great *Land-Flood*, which usually are then very Clean, to see, if happily we can Discover any *Metalline Stones* in the Sides or Bottoms thereof, together with the Cast of the Country, (i. e. any Earth of a different Colour from the rest of the Bank) which is a great help to Direct us, which side or Hill to search into. The *Mineral Stones* are Discovered either by their *Ponderousness*, or by their *Porosity*; for most *Tin-stones* are *Porous*, not unlike great Bones, almost throughly Calcined; yet *Tin* sometimes lies in the *firmest Stones*: Or by *Vauning*, which is performed by Pulverising the Stone or Clay, or what else may be suspected to Contain any *Mineral Body*, and placing it on a *Vauning-Shovel*; the Gravel remains in the Hinder part, and the *Metal* at the Point of the *Shovel*, whereby the Kind, Nature, and Quantity of the *Ore* is very nearly Guess'd at:
 3. If no *Sboad* be found in these *Frets*, we trust not to any found in the *River*, it being uncertain from whence the Water may have brought them. But we go to the Sides of those Hills most suspected, where there may be a conveniency of bringing a little stream of Water (the more the better) and Cut a *Leat*, *Gurt*, or Trench, about 2 *Foot* over, and as deep as the *Shelf*, in which we turn the Water to Run 2 or 3 *Days*; by which time the Water, by washing away the filth from the *Stones*, and the looser parts of the Earth, which easily discover what *Sboad* is there. If we find any, we have a Certainty of a *Load* in the Upper part of the Hill, or at least a *Squatt*.
 4. Sometimes *Sboad* may be found upon the Open Surface of the Ground, but then 'tis brought thither by some Accident, for the Corruption of Vegetables and other Creatures, have in a long Tract of Time since the *Deluge*, begotten a new Surface, Heightned in some places a *Foot* or more above the *Shelf*; and this is Demonstrable to the Eye in every *Tin Work*.
 5. At the Foot or Bottom of the Hill, we sink an *Essay Hatch*, or a Hole, about 6 *Foot* long, and 4 *Foot* Broad, and always as deep as the *Shelf*. If we find no *Sboad* before, or when we come to the *Shelf*, there is none to be expected: Yet sometimes the *Sboad* is Washed away Clean, when you come within two or 3 *Foot* from the *Load*, which then lies so much farther up in the Hill. If we find *Sboad*, we are almost at a certainty: And this is held as an infallible Rule, that the nigher the *Sboad* lies to the *Shelf*, the Nigher the *Load* is at Hand, & vice versa.
 6. If we find no *Sboad* in this *First Hatch*, we ascend commonly about 12 *Fathom*, and sink a *second hatch*, ● the former. And in case none appear in this,

this, we go then as many *Fathom* on each Hand at the same Height, and sink there as before; and so Ascend proportionably with *Three* or more *Hatches* (if the space of Ground requires) as it were in *Breast*, till we come to the top of the Hill, and if we find none in any of these *Hatches*, then farewell to that Hill.

7. But if we find any *Shoad* in any of these *Hatches*, we keep our Ascending *Hatches* in a direct Line; and as we draw nearer the *Load*, we lessen our first Proportion of *Twelve Fathom*, to *Six* or less, as our Conjecture Guides us.

8. If finding *Shoad* lying near the *Shelf* in one *Hatch*, and None in the next Ascending, we conclude that we have certainly over-shot the *Load*; and then we sink nigher that *Hatch*, wherein we last found *Shoad*.

9. Sometimes we find two Different *Shoads* in the same *Hatch* at different Depths, and then we have a certainty of another *Load* above the Former; and it may be in *Training* up to the *Second*, we meet with the *Shoad* of a *Third*. Some *Tinners* affirm that 7 *Loads* may lie parallel to each other in the same Hill, but yet one only *Master Load*; the other 6 (three on each side) being the Lesser Concomitants. So may Five lie in like manner; three are Common.

10. Every *Load* has (as it were) a Peculiar Coloured Earth or *Grewt*, about it; which is found likewise with the *Shoad* in a greater quantity, the Nearer the *Shoad* lies to the *Load*, and so lessened by degrees to about a $\frac{1}{4}$ of a *Miles* Distance; farther than which, that peculiar *Grewt* is never found with the *Shoad*.

11. A Valley may so lie, as at the Feet of 3 several Hills; and then we may find 3 several *Deads*, i. e. Common Earth, or that loose Earth which was moved with the *Shoad* in the *Concussion*, but not Contiguous to the *Load* in its first Position, (which is also termed by us the *Run* of the *Country*) with as many different *Shoads* in the midst of each. And here the Knowledge of the *Cast* of the *Country*, or each *Hill*, in respect of its *Grewt*, will be very necessary, for the surer *Training* of them one after another, as they lie in order, according to the foregoing Rules of *Essay Hatches*: For the Uppermost will direct you, with which Hill to begin first.

12. It may be that after we have *Trained* up the Hill, instead of a *Load*, we find nought but a *Bonny* or *Squat*, which likewise have their *Shoad*: whose Form is about 2 or 3 *Fathom* long, and half as Broad; few larger, most less; which Communicates with no other *Load* or *Vein*, neither doth it send forth any of its own; but is entire of it self, and may go down into the *Shelf* 5 or 6 *Fathoms* deep, and there Terminate.

2. When we have found the *Load*, the last *Essay Hatch* is then called a *Digging the Tin Shaft* or *Tin Hatch*, which we sink down about a *Fathom*, and then leave a little long square Place, Termed a *Shamble*, and so continue *Sinking* from *Cast* to *Cast*, (i. e. as high as a Man can conveniently throw up the *Ore* with a *Shovel*) till we find either the *Load* to grow small, or degenerate into some sort of *Weed*, which are diverse; as *Mundisk*, or *Maxy* Corrupted from *Marchasite*) *White*, *Yellow*, and *Green*; *Daze*, which is a kind of Glittering Stone.

Stone Enduring the Fire, of different Colours, *White, Black, and Yellow; Iremould, Black and Rusty; Caul, Red,* (differing both from *Mundick* and *Sparr*, Enduring the Fire) which *Marcasite* will not; *Glyter, Blood Red and Black.*

2. We then begin to make a *Drift* 3 Foot wide, and 7 Foot High: And if the *Load* be not Broad enough of it self, as some are scarce $\frac{1}{2}$ a Foot, then we usually break down the *Deads*, or that part of the *Shelf* which Contains no *Metal* but Encloseth the *Load*, as a Wall, between two Rocks, and then we begin to *Rip* the *Load* it self.

3. The *Instruments* we make use of, are, 1. A *Beele*, or *Cornish Tubber*, (*i. e.* Double Points) of 8 Pound or 10 Pound weight, sharpened at both Ends, well Steeled and Holed in the Middle; it may last in a Hard Country $\frac{1}{2}$ a Year, but New Pointed every Fortnight at least. 2. A *Sledge*, flat Headed from 10 Pound to 20 Pound Weight, 'twill last about 7 Years, New ordered once a quarter. 3. *Gadds*, or *Wedges*, of 2 Pound weight, 4 Square, well Steeled at the Point; they will last a Week; 2 or 3 Days, then sharpned. 4. *Ladders*, 5 *Wheel-Barrows*, to carry the *Deads* and *Ore* out of the *Drifts* or *A-dits*, to the *Shambles*.

4. There are two *Shovel-Men*, and 3 *Beele-men*; which are as many as one *Drift* can Contain, without being an Hindrance to each other. The *Beele-men* Rip the *Deads* and *Ore*; the *Shovel-men* carry it off, and Land it, by casting it up with *Shovels* from one *Shamble* to another, unless it be where we have a *Winder* with 2 *Keebles* (or *Buckets*) one of which comes up as the other goes down.

5. It is generally observed that most of our *Tin Loads* run from *West* to *East*, and then they constantly *Dip* towards the *North*, sometime they *Underlye* (that is, Slope down towards the *North*) 3 Foot in 8 perpendicular: Yet in the Higher Mountains of *Dartmoor* there are some considerable *Loads*, which Run *North* and *South*; these *Underlye* towards the *East*.

6. *Four* or *Five* *Loads* may Run Parallel to each other in the same Hill, and yet (which is rare) Meet altogether in one *Hatch*, as it were in a *Knot* (which well *Tins* the Place;) and so seperate again, and keep their former Distances. Such a *Knot* hath been Observed, and Wrought on *Hingston*, a known *Mineral-Down* or *Common*, in *Cornwall*.

7. The Breadth of *Master-Loads* may generally be from 3 to 7 Foot, seldom larger; unless where several *Loads* may chance to make a *Knot*, or send forth *Strings* or *Veins*. Neither Retain they their usual Breadth in all parts; for they may be 6 Foot at one place, and not 2 at another; nay sometimes scarce $\frac{1}{2}$ Inch over; but that is to be understood of *Strings*, and the Narrowest Places of the *Concomitant Loads*.

8. The *Load* is usually in a Hard Rocky Country, made up of *Metal, Sparrs* and other *Weeds*, at it were all along a continued Rock: But it hath many *Veins* and *Joints*, as we speak; but in some softer Countries, the *Tin* may lie in a softer Consistence, as that of *Clay* in a manner Petrify'd.

9. In most Places we meet with *Water* at some Feet deep from the *Loady* Surface, in other some not at many fathom deep: It runs continually thro' the

the Heart of the *Load*. When it begins to Trouble us, we begin at the foot of the Hill a *drift*, or *Adit*, scarce half so bigg as that of the *Load*, and work it on a *Level*, till we come up to the *Load*. But if we have not this Conveniency of an *Adit*, or if we Pass that *Level*, we are forced to draw it with *Winders* and *Keebles*, or with *Pumps*: Some, but very Few, *Works* may be Dry.

10. We observe, that if we have *Water*, we never want *Air* sufficient for *Respiration*, and our *Candles* to Burn in: Yet sometimes in a soft Clayie *Country*, our *Air* is so much Condensed, that it becomes in a manner a *Damp*, and requires an *Air-shaft* for Vent; which *Damps* are sometimes Enlarged by Working of the *Mündick* with the *Ore*.

11. If the *Country* be not strong enough, we underprop our *Drifts* with *Stemples*, and *Wall-Plates*, placed much like a Carpenter's Square, on the one side, and over Head

12. To know which Way the *Load* Enslines, or to bring an *Adit*, or to Sink an *Air-shaft* to the desired Place, the use of the *Dial* is needful, which we term *Plumming* and *Dialling*, and is thus performed. A Skilful Person first fastens the end of a Long Line at a Known Place, and then exactly observes the *Point* at which the *Needle* of his *Dial*, or *Compass* rests; and at the next Flexure he makes a Mark on the Line, and again notes the *Point* at which the *Needle* stands at this second *Station*; and so proceeds from Turning to Turning, still Marking the *Points*, and his Line, till he comes to the intended Place. He then repeats Above Ground what he had done Below, and his *Dial* and *Line* leads him, till he come exactly over the place where he Ended in the *Mine*.

3. When the *Ore* is Landed, and the greater *Stones* Broken at the Top of the *Mine* by the *Shovel-men*, 'tis brought on Horses to the *Stamping* or *Knock- Dressing of the Tin.*
ing-Mills, and Unloaded at the Head of the *Pass* (*i. e.* 2 or 3 Bottom-Boards with two Side boards sloping wise,) in which the *Ore* slides down into the *Coffer*: But that it may not Tumble down all at once, there is placed a *Hatch* nigh the lower end of the *Pass* (*i. e.* a Thwart Board to keep up the *Ore*); beneath that comes in the *Cock-Water* in a Trough cut in a long Pole, which with the *Ore*, falls down into the *Coffer*, (*i. e.* a long square Box of the firmest Timber, 3 foot long, and $1\frac{1}{2}$ foot over,) wherein the 3 usual *Lifters*, placed between two strong broad *Lones*, having two *Braces*, or Thwart pieces, on each side to keep them steady as a Frame, with *Stamper-heads* weighing about 30 or 40 pound a piece, of *Iron*; which serve to Break the *Ore* in the said *Coffer*. These *Lifters* about 8 foot long, and $\frac{1}{2}$ a foot Square, of *Heart-Oak*, and having as many *In-timbers*, or *Guiders*, between them, are Lifted up in order by double the Number of *Tappels*, (fastened to as many *Arms* passing Diametrically through a great Beam, Turned by an *Overshot water-wheel* on 2 *Boulsters*) which exactly, but easily, meet with the *Tongues* so placed in the *Lifters*, as that they quickly slide from each other, suffering the *Lifters* to fall with great Force on the *Ore*, thereby breaking it into small Sand, which is washed out by the *Cock-water* through a *Brass Grate*, Holed very thick, and placed within 2 *Iron Barrs* at one end of the *Coffer*, into the *Launder*, *i. e.* 2

Trench Cut out in the *Floor*, 8 foot long, and 10 foot over,) stopt at the other end with a *Turf*, so that the *Water* Runs away, and the *Ore* sinks to the Bottom; which when full, is taken up and emptied with a *Shovel*.

2. The *Stamping-Mill* is thus contrived to go 2 *Hours*, or more, after we give over our Attendance on it. We have a *Tiller* (*i. e.* a long Pole) fastened without at one end to the *Slew* or *Ponder* (*i. e.* that loose and last part of the *Trough* that conveys the *Stream* to the *Mill-Wheel*) and at the other end is tyed a Short Rope with a Transverse Stick at the End of it, curiously, but *Trap-ways* Hitcht at both ends under two little Pins fastned in the *Lones* for that purpose; there's another Pin set in one of the *Lifters*, at such an Exact Height, as that if there be no *Ore* in the *Coffer* to keep that *Lifter* high enough, the purposed Pin, in descending, Knocks out the *Water*, carrying it quite over the *Mill-wheel*; so that when the *Coffer* is emptied, the *Mill* rests of its own accord.

3. The *Launder* is divided into 3 parts, *i. e.* the *Fore head*, the *Middle*, and the *Tail*. That *Ore* which lies in the *Fore-head*, *i. e.* within $1\frac{1}{2}$ foot of the *Grate*, is the Best *Tin*, and is taken up in a *Heap* apart. The *Middle* and *Tails* in another, accounted the Worst.

4. The latter *Heap* is thrown out by the *Trambling Buddle*, *i. e.* a long square *Tye* of Boards, or *Slate*, about 4 Foot Deep, 6 long, and 3 over; wherein stands a Man Bare-footed with a *Trambling Shovel* in his Hand to Cast up the *Ore*, about an *Inch* thick, on a long square Board just before him, as High as his Middle, which is termed the *Buddle-Head*, who dexterously with the one Edge of his *Shovel* Cuts and Divides it longways in respect of himself, about half an *Inch* asunder; in which little Cuts the *Water* coming gently from the Edge of an Upper plain Board, carries away the Filth and lighter part of the prepared *Ore* first, and then the *Tin* immediately after: All falling down into the *Buddle*, where with his bare Foot he strokes and smooths it Transversly to make the Surface the plainer, that the *Water* and other Heterogeneous Matter, may without Let pass away the Quicker.

5. When this *Buddle* grows full, we take it up; here distinguishing again the *Forehead* from the *Middle* and *Tails*; which are *Trambled* over again: But the *Forehead* of this with the *Forehead* of the *Launder*, are *Trambled* in a second *Buddle*, but not different from the first, in like manner. The *Forehead* of this being likewise seperated from the two other parts, is carried to a third, both *Drawing, Buddle*, whose difference from the rest is only this, that it hath no *Tye*, but only a plain sloaping Board, whereon 'tis once more Washed with the *Trambling Shovel*, and so it new names the *Ore*, *Black Tin*, *i. e.* such as is compleatly ready for the *Blowing-House*.

6. We have another more curious way Termed *Sizing*, that is, instead of a *Drawing Buddle*, we have an Hair Sieve, through which we sift, casting back the Remainder in the Sieve into the *Tails*, and then new *Tramble* that *Ore*. After the second *Trambling*, we take that *Forehead* in the second *Buddle*, and *Dilve* it (*i. e.* putting it into a Canvas Sieve, in a large Tub of *Water* lustily shake it) so that the Filth gets over the Rim of the Sieve, leaving the

Black

Black-Tin behind, which is put into *Hogsheads*, Covered and Locked, till the next *Blowing*.

7. The *Tails* of both *Fuddles*, after two or three *Tramblings*, are cast out into the first *Strake*, or *Tye*, which is a Pit purposely made to Receive them; and what over-small *Tin* else may wash away in *Trambling*. There are commonly three or four of them successively, which contain two sorts of *Tin*; the One, which is too small, the other too Great. The latter is New Ground in a *Craze mill* (in all respects like a *Greist-mill* with two Stones, the Upper and the Nether) and after that *Trambled* in Order. The former, by reason of its exceeding smallness, is dressed on a *Reck*, provided for that purpose (that is a Frame made of Board about three foot and a half Broad, and 6 long, which turns upon two Iron Peggs fastened in both Ends, and the whole placed on two Posts, so that it hangs in an *Equilibrium*, and may, like a Cradle, be easily removed either way) with the Shovel and Water.

4. When we perceive much *Mundick* in our *Tin*, (which makes it Britly Hard) we are Necessitated to burn away the *Weed* in a *Tin-Kiln*. This *Kiln* is four square, and at the Top a large Moor-stone about 6 foot long, and 4 Broad; in the Middle thereof is an Hole made about half a foot Diameter. About a foot beneath this Stone, is placed another not so long by half a foot, because it must not reach the Innermost or Back part of the Wall, which is the Open Place through which the *Flame* Ascends from a Lesser Place below that, where a very strong Fire of *Furze* is constantly made. The fore-part is like a Common Oven; but near the Back on the one side, there is another little square Hole. When the *Kiln* is throughly Heated, the *Black Tin* that is to be Burnt, is laid on the *Top-stone*, and as much of it is Cast down at the Square Hole upon the *second* or *Bottom Stone* as will cover it all over about 3 or 4 Inches Thick. Then the Hole at the Top is immediately Covered with Green Turfs, that the *Flame* may *Reverberate* the stronger: And a *Rake man* with an *Iron Coal-Rake*, constantly spreads and moves the *Tin*, that all parts of the *Mundick* may get uppermost of the *Tin*, and so be *Burned* away; which we certainly know by this, that then the *Flame* will become *Yellow* (as usual) and the *Stench* lessened; for whilst the *Mundick* behind, Burns, the *Flame* is exceeding *Blew*. Then with the *Rake*, he thrusts it down, at the open place into the *Open Fire*, and receives a New supply of *Tin* from Above. Now when the place Beneath, where the *Fire* is made, grows full of *Tin*, *Coals*, and *Asbes*, with his *Rake* he draws it forth with the *Coals*, at the little square Hole on one side, near the Back, where the *Ore* (Fiery Hot and Red) lies in the Open Air to cool, which will scarce be in 3 Days, because of the *Coals* that lie hid in it: But in case we cannot stay so long, then we Quench it with Water, and it is like Morter. Albeit we let it Cool, of it self, or with Water, we must new *Tramble* it, or Wash it (as before) before we put it into the *Furnace*, which is no other than an *Alman Furnace*. *Moor-Tin* (i. e. such as is Digged up in the *Moors*) we find *Runs* or *Melts* best with *Moor-Coal*, *Chark't*: But our *Tin*, which lies in the Countrey, *Runs* best with an Equal Proportion of *Charcoal* and *Peate* (i. e. *Moor Coals*) for the *First running*; but when we come to *Remelt* our *Slags*, then we use *Charcoal*. When

Blowing of Tin

all is *Melted* down and *Remelted*, there sometimes Remains a Different *Slag* in the Bottom of the *Float*, which we Term *Mount Egg*; and that is mostly an *Iron Bodie*, though of a *Tin Colour*; as I accidentally Assured my self, by applying one of the *Poles* of a *Loadstone* to it, and quickly Attracted it, yet not such a Quantity, by far, as that of *Iron*.

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Merret. n. 138.
p. 949

2. The Stones from which *Tin* is wrought, are most usually found betwixt two *Walls* of Rocks (which are commonly of an *Iron Colour*, of little or no Affinity with the *Tin*) in a *Vein* or *Lead* (as the *Miners* call it) betwixt 4 and 18 *Inches* Broad, or thereabout. Sometimes there is a Rich and Fat Metal, sometimes Hungry and starved; sometimes nothing but a Drossy Substance, not purely Earth nor Stone, nor Metal; but a little resembling the rejected Cynders of a Smith's Forge: appearing sometimes of a more flourishing Colour, tending to *Carnation*; and sometimes more *Umbratile*; and where this is found, the *Miners* judge the Metal to be *Ripe*. The *Pits* are sometimes above 60 *Fathoms* Deep.

The *Lead* being very Rich and Good, above that is 10 *Fathoms* from the *Grass*, or thereabouts. And below that, there's a strange *Cavity* or Empty Place, wherein is nothing but *Air* for many *Fathoms* deep; as the *Miners* have tryed with long *Poles* and *Pikes*. This *Cavity* lies between hard stony *Walls*, distant one from another about 6 or 9 *Inches*. The *Labourers* tell Stories of *Sprights* or small People, as they call them: And that when the *Damp* ariseth from the subterranean *Vaults*, they hear strange Noises, Horrid Knockings, and fearful Hammerings. These *Damps* render many *Lame*, and *Kill* others outright, without any Visible Hurt upon them.

Though *Tin*, for the most part, be made from the *Stones* in which it is Incorporated: Yet sometimes it is, as it were, mixed with a small Gravelly Earth, sometimes White, but for the most part *Red*. From this Earth it is easily *seperated* with bare *washing*: This Gravelly *Tin* is called *Pryan Tin*; and is scarce half the goodness of the other.

The *Mundic Ore* is easily discover'd by its Glittering, yet sad Brownness wherewith it will soon Colour your Fingers. This is said to Nourish the *Tin*; and yet they say, where much *Mundick* is found, there's little or no *Tin*. Certain it is, if there be any *Mundick* left in *Melting* the *Tin*, it makes it Thick and *Cruddy*, that is not so Ductile as otherwise; and therefore usually draws down the Metal to an Abatement, from 5 *shillings* to 8 *shillings* in the *Hundred weight*. This *Mundick* seems to be a kind of *Sulphur*. Fire only *seperates* it from the *Tin*, and Evaporates it into *Smoke*. Little Sprigs or Boughs being set in the *Chimney*, the *Smoke* gathereth upon them, into a Substance which they call *Poyson*, and think it a kind of *Arsenick*; which being put into Water easily Dissolves, and produces very good *Vitriol*. The Water wherein it is Dissolved, soon changeth small iron Rods put into it; and they say, that in a very little Time, it will Assimilate the Rods into its own Nature. 'Tis generally concluded, that *Fish* will die in those Waters whereinto *Mundick* is cast: And they commonly impute the Death of some of their Neighbours to their Drinking of *Mundick-waters*. When they Burn it, to
seperate

seperate it from the *Tin*, there proceeds from it a *Stench* very Loathsome and Dangerous.

There also Occurs a sort of *Spar*, of a Shiny Whitish Substance which casteth a White Froth upon the Water in Washing it. When first taken out of the Earth 'tis Soft and Fattish; but soon after it grows somewhat hard. It is seldom found growing, but only Sticking to the Metal. The Miners call it *White Spar*; and some of them think it is the Mother or Nourisher of the Metal. But 'tis certain that *Sparr* is often met with in *Moorish Grounds*, where they never hope to find any *Ore*: Yet no *Tin Mines* are without it.

The *Cornish Diamonds*, so called, lie intermixed with the *Ore*, and sometimes on Heaps. They are hard enough to Cut Glass, and some of them are of a *Transparent Red*, and have the Lustre of a Deep *Ruby*. These *Diamonds* seem to me to be but a Finer, Purer and Harder sort of *Sparr*.

Godolphin Ball is the most famous of all the *Balls* or *Mines* in *Cornwall*, for the Quantity of Metal. Though some of late years pretend another *Mine* (which some call the *Silver-mine*, others the *Lead-mine*) more Rich than that. I have seen an Essay made of some of that *Ore*, as 'twas said, brought from thence; whereof 10 *Pound* weight yielded $2\frac{1}{4}$ *Ounces* of *Fine Silver*.

The Best *Ore* is that which is in Sparks; and next to this, that which hath Bright *Sparr* in it.

When the *Ore* has passed the *Stamping-mill*, and is well *Washed* and *Seperated* from the parts not *Mitalline* (which they call the *Causalty*) they *Dry* it in a *Furnace* on *Iron-Plates*, and then *Grind* it very *Fine* in a *Crasing-mill*. After this they *Re-wash* it, then *dry* it a little, and *Carry* it last of all thus fitted to the *Furnace*, called by them a *Blowing-House*, and there *melt* and *cast* it.

There swims on the Metal, when it runs out of the *Furnace*, a *Scum*, which they call *Dross*; much like to *Slag* or *Dross* of *Iron*; which being *melted* down with *fresh Ore*, Runneth into Metal.

The *Causalty* they throw in Heaps upon Banks, which in 6 or 7 *Years* they fetch over again: But they Observe that in less time it will not afford Metal worth the Pains; and at the Present none at all.

CIV. 1. I am well Inform'd, that all *Mendip* in *Somersetshire* is Mountainous: Yet the Hills not Equal in Height. It is Barren and Cold, and Rocky in some places. The Ridges thereof run Confusedly, but most *East* and *West*, and not in any Parallel one with another. Upon the Surface thereof, it is *Heathy*, *Ferny* and *Furzy*; and the Cattle it Feeds, for the most part, are *Sheep*, which go there all the Year; and *young Beasts*, *Horses* and *Colts*, at Spring and Fall. The *Sheep* are not Fair but Big-bellied, and will grow to no Bigness, after they have been there Fed; but will grow Fat, if they are removed into better Soil; and so their *Beasts* and *Horses*.

The *Inhabitants* live Wealthy, saving such as are Employed about *melting* of the *Lead* at the *Mines*; who, if they work in the *Smoak*, are subject to a Disease, that will kill them, and the Cattle likewise that feed thereabout: The *Smoak* that rests upon the Ground, will Bane them: And therefore the *Inhabitants*

Lead-Mines in
Somersetshire;
by Mr. Jos. Glan-
vil. n. 28. p.

525.

Inhabitants have Keepers to keep them from it, for fear of the Infection. At the Foot of the Hills there are many Springs which are very Wholsome; And Produce Rivers, after they have run to some distance from thence. The Air is Moist, Cold, Foggy, Thick and Heavy.

The Soil is Red and Stony; and the Stones are either of the Nature of Fire-stones or Lime stones, but no way Clayie, Marly, or Chalky. The Trees have their Tops Burnt, and their Leaves and Outsides Discoloured, and scorched with the Wind, and grow to no Bigness. The Stones that are washt by the Brooks and Springs, are of a Reddish Colour, and Ponderous. Snow, Frost, and Dew, stay upon Mendip longer, than upon any of the Neighbouring Grounds. Thunder and Lightning, Storms, Nocturnal Lights, and Fiery Meteors, are more frequent than Ordinary.

When they have got the Ore they Beat it Small, then Wash it Clean in a Running Stream; then Sift it in Iron-Rudders; then they make of Clay, or Fire-Stone, an Hearth, or Furnace which they set in the Ground, and upon it Build their Fire, which is Lighted with Charcoal, and continued with Young Oaken Gadds, Blown with Bellows by Men's Treading on them: And after the Fire is Lighted, and the Fire-place Hot, they throw their Lead-Ore upon the Wood, which Melts down into the Furnace; and then with an Iron-Ladle they take it out, and upon Sand Cast it into what Form they please.

A further account by Mr. Glanvil. n. 39. p. 767

2. I am farther informed, by experienced Mine-men, that they have sometimes known the Vein to Run up into the Roots of Trees, and yet they have observed no Difference at the Top, with respect to the other Trees there, into whose Roots no such Veins Run. The Snow and Frost near the Grooves Melt Quickly, but continue Long at further Distance. Sometimes when a Mine hath been very near the Surface, the Grass hath been Yellow and Discoloured. They have no value for the *Virgula Divinatoria*; yet they say when the Mine is Open, they may Guess by it, how far the Vein Leads. White, Yellow and Mixt Earth are Leaders to the Country (as they call it;) Changeable Colours always encourage their Hopes. For Stones, they are sometimes 12. Fathom Deep, before they Meet any: Other while, when a Stony-Reak at Top, they meet Ore just under the Sword [Superficies] of the Grass, which Ore hath gone down about 40. Fathom. A Black-Stone is of Bad Signification, and Leads to a Jam [a Black Thick Stone, that Hinders their Work:] A Grey Clear Dry one, they account Best. They seldom encounter Damps. If in Sinking they come to Wet Moorish Earth, they expect a Jam, and to be Closed up with Rocks. The Nearness they Guess by Short Brittle Clay; for the Tough is not Leading.

The Ore sometimes is Shole, and again it is 14. or 20 Fathom, more or less before they Hit it: They follow a Vein Inclining to some Depth, when it Runs away in Flat Binns.

When the Stones part it then they find a Vein again. Their Draughts are 14 or 16 Fathom, till they come to a Stone, where they Cast aside a Draught call'd a Cut. Then they Sink Plum again 4. or 5. Cuts, one under another They find Ore at 50. Fathom. Their Best Reaks are North and South; East and

and *West* are Good, though not so Deep. The *Groove* is 4 foot Long, $2\frac{1}{2}$ foot Broad, till they meet a Stone, when they carry it as they can. The *Groove* is Supported by Timber: A piece of an Arm's bigness will Support 10 *Tun* of Earth. It Lasts long: that which was put in beyond the Memory of Man (nay which by the Difference in the Manner of *Working* their *Mines*, they know to have layn above 200 *Years*) will serve in New-Works. It is Tough and Black, and being Exposed to the Sun and Wind for 2 or 3 *Days*, will scarce Yield to an *Ax*.

For the Supply of *Air* they have Boxes of *Elm* exactly Closed, of about 6 *inches* in the Cleer, by which they carry it Down above 20 *Fathom*. But when they come at *Ore* and need an *Air-shaft*, they sink it 4 or 5 *fathom* Distant, of the same Fashion with a *Groove*, to Draw as well *Ore*, as *Air*.

They make use of *Leathern Bags*, of 8 or 9 *Gallons* a piece, drawn up by Ropes, to *Free* the *Water*. If they find a *Swallet*, they drive an *Adit*, upon a *Levell*, till 'tis Dry.

If they cannot *Cut* the *Rock*, they use *Fire* to *Aneale* it, laying on Wood and Coal, and the *Fire* so Contrived, that they Leave the *Mine* before Operation Begins, and find it Dangerous to Enter again, before it be quite Clear'd of the *Smoak*; which hath Killed some.

Their *Beetles*, *Axes*, *Wedges*, &c. unless so Hardned as to make a Deep Impression upon the head of an *Anvil*, are not fit for their Use: and yet they sometimes Break them in an *hour*; others last 3 or 4 *days*, as it happens. They Work Cloathed in Frocks and Waist-Coats, by *Candle-Light* of Tallow, 14 or 15 to the *Pound*, each whereof Lasts 3 *hours*, if they have *Air* enough: which if they want to keep in the *Candles*, the Workmen cannot Stay there A *Vein* being *Lost*, they Drive 2 or 3 *fathom* in the *Breast*, as the nature of the Earth Directs them. They convey out their Materials in *Elm-Buckets* drawn by Ropes: The *Buckets* hold about a *Gallon*. Their *Ladders* are of Ropes.

The *Ore* runs sometimes in a *Vein*, sometimes dispersed in *Banks*. It lies many times between Rocks: Some of it is Hard, some Milder. Many times they have *Branched Ore* in the *Sparr*. About the *Ore* there is *Spar* and *Chalk*, and another Substance, which they call the *Crootes*, which is a Mealy, White Stone, mated with *Ore*, and Soft. The *Sparr* is White, Transparent and Britle like *Glass*. The *Chalk* White and Heavy; Heavier than any Stone. The *Vein* lies between the *Coats*, and is of Different Breadths. It Breaks off sometimes abruptly in an *Earth*, they call a *Deading Bed*, and after a *fathom* or 2 may come again, keeping the same *Point*. It *Terminates* sometimes in a *Dead Earth*, *Clayie*, without *Croot* or *Spar*; sometimes in a *Rock* call'd a *Fore-Stone*.

The Clearest and Heaviest *Ore* is the Best: 36 *hundred* of *Ore* may yield a *Tun* of *Lead*.

The *Hearth* for *Melting* the *Ore* is about 5 *foot* High, set upon Timber, to be Turned as a *Wind-Mill*, to avoid the Inconvenience of *Smoak* upon a Shifting *Wind*. It contains *half* a *Bushel* of *Ore* and *Coal*. There is a *Sink* up-

on the Side of the *Hearth*, into which the *Lead* Runs, that holds about $1\frac{1}{2}$ *Hundred*. They have a *Bar* to stir the *Fire*; A *Shovel* to Throw it up; and a *Ladle* Heated Red hot to Cast out the *Melted Metal*. Once *Melting* is enough: and the *Best* (which is Distinguisht by its *Weight*) *Melts* first.

There is a *Flight* in the *Smoak*, which falling upon the *Grass*, *Poysons* those *Cattel* that Eat of it. They find the *Taste* of it upon their *Lips* to be *Sweet*, and when the *Smoak* chances to Fly in their *Faces*. Brought home and laid in their *Houses*, it *Kills* *Rats* and *Mice*. If this *Flight* mix with the *Water*, in which the *Ore* is *washt*, and be carried away into a *Stream*, it hath *Poisoned* such *Cattel* as have drunk of it after a *Current* of 3 *miles*. What of this *Flight* falls upon the *Sand*, they gather up to *Melt* upon a *Flag-Hearth*, and make *Shot* and *Sheet Lead* of it.

They sometimes find *Slags*, 3, 4, or 5 *foot* under ground; but such as they judge were cast aside heretofore.

They have sometimes Heard *Knockings* beyond their own *Works*, which when followed by them, have afforded Plenty of *Ore*. And one *King* of *Wells* about 2 *Years* since found in his *Groove* a Piece of *Ore*, in which they fancied the shape of a *Man*, *Eyes*, *Arms*, *Leggs*, *Full Breast*, &c. The whole was about 4 *Inches* in length; the *Mine* proved *Rich*.

In Germany;
by n. 1. p.
10.

3. There is a Peculiar *Lead Ore* found in the *Upper Palatinate*, at a place call'd *Freyung*; and there are two sorts of it, whereof one is a kind of *Crystalline Stone*, and almost all good *Lead*; the other not so rich, and more *Farinaceous*. The *Mines* of that Place having lain long neglected, the People living thereabout take it from what their *Fore Fathers* had thrown away, and had lain long in the *Open Air*. It is of singular *Use* for *Essays* upon the *Coppel*, seeing that there is not any other *Metal* mixed with it.

The Poysonous
Quality of Lead
Ore; by Mr.
J. Beaumont.
Ph. Col.n. 2. p.6.

CV. Those who live near where *Lead-Ore* is *Washt*, cannot keep either *Dog* or *Cat*, or any sort of *Fowl*, but they all *Die* in a short time; and I have Known of a little *House* wherein *Lead Ore* was kept some time, though afterward made very *Clean* and well *Bedded* with *Fern*, yet when *Calves* were put into it, they all died shortly after; and *Children* sometimes, in these *Houses*, have died *Suddenly*. If any sort of *Cattle* Eat often of that *Grass*, on which the *Steam*, which rises from the *Smelting* of *Lead*, falls, they all die in a while after.

The Way of Ma-
king of Ceruls;
by Sir Philiberto
Vernati n. 137.
p. 935.

CVI: Pigs of *Clean* and *Soft Lead* are Cast into *Thin Plates*, a *Yard* long, and 6 *Inches* Broad. These are *Rolled* round, so as the *Surfaces* no where meet to *Touch*: For where they do no *Ceruss* grows. Each of these is put into a *Pot*, just capable to hold *One*, upheld by a little *Bar* from the bottom, that it come not to touch the *Vinegar*, which is put into each *Pot*, to effect the *Conversion*. *Twenty* of these a breast, are put into a *Square Bed* of *New Horse-Dung*; and each *Pot* is *Covered* with a *Plate* of *Lead*; and lastly, all with *Boards*, as *Close* as *Conveniently* can be. This repeated 4 *Times*, makes one *Heap*, so called, containing 1600 *Pots*.

After

After 3 Weeks the Pots are taken up, the Plates Unrolled, laid upon a Board, and Beaten with *Battle Doors* till all the *Flakes* come off; which, if good, prove Thick, Hard and Weighty. These *Flakes* are ground with Water, between *Millstones*, to almost an Impalpible Fineness. After which it is Moulded into smaller Parcels, and Exposed to the Sun to Dry, till it be Hard, and so fit for Use.

'Tis Observed, that some Pots will yield *Thick* and Good *Flakes*, whilst others, alike Ordered and set by them, without any possible Distinction of Advantage, yield few and small, or none at all. Sometimes the *Poles* are taken up all Dry, and so sometimes prove Best; sometimes again they are taken up Wet. The *Plates* that cover the *Pots* yield better and Thicker *Flakes*, than do the *Rolls* within. And the Outsides, next to the Planks, Bigger and Better than the Insides, next to the *Rolls*, and the *Spirits* that first arise out of the *Vinegar*.

The Accidents which happen to the Workmen, are 1. Immediate Pain in the *Stomach*, with exceeding *Contorsions* in the Guts, and *Costiveness* that yields not to *Catharticks*, hardly to often repeated *Clysters*: Best to *Lenitives*, *Oil of Olives*, or strong *New Wort*. It brings them also to *Acute Fevers*, and Great *Asthma's* or *Shortness* of *Breath*. And these we find Effected principally by the *Mineral Steams* in the Casting of the *Plates* of *Lead*, and by the Dust of the *Flakes*. Also by the *Steams* coming from out of the *Heaps*, when the *Pots* are taking up.

Next a *Vertigo*, or *Dizziness* in the Head, with continual great Pain in the *Brows*, *Blindness*, *Stupidity*, and *Paralytick Affections*; loss of *Appetite*, *Sickness*, and frequent *Vomitings*, generally of sincere *Phlegm*, sometimes mixed with *Choler*, to the extreamest Weakness of the Body; and these chiefly in them that have the Charge of *Grinding*, and over the Drying Place.

CVII: 1. The *Mines* of *Mercury* in *Friuli*, a Territory belonging to the *Venetians*, are about a Days Journey and an half distant from *Goritia* Northwards, at a place call'd *Idria*, scituated on a Valley of the *Julian Alps*. They have been, as I am informed, these 160 Years in the Possession of the *Emperor*, and all the Inhabitants speak the *Sclavonian* Tongue. In going thither we Travelled several Hours in the Best *Woods* I ever saw; being very full of *Firrs*, *Oaks*, and *Beeches* of an Extraordinary Thickness, straitness, and Height. The Town is built as usually Towns in the *Alps* are, all of *Wood*, the *Church* only excepted, and another House wherein the Overseer liveth. When I was there in *August* 1664, the Valley and the Mountains too, out of which the *Mercury* was dug, were of as pleasant a *verdure*, as if it had been in the midst of *Spring*, which they there attribute to the *Moistness* of the *Mercury*. That *Mine* which we went into, the Best and Greatest of them all, was dedicated to *St. Barbara*, as the other *Mines* are to others *Saints*. The usual way down to it is at the Beginning not Difficult, the Descent not being much, the greatest Trouble is, that in several Places you cannot stand Upright: but this holds not long, before you come to Descend in Earnest by Perpendicular *Ladders*, yet being Imagined produced, they do not make one

The Quicksilver-Mines in Friuli, by Dr. Walt. Pope. n. 2. p. 21.

Ladder, but several Parallel ones. At the End of each *Ladder*, there are Boards across, where we may Breathe a little. All the way down, and the Bottom, where there are several Lanes cut out in the Mountain, is lined and propt with great pieces of *Fir-Trees* as Thick as they can be set. They dig the *Mineral* with Pick-Axes, following the *Veins*: 'Tis for the most part *Hard* as a Stone, but more Weighty; of a *Liver-Colour*, or that of *Crocus Metallorum*. There is also some Soft Earth in which you plainly see the *Mercury* in little Particles. Besides this, there are oftentimes found in the *Mines* Round Stones like Flints, of several Bignesses, very like those *Globes of Hair* which I have seen in *England*, taken out of Ox's Bellies. There are also several *Marcasites* and *Stones*, which seem to have Specks of *Gold* in them; but upon Tryal, they say, they find none in them. These Round Stones are some of them very Ponderous, and well Impregnated with *Mercury*; others Light, having little or none in them.

The manner of getting the *Mercury* is this: They take of the *Earth*, brought up in Buckets, and put it into a *Sieve*, whose bottom is made of *Wires* at so great a Distance, that you may put your Finger between them; 'tis carried to a stream of Running Water, and washed as long as any thing will pass through the *Sieve*. That *Earth* which passeth not, is laid aside upon an Heap; that which passeth, is reserved in a *Hole*, and is taken up again, and put into a *second Sieve*; and so on to about ten or 12 *Sieves* proportionably less. It often happens in the *First Hole*, that there is *Mercury* at the bottom; but towards the farther End, where the Intervals of the *Wire* are less, its found in very great Proportion. The Waste Water is so much Impregnated with *Mercury*, that it cureth *Itches* and other *sordid Ulcers*. The *Earth* laid aside, is Pounded, and the same Operation repeated. The fine small Earth, that remains after this, and out of which they can wash no more *Mercury*, is put into *Iron Retorts*, and the *Fire* forces the *Mercury* into the *Receivers*: The Officer unluted several of them; and I observed in all that he first poured out *Perfect Mercury*, and after that came a *Black Dust*, which being Wetted with Water, discovered it self to be *Mercury*, as the other was. They take the *Caput Mortuum* and Pound it, and Renew the Operation. There are 16 *Furnaces* for this Use, each of them carrying 24 *Retorts*; in all 384 *Retorts*.

All the *Mercury* got without the use of *Fire*, whether by *Washing* or found in the *Mines* (for in the Digging some, the Particles get together, so that in some places you might take up two or three *Spoonfuls* of pure *Mercury*) is called by them *Virgin Mercury*, and esteemed above the rest. The Officer told me, that making an *Amalgama* of *Gold* and *Virgin Mercury*, and putting it to the *Fire*, that *Mercury* would carry away all the *Gold* with it, which *Common Mercury* would not do.

The *Engines* for drawing the Water, are all moved by Water, brought thither in no Chargeable *Aqueduct* from a Mountain 3 *Miles* distant. The Water Pump from the bottom of the *Mine*, by 52 *Pumps*, 26 on a side, is Contrived to Move other Wheels, for several other purposes.

The Labourers (being 280 always Employed) work for a *Julio* a Day, which is not above 6 or 7 pence, and Endure not long: For although None stay under-ground above 6 Hours; all of them in time (some later, some sooner) become *Paralytick*, and *Dye Hectick*. We saw a Man who had not been in the *Mines* for above *half a Year* before, so full of *Mercury*, that putting a piece of *Brass* in his *Mouth*, or Rubbing it in his *Fingers*, it immediately became as *White*, as if he had rubbed *Mercury* upon it. Those also that Work upon the Back side of *Looking-Glasses*, are very Subject to the *Palsy*.

They Convey their Wood thus, about 4 Miles from the *Mines* on the sides of Two Mountains; they Cut down the Trees, and draw them into the Interjacent Valley; Higher up in the same Valley they make a *Lock* or *Dam*; when the Water is ready to run over it, they open the *Flood Gates*, and the Water carries all the Trees impetuously to *Idria*, where the Bridge is Built very Strong, and at very Oblique Angles to the stream, on purpose to stop them, and throw them on shore near the *Mines*.

Those *Mines* heretofore Cost the Emperour 70000 or 80000 *Florens* Yearly; but now they Cost him not above 28000. They produced

Anno 1661.		Anno 1662.		Anno 1663.	
	ll.		ll.		ll.
Ordinary Mercury.	198481	225066	244119		
Virgin Mercury.	6194	9612	11862		
	<hr/>	<hr/>	<hr/>		
in all	204675	234678	255981		

2. The Town of *Idria* in the County of *Goritia* and Province of *Friuli*, is seated low, and Encompassed with Hills on all sides. A *River* of the same Name runs by it, and proves sufficient upon Plentiful Rains to Convey down the *Fir-Trees* and other Wood required in the Service of the *Mines*: And to this End there is an Handsome Work of *Piles* made sloping athwart the *River* (after the same manner as I observed in *Newsol* in *Upper Hungary*, cross the *River Gran*) to stop the Trees.

By Dr. Edw. Brown.
n. 54. p. 1089.

The Entrance into these *Mines* is not High, or upon an Hill, but in that Town it self. The deepest part of the *Mine* from the Entrance, is between 120 and 130 *Fathoms*.

The *Virgin Quicksilver*, which they call *Jungfraw*, is that which discovers it self without the help of *Fire*. Sometimes it is plainly seen in the *Ore*, or falls down in *Drops*, and sometimes *Streams* out in good quantity; as about 7 Years ago it ran out of the Earth at first in a *Stream* as small as a *Thread*, and afterwards as Big as a *Packthread*, but ceased in 3 or 4 days. That also is accounted *Virgin Quick Silver*, which is seperated only by *Water*.

Plain Quicksilver they obtain by *Fire* out of the *Ore*, or out of the *Cinna-ber* of *Mercury*, which they dig out of this *Mine*. The *Ore* of this *Mine* is of a *Dark Colour*, mixed with *Red*.

The *Quick silver Ore* of this *Mine* ordinarily contains *Half*, and sometimes $\frac{2}{3}$ of *Quicksilver*.

I went into the *Mine* by the Pit of *St. Agatha*, and came up again by that of *St. Barbara*, Descending and Ascending by *Ladders*. I Ascended at one of 639 Staves, or 89 *Fathoms*. It has been wrought 200 *Years*, about the same space of time with *Newsol-Mine*, but comes much short in time of the *Silver Mine* at *Schemnitz*; and much shorter yet of the notable *Lead Mines* in *Upper Carinthia*.

In a *Laboratory*, where the *Quicksilver* is separated by *Fire*, I saw an Heap of 16000 *Retorts* of *Iron*; every one of which Costs a *Crown* at the Best Hand from the *Iron Furnaces* in *Carinthia*. There are 800 *Retorts*, and as many *Recipients*, Employed together, in drawing over the *Quicksilver* in 16 *Furnaces*; 50 in each *Furnace*, 25 of a side; 12 above, and 13 below of each side.

June 12. 1669, when I was there, they Carried out 40 *Saumes* of *Quicksilver* into Foreign Parts, each *Saume* containing 315 pound Weight, to the value of 4000 *Ducats* of *Gold*. Some of it is sent as far as *Cremnitz* in *Hungary*, for the Use of the *Gold Mines*: And very much carried away Southward; for they are not far from the *Sontius*, or *Lysonzo*, a considerable River, which Runs into the *Gulf of Trieste* in the *Adriatick Sea*.

In the *Castle*, I saw 3000 *Saumes* of *Quicksilver* together in *Barrels*; the *Quicksilver* being first made up in *Double Leather*: And in another *House* as much *Ore* as can be *Distilled* in 2 *Years*, except they have great *Plenty* of *Rain* to bring down the *Wood*.

The *Country* is well stored with stately *Firs*, *Larches*, *Pines*, *Pinasters*, *Picea's*, and that Nobly Crisped and well Grain'd kind of *Acer*, whereof *Viols* and *Violins* are made: Whereof there is also *Plenty* in the *Country* of *Saltzburg* and *Carniola*.

Travelling sometimes in the *Night*, we had continually about us a great number of large *Glow-worms*, which put into *Papers*, gave a *Dimm Light* like *Candles* in *Lanthorns*; and the *Air* also was full of *Flaming Flies*, affording some delight unto us.

The way to this Place from *Croatia* I found *Difficult*; and coming from it to *Aidoschini* and *Croatia*, I passed over *Swarzenburg*, or the *Black Mountain*, from whence I descended 10 *Miles* in a *Rocky Country*, and far more *Stony* than the *Craw*, or *Campus lapidosus*, in *Province*.

Mercury found
in Plants; by
S. Manfred Sep-
talius. n. 27.
p. 493.

CVIII. In the *Valley* of *Lancy*, which runs between the *Mountains* of *Turin*, grows a *Plant* like the *Doronicum*, (so also called by the *Inhabitants* and *Botanists*;) near the *Roots* whereof you may find *Pure Quicksilver*, running in *small Grains* like *Pearls*; the *Juice* of which *Plant* being *Expressed*, and exposed to the *Air* of a *Clear Night*, there will be found as much *Mercury*, as there is *Lost* of *Juice*.

The Incalescence
of Mercury with
Gold; by B. R.
n. 122. p. 515.

CIX. Though I have many things to *Object* against the *Sympathy* of *Gold* with *Quicksilver*; yet perhaps there may be a *Quicksilver* more *Subtle* and *Ponderant*

Ponderant than that which is Common, which may enable the *Chymists* to Argue very speciously for it.

It is hotly disputed among the Curious in *Chymistry*, whether or no there be any such thing as a *Mercury* which being barely *Mingled* with *Gold*, reduced to fine Parts, will produce any sensible *Heat*. The *Affirmative* is Asserted by some that pretend to the *Transmutation* of *Metals*, who Ascribe this Virtue to the *Mercuries*, Extracted, as they suppose, from some *Compleat Metals*; which are therefore in their Phrase styl'd *Mercurii Corporum*, or the *Mercuries* of *Metalline* Bodies. But the *Negative* is more generally Maintain'd, not only by *Philosophers* and *Physicians*, but the more Learned *Spagyrist*s themselves, especially the *Modern*

I the less wonder at this latter Opinion; because having purposely enquired of several Prying *Alchymists*, they have a part ingenuously Confessed to me, that they never actually saw any *Incalescent Mercury*: though they had sometimes heard it boasted of.

But notwithstanding all this, having for several Reasons look'd upon *Mercury* as a Body which is not necessarily so *Homogeneous* as it is suppos'd, the Opinion I most liked of was, that of a Possibility of an *Incalescent Mercury*. For notwithstanding the vulgarly supposed *Similar nature* of *Quicksilver*, which I willingly Confess to be great enough to be Admirable, yet having devised two ways (unpractis'd) that I know of by any *Chymist*,) the one to Discover whether a Clean and carefully *Distilled Mercury* might not be a *Compounded* Body, and have in it Parts that were not *Mercurial*; and the other out of such a fine *Distilled Mercury* to seperate Parts, and that in no despicable number, that are Plainly *Heterogeneous*; I found upon Tryal, that both the Methods, I had thought on, would succeed: Which warranted me to think it possible, that a *Mercury* very fine and Clean, and even Purged by *Sublimations* and *Distillations*, may, by Art, have been made to Assume and Incorporate with it a multitude of *Heterogeneous* Corpuscles, not to be Discovered, much less separated, (as those of *Tinn*, *Lead*, &c. may be) but by a Skillful Artist.

This was enough to Ingage me to make Trials, whether some of these *Heterogeneous* Particles, that I found Reducible with *Mercury* into a lasting *Mercurial Flux*, might not so Alter it as to Dispose it to *Heat* with *Gold*: And that there were such, through God's blessing, my Trials afforded me positive Proof, about the Year 1652.

For when I was alone (that I might not be imposed upon by others) I took to one part of our *Mercury* sometimes half the weight, and sometimes an *equal* weight of *Refined Gold* reduced to a *Calx*, or subtle Powder. This I put into the Palm of my Left Hand, and putting the *Mercury* upon it, stirred it and Pressed it a little with the Fingers of my Right Hand, by which the two Ingredients were easily *Mingled*; and Grew not only sensibly but considerably *Hot*, and that so Nimbly, that the *Incalescence* did sometimes come to its Height in about a Minute of an hour, by a *Minute Clock*. I found the Experiment succeed, whether I took *Altogether*, or but *Half* as much *Gold* as *Mercury*; but

but the Effect seemed to be much Greater when they were Employed in *Equal Weight*.

I tryed also the same *Mercury* with *Refined Silver* reduced to a very fine Powder; but I could not perceive any Heat or Warmth at all; tho' I am apt to think with a sufficient Quantity of *Leaf Silver* it might have been sensible.

I made Tryal afterwards, oftner than Once, in the Hands of others, who were not a little surpris'd and Pleas'd at the Event; particularly having given the *Ingredients* to the Learned *Secretary* of the *Royal Society*, I desired him to make the Experiment in and with his own Hand, in which it proved successful within somewhat less than a *Minute* of an *Hour*. [And the *Lord Viscount Brounker* (*President* of *R. S.*) made the same Experiment with some of the same *Mercury*, in his own Hand with Good Success.]

This *Incalescence* was the more Considerable, since being willing to Husband my *Mercury*, I made these Tryals but with a *Drachm* at a time, which scarce amounts in Quantity to the bigness of half a middle sized *Bean*; and yet I have sometimes had of this *Mercury* so Subtile, that the Heat made me willing to put it Hastily out of my Hand.

However I will not hence Determine, whether those that are *Mercurii Corporum*, and were made, as *Chymists* presume, by *Extraction* only from *Metals* and *Minerals*, will each of them Grow Hot with *Gold*; as, if I much mistake not, I found *Antimonial Mercury* to do. Nor will I Affirm, that every *Metalline Mercury* (though never so disposed to *Incalescence*) or even that of *Silver* and *Gold* it self, is the same with that which the *Chrysopean* Writers mean by their *Philosophick Mercury*, or is near so Noble as this. Nay, I will not so much as Affirm, that Every *Mercury*, obtained by *Extraction*, even from the *Perfect Metals* themselves, must needs be more Noble and Fit (as *Alchymists* speak) for the *Philosophick Work*, than that which may with Skill and Pains, be at length Obtained from *Common Mercury*, Skilfully freed from its *Recrementitious* and *Heterogeneous* Parts, and Richly Impregnated with the Subtile and Active ones of *Congruous Metals* or *Minerals*. But if there be any Truth in what some of the most Approved *Spagyrist*s have delivered about a *Solvent* of *Gold*, that seems of Kin, and perhaps is not much Nobler than one that I had, it seems allowable to Expect, that even Ours should be of more than Ordinary Use, both in *Physick* and *Alchymy*.

I had almost forgot to tell you, that whereas 'tis usual to take 4, 5, or 6, nay 8 or 10 Parts of *Common Quicksilver* to make an *Amalgame* with one of *Gold*, even when both are Heated by the Fire; I found Our *Mercury* so Congruous to that *metal*, that it would presently Imbody with no less than an Equal weight of it, and produce a pretty Hard *Amalgame* or Mixture, in which the *Mercury* was so diffused, that the *Gold* had quite lost its Colour. Secondly, I shall add, what, for ought I know, has not been yet Observed, that this Power of *Penetrating Gold* and growing Hot with it, is so Inherent, not to say Radicated, in Our *Mercury*, that after it had been *Distilled* from *Gold*, again and again, I found it to retain that Property. And Lastly, I found by Tryal, that a single *Drachm* of *Mercury*, made after a certain manner, did the

the 3^d or 4th Year after I had laid it by, grow so *Hot with Gold*, that I fear'd 'twould have Burnt my Hand.

It may be Doubted whether the Good that the *Preparations* of it (such as *Precipitates* and *Turbiths* of diverse kinds, *Mercurius dulcis*, *Cinwaber* made of the *Sulphur* of *Antimony*, and with *Gold*, &c.) may do in *Physick*, is likely much to Exceed the *Political* Inconveniencies that may ensue, if it should prove to be of the Best kind, and fall into ill hands. The knowledge of the Opinions of the Wise and Skillful about this Case, will be requisite to assist me to take Right Measures in an Affair of this Nature. And till I receive this Information, I am Obliged to *silence*. In the mean while I shall make bold to Add this *Secret*, (which to some, I think, will seem a *Paradox*) namely, that a *Mercury* Qualified to *Heat with Gold*, and perhaps with other Powders, may be made by more ways than one or two; Experience having assured me, that such a *Mercury* may be Prepared, not only by employing *Antimony* and *Solid Metals*, as *Mars*, but without any such *Metal* at all, or so much as *Antimony* it self.

I shall also Admonish those Inquisitive *Spagyrist*s, that may be Desirous to Try, whether their *Purify'd Mercury* be *Incalescent*, that they be not too hasty to conclude it is not so; nor to Reject it, unless they have made the Trial with *Gold* duly Prepared. For the smallest *Filings* of *Gold* I could make, or even some *Calxes* of *Gold*, will not serve our Turn, as I have found by employing, without success, a very fine and Spongy *Calx* made after an Uncommon way, the *Golden Particles* having, as it seemed, some extremely fine, tho' unobserved Dust of the Additament sticking to them, which hindred the Adhesion of the *Mercurial Ones*. Now the *Calx* of *Gold* that I most used, as finding it still to do well, was that made by *Quartation* (as *Alchymists* call it) That is, by Melting together one part of *Fine Gold*, and 3 or 4 parts of *Cuppell'd Silver*, and then putting the Mass, wherein the *metals* are mixed almost *per minima*, into *Purify'd Aquafortis*, which dissolving the *Silver* only, leaves the *Gold* in the form of a fine *Calx*. Also, by making an *Amalgama* with *Pure Gold* and *Vulgar Mercury*, and Dissolving the *Mercury* in good *Aqua fortis*, there will remain a Powder, which being well washt in fair Water, to *Dulcifie* it, and kept a while in a Moderate Fire, to dry it thoroughly without melting it, will become a *Calx*, which I have more than once used with *Our Mercury* with good Success. I have also sometimes taken, instead of a *Calx* of *Gold*, a competent number of *Leaves* of *Gold*, Reduced by beating only, without the help of *Salts*, to a sufficient Thinness, (insomuch that 70 odd *Leaves* did not weigh a *Scruple*) and putting two or three times the weight of *Our Mercury* to them, I have found (more than once) that a *smart Heat* was presently produced in my Hand:

CX. There are diverse *Silver-mines* at *Schemnitz* in *Hungary*, but the Chiefst and most Wrought, are those of *Windschacht* and *Trinity*.

They have no River here, tho much Water in the *Mines*; so as they are constrained to send much of their *Ore* to *Hodrytz* and other Places, where are small Rivers, by which their *Bellows* and *Hammers* may be Moved, (their

Ore

The Silver-Mines in Hungary; by Dr. Edward Brown. n. 58. p. 1186.

Ore Pounded Washed, and other Works requisite, performed. To draw about the *Engines* to Pump out the Water, 12 Horses at a time are employ'd to each Wheel: But in *Windschacht-mine*, Deep in the Earth, is a large Wheel of 12 Yards Diameter, Turned about by the fall of *Subterraneous Water*; which, together with the other Water Pump'd from the deepest parts of the *Mine*, Runs out through a *Cuniculus* made on purpose) at the Foot of the Hill.

Trinity-Mine is 70 Fathoms Deep, built and kept open with under work at a great Expence. Much of this *Mine* being in Earthy Soil, the *Ore* of it is much esteemed. Diverse *Veins* lie North; and other rich *Veins* run to the North-East. When two *Veins* cross one another, they esteem it Fortunate. They use not the *Virgula Divina*, and have no certain way to know either which way the *Veins* run, or where they are, till by the Industrious persevering in the Labour of the *Mines*, they are at last found out. They shewed me one Place, which they had digged straight on 6 Years, when the *Ore* was but two Fathoms distant from the Place where they began; and in another Place they digged 12 Years outright, and at last found a *Vein*, which in a short time paid their Charges.

The *Blackish Silver Ore* is esteemed the Best; much of it hath a Mixture of a shining Yellow substance or *Marchasite*, which if it be not in too great a quantity, is not unwelcome; by reason that it disposeth the *Ore* to fluidity, or renders it more easie to be Melted: But if it be in too great a Proportion, they are of Opinion, that it Preys upon the *Silver* in the *Mine*, and in the *Furnace*, Carryeth it away while it Melteth, by Over-Volatilizing it.

There is often found a Red Substance, which grows to the *Ore*, called *Cinnaber*, *Cinnaber of Silver*, *Cinnabaris nativa*, *Minium Nativum*, or *Berg-Cinober*. This Substance grinded with Oil, maketh a *Vermilion*, equal to, if not surpassing the *Cinnaber* made by *Sublimation*. I Discovered a *Sulphur* in it, by Casting it upon a hot Iron Plate, on which it Burned Blew. The Miners say they met not with any *Quicksilver*; but they find *Crystals*, *Amethysts*, or *Amethystine mixtures*, in the Clefts of the Rock, and sometimes Nigh or Joined to the *Ore*, as also *Vitriol* naturally *Crystallized* in the Earth in diverse of the *Mines*, and particularly in a *Mine* in *Paradise-Hill* near *Schemnitz*.

An *Hundred Pound* weight of *Ore* sometimes yields but half an *Ounce*, or an *Ounce* of *Silver*; sometimes 2 *Ounces*, 3, 4, 5, and unto 20 *Ounces*. What is Richer is very Rare: Yet some hath been found to hold *Half Silver*; and I have seen of it so Rich, as to be Cut with a Knife.

A *Specimen* of each sort of *Ore*, which they dig out of the *Mines*, is carried to an Officer call'd the *Probierer*, who is to Prove and Judge of its Richness; which he doth in this manner: Of all sorts of *Ores* he taketh the same Quantity: The *Ores* being first Dryed, Burned, and Powdred, he giveth an Equal proportion of *Lead* to all; Melteth and Purifieth them; then by Exact Scales takes notice of the Proportion between the *Ore* and the *Metal* contained in it; and Reports it to those employed in the Great *Melting Furnaces*.

If the Ore be found to hold $2\frac{1}{2}$ Ounces or more of Silver in 100 Pound Weight, they Ordinarily melt it, without any foregoing Preparation, by the help of Iron-Stone, (which is not Iron-Ore, but a Stone found thereabout, of which the Liver-Coloured is the Best) Kys, (a sort of Pyrites,) and Slacken, (a Scum or Lake taken off from the top of the Pan, into which the melted Mineral runs, and is a Substance made out of the Former mentioned by Fusion;) which are thrown in with it into the melting Furnace.

If the Ore be Poorer, holding but 2 Ounces in an 100 Pound Weight, or less, it is first Pounded and Washed, till it becomes Richer, or hath a Greater Proportion of metal in respect of the Ore, much of the Earthy parts being Washed away. Then it is thrown into the Furnace with the Former Materials; and the Marchasite, which remains still with it, as sinking always to the Bottom with the Silver in the Wash works, helps to the quicker Fusion of the Ore.

Whatsoever is Melted in the melting Furnace, is let out through an Hole at the bottom thereof into the Pan, which is placed in the Earth before it; and, thus exposed, it immediately acquires an Hard Scum, Dross, Loaf, or Cake, which being oft taken off from the Top, the metal Remaining in it becomes Purer; to which is added Lead, and after some Time the melted Metal is taken out. Then being again Melted in the Driving Furnace, the Lead, or what else Remains Mixt with the Silver, is Driven off by the Blowing Two Great Bellows, and Runs over in the form of Litharge. That which first comes over is the White, and that which is last, being longer in the Fire, is the Red; not that it is Litharge of Gold, both being driven off from the same metal.

Most of the Schemnitz-Silver Ore holds some Gold; which they separate by Melting the Silver, then Granulating it, and afterwards by Dissolving it in Aquafortis, whereby the Gold is left at the Bottom, and is afterwards Melted. The Aquafortis is Distilled from the Silver, and serveth again for Use.

The Silver then separated from all its former Associates, is sent to Cremnitz, where they Coin it into Pieces of a mixt Metal, (which is the common Money of the Country) after this manner. They Melt it with about the same Quantity of Copper, and run it into Bars, which they Beat out; then softening them in the Fire, Draw them out to an Exact Thinness between two Steel-wheels; then they cut them out into Round Pieces with an Instrument like a Shoe-maker's Punch; and then Boil them with Tartar and Salt, shake them in a Sack with Small Coal and Water, dry them in a Kettle Perforated, and afterwards they are drawn between two Wheels, in which they receive their Stamp.

CXI. Among the 7 Mine-Towns in Hungary (which are not far from one another, viz. Chremnitz, Schemnitz, Newsol, Koningsberg, Bochantz, Libeten, and Tilm) Chremnitz is the Richest in Gold. They have also, at present, Gold Mines at Bochantz and Coningsberg; and they report in that Country, that there hath been formerly a Rich Gold Mine at Glass-Hitten,

The Gold Mines
in Hungary, by
Dr. Edward
Brown. n. 58
p. 1193.

but lost since that *Bethlem Gabor* over-ran Those Parts, when the Undertakers stopped up the *Mine* and fled.

They have Worked in the *Gold Mine* at *Chremnitz* 900 Years. This *Mine* is diverse *English Miles* in Length, and about 160 *Fathoms* Deep. Many *Veins* of the *Ore* run to the *North*, and to the *East*. They Work also towards *One, Two* and *Three* of the *Clock*, as they speak; for the *Miners*, direct themselves under Ground by a *Compass*, not of 32 *Points* (such as is used at *Sea*) but by one of 24; which they Divide, as we do the *Hours* of the *Day*, into twice *Twelve*. Of the *Gold Ore*, some is *White*, and some *Black, Red,* or *Yellow*: That with *Black Spots* in *White* is esteemed the Best, as also the *Ore* which lieth next) to the *Black Veins*. This *Ore* is not Rich enough to suffer any *Proof* in small *Parcels*, like that in other *Mines*, whereby to know what *Proportion* of *Metal* is contained in it; but they Pound a very great *Quantity* thereof, and wash it in a little *River*, which runs nigh the *Town*. The whole *River* being divided, and admitted into diverse *Cuts*, runs over the *Ore* continually, and so washeth away the *Earthy* parts from the *Metal*-line: And from a *Clear River* above the *Town*, by its *Running* through so many *Works*, and over so much *Pounded Ore*, it becomes below the *Town*, a *Dark-Yellow Stream*, of the *Colour* of the *Earth* of those *Hills*.

There have been *Pieces* of *Pure Gold* found in the *Mine*. Some of which I have seen in the *Emperor's Treasury*, and in the *Electors* of *Saxony's Repository*; one *Piece* as broad as the *Palm* of my *Hand*, and others less, and upon a *White Stone* many *pieces* of *Pure Gold*; but these are very *Rare*.

The common *Yellow Earth* of the *Country* near *Chremnitz*, although it be not Esteem'd *Ore*, affords some *Gold*: And in one *Place* I saw a great part of an *Hill* digg'd away, which hath been *Cast* into the *Works*, *Washed* and *Wrought* in the same manner, as *pounded Ore*, with *Considerable Profit*.

Some *Passages* in this *Mine*, *Cut* through the *Rock*, and long disus'd, have grown up again, and I observed the sides of some, which had been formerly wide enough to carry their *Ore* through, to approach each other, so as we pass'd with *Difficulty*. This happens in *Moist Places*. The *Passages* Unite not from the *Top* to the *Bottom*, but from one side to another.

There is *Vitriol* in this *Mine*, *White, Red, Blue* and *Green*; and also *Vitriol Waters*. There is a *Substance* found, which sticks to the *Gold Ore*, of small *Pointed* parts like *Needles*, call'd by them *Antimony* of *Gold*. I here are *Crystals* found here, and some *Tinctur'd Yellow*.

The *Miners* will not allow any *Quicksilver* or *Brimstone* to have been found here; yet in the lately mention'd *Antimony* of *Gold*, there is evidently *Sulphur*, as I perceived by *Burning*. The *Quicksilver Mine*, mention'd in the *Answer* to *Kircher's Inquiries. Mund. Subter.* is an *Hungarian Mile*, or seven *English Miles* distant from *Chremnitz*; and is not wrought in at *Present*.

There is a *Vitriol Mine* in these *Hills* near the *Gold-Mine*; the *Earth* or *Ore* of it is *Reddish*, and sometimes *Greenish*. This *Earth* is infused in *Water*, and after 3 *Days*, the *Water* is poured off, and *Boyled* 7 *Days* in a *Leaden Vessel*, till it comes to a *Thick Granulated Whitish Substance*, which

is afterwards Reduced to a *Calc* in an *Oven*, and serveth in the making *Aqua-fortis*, or the *Separating Water*, used at *Schemnitz*.

They have Divers ways of taking the *Gold* out of its *Ore*; by *Burning* the *Ore*; by *Melting*; by *Adding Silver Ore* and other *Minerals*, *Sand*, and *Lead*, as they find the *Ore Fluid* or *Fixt*. But without *Lead* they Proceed thus.

They Break and Pound the *Ore* in *Water* very *Fine*; they Wash it often, and lay it in *Powder* upon *Cloaths*, and by the gentle *Oblique Descending* of the *Water* over it, and their continual *Stirring* it, the *Earthy*, *Clayish*, and *Lighter Parts*, are Washed away, while the *Heavier* and *Metalline* Remain in the *Cloaths*; these *Cloaths* are afterwards Washed Clean in several *Tubs*, and the *Water* after some *Settling*, Poured off from its *Sediment*, which *Sediment* is again Washed, and stirred up in several *Vessels* and *Troughs*, till at length they sprinkle *Quicksilver* upon it, and Knead it well together for an *hour*, and then Washing it again in a *Wooden Vessel*, after the *Separating* of much of it which the *Quicksilver* touches not; by striking this *Vessel* against their *Leg*, they bring the *Gold* and *Quicksilver* together, in an *Amalgama*, to one *Corner* of it. From this *Amalgama* they Strain as much of the *Quicksilver* as they can through *Coarse Cloaths* first, and then through *Fine*; then they put the *Mass* Remaining upon a *Perforated Plate*, which they set over a deep *Pan* placed in the *Earth*, in the *Bottom* of which *Pan* they also put *Quicksilver*; This *Pan* they Cover, and Lute the Cover well, and then making a *Char-coal-Fire* Upon it, they Drive down the *Quicksilver*, yet Remaining in the *Gold*, to the rest in the *bottom* of the *Pan*; then taking out the *Gold*, they Cast it into the *Fire*, that it may become *Purer*.

Concerning *Cranach-Gold*, I cannot Learn, that there is any such *Gold*, or Place where *Gold* is digg'd, in *Hungary*: but in *Germany* I think there is, for *Agricola* mentions such a Place as *Golde-Cranacum*, and another call'd *Golde-Crona*.

CXII. It is evident from undoubted Experiment, that *Gravity* is in all Bodies Proportionable to the Quantity of *Matter* in each, and there is no such thing as a Propension of Some more, Others less, towards the *Earth's Center*; since the Impediment of the *Air* being removed, all Bodies Descend, be they never so Loose or Compact in Texture, with *Equal Velocity*. It follows therefore, that there is 7 times as much *Matter* in *Gold* as in a piece of *Glass* of the same Magnitude (their *Specifick Gravities* being nearly as 7 to 1) and consequently, that at least 6 parts of 7 in the Bulk of *Glass*, must be Pore or Vacuity. This some Favourers of the *Atomical Philosophy* have endeavoured to solve, by Supposing the *Primary* or *Constituent Atoms* of *Gold* to be much Larger than those of Other Bodies, and consequently the Pores Fewer.

In order to Examine the Magnitude of those *Atoms*, I informed my self among *Wire-drawers* that the very best *Double-Guilt Wire*, was made out of *Cylindrick Ingots* 4 Inches in Circumference, and 28 Inches long, which weigh 16 pounds Troy; on these they bestow 4 Ounces of *Gold*, that is, to every 48

The Extreme
Ductility, and
Exceeding Mi-
nuteness of the
Constituent Par-
ticles of Gold;
By Mr. Edmond
Halley n. 194.
p. 540.

Ounces of Silver, One of Gold: and that 2 Yards of the Superfine Wire weighs a Grain. Hence at first Sight it appeared, that the length of 98 Yards is in Weight 49 Grains, and that a single Grain of Gold Covers the said 98 Yards and that the 10000th part of a Grain is above $\frac{1}{3}$ of an Inch Long; which yet may be Actually divided into 10, and so the 100000th part of a Grain of Gold be Visible without a Microscope. And by means of the Specifick Gravities of the metals, viz. Silver $10\frac{1}{2}$ and Gold $18\frac{2}{3}$. I found the Diameter of such Wire, the $\frac{1}{382}$ part of an Inch, and its Circumference the $\frac{1}{123}$ part: but the Gold in Thickness not to Exceed the $\frac{1}{134500}$ part of an Inch; whence it may be Concluded, that the Cube of an hundred part of an Inch would contain above 2433000000, (or the Cube of 1345) of such Atoms. And yet tho' the Gold be Stretched to so great a Degree as is here Demonstrated, it shews it self of so Even and United a Texture, as not to let the White Colour of the Silver under it appear (even with a Microscope) through any the least Pores; which Argues that even in this Exceeding Thinness, very many of those Atoms may still lie one over the other.

A Mineral like Leaf-Gold near Mexico; By an English Gentleman at Seville n. 41. p. 817.

CXIII. 1. An. 1664. I travelled into the Kingdom of Mexico, under the Character of a Biscaner, and remained in that Country about 2 Years.

Some of the Minemen shewed me certain Stones, gathered in great abundance in the Mines of Tasco, which they would have to be Amethysts,

There is a famous Cave, some Leagues from Mexico, on the North-west side of the City, beyond the Lake. I found it situated somewhat High, in a place very convenient for Generation of metals. The Light of a Candle soon discovered to me on all sides, but especially above my Head, a Glistering Canopy Guilded with a kind of Leaf Gold. I heaped together a quantity of the Mineral mixt with Sand, and scraped also from the Superficies of the Earth, a Quantity of the same kind of Mineral Leaves; none of which exceed the breadth of a Man's Nail; and with the least Handling they divide themselves into many Lesser Spangles; with a little Rubbing they leave ones hand all Guilded over like Gold; and they equalize the Most Refined Gold upon the Touch stone.

It is reported that the Antient Indians knew how to make use of this Mineral. But the Spaniards have never been able to Reduce it into a Massy Form by the Violence of the Fire or Seperate it from Heterogeneous Substances by the Mild Tryal of Quicksilver. Some indeed of the Choicest Mines of Silver and Gold, are almost of the like Nature, till the Impediments are removed, which are certain Mineral Viscosities, that sometimes by their Oleaginous Fatness, and at other times by a Fretting Acrimony, hinder the ingress of the Mercury.

To find out therefore a Cure for this Disease I begin to make Experiment on the Sand, which had been the Matrix of the Mineral. I try'd it in a Strong Reverberating Fire, but it did not afford any Visible Fumes. I then boiled some

of it in Water, and having Poured that off, I observed the *Alkali*, left after the Waters *Evaporation*: and thereby I discovered, that it abounded rather in *Sulphureous Unctuousness*, than *Saline Acrimony*. Finding this, I applied first the *Quicksilver* Mingled with the Ordinary *Magistrals* (as they call them) used in that Country, to Curb and Break the force of the *Sulphureous Impediments*. But perceiving these to be of no Effect, I Encouraged the *Quicksilver* with the *Caput mortuum* of *Vitriol* or *Salt Peter*, (kept as a *Secret* among the *Chiefest-Minemen*) but with as little Signs of the *Mercuries* operation as before. Then I *boyled* my Mixture over the Fire; a way found out in *Peru* in such Difficult Cases: but all to no purpose. Then I devised a way to Torment it with a *Corrosive* of Ordinary *Separating Water*, Impregnated with *Common Salt*, and it made a *Dissolution* exactly like that of *Gold*: But having *Streamed* away the *Aqua Fortis*, I found a Dirt something *Yellow*, out of which with *Distilled Vinegar*, enforced with its own *Tartareous Salt*, I *Extracted* a *Tincture* more Curious than Useful.

An Experienc'd *Mineralist* Cemented it with the Powder of *Vulgar Sulphur*, *stratum super stratum*, and this in a *Moderate Fire* for 3 days together; hoping the *Sulphur* would Consume all the *Impediments*, which kept the *Mercury*, from entring: But (as I told him before hand) it only Served to Clog the matter with more *Sulphureous Unctuousness* than it had before.

2. When *Silver* is Generated (as commonly 'tis) in certain *Rocky Stones*, abounding with *Bituminous Corrosive* mixtures, so as 'tis Impossible to free it totally from its *Corrupt Matrix* by the Violent way of *melting*, what ever *Auxiliary Ingredients* may be added, as *Lead* and *Artificial Salts*, and the like because those *Sulphureous* and *vitriolick* Compounds, (in the way of *Fusion*) meeting together with the *Silver*, *Sublime* part of it away, in a *Volatile Fume*, by their *Corroding Acrimony*, *Calcinating* and *Vitrifying* the other part, and *Robbing* the Artificer of half his *Gain*: in this case the *Use of Quicksilver* is found most *Advantageous*. The Practice thus.

Having *Reduced* the *Ore* into small stones, they *Calcine* it first in a *Reverberating Oven*, yet with a *Moderate Fire* for fear of *Fusion*, and *Driving* away into the Air part of the *Treasure*; the *Volatile* parts being by nature not perfectly mixt *per minima* with the *Fixt*, as they afterwards come to be by *Industry* and *Art*. And I have heard some of the more *Intelligent Mineralists* say, that they Judge their *Metallick Labors* and *Operations* to be many times not so much a *Reaping of Silver* ready made, as a kind of *Artificial Compounding*, and *Bettering* of that, which Nature had left *Dispersed* and *Imperfect*.

This *Calcination* serves, chiefly to free the *Mineral* from many *Infirmities*, that *Hinder* the *Operation* of the *Quicksilver*; and it serves also to *Discover* by the *Colour* of the *Fumes* it yields, what *Corrosive* mixture chiefly abounds in it: besides that, it renders the *Ore* more *Tractable* and *Pliant* under the *Mill Stone*, which is to *Reduce* it to *Small Flower*, before the *Application* of the *Mercury*. This is chiefly observed in those *Silver Veins*, that are of a *Hard* and *Dry* Complexion; yet those which are usually more *Soft*, abounding

The use of Mercury in Separating Silver from the Ore; By the same English Gentleman ib. p. 820.

in *Oleaginous Sulphurs*, before *Burning*, are first ground into powder in such *Mills* as I have often seen in *Glass houses*, and then they Receive a Gentle *Calcination*, the *Mineralist* mingling therewith Suitable *Ingredients*. As if (e. g.) the *metal* be *Sulphureous* and *Antimonial*, *Rust* and *Dross* of *Iron* is found to be an excellent *Cure* of this *Distemper*: If *Martial*, and abounding in *Iron*, then *Sulphur* and *Antimony* reduced to *Powder*. And I have found by *Experiment* that *Sulphur* has a particular *Force* to *Soften* and *Dissolve Iron*.

The *Ore* being *Ground*, *Calcin'd* and curiously *Sifted*, they *Divide* it in several *Heaps*, and then by *Lesser Essays*, they find out how much *Silver* is contained in every *Heap*: where 'tis very *Ordinary* to find only 6 *ounces* in 100 *pounds*; sometimes 12; but if it yield 18, 'tis esteem'd a very *Rich Vein*; yet sometimes there are great *Masses* found all of *Pure Silver*, which is called *Virgin metal*. Then *Proportionable* to the *Quantity* of *Silver* in each *Heap* they besprinkle them with *Quicksilver*, and that not all at once, but at several times *Stirring* the *Ore* up and down. If the *Mercury* gives *Signs* of being *Tocado* (as they call it) i. e. if it appear *Mortified*, not in *Small* and *Clear* spherical *Figures* (which is a good *Prognostick*) but in the form of *Long Worms* of a *Wan*, *Pale*, *Dark* and *Leadish* Colour, (which indicate that the *Ore* abounds with *Lead* and *Pewter*;) it is *Cured* by certain *Magistrals* which have for their *Basis* or *Master Ingredient* *Calcin'd Copper* mingled with *Salt*.

The *Heaps* of *Ore* being thus *Mingled* with *Quicksilver*, they are often *Stirred* about, the better to *Incorporate* it with the *Silver*. I find, that they have none but *Conjectural Signs* to know, when the *Mercury* hath entirely performed its *Office* in *Seperating* All the *Silver* from those *Heterogeneous* Substances: the *Uncertainty* whereof occasions often very great *Losses*, especially when they *Work* about *Gold*; for in *Passing* the *Right Time*, the greatest part of the *Gold* *Flyes* away in a *Fume*. But when by the *Colour* of the *Mercury*, *Coagulated* by the *Silver* in *Clear* *Massy* lumps, they *Conjecture* the *Work* done, they *Wash* it by means of *Three Vessels*, standing in order the one under the Other, so that, the *Matter* in the *First* and *Highest* *Vessel* being *Washed* and *Stirred* about with a *Molinet*, all the *Dust* of the *Heterogeneous Minerals*, that Imbody not with the *Mercury*, is carried away together with the *Water* into the other *Vessels*, and from thence is quite thrown out by the *Continual Current* of the *Water*; whereas in the mean while the *Silver* in *clotted Lumps*, called *Pella's*, is by the weight of the *Mercury* *Depressed* down to the bottom of the *Tubbs*. Then the *Mercury* with the *Silver* is taken out of the *Vessels*, and diligently *Squeezed* in coarse and *Strong Linnen*, and even with *strokes* of a *Beetle*, the *Quicksilver* is *Separated* as much as may be from the *Silver*. And this *Mass* is afterwards *Reduced*, in *Molds* of the shape of the *Indian Pine apple*, into a *Pyramidal* or *Conical* *Figure*, which they call *Pineas de Plata*, thus fashioned for the easier placing them round about the *ridges* of a great *Earthen Vessel*, of the *Form* of a *Blind Alembick*; round about the *Top* of which, a *Fire* being made, all the rest of the *Mercury* forthwith abandons the *Silver*, and *Falls* to the bottom, from whence it is *Recovered*, and kept for the like use.

Lastly,

Lastly, The *Silver* is melted down with the *Liga*, (as 'tis call'd) which the King of *Spain* allows, by which he returns to the People in *Copper* that *Fifth Part*, which they allow him of all the *Silver*.

I have observed, that there is a very strong Offensive *Smell*, Ranker than that of *Sepulchres*, in some *Mines*: the Workmen telling me, that that is one of the *Chief Signs* of a *Rich Mine*.

Vegetable Silver.
ver. ib. 823.

A Friend of mine shewed me a very pretty Experiment more Curious than Gainful; it was a continual *Budding* forth of *Silver* in the Form of a *Branch*, in a *Glass*, over an indifferent strong *Fire* of *Coals*; which *Sprouts* being Clipped off with *Scissors*, and a small supply of *Crude Mercury* added to the Matter, in a small time there arose another *Branch* of *True Silver*, which had sucked and Converted into *Metallick Sprigs*, a considerable portion of the *Quicksilver*. This Motion, and the Increment of New *Silver Branches* Ceas'd not, as long as the *Fire* was continued, and *Fresh Mercury* applyed, for the due *Nutrimment* of this *Mineral Vegetation*. This whole Complex of Ingredients is known to consist only of *Vulgar Aquafortis* (abstracted from two Parts of *Vitriol*, and one of *Salt Peter*) and *Quicksilver*, and a small Quantity of *Silver*, far less than you may Reap in a small time from these *Silver Sprigs*. Yet *Gain* there is none, there being more Expences Blown away into *Smoke*, by the Continuance of *Fire* in *One Month*, than can be recovered from this *Silver Harvest* in a longer time.

I am of Opinion that in all *Transmutation* of *Metals* the *Imperfect Metal* is not totally *Transformed* into the more *Perfect*, by the Substance mixed with it: But that the Mixture added to the *Melted Metal*, joins it self, (as I conceive) to those Parts, which being *Homogeneous*, Symbolize together with the Nature of the more *Perfect*, whereby the *Pure Metalline* parts are separated from the other *Heterogeneous Impure Sulphurs*.

CXIV. The End of *Refining* is the *Separation* of all other Bodies from *Gold* and *Silver*, which is performed 4 ways, viz. by *Parting*; by the *Test*; by the *Almond Furnace* or the *Sweep*; and by *Mercury*. 1. *Parting* is done with the *Aquafortis*. Some *Refiners*, to make the *Aquafortis*, take *Salt Peter* 3 pound, and *Dantzick* (not *English*) *Vitriol* 2 pound (for the *English Vitriol* makes a weaker Water, and a *Dirty Colour'd Verditer*, and wholly spoils it.) After they are well Bruised and Mixed in a *Mortar*, they *Distill* 100 pound of the Materials, put into a *Cast-Iron Pot*, after this manner.

The Art of Refining; by Dr. Chr. Merret. n. 142. p. 1046.

Parting.

Build a *Furnace* 2 Yards high or more; and at the top place in your *Iron Pot*: To which fit a *Head* of *Earth*, like the *Head* of a large *Distillation* for *Chymical Oyls*, which must have a large *Belly*, branching it self out 8 Inches from the *Iron Pot*, into 3 *Branches*; one whereof in the midst, comes directly straight forwards, two other *Lateral* ones come *Obliquely*: All which *Branches* are 4 or 5 Inches hollow in *Diameter*, and 5 or 6 long. To these *Branches* are fitted *Glass Bodies*, *Narrow* and *Hollow* at both ends, *Large* and *Globous* in the midst. These must be exceedingly well *Luted* on with *Colcothar*, *Rags*, *Flower* and *Whites* of *Eggs*. To this first *Glass Body* is *Luted* on another *Glass*, of the same *Figure* and *Size*, and in order 8. alike
in

in all, till they come to the *Receiver*, which is an Ordinary *Gallon Glass*. All these Rows of *Glasses* lie on Boards, shelving from the *Head* to the *Receiver*. The two Upper *Receivers* or *Glass Bodies* need Exceeding good *Luting*, for the rest Ordinary *Lute* will serve.

The *Lute* is made of good *Lome*, some *Horse dung*, and a little *Colcothar*; although the two former do well.

A little *Fire* and that of *Newcastle-Coals* does the Work. And you need never Break or *Unlute* any of the *Receivers*, but the Lowermost.

The *Aquafortis* being *Distilled* off, is put into a large Earthen Pot, and there is added of *Fine Silver*, one or two *Penny weight* (which is called *Fixes*) to every *Pound* of *Aquafortis*, which within 4 *hours*, will Purge it from all *Dirt* and *Impurity*, and make it fit for *Parting*, which is thus done.

If their *Silver Guilt* be *Fine* enough for *Wire*, they only *Melt* it in a *Wind Furnace*, and *Cast* it, *Melted*, into a large *Tub* of *Water*, that they may have it in small *Pieces*; but if it be but *Standard*, they first *Fine* it on the *Test*. These small *Pieces* taken from the *Water*, being well *Dryed*, are put into a *Glass Taper-fashion'd*, a *Foot High*, and 7 *Inches* at the *Bottom*; and then the *Glasses* are Charged with *Aquafortis* about 2 *thirds* of it, and set in a *Range of Iron* Covered 2 *Inches* deep with *Sand*, and a *Gentle Char-Coal-Fire* is made under it.

Small *Bubbles* will soon arise, and the *Water* also Run over. If so they take off the *Glasses*, and hold them till it doth *Deservescere*, or else pour out some of it into a *Vessel* which is at *Hand*.

If *Lead* be Mixed with it, they cannot keep it from *Running* over.

When the *Water* hath been once *Quieted*, from this *Ebullition*, it will Rise no more.

The *Greenness* of the *Water*, manifesteth the *Quantity* of *Copper* contained in it.

If the *Water* Boil over, 'twill *Penetrate* the *Bricks* and *Wood*.

They commonly let it stand a *Night* on the *Iron-Range*, with a *gentle Heat* under it, and in the *Morning* softly Pour off the *Water* Impregnated with all the *Silver*; all the *Gold* lying like *Black Dirt* at the bottom; which being Washed out is put into small *Parting-glasses*, and set over the *Sand* with their *Conduit Water* for an *hour*, and then the *Water* Poured off. This is repeated 5 or 6 times, to *Seperate* the *Salt* from the *Gold*, which is now fit to be *melted*, and *Cast* into *Ingots*.

To Regain the *Silver*, they have large Round *Washing Bowls*, lined within with *Melted Rosin* and *Pitch* (for otherwise the *Water* would eat the *Wood* and penetrate the sides of the *Bowl*) Covered with *Copper Plates* 10 *inches* long, 6 wide, and *Half* or more *Thick*. Into which *Bowls* they pour good store of *Water* (the more, the better the *Verditer*) and then the *Silver-Water*; which Working on the softer *Metal* of *Copper*, leaves all the *Silver* in most fine *Sand* at the *Bottom*, and *Sides* of the *Bowl*, and *Plates* of *Copper*; which being taken out, is Washed, *Dryed* and *Melted* for any Use.

If any *Brass* or *Shroffe Metal* be in the *Plates*, they gather very little of the *Silver*; the *Latter* Mixing with the *Silver*.

With the *Copper-water*, poured off from the *Silver*, and *Whiting*, *Verditer*, is made thus. They put into a Tub a *Hundred Pound* weight of *Whiting*, and thereon pour the *Copper-Water*, and stir them together every day, for some *Hours* together. And when the Water Grows Pale, they take it out, and set it by for farther Use, and pour on more of the *Green water*; and so continue till the *Verditer* be made; which being taken out, is laid on large pieces of *Chalk* in the *Sun*, till it be dry for the Market.

The Water mention'd to be taken from the *Verditer*, is put into a *Copper*, and Boiled till it comes to the Thickness of *Water-Gruel*, now principally consisting of *Salt Peter* Reduced, (most of the *Spirit* of *Vitriol* being gone with the *Copper* into the *Verditer*.) a Dish full whereof being put into the other Materials, for *Aquafortis*, is Re distilled, and Makes a *Double-water*, almost Twice as good as that without it.

2 By the *Test*, all *Metals* are separated from *Silver*, except *Gold*, because they Swim over it, when they are all melted together.

The Test.

The *Test* is thus made. They have an *Iron Mould*, Oval, and two *Inches* Deep. At the Bottom hereof are 3 *Arches* of *Iron*, set at Equal Distances, 2 *Fingers* wide, if the great Diameter of it be 14 *Inches* long; and so proportionably in Greater or Lesser *Tests*. This Cavity they fill with Fine Powder of *Bone-Ashes*, moistened with *Lixivium*, made with *Soap-Ashes*. Some use Cakes of *Pot-Ashes*, or other *Ashes* well Cleansed, and so pressed well together with a *Muller*, that it becomes very Close and Smooth at the Top. There is left above, a *Cavity* in the Midst of it, to Contain the melted *Silver*. This *Cavity* is made greatest in the Middle; for the *Bone-Ashes* come up Parallel to the Circumference of the *Mould*; only a small *Channel* in that End, which is most remote from the *Blast*, for the Running off of the *Baser Metals*, and so is made *Declive* to the Center of the *Test*, where 'tis not above half an *Inch* deep.

The *Test* thus made, is set *Annealing* 24 *Hours*, and then 'tis set in a *Chimney* a *Yard* High, Parallel almost to the Nose of a Great Pair of *Bellows*; and then therein is put the *Silver*. Which being Covered all over with *Billets* of *Barked Oak*, the *Blast* Begins, and Continues all the while strongly. The *Lead*, purify'd from all *Silver*, (which they call the *Soap* of *Metals*) first put in, melts down with the *Silver*, and then the *Lead* and *Copper* swim at the Top, and run over the *Test*. Whose Motion the *Refiner* helps with a long Rod of *Iron* drawn along the Surface of the *Silver* towards the fore-mention'd *Shut*; and often stirring all the Metal, that the *Impurer* may the better Rise; and by continuing this Course, *Separation* is made in 2 or 3 *Hours*.

The greatest part of the *Lead* flies away in *Smoak*.

If the *Lead* be gone before all the *Copper*, 'twill rise in small Red fiery Bubbles; and then they say the *Metal Drives*, and must add more *Lead*. The force of the *Blast* Drives the Higher *Metals* to the lower side of the *Test*, and helps its Running over.

When the *Silver* is fully *Fixed*, it looks like most pure *Quicksilver*; and then they take off their *segs* and let it Cool. In the *Cooling*, the

Silver will frequently from the middle, Spring up in small *Rays*, and fall down again. If *moist Silver* be put into that which is *melted*, 'twill spring into the Fire.

A good *Test* will serve two or three *Firings*.

So soon as the *Silver* will hold together, they take it out of the *Test*, and Beat it on an *Anvil* into a Round Figure, for the *Melting-Pot*; which being set in a *Wind-Furnace*, surrounded with *Coal*, and Covered with an *Iron-Cap* that no *Charcoal* fall into it, is then *melted*.

If any *Dross* or *Filth* be in the *Melting-Pot*, they throw in some *Tincal*, which gathers the *Dross* together, that it may be separated from it.

These *Melting-Pots* are never *Burned*, but only *Dried*, and last a whole *Day*, if they be not suffered to *Cool*; but if they once *Cool*, they infallibly *Crack*.

The Almond
Furnace.

3. In the *Almond-Furnace* or *sweep*, all sorts of *Metals* are separated from *Cinders*, parts of *melting Pots*, *Tests*, *Brick*, and all other *Harder Bodies*; which must be first Beaten into small Pieces with a *Hammer* on an *Iron-Plate*.

Those which stick but superficially to the *Silver*, they *Wash* off thus; they have a *Wooden Round Instrument* 2 *Foot* wide, somewhat *Hollow* in the *Middle*, with a *Handle* on each side. On this they put the *Materials*, and hold them in a *Tub* of *Water* below the *Surface*, and so *Waving* it to and fro, all the *lighter* and *looser* matter is separated from the *Metal*.

The *Furnace* is 6 *feet* High, 4 *feet* Wide, and 2 *feet* Thick, made of *Brick*; having a *Hole* in the *midst*, at the top 8 *Inches* over, growing *Narrower* towards the *Bottom* of it, where on the *fore-part*, it *Ends* in a small *Hole*, environed with a *Semicircle* of *Iron*, to keep the *Molten Metal*. About the *Middle* of the *Back*, there is another *Hole* to Receive the *Nose* of a *Great* pair of *Bellows*.

When the *Furnace* is *Annealed* with *Charcoal* and *Hot*, they throw two or three *Shovels* of *Coal*, to one of the *fore-mention'd* *Stuff*, and so *Proceed* during the whole *Work*, which continues three *Days* and *Nights*, without *Intermission*. After *Eight* or *Ten Hours* the *Metal* begins to *Run*; and when the *Receiver* below is pretty full, they lade it out with an *Iron Ladle*, and *Cast* it into *Sows* in *Cavities*, or *Forms*, made with *Ashes*.

They frequently stop the *Passage-hole* with *Cinders* to keep in the *Heat*; and when they think a *Quantity* of *Metal* is *melted*, they *Unstop* the *Hole* to pass it off.

If the *Stuff* be hard to *Flux*, they throw in some *Slag* (which is the *Recrement* of *Iron*) to give it *Fusion*.

A stinking *Blew Smoak* proceeds from the *Furnace*, and all *By-standers* put on the *Colour* of *Dead men*.

By Quicksilver. To get the *Silver* from those *Metals*, and to *Refine* their *Copper* from the *Litharge*, they now use no other *Art* than that of the *Test*.

4. By *Quicksilver* the *Filings* of *Gold* and *Silver* are separated from *Dust* &c. This *Dust* is put into a *Hand-Mill* with *Quicksilver*, and being continually *Turned* upon that and the *Metals*, an *Amalgama* is made of them, and *Fair Water* Poured in, carries off the *Dust* as it runs out again by a *Small Quill*. By Quicksilver.

This *Amalgama* is put into an *Iron*, with a *Bolt-head* set into the *Fire*, having a long *Iron Neck* 3 *Feet* long, to which is fitted a *Receiver*. The *Fire* *Distills* off the *Mercury* into the *Receiver*, and the *Gold* and *Silver* remain in the *Bolt Head*.

CXV. 1. There was taken of *Crown-Gold* (which is as they call it, of 22 *Kerats* Fine, or $\frac{11}{12}$; and the *Alloy* is part *Silver*, part *Copper*, more of the *Copper* for the most part) to the *Quantity* of 178 *Grains*. This was melted down with 2 *Ounces* and 2 *Drachms* of *Antimony* (about 6 times as much as the *Gold*.) And because the *Gold* was put in *Plates*, for the more certain *Melting* and *Mixture*; the *First Regulus* of *Gold* being separated from the *Antimony*, both were *Powdered* apart, and the *Regulus* in the *Melting-Pot* laid upon the *same Antimony*, and so both *Melted* down again. In both which *Meltings*, such an *Heat* was given, as made all of a clear *Light*, even *Red Hot*, and *Boiling*. Then the *Pot* was taken out of the *Fire*, and all permitted to *Seperate*, *Settle*, and *Cool* in it. Upon the *Breaking* the *Pot* the *Regulus* of *Gold* (being very *Distinct* in the bottom, and *Easily separated* from the *Antimony*) weighed 163 *grains*. Experiments of Refining Gold with Antimony; by Dr. Jonath. Goddard. n. 138. p. 953. With fresh Antimony.

N. B. That this *Way of Cooling* All in the *Pots* was *Observed* in all the following *Experiments*, for the more certain *Seperation* and *Settlement* of the *Regulus*, without *Effusion* into the *Antimony-Horn* (as they call it) or *Hollow Iron Cone*. Which *Effusion* by *Confounding* and *Cooling* the *Mixture* may be some hindrance to a more perfect *Separation*. And to be sure, in the bottom of the *Cone*, there is always a *Thin Crust* of the *Crude Antimony*, troublesome to be *Separated*, without taking off some part of the *Regulus*.

Note also, That *Borax* was used in every *Pot*, for prevention of the sticking of the *Regulus* to the *Bottom*, and the *Antimony* to the *sides* of it; so that both were gotten off *Clean*, and in full *Quantity*.

Of the *Regulus* a piece was broken off, which weighed $38\frac{1}{2}$ *grains*, and was kept to be *Refined* upon the *Coppel* apart; the *Weight* of the *Remainder* therefore was $124\frac{1}{2}$ *grains*, which being *Powdered* and put upon $2\frac{1}{4}$ *Ounces* of *fresh Antimony* and *melted* down, the *Regulus* weighed 74 *grains*.

The other *Piece* of $38\frac{1}{2}$ *grains* being *Refined* on a *Coppel*, from the *Antimonial* Substance mixed with it, (by *Exhalation*, promoted some time with a *Blast* upon it, especially toward the latter end, as in all the following *Experiments* of *Refining* upon the *Coppel*) $30\frac{1}{2}$ *gr.* and upon *melting* with *Borax* in a *Crucible*, lost not above *half a grain*. So that the *Weight* of the whole to the *Gold* it held, was as $38\frac{1}{2}$ to $30\frac{1}{2}$, or the *Gold* almost $\frac{1}{2}$ of the whole. The *Latter Regulus* Weighing 74 *gr.* being *Refined* in the same manner, Weighed

Weighed 63 gr. the *Gold* holding Proportion to the whole, as 63 to 74; that is, near upon $\frac{6}{7}$ of the whole. So that the same *Regulus* of *Gold* and *Antimony*, in passing through *New Antimony*, though it lose in Weight, yet it is Richer in *Gold*; and appears so to Sense, being of a *Redder* Complexion, more Tough and Harder to Powder.

Both the parcels of *Antimony* were severally Mixed, with equal weight both of *Tartar* and *Nitre*, and then *Fired*, and so reduced to a *Regulus*. Then the *Regulus* of each, *Exhaled*, and Blown off upon *Coppels*. Of the *First* Parcel of *Antimony* wherewith the *Gold* was first Melted, the *Regulus* being *Exhaled*, there remained in *Gold* 36 gr. Which upon melting in a *Crucible*, lost somewhat, but scarce $\frac{1}{2}$ gr.

Of the *second* Parcel of *Antimony*, wherewith the *First Regulus* of *Gold* and *Antimony*, weighing $124\frac{1}{2}$ gr. was Melted, there remained in *Gold* 27 grains.

All the other Parcels were *fine Gold* to Sense, upon the *Touch*. Only that out of the *First Antimony*, was apparently *Unfine* and *Pale*, from the *Silver* in the *Original Alloy* Mixed with it, as appeared by Comparing on the *Touch-stone*, with *Sovereign Gold Allayed* with *Silver*; holding (to the judgment of Sense) about a *fourth Part* of *Silver*, as the *Sovereign Gold* doth a *sixth*. Neither was it altogether free from *Copper*; because upon *Neaking*, it always turned *Black* on the Surface. But for more exact Discovery, it was taken and first *Refined* with *Lead* upon a *Coppel*, for *Seperation* of any *Copper* that might be in it. Upon which Operation it came forth $33\frac{1}{2}$ grains, which was $2\frac{1}{2}$ grains less than it was before. Afterwards this *Last* was melted with betwixt *two* and *three* parts of *Silver*, and so wrought in *Aqua fortis*, for *Seperation* of the *Silver*: And there Remained in *Gold* but $28\frac{1}{2}$ grains, and yet it appeared upon the *Touch*, not *Fine*, but *Paler* than *Fine Gold*, and deeper than *Crown Gold* allayed with *Silver*. So that what remained in it, was necessarily of *Silver*; and it might be estimated about twenty three *Keratts Fine*; or to hold in *Fine Gold* about twenty seven grains. What Loss of *Gold* was upon this *Refining* with *Antimony*, may be easily Computed. First, $14\frac{1}{2}$ grains for *Alloy*, being Deducted from the *First Quantity* of *Crown Gold*, Weighing 178 grains, the Remainder is $163\frac{1}{2}$ grains. Then the several Parcels of *Fine Gold* was Recovered and *seperated* from the *Regulus* of *Antimony* and *Gold*, and also from the Parcels of *Crude Antimony*, Reduced to *Regulus*, are to be added together; that is, 30 grains, 63 grains, 27 grains, and 27 Grains, all which Amount to 147 grains, which being Deducted from the *First Quantity* of $163\frac{1}{2}$, the Difference is $16\frac{1}{2}$ grains, which is more than $\frac{99}{1000}$, or very near a *Tenth*.

Where and how this Loss of *Gold* ariseth, it appears thus. The *First* parcel of the *Antimony*, was Charged with $163\frac{1}{2}$ grains of *Fine Gold*; of which the *First Regulus* Weighing 163 grains (in proportion to that piece of it Weighing $38\frac{1}{2}$, and producing upon *Refining* on the *Coppel* 30 grains) must hold 127 grains of *Fine Gold*. Then 27 grains
of

of *Fine-Gold*, Estimated to be Contained in the 36 gr. Separated from this *First Parcel of Antimony*, being added to the 127 gr. makes 154 gr. which is short of 163 $\frac{1}{2}$ gr. by 9 $\frac{1}{2}$ gr. and so much was Irrecoverably Lost in this Parcel of *Antimony*.

Then the Piece of *Regulus* Weighing 124 $\frac{1}{2}$ gr. Melted with the *Second Parcel of Antimony* (in Proportion to the former piece broke off, Weighing 38 grains, and upon *Refining* yielding 30 grains of *Pure Gold*) must contain 98 gr of the *Like Gold*; and so much this *Second parcel of Antimony* must be Charged with. Towards which the *Regulus* Weighing 74 gr. being *Refined* produced 63 gr. and that *Gold*, Separated from this 2d. Parcel of *Antimony*, Weighing 27 gr. being added, make 90 gr. short of the *First quantity* Charged upon this part of the *First Regulus* by 7 gr.

Some loss of *Gold* may be upon Powdering of the *Regulus*, as also by the papers necessarily used: but the greatest Loss was by small Sparks, which continually Fly up, while the *Antimony* is in a Boiling Heat with the *Gold*, many whereof Fly over the *Pot* into the Fire. That these sparks were *Gold* appeared thus, when many of them Stuck to an Earthen Cover, and had Coloured it of a Deep Red, *Aqua fortis* did not Fetch off or Dissolve any thing, but *Aqua Regis* run off it Yellow, like a *Solution of Gold* in the same *Water*.

Some Loss of *Gold* may also be upon the *Firing* of the *Antimony* with *Tartar* and *Nitre*, which make a *Vehement Conflagration* with abundant Sparkling.

It hath been Suspected that somewhat of the *Gold* may be Dissipated by the *Blasts* upon the *Coppels* in *Refining* it from the *Antimony* remaining in it. But this is not so Probable, because when *Refiners* to give their *Fine-Gold* a Higher Colour for *Gilding*, put to it a *Third* or *Fourth* part of *Crude Antimony*, or of *Regulus of Antimony* (which is a Constant practice among some of them) and with a great Heat and Strong *Blast* work it off; in which Operation, in some *Ounces of Gold*, they Lose not one *Grain*.

2. There was taken of *Crown-Gold* 141 $\frac{1}{2}$ gr. which was Melted with 1 $\frac{3}{4}$ ounce of *Antimony* and the *Regulus* Weighed 123 gr. from this a piece Weighing 30 gr. was broken off, and Reserved for *Refining* by it self; the Remainder, being 93 grains, was Melted down again with the Same *Antimony*, being powdered and put on the Top: and thereupon the *Regulus* came forth, weighing 91 gr. So that here was no Considerable Loss. And there is Ground to Suspect, that it might be upon some Accidental Difference in the Managing, that the *Regulus* did not so perfectly Separate and Settle: for in all other Experiments of *Melting* the Same *Regulus* again with the Same *Antimony*, the *Regulus* Gained Weight.

From this 2d. *Regulus*, a piece was broken off and reserved for *Refining* a part, weighing 36 gr. the Remainder being 55 gr. was Melted down, as the Former, and in the Same *Antimony*. Whereupon the *Regulus* came forth in weight 72 gr. 17 gr. being here Gained.

The

With the same
Antimony ib.
p. 958.

The *First* Piece of 30 gr. being *Refined* upon the *Coppel*, produced of *Fine-Gold* 24 gr. and the 2^d. Piece of 36 gr. produced 28 gr. and the *Regulus* (upon the 3^d *Melting*) of 27 gr. Produced 55 gr. So that each of the Pieces contained about 4 *fifths* of *Gold*, and but one *5th* of *Antimonial* Substance in it, yet *Losing* something of that Proportion at each *Melting*, tho' the *Regulus* Gained weight; Both which are contrary, in Repeating the *Melting* of the *Regulus* with *Fresh Antimony*, as in the Former Experiments.

The Remaining *Antimony* being Reduced to a *Regulus* by *Firing* with *Nitre* and *Tartar*, as before, and that *Regulus* Exhaled upon the *Coppel* there remained of *Gold* 19 gr. This was *Less Fine* than that Fetched out of the *First Antimony* in the former Experiment. But this *Impurity* was wholly from the *Alloy*: and upon *Refining* it, First with *Lead* upon the *Coppel* for Fetching out the *Copper*, it weighed 17½ gr. having lost 1½ gr. and then with the *Aquafortis*, after the *Melting* down with more than the Double Weight of *Silver*, upon which operation there Remained 15 gr. and that not *Perfect Fine*, but retaining somewhat of *Silver*; but *Finer* than *Crown-Gold* Alloyed with *Silver*; upon the *Touch*, about 23 *Kernals*.

The *Loss* of *Gold* is thus Computed. From the First Quantity of 141½ gr. a 12th. part or about 11½ gr. being Deducted for *Alloy*, the Remainder is 129¼ gr. And the several Parcels of *Fine Gold* produced of the *Regulus*, according to the account given in particular, being 24 gr. 28 gr. 55 gr. 14½ gr. all together make 121½ gr. short of the First Quantity by 8½ gr. or very near one *Sixteenth*.

By Exhaling the
Whole Antimony
ib. p. 960

3. A parcel of *Crown-Gold*, weighing 82½ gr. was *Melted* down with an Ounce of *Antimony*, and the *Antimony* was *Exhaled* in the *Crucible* to a *Regulus*. Then the *Antimonial* part of that *Regulus* was *Exhaled* on a *Coppel*: Whereupon there Remained 84 gr. or 1½ gr. more than the First Quantity. This must Happen, for want of a Heat Strong enough at last to Force off All the *Antimonial* Substance. Whence afterward, upon *Melting* in a *Crucible* it came forth 80 gr. the 2½. Wanting, being *Less* than the Least part of the Proportion of *Copper*, that must be in it, according to the Usual *Alloy* of *Crown-Gold*. And that there Remained *Copper* in this *Gold* appeared by the *Black* Complexion of it upon *Nealing*; As also by the *Loss* upon Working it with *Lead* on a *Coppel*: whereupon it came forth only 76 gr.

So that *Antimony* in a far Greater Proportion, doth not so much, as *Lead*, in *Exhaling* or *Separating* *Copper* from *Gold*; if the work be done meerly by *Exhalation*: but doth only Retain it with it self, whilst the *Gold* Separates and Settles in a *Regulus* at the bottom. Neither is it so Destroyed but that it may, in part at least, be United to the *Gold* again.

CXVI. Papers of less general Use, Omitted.

1. Articles of Inquiries concerning *Mines*; by Mr. Rob. Boyle. n. 19. p. 330.
2. Some Uses of *Vaults* and *Cold Conservatories* in discovering *Minerals*, n. 56. p. 1136.
intimated; by Dr. Jo. Beale.
3. Several *Coal-Boreings* near *Leeds* in *Yorkshire*, in the Year 1659, for the n. 250. p. 73.
Concerns of a private Family; Communicated by Dr. M. Lister.
4. Enquiries concerning *Quarries* and *Stones*, and the Ancient way of *Tem-* n. 93. p. 6012:
pering Tools, for *Cutting Porphyry* and other *Hard Marbles*.
5. Several *Curiosities* relating to *Amber*, lately sent to the *R. Society* from n. 249. p. 49.
Philippus Jacobus Hartmannus: and which are now in their *Repository* at
Gresham College.
6. Enquiries about the *Salt-Springs* in *Worcestershire* and *Cheshire*; by n. 28. p. 359.
Dr. Beale.
7. Queries concerning *Salt-Petre*. n. 193. p. 503.
8. The way used in the *Mogul's Dominions*, to make *Salt Petre*. Extra- n. 6. p. 103.
cted from Mr. *Thevenot's Voyages*.
9. Some *Natural Curiosities* sent the *Royal Society* from *Sicily*; by Dr. Pet. n. 265. p. 632.
Silvester.

CXVII. Accounts of Books Omitted.

1. *The Mundus Subterraneus* of *Athanasius Kircher*. n. 6. p. 109.
2. *Admirandorum Fossilium, que in Tractu Hildesheimensi reperiuntur, De-*
scriptio; Iconibus Illustrata; a D. Frederico Lachmund Hildesheimi, 1669; n. 77. p. 3016.
in 4to.
3. *Lezzioni alla Natura delle Mofsette, &c.* Discourses concerning the n. 207. p. 38.
Nature of *Damps*; by *Leonardus Capuanus*; a Member of the *Academy* of
the *Investigantes*. *Naples, 1683.* In 4to.
4. *Dissertationes Medico Physicæ de Antris Lethiteris; de Montis Vesu-* n. 219. p. 215.
vii Incendio; de stupendo Ossium Coalitu; de Immani Hypogastrii sarcomate;
à *Bernardo Connor, M. D. Oxon. 1695.* in 8vo.
5. *Franc. Travagini, super Observationibus à se factis tempore Ultimorum* n. 60. p. 1084.
Terræ-Motuum, ac potissimum Ragusiani, Physica Disquisitio; seu, Gyri Ter-
ræ Durni Indicium. *Lugduni Bat 1669* in 4to.
6. *Historia & Meteorologia Incendii Ætnæi, Anni 1669.* *Joh. Alph. Bo-* n. 75. p. 2264.
relli. Regio Julio. 1670 in 4to.
7. *Epistola ad Regiam Societatem Londinensem; qua de Nuperis Terræ-* n. 203. p. 893.
Motibus differitur, & veræ eorum causæ eruuntur. *Lond. 1693* in 4to.
8. A Philosophical Essay declaring the probable Causes of *Stones* in the n. 81. p. 4030.
greater World, in order to find out the Causes and Cure of the *Stone* in the
Kidneys and *Bladder* of *Men*; by *Dr. Tho. Sberly.* *Lond. in 8vo.*

- n. 23. p. 419. 9. Histoire des *Foyaux* & des Principales Richesses de l'*Orient* & de l'*Occident* ; par le Sieur *Chapuzeau*.
- n. 84. p. 4095.
n. 87. p. 5082. 10. An Essay about the Origine and Vertues of *Gemms* ; by the Honourable *R. Boyle*, Esq. *Lond.* 1672, in 8vo. The same in *Latin*.
- n. 67. p. 2039. 11. *Erasmi Bartholini* Experimenta *Cristalli Islandici* *Dis-Diaclastici* ; quibus *Mira* & *Insolita Refractio* detegitur. *Hafniæ.* 1669.
- n. 28. p. 538.
n. 263. p. 573. 12. *Historia Ambræ-Griseæ* ; Auth. *Iusto Klobio*.
13. Description de la piece de *Ambergris* que la *Chambre d'Amsterdam* a recue des *Indes Orientales*, pesant 182. *Livres* : Avec un petit *Traite* de son *Origine* & de sa *Vertue* ; par *Nicolas Chevalier*. a *Amster.* 1700. in 4to.
- n. 58. p. 1202.
n. 61. p. 2008. 14. *Jo. Ludov, Gensii* M.D. *Coralliorum* *Historia*. *Frankofurti.* 1669. in 12°.
15. The Natural History of *Nitre*, or a Philosophical Discourse of the Nature, Generation, Place, and Artificial Extraction of *Nitre*, with its Vertues and Uses ; by *Will. Clark*. *Lond.* 1670. in 8vo.
- n. 40. p. 810. 16. *Scrutinium Chymicum Vitrioli*. Auth. *Joh. Georgio Trumphio*. *Fenæ.* 1667. in 4to.
- n. 71. p. 2162. 17. *Theod. Kerkringii* M. D. *Commentarius in Currum Triumphalem Antimonii Basil. Valentini* ; à se *Latinitate* donatum. *Amstelodami.* 1671. in 12°.
- n. 176. p. 1208. 18. *Frederici Hoffmanni* *Fred. Fil. M. D. Exercitatio Medico-Chymica de Cinnabari Antimonii*. *Lugd. Bat.* 1685. in 8vo.
- n. 60. p. 1086. 19. De *Lactæ Lunæ* *dissertatio Medica*, *Joannis Danielis Majoris*, Ph. & M. D. *Kiloni.* 1657. in 4to.
- n. 66. p. 2034. 20. *Metallographia* ; or an History of *Metals* ; by *Jo. Webster*, Practitioner in *Physick* and *Chyrurgery*. *Lond.* 1670. in 4to.
- n. 108. p. 187. 21. 1. The First Book of the *Art of Metals* ; written in *Spanish* by *Alonso Barba*, &c. and *Englisht* by the Right Honourable *Edward Earl of Sandwich*, *Lond.* 1674. in 8vo.
- n. 109. p. 211. 2. The Second Book of the *Art of Metals* ; wherein is taught the common way of *Refining Silver* by *Quicksilver* ; with some new *Rules* added for the better performance of the same ; Written in *Spanish* by *Alonso Barba* ; and *Englisht* by the Right Honourable *Edward Earl of Sandwich*, *Lond.* 1674. in 8vo.
- Ph. Col. n. 3.
p. 80. 22. *Prattica Minerale del Marchese Marco Antonio della Fratta*, in *Bologna*, 1678. in 4to.
- n. 147. p. 189. 23. *Fleta Minor*, or the *Laws of Art and Nature* in *Knowing, Judging, and Assaying, Fining, Refining, and Inlarging the Body of Confined Metals, &c.* By *Sir Jo. Pettus*.
- n. 132. p. 814. 24. A *Touchstone for Gold and Silver Wares* ; or a *Manual for Goldsmiths*, and all other *Persons*, whether *Buyers or Sellers, or Wearers* of any manner of *Goldsmiths work, &c.* By *W. B. of London*, *Goldsmith.* in 8vo.
- n. 74. p. 2232. 25. *Joh. Joachimi Becheri Spirensis* *Med. Doct. Experimentum Chymicum Novum, quo Artificialis & Instantanea Metallorum generatio & Transmutatio ad Oculum Demonstratur.* *Frankofurti.* 1671. in 8vo..

C H A P. IV.

Magneticks.

I. 1. **A** considerable *Load Stone* was digg'd out of the ground in *Devonshire*, which weighed 60 l. It takes up no great weight, yet it Moves a *Needle* about 9 *Foot* distant. Some Part of it was broken off, which being put in its proper place, adds much strength; for without that, it Moves not much more than 7 *foot*.

2. I can assure you, that those *Courses, Veins* or *Loads*, where *Loadstones* are found in the Lower parts of *Devonshire* (either as they lye sparingly here and there amongst *Iron Ore*, or as they lie in considerable Bodies with it) do all generally run *East* and *West*; which is contrary to the Imagination of those who have thought that the *Loadstone* gave a *Northberly Direction*, because its Natural Position in its *Mine* was (as they fancied) *North* and *South*.

II. 1. A Noble Person did affirm, That a *Needle* of a *Sea-Compass*, put in a good *Iron Mine* (which, he said, yielded 23 *Pounds* of Metal, out of 120 *pounds* of Ore) was not sensibly Moved thereby.

2. Intelligent Persons say, That all the *Perfection* of our *Sea-Compasses*, as yet, consisted in this, That the *Needle* be touched by good *Loadstones*, and well *Librated*, and that the *Variation* be truly Placed.

3. I have often made Tryal with many *Needles*, *Touching* them in each *Hemisphere* of the *Stone*, with all Variety of ways I could imagine, to find if it were possible by that means, to cause any of these *Needles* to Vary in its *Direction*; but all of them Conform'd to the *Magnetical Meridian*, standing *North* and *South*, as other *Needles*, that were *Toucht* upon the very *Pole* of the *Stone*.

All *Needles* *Toucht* upon Different *Loadstones*, of several Bignesses and Different Virtue, in all Parts of the World, Agree in this *Magnetical Harmony*, that they all give the same *Directions*.

Having sometimes drawn a *Needle* only over the *Pole* of the *Stone*, within the *Sphere* of its *Vertue*, without at all *Touching* the *Stone*; it hath received the same *Directive Quality*, though not altogether so strong as if it had been really *Toucht* upon the *Stone* it self. I have also *Toucht* *Needles* with faint Strokes, and other *Needles* with stronger; all these *Needles* received the same Effect upon the *Stone*, both for *Strength* and *Direction*. But the nature of the *Steel*, whereof the *Needle* is made, and the *Temper* that is given thereunto, causeth different Effects, as to the *strength* it receiveth from the *Stone*. So that I can infuse such *Vertue* into a piece of *Steel*, that it shall take up a piece of *Iron* of 2 *Ounces* Weight or more; and give also to a *Needle*, the vertue of Conforming to the *Magnetical Meridian*, without the help of a *Loadstone*, or any thing else, that hath received *Vertue* therefrom.

Loadstone found
in Devonshire;
by Dr. Edw.
Cotton. n. 23.
p. 423.

By Mr. J. Beau-
mont. Ph. Col.
n. 1. p. 81.

Magnetical Ob-
servations; by
--- n. 23. p. 423.

By Mr. Sellers.
n. 23. p. 423.
n. 26. p. 478.

By Mr. Sam.
Coleprens, n. 27.
p. 500.

4. I took a *Loadstone* Unpolished, which *Attracted* but meanly; and I *Heated* a *Lath-Nail* Glowing Hot, nimbly applying the *North-Pole* of the said *Magnet* to it, which quickly took it up, and Held it suspended. Then I cast the *Stone* into the *Fire*, and when it was *Red Hot*, I applied the *North Pole* to another *Lath Nail* Cold and Untouch'd before, which it took up but faintly, yet held it suspended. Two or three *Days* after, I found that the *Loadstone* *Attracted* then as strongly, as before it was cast into the *Fire*.

The Respect of
the Needle to a
piece of Iron.
held Perpendi-
cular, in several
Climates; by
---- n. 177.
p. 1213.

III. All the way from *England* to 10 deg. *North Latitude*, the *North Point* of the *Needle* respected the *Upper end* of the *Iron*, and the *South point* the *Lower end*, very strongly.

Lat. 90. 42'. N. and *Meridian distance* from the *Lizard* 9°. 32'. W. The *S. point* of the *Needle* did strongly respect the *Lower end* of the *Iron*, but the *N. point* did not so strongly respect the *Upper end*, as before. *Lat.* 4° 33', N. and the *Meridian Dist.* 5°. 18. W. from the *Lizard*, the *North point* of the *Needle* began to decline from the *Upper end* of the *Iron*, and the *South point* to Encline more strongly to the *Lower end*. *Lat.* 0°. 52' S. and the *Meridian Dist.* 11°. 52'. W. from the *Lizard*, the *North point* of the *Needle* would not respect the *Upper end* of the *Iron*, nor the *Lower end* neither; but the *South point* did still incline to the *Lower end*, though not so strongly.

Lat. 5°. 17'. S. and *Meridian Dist.* 15°. 9'. W. from the *Lizard*, the *South point* of the *Needle* would Turn to the *Lower end* of the *Iron*, about 2 *Points*, but remove the *Iron* any farther, and it would fly away from it, and respect the *Poles* again; but it would not respect the *Upper end* at all; neither would the *North point* Respect either, but lay the *Iron Horizontal*, and let the *Ends* of the *Iron* respect the *Poles* of the *World*, and the *North point* of the *Needle* would turn to the *South End* of the *Iron*, and contrarily the *South point* of the *Needle* would turn to the *North End* of the *Iron*; and alter its respect to the *Poles* 5 or 6 *Points*, and no farther; but hold the *Iron Perpendicular*, and put the *Middle* thereof to the *Needle*, it would still respect the *Poles*.

Lat. 8°. 17'. S. and *Meridian Dist.* from the *Lizard* 17°. 35'. W. the *North point* of the *Needle* would not respect the *Upper end* of the *Iron*, but rather forsake it, but the *South point* would still something respect the *Lower End*, and alter its true Position about 2 *Points*; but take the *Iron* and lay it *Aslope* over the *Compass*, so that the *Upper end* be towards the *South Pole*, and the *Lower end* to the *North*, and then the *North point* would respect the *Lower end*, and follow it; but if you Point the *Upper end* to the *North*, and the *Lower end* to the *South*, the *North point* will forsake it. But if you lay it *Horizontal*, it would do as in the foregoing Observations.

Lat. 15°. 00'. S. and 20°. 00'. W, from the *Lizard*, the *South point* of the *Needle* began to Respect the *Upper end* of the *Iron*, and the *North point* the *Lower end*, and followed it about *One point*; but lay the *Iron Horizontal*, and the *North point* respected the *South end* of the *Iron*, and contrary wise, &c.

Lat. 20.

Lat. $20^{\circ} 20'$ S. and $19^{\circ} 20'$ W. from the *Lizard*, the *South* point of the *Needle* respected the *Upper* end of the *Iron*, and the *North* point the *Lower* end pretty strongly, and followed it 3 or 4 *Points*; but lay it *Horizontal*, and it would do as before.

Lat. $29^{\circ} 25'$, and $13^{\circ} 10'$ W. from the *Meridian* of the *Lizard*, the *South* point of the *Needle* respected the *Upper* end of the *Iron*, and the *North* point the *Lower* end strongly.

IV. 1. It's known that a Rod of *Iron*, held *Perpendicular* to the *Horizon*, or *Inclining*, the *Lower* end is its *North Pole*, or attracts the *South* end of a *Magnetick Needle*; and that the same end held *Upwards*, becomes a *South Pole*, *sc.* Attracts the *North* end of the *Needle*, and Repels the *South* end.

The Polarity of
Iron, by Mr. J. C.
n. 214. p. 257.

I call that a *Mutable Pole*, which may be *North* or *South*, as you Hold it; and a *Fixt Pole* that which does not Change however you hold it.

2. The *Species* of the *Pole*, whether *North* or *South*, may be found by passing the *Iron Rod* through *Cork* or *Wood*, and then leaving it to swim on *Water*, it will turn to its *Proper Pole*: But this way is slow and not nice. A better way to try, for Instance a *North Pole*, is to hold the *Iron Perpendicular* to the *Horizon*, and to try whether being held under the *North* end of the *Needle*, it Attracts it. But a yet better way is to try whether the *Upper* end of the *Rod* Attracts the *South* end of the *Needle*: for *Attraction* is more sensible than *Expulsion*.

3. A *Fixt North Pole* may be made with all the *Ways* and *Rods* that you can make a *Fixt South Pole*; but not *vice versa*; for there are many *Cases* wherein you can make a *Fixt North Pole*, but not a *Fixt South Pole*: And whatever way you get a *Fixt South Pole*, 'tis weaker than a *Fixt North Pole* made the same way. Applying a *Needle* to an *Erect Bar*, beginning at the *Top*, and so *Down*, the *Needle* Turns not at the *Middle*, but *nearer*. Of some *Rods* you cannot make a *Fixt South* primarily, yet you may consequentially; so you may make one *End* a *Fixt North Pole*, and then the other end of those *Rods* may, without more to do, become a *Fixt South Pole*. But this does not always hold, for the *One* may be a *Fixt North Pole*, and the other may be a *Mutable Pole*.

4. *Fire* destroys all *Fixt Poles*, *sc.* whether made by the *Magnet*, or otherways; but it increases, or rather less hinders that *Magnetism*, which proceeds from the *Earth*; *sc.* a *Wire* or *Rod* of *Iron* Heated at one end, that end is a *Mutable Pole*, but more vigorous while *Hot* than *Cold*. The *Vigour* of *Mutable Poles* is more in *Great* than *Little Rods*; but 'tis otherwise in *Fixt Poles*.

5. Heat the *End* of a *Rod* of *Iron* *Red Hot* (or Heat All the *Rod*) and Cool that *Ignited* end *Northward*, it will be a *Fixt North Pole*; if *Cooled South* it becomes a *Fixt South Pole*. This say *Gilbert* and others from *Experience*: But I say this holds but in some *Cases*; *sc.* if the *Rod* is short, you cannot make a *Fixt Pole* that way. Take a *Round Wire* whose *Diameter* is $\frac{1}{2}$ inch, and *Length* 10 inches, you cannot produce a *Fixt Pole* by *Ignition*; but if this *Wire* were longer, as suppose 30 Inches long, or never so much longer,

'tis capable of a *Fixt Pole* by *Ignition*. Again, take a round Rod 30 *Inches* long, and 1 *Inch* Diameter, this Rod is not capable of a *Fixt Pole* at that length, though the lesser was capable at that Length. And so my Experiments give me reason to think, that there is no Rod nor Bar of Iron ever so thick, but which if it had length enough, would be capable of a *Fixt Pole* by bare *Ignition*; for of that I only speak in this Paragraph: And there is no Rod ever so short, but which if you make it sufficiently Thin, is capable of a *Fixt Pole*. So when in a Rod I could not obtain a *Fixt Pole* at 21 *Inches* Length in that Thickness, I could, by making the Rod Thinner, produce a *Fixt Pole*, even in the Length of one *Inch* and Less, and the *Pole* should be of what kind I Pleas'd. The *Terminus*, or necessary Length, for every Thickness increases more than you would be apt to think.

6. Heat a Rod, or its End *Red Hot*, and throughly *Cool* this end *Downwards* or *Towards* the *Nadir*, it will have somewhat more *Magnetism* than if *Cooled Horizontally* towards the *North*. But the better way is to *Cool* it a little inclining towards the *North*. I cannot find that multiplicity of *Ignitions* does produce more *Magnetism* than One good *Ignition*; but it must be throughly *Ignited*. Nor can I find by many Experiments, that *Quenching* in Water signifies to the Producing or Hindring *Magnetism*; but many *Ignitions* may accidentally Promote it by Purifying the Iron.

7. Dr. Power says, that if we hold a Rod *Northward*, and *Hammer* in that Position the *North* end, that will become a *North Pole*, i. e. a *Fixt North Pole*: contrarily if you *Hammer* the *South* end. But this is True (as I said before of *Ignitions*) only in Rods of a Certain Length and Thickness.

8. What is said of *Hammering* is to be understood of *Filing*, *Grinding*, *Dripping*, *Sawing*: Yea, a *soft Rubbing*, provided it is long, will produce *Fixt Poles*. The more Heavy the Blows are, *cæteris paribus*, the *Magnetism* is more. I say *cæteris paribus*, as when the Blows be not so Heavy in either Case as to flat; for flattening the Iron produces more *Magnetism*, though other things don't vary. A few Hard Blows will Produce as much *Magnetism* as many, yet a soft Blow, may produce but little *Magnetism*. The utmost *Magnetism* that I could Produce in Ordinary Rods this way, did not exceed that which an Ordinary *Lodestone* would have Infused.

9. *Beating* many Rods *Northward*, whose Lengths I knew sufficient, I never failed of producing a *Fixt North Pole*; but *Hammering* the same or like Rods *Southward*, I found that I could not produce a *Fixt South Pole*, only a *Mutable Pole*; nay *Hammering* one full *South*, I produced a *Fixed North Pole*. Then I thought the Reason might be, that the *Hammer'd South* end, on the *Anvil* was a little *lower* than the End which I held in my Hand: Then I held the End Higher, and so *Hammering* it *South* Upwards, I never failed Producing *Fixt South Poles* in proper Rods.

10. Old *Drills* and *Punches* are *Fixt North Poles*, because almost constantly used downwards: But new *Drills* are either *Mutable Poles*, or *weak North Poles*. When I say a *New Drill*, I don't mean one made on the Spot, for that is probably a *North Pole*, because *Quench'd* downwards in *Water*; but then such *Polarity* made by bare *Ignition* is a *Weak Pole*,
and

and soon Decays and turns to a *Mutable Pole*: But I mean a *Drill*, which though never or Little Used, yet has been made some *Days* or *Weeks*. *Drill* with this *Southward Horizontally*, and 'tis a Chance if you Produce a *Fixt South Pole*; but much Less if you *Drill South Downwards*: But if you *Drill South Upwards*, you may make it a *Fixt South Pole*.

11. The Stronger the *Polarity* is, the Longer it will Last. A Weak *Fixt Pole* may Degenerate into a *Mutable Pole* in a Day's time; yea I have known it in a few *Minutes*, while exposed to the Air, and held in a Position contrary to its *Pole*: On the Contrary we find *Needles Touched* with good *Loadstones* hold that Vertue a great while, if kept from *Air*, and in a *Meridian* Site.

12. The *Loadstone* it self will not make a *Fixt Pole* of any *Iron*; it must have a Proper Length if 'tis Thick: or if 'tis Short, it must have a sufficient Thinness. So Ordinary or Weak *Loadstones* cannot *Fix* a *Pole* in a Thick Short Key, which yet they will do in a little Key. So in a Short Thick Iron Tapering, a *Loadstone* may *Fix* a *Pole* in the Little End, when it Cannot in the Great End.

13. When *Ignition*, *Hammering*, or a *Loadstone* cannot make *Fixt Poles*, it must not be thought that it can do absolutely Nothing on such Rods: for even then it may be found that there's an Effect of *Magnetism* in them Discernable enough otherways, though not enough to make *Fixt Poles*.

14. When you have the due Length for making of a *Fixt Pole*, you will find the making One a *Fixt North* will consequently render the other a *Fixt South Pole*: but if keeping the same Diameter of this Rod, you increase it's Length enough, the making One End a *Fixt North Pole*, will not necessarily make the Other a *Fixt South Pole*, but leave it a *Mutable Pole*. So if you by a like Primary Operation make the Second end a *Fixt Pole*, the First end will Lose its *Fixity*, and become *Mutable*.

I say there's a *Certain Length* suited to every *Thickness* of Iron, to leave one end *Mutable*, while the other is *Fixt*, and the Thicker the Iron is, the Greater is the *Length*.

15. If you Farther Increase the Length of the Same Rod, you will Attain such Length; that when you have *Fixed* a *Pole* on One end, and then go to *Fix* the Other end, the *Fixity* of the First will not be Destroyed, and that end become *Mutable* as before: but the *Fixity* of the *First* end will Remain, and so you make Both ends Two *Fixt North Poles*, or Two *Fixt South Poles*. I say the Shortest Length (for there's no *Terminus* of the Greatest Length) for this is more in Thick than in Thin Iron.

16. The aforesaid Lengths are Less, according to the Strength of *Magnetism*; *sc.* *Ignition* requires a Greater Length than when a Rod is Actuated by a *Loadstone*; and a Rod *Touched* with a Strong *Loadstone* requires Less Length than one *Touched* with a Weak one.

2. I caused 6 or 7 several *Drills* to be made before my Face, and the *Bit* or Point of every one became a *North Pole*, only by *Hardening*, before they ever came to be workt, either in Iron or any other Matter; so that I cannot suppose

those

those found in a Shop to have gotten their *Polarity* so much from their After-use as from their First make.

2. That Pieces of Plain Iron, in shape like *Drills*, (that is something Long and Small) do always *Change* their *Poles* as they are Inverted, the End Downwards being ever the *N. Pole*, I find not Always True: For though it hold Generally in such small Pieces, and Always (as far as I can yet find) in Pieces of any Bulk, as Large Hammers, Anvils, Andirons, Bars of Windows, &c. Yet I found several Small pieces of Steel, such as the *Drills* are made of, to have *Fixed Poles*, one End *North*, the other *South* in whatever Postures I held them. Some of these were very *Vigorous* in such their *Polarity*, others shew'd plainly a Tendency to such a *Pole*, rather than the other, yet so faintly that it applyed contrary to their Inclination; (that is, at the *Upper* end, if it Affected to draw the *South*; or the *Lower* End, if the *North*;) They caused the *Needle* to stand in *Aequilibrio*, *East* and *West*; the Particular Inclination of one End seeming, in some pieces, quite to Conquer; in others, quite to Hinder that more General *Polarity* they both acquire, by being either *Upward* or *Downward*. Yet this seems only to be found in small Stems of Iron; the being either *Upward* or *Downward* always prevailing in Pieces of Greater Bulk,

3. I took my Knife, which had been *Toucht* a *Quarter* of a Year or more before, and profering it to the *Needle*, it Drew the *North Pole*; which happened right for my Purpose. I Whetted it briskly on a Dry Dirty Threshold, and being Thin it became very Hot towards the Point, the Edge being Whet away to a *Wire*, as they Term it, I struck the very Top, and Back towards the Top against the Ground, as I had done the Sides, to Destroy and Rub off, if I could all its former *Polarity*, which was *Southward*; then offering it again to the *Needle*, it Drew the *South End*, and was quite Changed. To confirm the thing, I *Toucht* the same Knife again with the *North Pole* of my *Loadstone* and it Drew vigorously the *North End* of the *Needle*. I Whet it again strongly in the same manner, and it *Changed* again. This I repeated 5 or 6 Times, and it still *Changed* by Whetting, especially on the Sides towards the Top of the Knife; the very Top and Back, which could not be Whet to so great an Heat, retaining still some Affection for that *Pole*. the *Loadstone* had Inclined them to. This I tryed with a Knife of a Thicker Blade; but I could not with my Hand whet it to that Heat, as to have the same Effect wrought upon, as my own; though I used such Force as at last to break it in Two.

4. I suppose that bare *Drilling* might be able to give a *Polarity* to a *Drill* if it could be made Indifferent, as well as *Filing* does, if the *Drill* be used so briskly as to be made as Hot as the *File* makes the Iron. And though a *South Pole* given by the *Magnet* cannot be taken off by the Heat of a Brisk Motion (as that of *Drilling*;) which yet by the Experiment of my Knife seems to be Contradicted; yet perhaps the Heat may be great enough to produce a *Polarity* in an Indifferent Piece of Iron, as may be done in little Indifferent *Drill-like* Pieces of Steel, by *Filing*.

V. Two Degrees to the Northward of the Line, the North Point of the Needle did Incline 8 degrees downward: but as we went to the Southward it was Inclined above 48 Degrees Upward.

The Declination of the Needle Observ'd; by Mr. Ja. Cunningham n. 264. p. 577.

VI. 1 An. 1666. Jun. 13. In Rownham Meadows near Bristol by the Water side, Capt. Sturmy took the following Observations.

Magnetical Variations, near Bristol; by Capt. Sam. Sturmy n. 37. p. 726.

☉ Alt.	Magnetick Azimuth.	☉ Azim.	Variation Westerly.
44. 20'	72. 00'	70. 38'	1. 22'
39. 30	80. 00	78. 24	1. 36
31. 50	90. 00	88. 26	1. 34
27. 2	95. 00	93. 36	1. 24
23. 20	103. 00	101. 23	1. 23

In this Table He notes the greatest Difference to be 14'. and taking the Mean for the True Variation, he Concludes it then and there, to be just 1°. 27'. He observed again in the same Day of the next Year, viz. Jun. 13. 1667. and then he found the Variation encreased about 6'. Westerly.

2. An. 1630. I traced 3 different Meridian Lines in several places of Paris, and found, that the Needle Declined $4\frac{1}{2}$ deg. North-East: which having Publisht, and made known here to the Curious, and to Artists, some of whom counted 9 or 10 deg. according to the Tradition and Writings of Orontius Fineus, and Castle Franc; others, $11\frac{1}{2}$ deg. following Sennertus and Offusius: all at first Rejected my Observation; and as commonly New things meet with Obstacles and Contradictions, before they are Establisht, those that could not Contradict what they Saw, pretended that this Variety did perhaps proceed from the greater or lesser Vigour in the Loadstones employed to touch with; or from thence, that the Needles had been Toucht nearer to or farther from their Poles.

At Paris; by M. Petit n. 28. p. 527.

To remove the Objections and to try another Quality which Gilbert had assigned to Terrella's, I caused a Magnet to be Turned with the Powder of Emery till it became Spherical $\frac{1}{2}$ Inch in Diameter, its 3 Centers of Magnitude Gravity and Strength being the same with so much Justness, that after I had exactly found the two Poles of this Stone, I caused 2 Small Holes to be made therein, to support it by two points of Needles, as by two Pivots: which having put in a Meridian of Brass, and Suspended the Ball betwixt them like

a little *Globe*, it was so easily moveable that I made it Turn every way with a Blast only of my Mouth, and it Stopped Indifferently, now in one, then in another place, not any side of it Prevailing.

This *Stone*, being thus prepared without any Defect in Vertue or Figure, Uniform, Homogeneous, Equilibrated, was adjusted on its *Meridian* and an *Horizon*, and so Placed on its *Meridian* Line that the *Poles* thereof answered to the *Poles* of the *Heavens*. The Success was that it had not any Motion at all; whence I thought the Proposition of *Gilbert*, that such a *Stone* so Posited would Turn round in 24 *hours*, was sufficiently Refuted.

This *Stone* together with others (whereof the *Poles* were well mark'd) serv'd me also to find out, whether the *Needles Touched* in Different Places, nearer to or farther from the *Poles*, had different *Declinations*. Which having tryed frequently, I found no Difference at all in the *Declination* of the *Needles* but all of them *Declined* then from the *Meridian* $4\frac{1}{2}$ deg. from the North-Eastward, I also found it to be the Same in Many Places, from *Brest* in *Brittany* to the *Valtoline* amongst the *Alps*. I believed at First, that the Ancients had Ill Observed the *Variation*: but I was soon undeceived of this Error, by the Observations in *England* of *Mr. Burrows*, An. 1580. of *Mr. Gunter*, An. 1612: and of *Mr. Gellibrand*, An. 1633, which did assure me, that those *Declinations* were not Constant.

And that I might be Convinc'd by my self, in *June* An. 1660 after I had very exactly Traced a *Meridian* by many *Azimuths*, before and after Noon, with a *Brass Quadrant* of 6 Foot Diameter, and applyed good *Needles* upon it; the one of 7. the other of 10. *Inches* long, I found that they *Declined* but One Degree, or thereabout: And the Last year (1666) I found no more but 10 *minutes* on the same *Meridian*. And methinks that the *Declination* this year 1667 is Still less: but yet some *Minutes* towards the *East*, at least at *Paris*. But I doubt not, but in 12 or 15 *Years* the *Declination* will be $1\frac{1}{2}$ degree North-west: As I have Prognosticated by my *Hypothesis*, which maketh the *Declination* to Vary a degree every 7 or 8 years.

At Rome; by
M. Adrian Au-
zout n. 58. P.
1184.

3. An. 1670, *M. Adrian Auzout* made the following Observation here at *Rome* on many *Meridian Lines*, with a *Needle* about 6 *Inches* long; and on all the *Lines* it was seen to *Decline* somewhat more than 2 degrees Westward and on some near $2\frac{1}{2}$ degrees. But by the Observations here made formerly, it appears, that the *Needle* hath *Declined Eastward* to 8 Degrees, and hath afterwards been Diminishing, until it's come to the other Part, where we find it at present.

It seems not, that this Difference of 10 Degrees and more, can be attributed to the Change of the *Pole* of the *Earth*; or to the *Magnet*, or to the *Iron*, that are found in certain Places, because there is but Little *Loadstone*: and *M. Auzout* affirms, that the *Mines* which he hath seen, make no Impression at all on the *Needle*. So that 'tis difficult to Hit the true Cause of such a *Variation*: Yet however, if the Direction of the *Magnet*, and of the *Needle Touched* by it, depends from the Flux of a certain Matter, passing through the Whole *Earth*, or the Exterieur Parts of it, strait along the *Axis*; it may be said, that it proceeds from Changes made in the said *Flux*: which supposing the Inequalities

lities of the Earth, and the Alterations made continually therein, as well Artificial, by Excavations, and such like other works, as Natural, by Corrosions, caused by Fire and Water, or by the Generation of *Metals* and *Stones* (besides the various Changes, we cannot think of, by reason of the little Knowledge we have of so vast a Body as the Earth) cannot but in progress of time, Change its situation. The Inequalities of the Earth may in time occasion some Bending in the Current of this *Magnetick* matter, and make it Change its Bed and Channel: Whence it comes to pass, that the *Needle* Changeth its *Direction* according as the Current Changeth, which directs it. And if it should be so, there would be no Hopes of finding a Regular *Hypothesis* for that Change; for as much as it would depend from Causes that have no Regularity at all in them; as most of the Mutations of Nature are.

4. An 1642. I observed the *Declination* of the *Magnet* here, at *Dantzick*, as did M. *Linnermannus* about the same time at *Koningsberg*: And we both found the *Magnetick Needle* at that time to *Decline* from the *North* $3^{\circ} 5'$ *Westward*. But now (*Jun. 22. 1670, St. n.*) it is far otherwise; for it *Declines* at present, as I have very carefully Observed, $7^{\circ} 20'$. to the same *Quarter*; so that in the space of 28 *Years*, that *Declination* is increased $4^{\circ} 15'$. In the *Year* 1628, if I remember aright, I found it near *one Degree Westward*: Which *Declination* was affirmed by the Learned *Petrus Crugerus* (once my worthy *Præceptor*) to have been, about the Beginning of this Age, or the end of the next foregoing, $8^{\circ} 30'$ *Eastward*. Hence it appears, that this *Declination* of the *Loadstone* doth here, at *Dantzick*, Encrease each *year* to $9' 6''$. Which is sufficiently Confirmed by the Observations made at *Lime-House* near *London*, by those 3 famous *English-men*, *Burrows*, *Gunter*, and *Gellibrand*: Of whom the *First* found the *Declination A.* 1580. to be $11^{\circ} 16'$; the *Second* $5^{\circ} 36' 30''$. An. 1622; the *Third*, $4^{\circ} 3' 30''$. A. 1634

At Dantzick;
by Mr. Hevelius. n. 64.
p. 2059.

I cannot yet devise any Cause of those Appearances, except we impute them to a kind of Libration in the Motion of the *Earth*, and the variation of the *Meridian*.

5. The Last Summer 1680. I was present with Dr. *Geo. Volcamer*, at *Nuremberg*, while he was making some Observations and Tryals, with his *Magnetical Needle*. He Repeated the Tryals several Days one after another, and with various ways of Examination; but still in every of them, with the same success, he most certainly found, that the *North* End of the *Magnetical Needle*, (which the former Age always reported to us, to vary from the *North*, and to Direct or Point more towards the *East*, by several *Degrees*) did now *Decline* towards the *West* near 5 *Degrees*.

At Nuremberg
in Germany;
by Joh. Chr. Sturm.
Ph. Col. n. 2. p. 8.

An. 1685 Sub initium Mensis *Augusti*, de certitudine *Meridianarum* omni qua fieri potuit Cura ex Circumspectione *Securi redditi*, applicatis variis *Pyxidibus Magneticis*, tam iis *Vetustioribus*, quæ ante *Quinquennium* huic *Usui* adhibebantur, quam aliis *Recentioribus* plurimis, mediocris quidem *Longitudinis*, quarum maximæ *Semissens Pedis* non excedebant, sed *Gracioribus* & *Vivacibus*, animadvertēbamus, quod mirum, *Declinationem A-*cus à *Pristina* nec in uno minuto *Discrepare*, sed in quavis *Meridiana* exacte cum *Priori* convenire, ad *Occas. Scil. 5° 5'*. An autem interea temporis

M. G. C. Eimmart. n. 178.
p. 1253.

alterius processerit, aut nunc in Situ *Retrogrado* ejus *Deviatio* deprehensa fuerit, quod certe casu evenisse potuisset, non Liqueat, cum nec temere istud statuere, quin in eam *Sententiam*, quod *Stationarius* (procul dubio *Circularis Motus*) in eodem puncto permanerit, pronius abire velimus.

On the Coast of Guinea; by Mr. Heathcot n. 158 p. 578.

7. An. 1683. The *Magnetical Variation* here at *Cabo Corse Castle* was 3°. 49'. from the *North* to the *Westward*.

Magnetical Variations Predicted; by Mr. Hen. Bond n. 40. p. 789.

VII. Mr. Hen. Bond, having entertained an *Hypothesis* of the *Variations* of the *Needle* hath (for the Examination of it) Calculated the Following Table.

Years.	Variation West.						
1663	1°.—56'	1701	7°.—19'	1706	8°.—1'	1711	8°.—41'
1670	2—18	1702	7—28	1707	8—9	1712	8—49
1680	4—00	1703	7—36	1708	8—17	1713	8—56
1690	5—39	1704	7—45	1709	8—25	1714	9—4
1700	7—10	1705	7—53	1710	8—33	1715	9—11

A Theory of the Magnetical Variation, by Mr. Edm. Halley n. 148. p. 208.

VIII. Before I proceed to the *Theory* of the *Variation* of the *Magnetical Compass*, it is necessary to lay down the *Grounds* upon which I raise my *Conclusions*: and at once to give a *Synopsis* of those *Variations* which I have reason to look upon as sure, being mostly the *Observations* of Persons of Good Skill and Integrity.

Names of Places.	Long. from London.	Latitude.	An. Dom.	Variation Observed.
London	0° 0'	51° 32' N.	1580	11° 15' E
			1622	6 0 E
			1634	4 5 E
			1672	2 30 W
			1683	4 30 W
Paris	2 25 E	48 51 N	1640	3 00 E
			1666	0 00
			1681	2 30 W
Uraniburg	13 00 E	55 54 N	1672	2 35 W
Copenhagen	12 53 E	55 41 N	1649	1 30 E
			1672	3 35 W
Dantzick	19 07 E	54 23 N	1679	7 00 W
Mompelier	4 00 E	43 37 N	1674	1 10 W
Brest	4 25 W	48 23 N	1680	1 45 W

Rome	13 00	E 41 50	N	1681	5 00	W
Bayonne	1 20	W 43 30	N	1680	1 20	W
Hudson's Bay	79 40	W 51 00	N	1668	19 15	W
In Hudson's Streights	57 00	W 61 00	N	1668	29 30	W
In Baffin's Bay at Sir Th. Smith's	80 00	W 78 00	N	1616	57 00	W
At Sea (Sound)	57 00	W 38 40	N	1682	7 30	W
At Sea	31 30	W 43 50	N	1682	5 30	W
At Sea	42 00	W 21 00	N	1678	0 40	E
Cape St. Augustine off Brazile	35 30	W 8 00	S	1670	5 30	E
Cape Frio	41 10	W 22 40	S	1670	12 10	E
At Sea off of the Mourh of the River of Plate.	53 00	W 39 30	S	1670	20 30	E
At the East Entrance of Magellan Streights.	68 00	W 52 30	S	1670	17 00	E
At the West Entrance of the Magellan Streights.	75 00	W 53 00	S	1670	14 10	E
Baldivia	73 00	W 40 00	S	1670	8 10	E
At Cape d'Agulkas	16 30	E 34 50	S	1622	2 00	W
				1675	8 00	W
At Sea	1 00	E 34 30	S	1675	0 00	
At Sea	20 00	W 34 00	S	1675	10 30	E
At Sea	32 00	W 24 00	S	1675	10 30	E
At St. Helena	6 30	W 16 00	S	1677	0 40	E
At Ascension	14 30	W 7 50	S	1678	1 00	E
At Johanna	44 00	E 12 15	S	1675	19 30	W
At Mombasa	40 00	E 4 00	S	1675	16 00	W
At Zocatra	56 00	E 12 30	N	1674	17 00	W
At Aden, at the M. of the R. Sea.	47 30	E 13 00	N	1674	15 00	W
At Diego Roiz.	61 00	E 20 00	S	1676	20 30	W
At Sea	64 30	E 0 00	S	1676	15 30	W
At Sea	55 00	E 27 00	S	1676	24 00	W
At Bombay	72° 30'	E 19° 00'	N	1676	12° 00'	W
At Cape Comorin	76 00	E 8 15	N	1680	8 48	W
At Ballasore	87 00	E 21 30	N	1680	8 20	W
At Fort St. George.	80 00	E 13 15	N	1680	8 10	W
At the West Point of Java	104 00	E 6 40	S	1676	3 10	W
At Sea	58 00	E 39 00	S	1677	27 30	W
At the Isle of St. Paul	72 00	E 38 00	S	1677	23 30	W
At Van Diemens Land	142 00	E 42 25	S	1642	0 00	
At New Zealand	170 00	E 40 50	S	1642	9 00	E
At Three Kings Isle in New Zeal.	169 30	E 34 35	S	1642	8 40	E
At the Isle Rotterdam in the S. Sea.	84 00	E 20 15	S	1642	6 20	E
On the Coast of New Guinea.	149 00	E 4 30	S	1643	8 45	E
At the West point of New Guin.	126 00	E 0 26	S.	1643	5 30	E

By this *Table* it appears,

1. That in all *Europe* the *Variation* at this Time is *West*, and more in the *Eastern* parts thereof than the *Western*; as likewise that it seems throughout to be upon the *Increase* that way.

2. That on the Coast of *America*, about *Virginia*, *New England*, and *Newfoundland*, the *variation* is likewise *Westerly*; and that it *Increases* all the way as you go *Northerly* along the Coast, so as to be above 20 *Degrees* at *Newfoundland*, nearly 30 *deg.* in *Hudson's Straights*, and not less than 57 *deg.* in *Baffin's Bay*; also that as you sail *Eastward* from this Coast the *Variation* diminishes. From these two it is a *Legitimate Corollary*, That somewhere between *Europe*, and the *North-part* of *America*, there ought to be an *Easterly Variation*, or at least no *Westerly*; and so I conjecture its about the *Eastermost* of the *Tercera* Islands.

3. That on the Coast of *Brasil* there is *East-Variation*, which *Increases* very Notably as you go to the *Southward*, so as to be 12 *deg.* at *Cape Frio*, and over against the *River of Plate* 20½ *deg.* and from thence, sailing *Southwesterly* to the *Straits* of *Magellan*, it *Decreases* to 17 *deg.* and at the *West Entrance* it is but 14 *Degrees*.

4. That to the *Eastward* of *Brasil* properly so Called, this *Easterly Variation* *Decreases*, so as to be very little at *St. Helena* and *Ascension*; and to be quite gone, and the *Compass* to Point *True* about 18 *deg.* of *Longitude*, *West* from the *Cape of good Hope*.

5. That to the *Eastward* of the aforesaid Places a *Westward Variation* begins, which *Reigns* in the whole *Indian Sea*, and arises to no less than 18 *deg.* under the *Aequator* it self about the *Meridian* of the *Northern* part of *Madagascar*, and near the same *Meridian* but in 39 *deg. South Latitude*, it is found full 27½ *deg.* from thence *Easterly* the *West Variation* *Decreases*, so as to be but little more than 8 *deg.* at *Cape Comorin*; and than 3 *deg.* upon the Coast of *Java*; and to be quite *Extinct* about the *Molucca* Islands, as also a little to the *Westwards* of *Van Diemens Land* found out by the *Dutch* in 1642.

6. That to the *Eastward* of the *Molucca's* and *Van Diemens Land* in *South Lat.* There arises another *Easterly Variation*, which seems not so great as the former, nor of so Large *Extent*; for that at the *Island Rotterdam* it is sensibly less than upon the *East-Coast* of *New Guinea*; and at the Rate it *Decreases*, it may well be supposed, that about 20 *deg.* farther *East*, or 225 *deg. East Long.* from *London*, in the *Latitude* of 20 *deg. South*, a *Westerly Variation* begins.

7. That the *Variations* observed by the Honourable Sir *John Narborough* at *Baldivia*, and at the *West Entrance* of the *Straights* of *Magellan*, do plainly shew, that that *East Variation* noted in our 3d *Remark* is *Decreasing* apace; and that it cannot reasonably *Extend* many *Degrees* into the *South-Sea*, from the Coast of *Peru* and *Chili*, leaving room for a small *Westerly Variation*, in that *Tract* of the *Unknown World* that lies in the *Midway* between *Chili* and *New-Zealand*, and between *Hounds Island* and *Peru*.

8. That in sailing *North west* from *St. Helena* by *Ascension*, as far as the *Aequator*, the *Variation* continues very small *East*, and as it were constantly
the

the same : So that in this part of the World, the Course wherein there is no variation, is evidently no *Meridian*, but rather *Northwest*.

9. That the Entrance of *Hudson's Streights* and the Mouth of the *River of Plate*, being nearly under the same *Meridian*, at the One place the *Needle* *Varies* $29\frac{1}{2}$ deg. to the *West*, at the other $20\frac{1}{2}$ deg. to the *East*. This plainly demonstrates the Impossibility of reconciling these *Variations* by the Theory of *Bond* : which is by *Two Magnetical Poles and an Axis, Inclined to the Axis of the Earth* ; from whence it would follow that under the same *Meridian*, the *Variation* should be in all Places, the same way.

These things being premised, may serve as a sure Foundation for this *Theory*, That the whole *Globe of the Earth* is one great Magnet, having 4. Magnetical Poles, or *Points of Attraction*, near Each Pole of the *Æquator* 2, and that in those Parts of the World which lye near adjacent to any one of those Magnetical Poles, the *Needle* is governed thereby ; the nearest Pole being always *Predominant over the more Remote*. The parts of the Earth wherein these *Magnetical Poles* lye, cannot as yet be exactly determined for want of sufficient *Data* to proceed *Geometrically* : But, as near as *Conjecture* can reach, I reckon that the *Pole* which is at present Nearest to us, lies in or near the *Meridian* of the *Lands End of England*, and not above 7 Deg. from the *Pole Artick*. By this *Pole* the *Variations* in all *Europe*, and *Tartary*, and the *North Sea*, are principally Governed ; tho' with regard to the other *Northern Pole*, whose Situation is in a *Meridian* passing about the middle of *California*, and about 15 gr. from the *North Pole* of the World. To this the *Needle* has chiefly respect in all the *North America*, and in the *Two Oceans* on either side thereof, from the *Zores* Westwards to *Japan*, and farther. The *Two Southern Poles* are rather farther distant from the *South Pole* of the World. The one about 16 deg. therefrom, is in a *Merid.* some 20 deg. to the Westward of *Magellan's Streights*, or 95 deg. West from *London* ; this Commands the *Needle* in all the *South America*, in the *Pacifick Sea*, and the greatest part of the *Æthiopic Ocean*. The 4th and last *Pole* seems to have the Greatest Power and largest Dominions of all, as it is the most remote from the *Pole* of the World, being little less than 20 deg. distant therefrom, in the *Meridian*, which passes through *Hollandia nova*, and the *Island Celebes* about 120 deg. East from *London*. This *Pole* is *Predominant* in the *South* part of *Africa*, in *Arabia*, and the *Red Sea*, in *Persia*, *India*, and its *Islands*, and all over the *Indian Sea* from the *Cape of Good Hope* Eastwards to the middle of the *Great South Sea* that divides *Asia* from *America*. This seems to be the present *Disposition* of the *Magnetical Vertue* throughout the whole *Globe* of the Earth.

By this *Hypothesis* it is Plain that (our *European North Pole*, being in the *Meridian* of the *Lands End of England*) all Places more *Easterly* than that will have it on the *West* side of the *Meridian* ; and consequently the *Needle*, respecting it with its *Northern Point*, will have a *Westerly Variation*, which will still be greater as you go to the *Eastwards*, till you come to some *Meridian* of *Russia*, where 'twill be greatest, and from thence *Decrease* again. Thus at *Brest* the *Variation* is but $1\frac{3}{4}$ deg. at *London*. $4\frac{1}{2}$ Deg. but at *Dantzick*, 7 deg. West. To the *Westward* of the *Meridian* of the *Lands End*, the *Needle* ought

to have an *Easterly Variation*, were it not that (by Approaching the *American Northern Pole*, which lies on the *West* side of the *Meridian*, and seems to be of greater Force than this other) the *Needle* is drawn thereby *Westwards*, so as to Counterballance the Direction given by the *European Pole*, and to make a small *West Variation* in the *Meridian* of the *Lands End* it self. Yet I suppose that about the *Meridian* of the *Ile Tercera*, our *Nearest Pole* may so far prevail as to give the *Needle* a little turn to the *East*, though but for a very small space, the Counterballance of those two *Poles*, permitting no considerable *Variation* in all the *Eastern Parts* of the *Atlantick Ocean*; nor upon the *West Coasts* of *England* and *Ireland*, *France*, *Spain*, and *Barbary*. But to the *Westwards* of the *Azores*, the Power of the *American Pole* overcoming that of the *European*, the *Needle* has chiefly respect thereto; and Turns still more and more towards it as you approach it. Whence it comes to pass, that on the *Coast* of *Virginia*, *New-Engl.* *New found-land*, and in *Hudson's Streights* the *Variation* is *Westwards*; that it Decreases as you go from thence towards *Europe*; and that it is less in *Virginia* and *New-England* than in *New-foundland*, and *Hudson's Streights*. This *Westerly Variation* again Decreases, as you pass over the *North America*; and about the *Meridian* of the middle of *California*, the *Needle* again Points due *North*; and from thence *Westwards* to *Yedzo*, and *Japan*, I make no doubt but the *Variation* is *Easterly*; and Half Sea over not less than 15 deg. This *East Variation* Extends over *Japan*, *Yedzo*, *East Tartary*, and part of *China*; till it meet with the *Westerly*, which is governed by the *European North Pole*, and which I said was greatest somewhere in *Russia*.

Towards the *Southern Pole* the Effect is much the same, only that here the *South* point of the *Needle* is Attracted. Hence it will follow, that the *Variation* on the *Coast* of *Brazil*, at the *River of Plate*, and so on to the *Streights* of *Magellan*, should be *Easterly* as in the 3d. remark. And this *Easterly Variation* doth extend Eastward, over the greatest part of the *Ethiopic Sea*, till it be Counterpoised by the Vertue of the other *Southern Pole*; as it is about mid-way between the *Cape of Good Hope*, and the *Isles* of *Tristan d'Alcunba*. From thence Eastwards, the *Asian South Pole* (as I must take the liberty to call it) becoming Prevalent, and the *South* Point of the *Needle* being Attracted thereby, there arises a *West Variation* very great in Quantity and Extent, because of the great Distance of this *Magnetical Pole*, from the *Pole* of the *World*. Hence it is, that in all the *Indian Sea* as far as *Hollandia Nova*, and farther, there is constantly *West Variation*: And that under the *Equator* it self, it arises to no less than 18 deg. where 'tis most. About the *Meridian* of the *Island Celebes*, being likewise that of this *Pole*, this *Westerly Variation* Ceases, and an *Easterly* begins; which reaches, according to my *Hypothesis*, to the middle of the *South Sea* between *Zelandia Nova* and *Chili*, leaving room for a small *West Variation* Governed by the *American South Pole*; which I shewed to be in the *Pacifick Sea*, in the 6th and 7th Remarks.

In the *Torrid Zone*, and particularly under the *Aequinoctial*, respect must be had to all 4 *Poles*, and their Positions well considered, otherwise it will not be easie to determine what the *Variations* shall be; the *Nearest Pole* being always the strongest; yet not so, as not to be Counterballanced sometimes by the

the United Forces of Two more Remote. A Notable instance hereof is in our 8th Remark, where I took notice, that in Sailing from *St. Helena*, by the *Ile of Ascension* to the *Equator* on a N. W. Course, the *Variation* is very little *Easterly*, and in that whole Tract *Unalterable*: For which I give this Reason, that the *South American Pole* (which is considerably the nearest in the afore-said Places) requiring a great *Easterly Variation* is Counterpoised by the Contrary Attraction of the *North American* and the *Asian South Poles*; each whereof singly is in these Parts, Weaker than the *American South Pole*; and upon the N. W. Course, the Distance from this Latter is very little Varied; and as you Recede from the *Asian South Pole*, the Ballance is still preserved by the Access towards the *North American Pole*. I mention not in this Case, the *European North Pole*, its *Meridian* being little removed from those of these Places; and of it self requiring the same *Variations* we here find:

What I have here said does plainly shew, the sufficiency of this *Hypothesis* for solving the *Variations* that are at *This Time* observed. n. 195. p. 564.

But there are two Difficulties not easie to surmount. The One is, that no *Magnet* I have ever seen or heard of, hath more than *Two Opposite Poles*: Whereas the Earth hath visibly 4, and perhaps more. Secondly, It is plain by the *Change* of the *Variation*, not only at *London* (where this Discovery was first made) but also almost all over the *Earth*, that these *Poles* are not at least all of them *fixt* in the Earth, but shift from Place to Place, whereas it is not known that the *Poles* of the *Load-stone* ever shifted their Place in the *Stone*, nor (considering the Compact Hardness of that Substance,) can it easily be supposed. These Difficulties for a Long Time made me Despond, when in Accidental Discourse, and least expecting it, I stumbled on the following *Hypothesis*.

It is sufficiently known and allow'd, that the *Needles Variation* Changes, and that this Change is Gradual and Universal, will appear by the following Examples. At *London*, An. 1580. The *Variation* was observed by Mr. *Burrows*, to be 11°. 15'. East. In An. 1622, the same was found by Mr. *Gunter*, to be but 6°. 00'. East. In the Year 1634, Mr. *Gellibrand* found it 4°. 5' East. In 1657. Mr. *Bond* observed that there was *No Variation* at *London*. An. 1672. my self Observed it 2°. 30'. to the West; and this present year 1692. I again found it 6°. 00' West. So that in 112 Years the Direction of the *Needle* has Changed no less than 17 Degrees.

At *Paris*, *Orontius Finæus* about the Year 1550, did account it about 8 or 9 Deg. East Variation. An. 1640. it was found 3 deg. East. An. 1666. there was *No Variation* there, and An. 1681. I found it to be 2°. 30'. to the West.

At *Cape d'Agulhas*, the most Southerly Promontory of *Africa*, about the Year 1600. the *Needle* pointed due North and South without Variation, whence the *Portuguese* gave its Name. An. 1622. There was 2 deg. West Variation. An. 1675. it was 8°. 00'. West, and this Year 1692, it was curiously observed not less than 11 deg. West.

At *St. Helena*, about the Year 1600. the *Needle* declined 8. deg. to the East. An. 1623. It was but 6°. 00'. East. An. 1677. when I was there, I observed

observed it accurately on shore to be $0^{\circ} 40'$ East; and now this Year it was found 1° to the *Westward* of the North.

At Cape Comorin in India, in the year 1620, there was $14^{\circ} 2'$ *West Variation*; in the year 1680, there was $8^{\circ} 48'$: but in the year 1688. it was no more than $7^{\circ} 30'$. so that here the *Needle* has returned to the *East*, about 7° . in 70 Years.

From these and many other Observations, it is Evident, that the Direction of the *Needle* is in no place *Fixt* and *Constant*, tho' in some it Change faster than in others. And where for a long time it has continued, as it were *Unaltered*, it is there to be understood, that the *Needle* has its greatest *Deflection*, and is become *Stationary*, in order to Return, like the Sun in the *Tropick*. This at present is in the *Indian Sea*, about the Island *Mauritius*, where is the Highest *West Variation*, and in a Tract tending from thence into the *N. N. W.* towards the *Red Sea* and *Agypt*. And in all places to the *Westward* of this Tract, all over *Africa* and the Seas adjoining, the *West Variation* will be found to have Encreased; and to the *Eastwards* thereof, as in the Example of Cape Comorine, to have decreased; *viz.* all over the *East-Indies*, and the Islands near it.

After the like manner in that space of *East Variation* which, beginning near *St. Helena*, is found all over the *South America*, and which at present is Highest about the Mouth of *Rio de la Plata*, it has been observed, that in the *Eastern* Parts thereof, the *Variation* of the *Needle* Gradually Decreases. And by Analogy we may Infer (though we have not Experience enough to Ascertain it) that both the *East* and *West Variation* in the *Pacifick Sea*, do gradually Increase and Decrease after the same Rule.

These *Phænomena* being well understood, and duly consider'd, do sufficiently evince, That the whole *Magnetical System* is by one, or perhaps more *Motions* Translated: That this moving thing is very Great, as extending its Effects from *Pole* to *Pole*; and that the Motion thereof is not *per Saltum*, but by a *Gradual* and *Regular* Motion.

Now considering the structure of our *Terraqueous Globe*, the only way to render this Motion *Intelligible* and *Possible*, is, to suppose it possible to Turn about the *Center of the Globe*, having its *Center of Gravity* *Fixt* and *Immoveable* in the same common *Center of the Earth*: And there is yet required, that this *Moving Internal Substance* be *Loose*, and detached from the *External* Parts of the *Earth* whereon we live. So then the *External* Parts of the *Globe* may well be reckoned as the *Shell*, and the *Internal* as a *Nucleus* or *Inner Globe* Included within ours, with a fluid *Medium* between. Which having the same *Common Center* and *Axis* of *Diurnal Rotation*, may turn about with our *Earth*, each 24 hours; only this *Outer Sphere* having its *Turbinating Motion*, some small matter either *Swifter* or *Slower* than the *Internal Ball*; and a very minute *Difference* in length of time, by many *Repetitions* becoming sensible, the *Internal* Parts, will, by *Degrees* recede from the *External*, and not keeping pace with one another, will appear gradually to move either *Eastwards* or *Westwards* by the difference of their *Motions*. So that if this *Exterior Shell* of *Earth* be a *Magnet*, having its *Poles* at a distance from the *Poles* of *Diurnal Rotation*;

Rotation; and if the *Internal Nucleus* be likewise a *Magnet*, having its *Poles* in two other Places distant also from the *Axis*, and these Latter by a Gradual and Slow Motion, *Change* their place in respect of the *External*, we may then give a Reasonable Account of the 4 *Magnetical Poles*, as likewise of the *Changes* of the *Needles Variations*, which, till now, hath been unattempted.

The *Period* of this Motion being wonderful Great, and there being hardly an Hundred Years since these *Variations* have been duly observed, It will be very hard to bring this *Hypothesis* to a *Calculus*, especially since, tho' the *Variations* do Increase and Decrease Regularly in the same Place, yet in differing Places, at no great distance, there are found such Casual *Changes* thereof, as can no ways be Accounted for by a Regular *Hypothesis*; as depending upon the Unequal and Irregular Distribution of the *Magnetical* matter within the substance of the *External* Shell or Coat of the Earth, which Defect, the *Needle* from the Position, it would acquire from the Effect of the General *Magnetism* of the whole. Of this the *Variations* at *London* and *Paris* give a notable Instance: For the *Needle* has been constantly about $10\frac{1}{2}$ more *Easterly* at *Paris* than at *London*, tho' it be certain according to the General Effect, the difference ought to be the contrary way: Notwithstanding which the *Variations* in both places do change alike. Hence, and from some other of like nature, I conclude, That the Two *Poles* of the *External* Globe are *Fixt* in the Earth, and that of the *Needle* were wholly govern'd by them, the *Variations* thereof would be always the same, with some little Irregularities upon the account I but just now mentioned: But the *Internal* Sphere having such a gradual Translation of its *Poles*, does Influence the *Needle*, and direct it Variously, according to the result of the Attractive or Directive Power of each *Pole*; and consequently there must be a Period of the *Revolution* of this *Internal* Ball, after which the *Variations* will return again as before.

If then Two of the *Poles* be *Fixt*, and Two *Moveable*, I think we may safely determine that the *European Pole* is that that is moveable of the Two *Northern Poles*, and that that has chiefly Influenced the *Variations* in these Parts of the World: For in *Hudson's Bay*, which is under the Direction of the *American Pole*, the *Change* is not observed to be near so fast as in these Parts of *Europe*, tho' the *Pole* be much farther removed from the *Axis*. And that the *Asian*, of the two *South Poles* is *Fixt*, and consequently the *American* moveable; from the like observation of the slow Decrease of the *Variation* on the Coast of *Java*, and near the *Meridian* of the *Asian Pole*.

If this be allowed me, 'tis plain that this Motion is *Westwards*, and by Consequence that the aforesaid *Nucleus* has not precisely attained the same Degree of Velocity with the *Exterior* parts in their *Diurnal Revolution*: But so very nearly equals it, that in 365 Revolves, the difference is scarce sensible. This, I conceive, to arise from the Impulse, whereby this *Diurnal* Motion was Imprest on the Earth, being given to the *External* Parts, and from thence in Time Communicated to the *Internal*.

The *Period* of this Motion appears, by all Circumstances, to be of many Centuries of *Years*; and considering the Change of the Place, where there was *no Variation*, by reason of the *Æquilibrium* of the *Two Southern Magnetical Poles*, *viz.* from Cape d'*Agulhas* to the Meridian of *St. Helena*, (which is about 23° . in about 90 *Years*;) and of the Place where the *Westerly Variation* is in its *acumē* or Greatest Deflection, being about half so much, *viz.* From the Isle of *Diego Roiz* to the South-West Parts of *Madagascar*; we may with some Reason Conjecture, that the *American Pole* was Moved *Westwards* 46° . in that Time; and that the whole *Period* thereof is performed in seven Hundred *Years*, or thereabouts: So that the Nice Determination of this, and of several other Particulars in the *Magnetick System*, is reserved for Remote Posterity.

I doubt not but this *Hypothesis* of an *Internal Nucleus* will find Opposers enough: But the Globe of *Saturn* being environ'd with his *Ring*, is a Notable Instance of this kind, as having the same common Center, and moving along with it, without sensibly approaching one side of it more than another: And if this *Ring* were turned on one of its *Diameters*, it would then describe such a *Concave Sphere* as I suppose our *External* one to be. And since the *Ring* in any Position given, would, in the same manner, keep the Center of *Saturn* in its own, it follows that such a *Concave Sphere* may move with another Included in it, having the same common Center. Nor can it well be supposed otherwise, considering the Nature of *Gravity*: For should these *Globes* be adjusted once to the same Common Center, the *Gravity* of the Parts of the *Concave*, would press equally towards the Center of the *Internal Ball*, which Equality must necessarily continue till some External Force disturb it; which is not easie to imagine in our Case. This perhaps I might more intelligibly express, by saying, That the *Inner Globe* being Posited in the Center of the *Exterior*, must necessarily Ascend, whatsoever way it move; that is, it must overcome the Force of *Gravity* pressing towards the Common Center, by an Impulse it must receive from some Outward Agent: But all Outward Efforts being sufficiently fenced against, by the *Shell* that surrounds it, it follows, that this *Nucleus* being once Fixt in the Common Center, must always there remain.

It may be Objected, that the Water of the Sea would perpetually Leak through this *Shell*, unless we suppose the Cavity full of Water: But when we consider how tightly great Beds of Chalk or Clay, and much more Stone, do hold Water, and even Caves Arched with Sand, no Man can doubt but the Wisdom of the Creator has provided for the *Macrocosm*, by many other ways than I can either Imagine or Express. We cannot think it a hard supposition that the internal Parts of this Bubble of Earth should be Replete with such

Saline and *Vitriolick* Particles as may contribute to *Petrification*, and dispose the transuding Water to shoot and Coagulate into *Stone*, so as continually to fortifie, and if need were, to Consolidate any Breach or Flaw in the Concave surface of the *Shell*. And this perhaps may, not without Reason, be supposed to be the *Final Cause* of the Admixture of the *Magnetical* Matter in the Mass of the *Terrestrial* Parts of our Globe, *viz.* To make Good and Maintain the *Concave Arch* of this *Shell*: For by what the Excellent Mr. *Newton* has shewn, in his *Principia Philosophiæ*, it will follow, That according to the General Principle of Gravity, Visible throughout the whole Universe, all those Particles that by length of Time, or otherwise, shall Molder away, or become loose on the *Concave* Surface of the *External* Sphere, would fall in, and with great force descend on the *Internal*, unless those Particles were of another sort of Matter Capable by their stronger tendency to each other, to suspend the Force of Gravity; but we know no other Substances capable of supporting each other by their *Mutual Attraction*, but the *Magnetical*; and these we see miraculously to perform that Office, even where the Power of Gravity has its full Effect, much more within the Globe where it is Weaker. Why then may we not suppose these said Arches to be lined throughout with a *Magnetical* matter, or rather to be one great *Concave Magnet*, whose *Two Poles* are the *Poles* we have before observed to be *Fixt* in the Surface of our Globe.

Another Argument favouring this *Hypothesis*, is drawn from a Proposition of the same Mr. *Newton*, where he determines the Force wherewith the *Moon* Moves the *Sea* in producing the *Tides*: His Words are, *Densitas Lunæ est ad Densitatem Terræ ut 680 ad 387. seu 9 ad 5. quam proxime. Est igitur Corpus Lunæ Densius, ac magis Terrestre quam Terra nostra.* Now if the *Moon* be more Solid than the *Earth* as 9 to 5, why may not we reasonably suppose, the *Moon* being a small Body, and a *Secondary Planet*, to be solid Earth, Water and Stone, and this Globe to consist of the same Materials, only 4 *Ninths* thereof to be *Cavity*, within and between the *Internal* Spheres, which I would render not *Improbable*.

It must be allowed indeed, that these *Included* Globes can be of very little service to the Inhabitants of this *Outward* World, nor can the *Sun* be serviceable to them, either with his *Light* or *Heat*: But since we see all the Parts of the Creation abounds with *animate Beings*, why should we think it strange that the Prodigious Mass of Matter, whereof this Globe does consist, should be capable of some other Improvements, than barely to serve to support its surface? Why may we not rather suppose that the exceeding small quantity of solid Matter in respect of the fluid *Æther*, is so disposed by the Almighty Wisdom, as to yield as great a Surface for the use of Living Creatures, as can consist with the *Conveniency* and *Security* of the whole.

And tho' without *Light*, there can be no *Living*, yet there are many ways of producing *Light* which we are wholly Ignorant of: The Medium it self may be always *Luminous* after the manner of our *Ignes fatui*; the *Concave Arches* may in several places shine with such a Substance as invests the surface of the *Sun*; nor can we without a Boldness unbecoming a Philosopher, ad-

adventure to assert the Impossibility of *Peculiar Luminaries* Below, of which we have no sort of *Idea*.

Thus I have shewed a Possibility of a much more ample Creation, than has hitherto been Imagined: A Notion till hitherto not so much as started in the World, and of which we could have no Intimation from any other of the Phænomena of Nature.

But there may be a farther use of this *Cavity* of the Earth; *viz.* to Diminish the *Specifick Gravity* thereof in respect of the *Moon*: for I think I can Demonstrate that the Opposition of the *Æther* to the *Motions* of the *Planets* in long Time becomes Sensible, and consequently the Greater Body must receive a Less Opposition than the smaller, unless the *Specifick Gravity* of the smaller do Proportionably exceed that of the Greater, in which Case only they can Move together. So that the *Cavity* I assign in the *Earth*, may well serve to Adjust its Weight to that of the *Moon*: For otherwise the *Earth* would Leave the *Moon* behind it, and she become another *Primary Planet*.

An Invariable
Compass; by
M. de la Hire.
n. 188. p. 344.

IX. 1. Having determined, as well as I could the *South Pole* of a *Terrella* or *Spherical Loadstone*, of 3 *Inches* Diameter which accidentally had fallen into my hands, I was much surpris'd to find it 18° . distant from a Cross, deep engraven on the Stone, which according to all appearance had heretofore been the *Pole* of this Stone, as it had been observed by him that Cut it. This Change having revived some Thoughts I had formerly entertained concerning the *Variation* of the *Needle*, I believed that if it were True that the *Poles* of the *Magnetical Vertue* Changed in the *Loadstone*, as we see they Change in the *Earth*, one might derive great Advantages there from: For if this Change of these *Poles* in the *Loadstone* were Certain, and that it was Analogous to the Change of the *Poles* of the *Magnetick Vertue* in the *Earth*, it is not to be Doubted but a *Terrella*, being suspended at Liberty, would remain Immoveable, and that One Point thereof would regard the *Pole* of the World, which might be called the *True Pole* of the *Stone*, whilst the *Poles* of its *Vertue* would pass successively from one part to another, after the same manner as they Change in the *Earth*.

After having well considered this *Hypothesis*, and having Cleared up some doubts which I had, concerning the Position of the *Stone* at the Time when its *Pole* had formerly been Determined, I concluded that this Former *Pole* was Distant from the Point I call the *True Pole*, 13 *Degrees* towards the *East*, in the Place where it had been Marked, (and which is Unknown to me,) since that at this time in this Country the *Needle* *Varies* about 5 *Deg. Westward*.

Upon this *Hypothesis*, which I know not that any one else has yet thought upon, I have invented a new sort of *Needle* for the *Compass*, which may have the same Alterations as a *Spherical Loadstone*, and at the same time the same Conveniencies as the Ordinary *Needle* hath.

I caused a *Ring* of 3 *Inches* Diameter to be made of *Steel-Wire*; from which there went 3 *Radii* of very Fine *Brass-Wire* meeting at the Center in

a *Cap* perfectly like that of an Ordinary *Compass*, that so this *Circle* might rest on a *Pin* in its *Center*, and be at full *Liberty* to turn round, its *Center* being *Fixt*. This done I gave the *Magnetical Touch* to this *Steel Ring*, by applying indifferently to a *Point* thereof one of the *Poles* of a strong *Loadstone*, and the other *Pole* of the *Stone* to the *Opposite Point*, to give the greater *Vertue* to the *Ring*. Then I observed that the *Ring* was strongly *Magnetical*; and that the *Point* called the *South-Pole* did readily turn it self towards the *North*, and after several *Vibrations* stopped there; and that it had also the same *Inclination* towards the *Pole* which is found in *Needles* after they have been *Touched*; Lastly I fix'd upon the *Ring* a small *Fleur de Lis* of *Brats*, in the *Point* which exactly respected the *North*, the *Ring* being first well settled.

To inform my self, if this *Steel Ring* had the same *Effects* as a *Terrella*, I made the following *Experiment*. Having *Touched* a *Steel Ring*, and having laid it on a *Paper*, I strewed the *Filings* of *Steel* upon it, and then gently shaking the *Paper*, I saw that the *Direction* of the *Magnetical Matter* passed directly cross the *Ring* from one *Pole* to the other, and that there were two *Vortices* on the sides, as it is observed in the *Spherical Magnet*; which seems very surprising: For according to the Ordinary *Hypothesis* of the *Magnet*, the *Magnetical Vertue* passing more easily in the *Steel* than in the *Air* should run on both sides of the *Pole* round the *Ring*, and only Form a *Pole* *Opposite* to the *First*. But I was further confirmed in this *Opinion*, by applying a *Flat* and *Pointed* piece of *Iron* like the blade of a *Knife*, to a *Loadstone*, so as the *Point* of the *Iron* reached beyond the *Stone*: And having afterwards presented this *Point* to the *Magnetical Ring*, I observed that different *Points* of the *Ring* did apply to the *Point* of the *Iron*, according as the several *Points* thereof had been applied to the *Stone*; which happens not in the *Magnetical Needle*, for that always presents one of its *Ends* to the *Point* of the *Iron*, being not disposed, by reason of its *Length*, to receive the *Magnetical* matter in all the *Parts* thereof Analogous to those of the *Stone*. It must only be noted that in an *Irregular Stone*, the *Magnetical Vertue* appears stronger towards the *Angles* than in the other *Parts*, which may cause some *Irregularity* in this *Experiment*, if it be tryed with a *Stone* that is very *Uneven*.

Those *Experiments* gave me the *Curiosity* of making another, by *Touching* two *Semicircles* of *Steel*. Having *Joyned* the *Two Ends* *Touched* by the same *Poles*, I observed by the *Steel Dust* the same effect as in the *Ring*: But having *joyned* the *Ends* *Differently Touched*, I found that immediately the two *Half Rings* run together, and stuck to each other; and by the *Steel Dust* strowed on *Paper* I observed, that there were 4 *Vortices*, one in the middle of each *Semicircle*, and one at each of the places where they were *Joyned*, and that the two *Latter* were *Less* than the others, and much stronger. I saw likewise, that there were 4 *Poles*, each of which was within a *Vortex*, and that each retained in its *Semicircle* the *Vertue* of the *Ends* of the *Half Rings*.

I Tried, after having *Touched* a *Steel-Wire* that was *Straight*, to make a *Ring* thereof. But I found, that it had quite lost its *Vertue*: Which cannot be

be attributed to the Junction of the *Poles*, since they ought to stick together, according to the other Experiments which have been made, but only to this, that hath been already noted, that when a *Magnetical Virgula* is a little bent, it looses its Vertue, which cannot happen, but from the Alteration of the *Pores* of the *Steel*.

I farther Remark'd, that a *Ring* of *Steel* having been Touched, does for a Long Time retain its Vertue, although it be put in a Position contrary to its *Poles*. And this Experiment is confirmed by another much more Considerable, Which is, that a *Ring* of *Steel* having been Touched with a strong *Loadstone*, cannot without Difficulty receive a contrary Touch from a *Magnet* Less Strong than the first: But that in Time, by little and little, it resumes its Former Vertue; much as we see *Magnets* do, which being Applied to another stone, by the *Poles* of the same Denomination, lose their First Vertue and take a Contrary, which they afterwards Lose by Degrees. to Reassume their First.

After I had presented this New System of the *Magnet* to the *Academy*, there were made some Experiments upon a *Terrella* of much the same Diameter with Mine, but whose *Poles* were not diametrically Opposite; and upon a *Half Globe* very much bigger than the *Terrella*: But we could find in them no considerable Difference or *Alteration* of *Poles*. Because of some Circumstances, the Company thought fit that some Experiments should be made with this sort of *Compass*.

These *Circular Needles* may be Touched a new after this manner; Apply the *Poles* of the *Stone* to the *Ring*, and the *Ring* which is suspended upon its *Pivot*, will turn so, as the Point answering to the *Pole* of the Vertue of the *Stone* which is applied to it, will come as near to it as possible: In so much, that without Touching the one or the other, the *Ring* will not fail to receive very much Force. The same may be done at the Opposite Point.

The Principle
Examined; by
---- *ib.* p. 350.

2. This account having been read before the *Royal Society*, it was ordered that the *Terrella*, which has been in their *Repository* these 25 Years, should be Examined: And it was found, that the Points which are Marked thereon with crosses, were as near as could be discerned, the *True Poles* of the *Stone*; notwithstanding that the *Variation* has Changed at *London* full 4 deg. since this *Terrella* has been in the *Society's* Custody, and perhaps many more since it was Marked; and had there been a *Change* in the *Poles* of the *Loadstone* Analogous thereto, it must needs have been Perceived in this, whose Diameter is about $4\frac{1}{2}$ Inches. However to put this matter past Dispute, care was taken to find out exactly and Mark the *Poles* of the *Societies* Great *Loadstone*, the Sphere of whose Activity is above 9 foot Radius, and whose *Poles* are 13 inches asunder: whereby if this *Translation* of the *Poles* be real, it cannot fail of being made very Sensible hereafter. In the mean time some of the Company well skill'd in *Magneticks* were of Opinion, that such a *Circular Needle* would librate on its Center, so as to respect the *Magnetical Meridian* with the Points that had at First received the *Touch*, rather than that the *Ring* remaining immoveable, the *Directive* vertue should be *Transferred* therein from Place to

Place,

Place, either by Length of time, or by Transporting this *Compass* into those Parts where the *Variation* of the *Needle* is considerably Different.

X. An Account of a *Book*, Omitted.

Epistola Invitatoria, ad Observationes *Magneticæ Variationis*, communi n. 143. p. 23. Studio junctisque Laboribus, instituendas, *Altorfi*. 1682.

C H A P. V.

Botany. Agriculture.

I. **P**Repare two Plates of Iron as large as you desire to preserve the *Specimens*. These Plates must be too Thick to Bend, very smooth on one side, and Holes for Screws on each Corner, to Screw them close. Then take your *Flowers, Leaves, &c.* when perfectly Ripe, and in their True Colours; Spread them on a Brown-paper, with the *Leaves* as Distinct as you can; and if the *Flowers* be Large, there must more Paper lye under it; and if it be Thick, you may pare away the one half thereof, as also of the Stalk, so as to make it lye almost Flat, and some Distinct *Leaves* may be separated and taken out, as a by store, to be afterwards Stuck in, and compleat the *Flower*. Then lay, over all more Brown-Paper, and put these between the Iron Plates, Screw 'em close, put the same into an *Oven* for two Hours, just as the Bread is drawn; After which take out the *Flowers*; then take *Aqua Fortis*, and *Aquavitæ*, or *Brandy*, in equal Quantity, mixed together, and with a Brush pass over the *Leaves* of the *Flowers*. Then lay them on Fresh Brown-Paper and Press them a little with a Handkerchief, or with your Fingers, to grow Dry. Then take the bigness of a *Walnut* of *Gum Dragon*, which in less than 24 *Hours*, will be Dissolved in a Pint of Fair Water; and with a fine Brush, rub the backides of your *Flowers* and *Leaves*, to make them Stick, and then lay them into your Paper Book, where they will lye Fast, and always look Fresh.

To Preserve the
Specimens of
Plants; by Sir.
Rob. Southwel.
n. 237. p. 42.

There must be a little Skill after the *Oven*, to turn the *Leaves* into Shape, and a sort of *Perspective*, in case the *Flower* be too Thick. And if you would add any *Smell* to these *Flowers*, which will have none, touch them with such *Essence* as you think fit.

II. 1. As I passed through *Marton Woods* under *Pinno Moor* in *Craven*. Aug. 18. 1672. I found an infinite Number of *Mushrooms*, some Withered, and others new Sprung and Flourishing. They were of a Large Size, something bigger than the Ordinary *Red gilled Eatable Mushroom*, or *Champignon* and very much of their Shape; that is with a perfectly Round Cap, or Stool (as we vulgarly call it,) Thick in Flesh, and with open *Gills* underneath; having a Thick, Fleshy not Hollow, and Round *Foot-Stalk*, of about 6 Fingers-

An Odd kind of
Mushrom; by
Dr. Lister. n. 89.
p. 5116.

gers breadth High above Ground, and ordinarily as Thick as my Thumb. If you Cut any part of this *Mushroom*; it will Bleed exceeding freely a *Milk-White Juice*, which Tasts much Hotter upon the Tongue than *Pepper*; it is not Clammy to the Touch; and the Air does not much Discolour it, or the Blade of a Knife, as is usual with most *Vegetable Juices*. It became in the Glass Viol I drew it into, suddenly Concrete and Stiff, and did in some Days Dry into a Firm Cake; Which also when well Dried, retained its Fierce Biting-Tast and White Colour.

Further: I Observed these *Mushrooms*, full of *Juice* not to be endured upon our Tongues, to abound with *Fly Maggots*. Also the youngest and Tenderest of them, that is such as are most *Juicy*, to have been very much Eaten by the *Grey Meadow Naked Snail*, lodging themselves within the side of the *Plant*.

By Mr. Wray.
ib. p. 5117.

2. I doubt not but this *Mushrom* is that Describ'd in *Job. Baubin.* l. 40. c. 6. under the Title of *Fungus Piperatus Albus, Lacteo Succo turgens*: For in almost all Points the Descriptions agree exactly.

Another sort of
Mushrom; by
Dr. Lister.
n. 110. p. 225.

3. The *Fungus porosus crassus magnus*. J. B. when Fresh gathered is of a *Buff Colour* Inside and Out-side; and, yet Cut through the middle, it will in a Moment Change from a *Pale Yellow* to a *Deep Purple* or *Blew*, and stain Linnen accordingly. A drop of the *Juice*, leisurely Squeezed out, will Change, holding it betwixt your Eye and the Light, through all the Colours of the *Rainbow*, in the very time of its Falling, and Fix in a *Purple*, as it doth in the Springing out of its Veins.

The Flowers and
Seed of Mush-
rooms; by Dr.
Lister. n. 110.
p. 225.

III. I am of Opinion that *Mushrooms* are *Plants* of their Own Kind, and have more than a *Chance Original*. We will Instance in that Species, call'd *Fungus Porosus Crassus Magnus*. J. B. The Texture of the *Gills* is like a Paper prick'd full of *Pin-holes*. In *August* this is very frequent under Hedges, and in the middle of the *Moors* in many places of *Yorkshire*. It seems to me (and, no doubt, it will to any Person that shall well examine it,) that the *Gills* of this *Mushrom* are the very *Flower* and *Seed* of this *Plant*. When it is Ripe, the *Gills* here are easily Separable from the rest of the *Head*: Each *Seed* is Distinct from other, and hath its Impression in the Head of the *Mushrom*, just as the *Seeds* of an *Artichok* hath in the Bottom of it. The Bigger End of the *Seed* is full and Round; and they are Disposed in a *Spiral Order*, just as those of the *Artichok*. The like we do think of all other *Mushrooms*, however differently Figured.

And if it shall Happen to him that shall Sow them, that these will not Produce their Kind, but be *Sterile*, it is no strange thing amongst *Plants*, there being whole *Genus's* of *Plants* that come up, and *Flower*, and *Seed*, yet their *Seed* was never Known to produce *Plants* of their Kind: Being naturally *Sterile*, and a *Volatile Dust*, as all the *Orchides* or *Bee-Flowers*.

Truffles; by Dr.
Tanc. Robin-
son. n. 202 p. 814.
824. n. 204.
p. 235.

IV: The *Tubera Terræ* observed lately at *Rushton* in *Northamptonshire*, by Dr. *Hatton* of *Harborough* in *Leicestershire*, are the true *French Truffles*, the *Italian*

Italian Tartuffi or *Tartuffole*, and the *Spanish Turmas de Tierra*, which are not noted by Mr. Ray to be found in our *British Soil*. I have seen them thrice as large at *Florence, Rome, and Naples*: Where they Eat them as a Delicious and Luxurious piece of Dainty, either Fryed in Slices with Butter or Oil, Salt and Pepper; or else out of Pickle, and often Boyled in their Soup. These Observ'd in *England* are all included in a *Studded Bark* or *Coat*, the *Tubercules* resembling the *Capsules* or *Seed Vessels* of some *Mallows* and *Alcea's*. The inward Substance is of the Consistence of the *Fleshy part* in a young *Chestnut*, of a *Paste Colour*; of a *Rank* or *Hircine* Odour, and Unfavorable; streaked with many white *Veins* or *Threds*, as in some *Animals Testicles*: The whole is of a *Globose Figure*, though unequal and Chinky. They are most Tender in the Spring; though after *Showers* and *Sultry Weather* they may be plentifully found in the *Autumn*: The *Wet* swells them; and *Lightning* and *Thunder* may dispose them to send forth their particular Scent so Alluring to the *Swine*; For some of the *Ancients* call'd them *Ceraunia*.

Fig. 157.
Fig. 158.

Dr. *Hatton* Observed *Fibres* issuing out of some of these *Tubera*, which lay Spit deep under *Ground*: so that perhaps, they may be *Plantæ sui Generis*, and their *fulcated Papillæ* Analogous to, if not *Seed Vessels*. You know several *Vegetables* bear their *Seed* near the *Root*, as the *Trifolium Subterraneum Tricoccum*, *Reticulatum Flosculis longis albis*; most of the *Arachydnæ's*, and some other *Legumes*, which *Flower* above, but *Seed* Under *Ground*. As to the *Truffles* lying so deep, that is Common to many *Roots* that shoot up *Stalks* above the *Earth*. To instance only in that *Lathyrus Tuberosus*, call'd commonly *Chamæbalanus* and *Terræ Glandes*, (in *English*, *Pease Earthnut*, Digg'd up and Eaten by the *Poor People*,) non nisi Altâ Fossione inveniendæ, says *John Baubine*. The *Roots* of our *Bulbocastanum* (of the *Umbelliferous Tribe*) commonly call'd *Kepper-Nuts*, *Pignuts*, and *Gernuts*, in the *North*, lie very Deep, and Fatten *Hogs*, which are very Greedy of them.

Fig. 157.

V. Some years since *M. Perrault* related to the *Royal Academy of Paris*, that travelling through *Sologne*, he had been informed by some *Phyicians* and *Chyrurgions* of that *Country*, that the *Rey* there was sometimes so *Corrupted*, that those who did Eat of the *Bread* which had much of this *Corrupted Grain* in it, were seized on by a *Gangrene*. We have viewed some of these *Grains of Rey* thus Degenerated; they are *Black* without, and pretty *White* within, and when they are *Dry*, they are *Harder* and closer than the *Natural Good Grain*. They have no ill *Taste*. I have found some of them that had *Hanging* at their *Basis* a substance of a *Honey taste* and *Consistence*. They become much *Longer* in the *Ear*, than the other. There are some of them that are 13 or 14 *Lines* long, and 2 *Lines* large, and at times you will find 7 or 8 of them in *One Ear*. It may be seen, in *Examining* these *Ears*, that they are not *Bodies of Another Kind*, Generated among the *Grains of Rey*, as some pretend: But that they are true *Grains of Rey*, having their *Coats* like the rest, wherein may be *Distinguisht* the place of the *Germen* and of the *Furrow*.

A Strange sort of Rey in France; by --- n. 130. p. 758.

There happened many like *Accidents* in 1674. at *Montargis* from the same Cause. *M. Dodart* caused to be brought to him some *Ears* of this *Rey*,

and the Company found the Grains of them altogether like those they had seen formerly.

M. *Tuillier* hath imparted a Letter of M. *Chatton*, an Old and Expert Chyrurgion at *Montargis*; whence he saith he hath learned the Particulars following; viz, *Rey* doth in this Manner *Degenerate* in *Sologne*, *Berry*, the Country of *Blaise* and *Gastinois*, and almost every where, especially in Light and Sandy Land. There are Few Years but some little of this *Ill Grain* grows. When there is but little, the Ill Effects of it are not Perceived. It Grows Plenteously in Wet Years, and most of all when after a Rainy Spring there follow Excessive Heats. The Constitution of the Air or of the Rains, which impress this *Malignity* in the *Rey*, is Rare: there having been found none at *Montargis* but Thrice in 38 Years; and there having been but Few Distempers of it the second time, because there was but little of that *Corrupted Grain*. The Bread made of the *Rey* which holds some of this *Corrupted Corn*, Tasts neither worse nor better than other. The *Rey* thus *Corrupted* hath its Effects chiefly when 'tis New, yet not till it hath been Used a considerable Time,

These Effects are, to Dry up the *Milk* in *Women*; to cause sometimes *Malign Fevers*, accompanied with *Drowsiness* and *Raving*; to Breed the *Gangrene* in *Arms*, but most in *Legs*, which ordinarily are *Corrupted* first, and to which this Distemper fastens it self, as the *Scorbute* doth. This *Corruption* is preceded by a certain *Stupefaction* in the *Legs*; upon which follows a Little *Pain*, and some *Swelling* without Inflammation, and the Skin becomes Cold and Livid. The *Gangrene* begins at the Center of the Part, and appears not at the Skin but a long while after, so that People are often obliged to Open the Skin to find only the *Gangrene* Lurking under it.

The only *Remedy* for this *Gangrene* is to Cut off the Part Affected: If it be not Cut off, it becomes Dry and Lean, as if the Skin were Glued over the Bones, and 'tis of a Dreadful *Blackness* without *Rottenness*.

Whilst the *Legs* are Drying up, the *Gangrene* Ascends to the *Shoulders*: and one knows not, which way it Communicates it self.

We have not as yet Lighted upon a *Specifick Remedy* against this Evil. There is some Hope of Preventing it by *Hot Spirits* and *Volatile Salts*. The *Orvietan* and *Ptisan* of *Lupins* do considerable Good to the Person Distempered. Poor People are almost Only subject to these Evils.

M. *Tuillier* also writes word, that in 1675 he saw much of this *Corrupted Grain* among the *Rey* of the Country of *Gastinois*; and that the Country People told him, that there was much more of it this Year 1676. than the Last Year; and that it caused great Disorders: And yet 'tis certain, that this Summer hath been rather *Cold* than *Hot*; and that there hath not been any considerably Intemperate Weather this Year, but Excess of *Wet*.

However, it may be Doubted, whether these *Gangrenes* are the Effect of this *Corn* Eaten; or whether the *Corruption* of the *Rey* and that of the *Parts* in the Bodies of Men, are not Accidents equally derivable from the same Constitution of the Air, and independent the one from the other. Yet M. *Tuillier* has assured M. *Dodard* that in the Year 1638. which was Fatal to the Poor of the Countries subject to these Evils, he being at *Sully*, and having understood by a Physician and

and Chirurgion, that the *Cornuted Rey* was the Cause of the *Gangrenes* that were then very Frequent, being desirous to satisfy himself, whether this *Grain* was indeed the Cause thereof, he gave of it to several *Animals*, which Dy'd of it.

VI. Malt is made in *Scotland* of no other Grain, but *Barly*: Whereof there are two Kinds; 1, which hath 4. Rows of Grains on the Ear; the *other* 2. Rows. The *first* is the more commonly used: but the *other* makes the best *Malt*.

To make Malt,
by Sir Rob.
Murray. n. 142.
p. 1069.

The more recently *Barly* hath been Threshed, it makes the Better *Malt*. But if it hath been Threshed 6 *Weeks* or upwards, it proves not good *Malt*, unless it be kept in one Equal Temper; whereof it easily fails, especially if it be kept up against a Wall: For that which lies in the Middle of the Heap is Freshest; that which lies on the Outsides and at Top is over dry'd; that which is next the Wall, Shoots forth; and that which is at the Bottom Rots. So that some Grains do not *Come Well* (as they call it) that is, never gets that right Mellow Temper *Malt* ought to have, and so spoils all the rest. For thus some Grains *Come Well*, some not at all, some Half, and some too Much.

The best way to Preserve Threshed *Barly* long in good Temper, is not to Separate the Chaff from it, But as long as it is Unthreshed, it is always Good. Brewers Use to keep their *Barley* in Large Rooms on Boarded Floors, laid about a Foot in Depth, and so Turned over now and then with Scoops,

Barly that hath been Overheated in the Stacks or Barnes, before it be separated from the Straw, will never Prove Good for *Malt*, nor any other Use. But though it Heat a little, after it is Threshed, and kept in the Chaff, it will not be the Worse, but rather the Better for it: for then it will *Come* the sooner, and more Equally. A Mixture of *Barly* that grow on several Grounds, never proves Good *Malt*, because it *Comes* not Equally. So that the best *Barly* to make *Malt* of, is that which grows in One Field, and is kept and Thresh'd together.

Take then Good *Barly*, newly Threshed, and well purged from the Chaff and put hereof 8 *Bolls*, that is about 6. *English Quarters*, in a stone-Trough. Where let it infuse, till the Water be of a bright Reddish Colour; which will be in about 3 *Days*, more or less, according to the Moistness or Dryness, Smalness or Bigness of the Grain, Season of the Year, or Temper of the Weather. In Summer *Malt* never makes Well; in *Winter* it will need Longer Infusion, than in the *Spring* or *Autumn*.

It may be known when *Steeped* Enough, by other Marks besides the Colour of the Water, as the Excessive Swelling of the Grain: or if, *Over steeped*, by too much Softness; being, when in the Right Temper, like that *Barly* which is prepared to make Broth of.

When the *Barly* is sufficiently *Steeped* take it out of the Trough, and lay it on *Heaps*: so let the Water Drein from it. Then after 2 or 3 *Hours*, Turn it over with a *Scoop*, and lay it in a New *Heap* about 20 or 24 *Inches* Deep.

This *Heap* they call the *Coming Heap*: And in the managing of this *Heap* aright, lies the greatest Skill. In this *Heap* it will lie 40 *Hours*, more or less, according to the forementioned Qualities of the Grain, &c. before it come to the right Temper of *Malt*; which that it may do *Equally*, is most to be Desired.

Whilst it lies in this *Heap*, it is to be carefully looked to, after the first 15 or 16 *Hours*: For about that time, the Grains will begin to put forth the *Root*, which when they have *Equally* and *Fully* done, the *Malt* must within an *Hour* after, be Turned over with a *Scoop*; otherwise the Grains will begin to put forth the *Blade* or *Spire* also, which by all means must be prevented: for hereby the *Malt* will be utterly Spoil'd, both as to the Pleasantness of *Taste*, and *Strength*.

If all the *Malt* Come not *Equally*, because that which lies in the Middle being Warmest will usually Come first, Turn it over, so as the Utmost may lie Inmost, and so leave it till all be Come alike.

So soon as the *Malt* is sufficiently Come, Turn it over, and spread it to a Depth not exceeding 5 or 6 *Inches*. And by that time it is all spread out, begin and Turn it over and over again, three or four times. Afterwards Turn it over in like manner, once in 4 or 5 *Hours*, making the *Heap* Thicker by Degrees, and continuing so to do constantly, for the space of 48 *Hours* at least. This Frequent *Turning* it over, Cooles, Dryes and Deads the Grain, whereby it becomes Mellow, Melts easily in *Brewing*, and then separates entirely from the *Husk*.

Then Throw up the *Malt* into a *Heap*, as High as you can. Where let it lye, till it Grows as Hot as your Hand can endure it: which usually comes to pass, in some 30 *Hours* space. This perfects the sweetness, and Mellowness of the *Malt*.

After the *Malt* is sufficiently Heated, throw it abroad to Cool, and Turn it over again about 6 or 8 *Hours* after, and then Dry it upon the *Kiln*. Where after One Fire, which must serve for 24 *Hours*, give it another more Slow, and if need be a third. For if the *Malt* be not thoroughly Dried, it cannot be well Ground, neither will it Dissolve well in the *Brewing*, and the *Ale* it makes will be Red, Bitter, and will not Keep.

The best *Fewel* is *Peat*; The next, *Charcoale*, made of *Pit Coal* or *Cinders*. *Heath*, *Broom*, and *Firzes*, are nought. If there be not enough of one Kind, Burn the Best First, for that gives the strongest Impression, as to the *Taste*.

VII. 1. All the 12 *Companies* of London, and some other *Companies* and Private Persons, have their *Granaries* at the *Bridge-House* in *Southwark*; (where are a *Justice of the Peace*, a *Steward*, and two *Masters*.) These *Granaries* are built on two sides of an Oblong Square; one whereof stands North and South, and is near 100 *Yards* long; whose *Lattice-Windows* respect *North-East*: the other side may be about 50 *Yards* long; the *Windows* look to the *North*; and the Opposite sides have no Apertures. All the *Windows* are

are about a *Yard* High, without any *Shutters*, and run on in a continued *Series*, with very small Partitions, sufficient only to nail the *Lettices* to. Each of them is 3 or 4 *Stories* High. The Ground or lowermost *Story*, 12 *Foot* from the Ground, is used only for a *Ware-House*, &c. To settle the First *Story* upon strong Pillars, fortify'd with Spikes of Iron, that no *Vermin* might get up, would make that *Story* fitter for drying of Corn, and more *Perflatile*. In some places they put, in all the Inside of their Rooms, Iron *Wire*, of so narrow *Meshes*, that neither *Rats* nor *Mice* can get through them, 2 or 3 *Foot* deep. Others erect, on all the sides, *Boards* of Timber, and fasten others to the top of the Perpendicular one, lying either Parallel to the *Horizon*, or so that they make an Acute Angle with the former, to the same purpose: For, besides the devouring of the Grain, the Excrements and Urine of that *Vermin*, Moistning the *Wheat*, or *Rye*, make them apt to Corrupt and Breed *Weivels*.

The two main Considerables, in Building these *Granaries*, are, To make them *strong*, and to expose them to the *Most Drying Winds*.

The *Ordering* of their *Corn* is this, in *Kent*, to seperate the Dust and other Impurities in it; when 'tis Thrash'd, they throw it in Shovels from one side to the other, which the longer it is, the better; by which means all such Impurities remain in the Middle, betwixt the two *Heaps* of *Corn*; which they *Skreen* to Part the *Corn* that is good, from the said Impurities. Then, when they first bring the Grain into the *Granaries*, they lay it about *half a Foot* Thick, and Turn it twice a *Week*, and once in that time *Skreen* it; and this for 2 *Months* space. After that, they lay it a *Foot* Thick for 2 *Months* more, Turning it once or twice a *Week*, and *Skreen* it proportionably, according as the *Drying* Season is, seldomer or oftner. After 5 or 6 *Months*, they raise it to 2 *Foot* in Height, and Turn it once a *Fortnight*, and *Skreen* it once a *Month*, as Occasion is. After a *Year*, they lay it *two and a half*, or 3 *Foot* Deep, and Turn it once in 3 *Weeks* or a *Month*, and *Skreen* it proportionably.

When it hath lain 2 *Years* or more, they Turn it once in 2 *Months*, and *Skreen* it once a *Quarter*, and so on, as they find it in Brightness, Hardness and Dryness. The oftner these two things are done, the better the Grain proves. They leave an empty space about a *Yard* wide on all sides of the Room, and at 6 *Foot* distance, through the whole *Area*, empty of *Corn*; into which empty Places, they Turn the *Corn* as often as 'tis Needful.

In *Kent* they make two square Holes in both the Ends of the Floor, and one Round in the Middle; by which they throw the *Corn* from the Upper into the lower Rooms, & *contra*, to Air and Dry it the better.

The *Skreens* are made with two Partitions, to separate the *Dust* from the *Corn*; which falls into a Bag, and when sufficiently full, is cast away, the good *Corn* remaining behind.

Corn has been kept in *London Granaries* 32 *Years*: and the longer 'tis kept the more *Flower* it yields, in Proportion to the Quantity of *Corn*, and makes the Purer and Whiter Bread; the superfluous Humidity only Evaporating.

At Zurich: by
Dr. Pell. ib.

2. Dr. Pell mentioned at a Meeting of the R. Society, that they keep Corn at Zurich in Helvetia 80 Years.

In Dantzick and
Muscovy; by
---ib. p. 466.

3. Observing Merchants and Travellers tell us, that the Granaries of Dantzick are generally 7 Stories High, and some 9 Stories; having each of them a Funnel, to let the Corn Run down from one Floor to another; thereby chiefly saving the Labour and Charges of carrying it down. And then, that they in that Town, are built altogether surrounded with Water, whereby the Ships have the Conveniency of lying close to them, to take in their Lading. No Houses are suffer'd to be Built near them, to be thereby secured from the Casualties of Fire.

Those of Muscovy are made Under-ground by digging a Deep Pit, of almost the Figure of a Sugar-Loaf; Broad Below, and Narrow at the Top; the Sides well Plaistered round about; and the Top very closely Covered with Stone

The People of that Country are so very careful, to have the Corn well Dried, before they put it into those Subterraneous Granaries, that when the Weather of that Northern Climate serves not to Dry it sufficiently, they Heat their Barns by the means of great Ovens, and thereby well Drying their Corn, supply the Deficiency of their short Summer.

Turnep and Potato Bread; by
Dr. Beal, n. 90.
p. 5142:

VIII. 1. In the Year 1629, and 1630. there was a Dearth in England; And much talk they had then, that in London they had a way to Knead and ferment Boyl'd Turneps with a small quantity of Meal; and that it made Better Bread for Whiteness, Pleasantness, Lasting and Wholsomness, than is made of the finest Flower of Wheat. Turneps, Rapes, Carrets, Parsneps, Potatoes, and other Roots, lie safe Under Ground from scorching Heat, and are said to Thrive best in the greatest Rain. Potatoes were a Relief to Ireland in their last Famine. They yield Meat and Drink.

Turnep Bread;
by Mr. Sam. Dale.
n. 205. p. 970.

2. The Dearness of all sorts of Corn in 1693, occasion'd many Poor People in Essex to make Bread of Turneps. The way of making it is this, They take Pilled Turneps, and Boil them in Water until they are soft or Tender; then pressing strongly out the Juice, they Mix them with their Weight of Wheat-Meal; then adding Salt and Yeast, of each q. s. and Warm Water, they Knead it up as other Dough, or Paste; which having lain a little while to Ferment, they Order and Bake it as Common Bread. This Turnep Bread, to the Eye, is not to be distinguisht from Common Wheaten or Household-Bread; neither doth the Scent much betray it, especially when Cold; only to Dainty and Nice Palates, the Turneps are a little, and but a little perceived.

The Culture of
Maize; by Mr.
Winthrop: n. 142
p. 1065.

IX. The Corn used in New England before the English Planted there, is call'd by the Native Weachin, and is known by the Name of Mais in some Southern Parts of America. The Ear is for the most part, about a Span long, composed of several, commonly 8 Rows of Grains, or more according to the Goodness of the Ground: And in each Row, usually above 30 Grains. It is of various Colours, as Red, White, Yellow, Blue, Olive, Greenish

Greenish, Black, Speckled, Striped, &c. Sometimes in the same Field, and the same *Ear*. But the White and Yellow are the most common.

The *Ear* is clothed and Armed with several strong thick *Husks*: Not only defending it from the Cold of the Night (being the latter End of *September*, in some Parts, before it be full Ripe,) and from Unseasonable Rains; but also from the *Crows*, *Starlings* and other Birds; which being allured by the sweetness of the Corn before it hardeneth, come then in great Flights into the Fields, and pecking through the top of the Cover, devour as far as they can Reach.

The *Stalk* groweth to the height of 6 or 8 *Feet*; more or less, according to the Condition of the Ground, or Kind of *Seed*. The *Virginian* groweth Taller than that of *New England*: And there is another sort used by the *Northern Indians* far up in the Country, that groweth much shorter than that of *New England*. 'Tis always jointed like a *Cane*: And is full of sweet Juice, like the *Sugar-Cane*: And a Syrup as sweet as *Sugar* may be made of it; as hath been often try'd. And Meats sweetned with it, hath not been distinguished from the like sweetned with *Sugar*. At every *Joint* there are long *Leaves* almost like *Flags*, and at the Top a Bunch of *Flowers*, like the Blossoms of *Rye*.

It is *Planted* between the Middle of *March* and the Beginning of *June*: But most commonly from the Middle of *April* to the Middle of *May*.

In the more *Northerly* Parts, they have a peculiar kind call'd *Mohawks-Corn*, which though *Planted* in *June*, will be Ripe in Season. The *Stalks* of this kind are shorter, and the *Ears* grow near the bottom of the *Stalks*, and are generally of diverse Colours.

The manner of *Planting* is in Rows, at Equal distance every way, about 5 or 6 *Feet*.

They open the Earth with an *Howe*, taking away the surface 3 or 4 *Inches* deep, and the breadth of the *Howe*; and so throw in 4 or 5 Grains, a little distant one from another, and cover them with Earth. If two or three grow, it may do well: For some of them are usually destroyed by *Birds*, or *Mouse Squirrels*.

The Corn grown up an Hand's length, they cut up the Weeds, and loosen the Earth about it, with a broad *Howe*: Repeating this Labour, as the Weeds grow. When the *Stalk* begins to grow high, they draw a little Earth about it, and upon the putting forth of the *Ear*, so much as to make a little Hill, like a *Hop-Hill*; after this, they have no other Business about it, till Harvest.

After 'tis gathered, it must, except laid very Thin, be presently Stripped from the *Husks*, otherwise it will Heat, grow Mouldy, and sometimes Sprout. The common way (which they call *Tracing*) is to weave the *Ears* together in long *Traces* by some parts of the *Husk* left thereon. These *Traces* they Hang upon *Stages*, or other Bearers within doors, or without: For, Hung in that manner, they will keep good and sweet all the Winter after, though exposed to all Weathers.

The Natives commonly *Thresh* it as they Gather it, Dry it well on Matts in the Sun, and then bestow it in *Holes* in the Ground (which are their Barns) well Lined with Withered Grass and Mats, and then covered with the like; and over all, with Earth; and so it's kept very well, till they Use it.

The *English* have now taken to a better way of *Planting* by the help of the *Plough*, in this manner: In the *Planting-time* they *Plough* single Furrows through the whole Field, about 6 Feet distant, more or less as they see convenient. To these they *Plough* others across at the same Distance Where these Meet they throw in the Corn, and cover it either with the *Howe*, or by running another Furrow with the *Plough*. When the *Weeds* begin to overtop the Corn, then they *Plough* over the rest of the Field between the *Planted Furrows*, and so Turn in the *Weeds*. This is repeated where they begin to *Hill* the Corn with the *Howe*; and so the Ground is better loosened then with the *Howe*, and the Roots of the Corn have more Liberty to spread. Where any *Weeds* escape the *Plough*, they use the *Howe*.

Where the Ground is Bad or Worn out, the *Indians* us'd to put 2 or 3 of the Fishes call'd *Aloofes*, under or adjacent to each *Corn-Hill*, where they had many times a Crop double to what the Ground would have otherwise produced. The *English* also have learned the like Husbandry, where these *Aloofes* come up in great Plenty, or where they are near the *Fishing stages*; having there the Heads and Garbage of *Cod-Fish* in abundance, at no charge but the fetching,

The Fields thus Ploughed for this Corn, after the Crop is off, are almost as well fitted for *English Corn*, especially *Summer-Grain*, as *Peason* or *Summer-Wheat*; as if lying *Fallow*, they had a very good *Summer-Tilth*.

The *Indians*, and some *English* (especially in good Ground, and well *Fished*) at every *Corn-Hill*, plant with the Corn, a kind of *French* or *Turkey Beans*: The *Stalks* of the Corn serving instead of *Poles* for the *Beans* to climb up with. And in the vacant places between the *Hills* they will plant *Squashes* and *Pompions*; loading the Ground with as much as it will bear. And many after the last Weeding, sprinkle *Turnep-Seed* between the *Hills*, and so, after Harvest, have a good Crop of *Turneps*. The *Stalks* of this Corn, cut up before too much dried, and so laid up, are good *Winter Fodder* for Cattle. But they usually leave them on the Ground for the Cattle to feed on. The *Husks* about the *Ear* are Good *Fodder*, given for Change sometimes after Hay. The *Indian Women* Slit them into narrow parts, and so Weave them artificially into Baskets of several Fashions.

This Corn the *Indians* dressed several ways for their Food; sometimes Boiling it whole till it swelled and became Tender, and so either eating it alone, or with their Fish or Venison instead of *Bread*; sometimes Bruising it in Mortars, and so Boiling it: But commonly this way, *viz.* by Parching it in Ashes or Embers, so artificially stirring it, as without Burning to be very Tender, and Turned almost Inside Outward, and also White and Flowry. This they sift very well from the Ashes, and beat it in their Wooden Mortars with a long Stone for a Pestle, into Fine Meal. This is a constant Food

Food at Home, and especially when they Travel, being put up in a Bag, and so at all times ready for Eating either Dry or Mix'd with Water. They find it very wholesome Diet: And the *English* sometimes for Novelty, will procure some of this to be made by the *Indian Women*, adding Milk or Sugar and Water to it, as they please.

The *Indians* have another sort of Provision out of this Corn, which they call *Sweet Corn*. When the Corn in the Ear is full, while it is yet Green, it hath a very *sweet* Taste. This they gather, Boil, and then Dry, and so put it up into Bags or Baskets for their Use: Boiling it again, either whole or Grossly beaten, when they Eat it, either by it self, or amongst their Fish, or Venison, or Beavers or other Flesh; accounting it a Principal Dish.

These Green and *Sweet Ears* they sometimes Roast before the Fire, or in the Embers, and so Eat the Corn: By which means, they have sufficient Supply of Food, though their Old Store be done.

The *English*, of the full ripe Corn, Ground, make very good *Bread*: But 'tis not Ordered as other Corn. For if it be Mixed into stiff Paste, it will not be so good, as if made only a little stiffer than for Puddings; and so Baked in a very Hot Oven, standing therein all Day, or all Night. Because upon the first pouring of it on the Oven Floor, it spreads abroad, they pour a Second Layer or Heap upon every First, and thereby make so many Loaves: Which if Baked enough, and Good, will be of a deep *Yellowish* Colour; if otherwise, a *White*.

It is also sometimes Mixed with half or a third part of *Rye* or *Wheat-meal*, and so with Leaven or Yeast, made into Loaves of very good Bread.

Before they had *Mills*, having first watered and *Husked* the Corn, and then Beaten it in Wooden Mortars, the Courser part sifted from the Meal, and separated from the loose Hulls by the Wind, they Boyled to a Thick Batter: to which, being Cold, they added so much of the Fine Meal, as would serve to Stiffen it into Paste, whereof they made very Good *Bread*.

The Best sort of Food which the *English* make of this Corn, is that they call *Samp*. Having first Watered it about *half* an Hour, and then Beaten it in a Mortar, or else ground it in a Hand or Other *Mill*, into the bigness of *Rice*, they next sift the Flower, and Winnow the Hulls from it. Then they Boil it gently till it be Tender, and so with Milk, or Butter and Sugar, make it into a very Pleasant and wholesome Dish.

This was the most usual Diet of the First Planters in these Parts, and is still in Use amongst them, as well in *Fevers* as in *Health*: And was often prescribed by the Learned Dr. *Wilson* to his Patients in *London*. And of the *Indians* that live much upon this Corn; the *English*, most acquainted with them, have been informed by them, that the Disease of the *Stone* is very seldom known amongst them.

The *English* have also found out a way to make very good *Beer* of this Grain: That is, either of *Bread* made hereof, or else by *Malting* it. The way of making *Beer* of *Bread*, is by breaking or cutting it into great Lumps about as big as a Man's Fist, to be *Mashed*, and so proceeded with as

Malt, and the Impregnated Liquor, as *Wocrt*; either Adding or Omitting *Hopps*, as is desired.

To make Good *Malt* of this Corn, a particular way must be taken. The *Barley Malt-Masters* have Used all their Skill to make good *Malt* hereof the Ordinary way, but cannot Effect it; that is, that the Whole Grain be *Malted*, and Tender and Flowry, as in other *Malt*. For it is found by Experience, that this Corn, before it be fully *Malted*, must sprout out both ways, (*i. e.* both *Root* and *Blade*) to a great Length; of a Finger at least; if more, the better. For which, it must be laid upon an *Heap* a convenient time; wherein on the one hand, if it lyeth of a sufficient Thickness for *Coming*, it will quickly Heat and Mould, and the tender sprouts be so Intangled, that the least opening of the *Heap* break them off, and so hinders the further Maturation of the Grain into *Malt*; On the other, if it be stirr'd and open'd to prevent too much Heating, the *Sprouts* which have begun to shoot, cease growing, and consequently the Corn again ceaseth to be promoted to the Mellowness of *Malt*.

To avoid all these Difficulties, this way was tryed and found effectual. Take away the top of the Earth in a Garden or Field 2 or 3 *Inches*, throwing it up Half one way and half the other; then lay the Corn for *Malt*, all over the Ground so as to cover it; then cover the Corn with the Earth that was pared off, and there is no more to do, till you see all the Plat of Ground like a green Field, Covered over with the *Sprouts* of Corn, which will be within 10 *Days* or a *Fortnight*, according to the time of the Year; Then take it up, and shake the Earth from it, and Dry it: For the *Roots* will be so Intangled together, that it may be raised up in great pieces. To make it very Clean, it may be Washed, and then presently dry'd on a *Kiln*, or in the *Sun*, or spread Thin on a Chamber-Floor.

This way, every Grain that is good will grow, and be Mellow, Flowry and very Sweet; and the *Beer* made of it, will be Wholsome, Pleasant, and of a good Brown Colour. Yet *Beer* made of the *Bread*, as aforesaid, is as well Coloured, as Wholsome and Pleasant, and more durable; this therefore is Most in use.

Improvement to
be made by
Maize; by Sir
Rich Bulkley.
n. 205. p. 928.

X. 1. The greatest Profit that ever I have heard of the *Field White Pease*, has been 20 Barrels Reap'd for one Sown: But *Maize* will yield more than 2000 for one. I made an Experiment in *Ireland*, with a *Grappe* of 8 sides, or *Rows*, having in each 30 Grains, (which Grew in *Brandenburg*) in good *Orchard Ground*, (which had been indeed Dung'd for some other *Legumes* the last Year) and sow'd them in *Rows*: each *Row* being about a *Yard* asunder, and each Grain about a *Foot* asunder in the *Row*; taking care to preserve them from the *Mice* till above Ground. Now out of Each Grain came up 3, 4, 5 or 6 *Stems*, (my *Suiss* says, he rarely has seen above 2 or 3 elsewhere) every of which *Stems* had 4, 3, or 2 of these *Grappes*. So that we may suppose, that each Grain will give 3 strong *Stems*, and each of these *Stems* 3 *Grappes*, and each *Grappe* 240 Grains which makes 2160. for One.

There

There are some things very odd in the Manner of its growth, It first sends up a Thick *Reedy Stalk*, about a *Yard* High, with long *Leaves* of a very Thick Woody Substance, and *Half a Yard* long Enwrapping the *Stalk*, just like the *Iris*. At the Top of this *Stalk*, when the *Leaves* Open, there appears 20 or 30 *Ears*, as it were of our Unripe *Wheat*; but this, when it is Opened must be Plucked away, for it is nothing but the *Flower*: And what is most surprising, the *Fruit* comes not where the *Flower* was, but on the Inner-side of every *Leaf*, where it joyns to the *Stem*, comes forth, after a time, a large *Shoot*, Thicker than ones *Wrist*, at the End of which hangs out a bundle of Fine *Strings*, like a *Horse-Tail*, which is the True *Flower* of the Plant. As this *Withers*, the *Fruit* grows on within, being Envelop'd in a great number of *Leaves*, which when they are *Withered*, the *Fruit* is Ripe, (but is never Naked while on the *Stalks*) and must then be taken off, and Hung up to Dry, or Kept in Chests. It will serve for all the *Uses* of the *White Pea* (to which Grain it is the most like in *Tast* and *Figure*) either in *Bread* (with *Wheat*) or *Soup*, or *Pudding*, or with *Pork*.

2. If the *Maize* be Equal in goodness to *Pease*, and an *Acre* Planted with it will certainly yield more than one Sown with *Pease*, without Impoverishing the Land, then indeed it will be Advantageous to *Plant* it: But if only an Equal Quantity, then tho' One Grain should yield a 1000 fold, all the Advantage will be in the Difference of the *Seed*, which is not very Considerable; and which the *Compendium* of *Sowing* above *Setting* may in some Measure Countervail.

Consider'd, by
Mr. J. Ray.
ib. p. 930.

By Sir *Richard's* Description of it, I am Confirm'd in my Opinion, That there are two really Distinct *Species* of *Maize*: For what I have seen Cultivated in Gardens, and have my self Planted, ariseth to Double the Stature he ascribes to this, that is 7, 8 or 10 *Feet*; and besides, with us, never brings the *Seed* near to Perfection. But that I have seen Planted in the Fields in *Germany*, is of about the same Height with Sir *Richard's*, and Ripens the *Seed*. *Lobel* also acknowledges two sorts thus Differing.

XI. A Distiller with us (at *Newcastle*) hath made a quantity of an Extraordinary *Spirit* of *Sugar*. It seems to be the Result of some *Anomalous Fermentation*: It is so strong that no Man is able to Smell at it in an open Vessel, without being made almost *Breathless*; neither do I think the Person that made it, can make it again. It was Drawn from bare *Sugar-Water* (which is nothing but the Water wherewith the *Molds*, *Aprons*, &c. are Washed) *Fermented* with the *Scum*: And it was so exceedingly *Volatile*, that it would not be Carried, but lost all its Force in the Carriage, though it was very well Stopt.

An extraordinary
Spirit of
Sugar; by Dr.
Lucas Hodge-
son. n. 130.
p. 766.

XII. *Saffron-heads* Planted in a Black Rich Sandy Mold, or in a Mixt Sandy Land, between White and Red, yields the greater store of *Saffron*. A Clay, or stiff Ground, be it never so Rich, produceth little *Saffron*, though increase of *Heads* or *Roots*, if the Winter prove Mild and Dry: but the Extremity of Cold and Moisture will Rot them. So that the Finest Light sandy Mold, of an indifferent Fatness is esteemed most Profitable.

The Culture of
Saffron; by Mr.
Ch. Howard.
n. 138. p. 945.

Plough the Ground in the beginning of *April*, and lay it very smooth and Level.

About 3 *Weeks* or a *Month* after, spread upon every Acre 20 Loads of Rotten Dung, and Plough it in.

At *Midsummer* Plough it again, and Plant the *Saffron-Heads* in Rows, every way 3 *Inches* distant one from another, and 3 *Inches* deep.

The most expedite way of Planting, is to make a Trench the whole length of the Field, 3 *Inches* deep with a *Spit-Shovel*. The *Spit-Shovel* is to be made of a Thin streight Iron 10 *Inches* long, and 5 *Inches* broad, with a *Socket* in the side of it to put a Staff or Handle. Lay the *Saffron-Heads* 3 *Inches* distant in the Trench, and with the *Shovel spit* up 3 *Inches* of Earth upon them.

Observe this Order in *Planting* of whole Fields, whereby the *Heads* will lie every way 3 *Inches* one from another. Only Paths or shallow Trenches are to be left 2 or 3 *Yards* alunder, which serve every Year to lay the Weeds to rott, that are to be Weeded and Pared off the Ground.

As soon as the *Heads* begin to shoot or *speer* within the Ground (which is usually a *Fortnight* before *Michaelmas*) *Howe* or Pare the Ground all over very Thin, and Rake lightly all the Weeds and Grass very Clean, least it Choak the *Flowers*, which will soon after Appear; and are then to be Gather'd and the *Saffron* to be *Picked* and *Dried* for Use.

The Ground must be very carefully fenced from Sheep or Cattle, which by Treading break the *Saffron Grass*, and make the *Chives* come up small.

In *May*, the *Saffron-Grass* will be quite Withered away, after which the Weeds and Grass the Ground produceth may be cut or Mowed off from time to time to feed Cattle till about *Michaelmas*, at which time the *Heads* will begin to *speer* within the Ground. Then *Howe*, Pare and Rake the Ground Clean as before, for a *Second* Crop. The like Directions are to be Observed the next Year for a *Third* Crop. The *Midsummer* following Dig up all the *Saffron-Heads*, and Plant them again in another New Ground Dunged and Ordered as aforesaid) wherein no *Saffron* hath been Planted, at least not within 7 ~~Years~~ *Years*.

The *Flowers* are to be Gathered as soon as they come up, before they are full Blown, whether *Wet* or *Dry*.

Pick out the *Chives* clean from the Shells or *Flowers*, and sprinkle them 2 or 3 *Fingers* thick, very equally on a double *Saffron Paper*. Lay this on the *Hair-Cloth* of the *Saffron-Kiln*, and Cover it with two or more *Saffron Papers*, a piece of *Woolen Cloth* or *Thick Bays*, and a *Cushion* of *Canvas* or *sack-cloth* fill'd with *Barly-straw*, whereon lay the *Kiln Board*.

Pur into the *Kiln*, throughly Kindled, *Charcoal*, *Oven-Coals*, or the like, keeping it so Hot, that you can hardly endure your *Fingers* between the *Paper* and the *Hair Cloth*.

After an *Hour* or more Turn in the *Edges* of the *Cake* with a *Knife*, and loosen it from the *Paper*. If it stick fast, wet the *Outside* of the *Paper* with a *Feather* dip'd in *Beer*, and then *Dry* the *Papers*. Turn the *Cake*, that both sides may be of a Colour.

If it stick again to the *Paper*, loosen it, and then dry it with a very gentle Heat, with the addition of a quarter of 100 l. Weight laid upon the *Kiln-board*.

The *Saffron Cake* being sufficiently dried, is fit for Use, and will last good many *Years*, being wrapt up and kept close.

The *Best Saffron* is that which consists of the Thickest and Shortest *Chives*, of a High Red and shining Colour, both without and within alike.

Saffron is oftentimes *Burnt*, and in Knots, spotted and mixed with the *Yellows* that are within the *Shells*.

It's usually observed, that one *Acre* doth yield, at the least, 12 *pounds* of Good *Saffron* One Year with Another; and some *Years* 20 *pounds*.

Good *Saffron* is seldom or never sold at so low a Rate as 30 *Shillings* per *pound*, frequently at 3 *Pounds* per *pound*, and upwards. Wherefore one *Acre* bearing 12 *Pounds* at 40 *Shil.* per *Pound*, cometh to 24 *Pound* per *Annum*.

The Gathering and Picking of one *Pound* of *Saffron* is worth one *Shil.* which cometh to 12 *Shil.* per *Acre*.

The Fire and care of Drying may come to 3 *Shil.* more, at 6 *Pence* the *Pound*; which is in all 15 *Shill.*

The *Grass* that is Mow'd and cut off the Ground for the use of Cattle, will be very near worth as much as will Countervail the Picking and Drying the *Saffron*; the Soil being enriched, not only by the Dung, but the *Saffron* it self, as appears by the rich Crops the Ground yields for several *Years* after, without any other *Manuring* or Improvement.

Sixteen *Quarters* of *Saffron-Heads* are sufficient to Plant one *Acre*. A *Quarter* of these *Heads* is usually sold in the place for 10 *Shill.* which comes to 8 *Pounds* per *Acre*.

Twenty *Loads* of Rotten Dung laid on the Ground, may be worth 40 *Shill.* at 12 *Pence* a *Load* for the Dung, and as much for Carriage into the Field.

For Thrice Ploughing the Ground 20 *Shillings*.

For Planting the *Heads* about 4 *Pounds*. Which in the whole makes 14 *Pounds* the Charges of Planting an *Acre*, which will bear 3 Crops.

So that all things reasonably Computed, it appears that an *Acre* of *Saffron* will be worth, notwithstanding all Casualties, one *Year* with another, over and above the 14 *Pounds* Charges, for the *First years* Planting (at the least) 20 *Pounds* per *Annum*. Besides the great Increase of the *Saffron-Heads*, which will be as 3 for one.

The *Kiln* consists of an Oaken Frame, Lathed on every side; 12 *Inches* square in the Bottom, 2 *Foot* high, and 2 *Foot* square at the *Top*; upon which is nailed a *Hair cloth*, and strained hard by *Wedges* drove into the sides; a square Board, and a Weight to press it down, weighing about a quarter of an *Hundred*.

The *Insides* of the *Kiln* are covered all over with the strongest *Potters Clay*, very well wrought with a little Sand, a little above 2 *Inches* thick.

The Bottom must be Lined with Clay 4 or 5 *Inches* Thick, which is the *Hearth* to lay the Fire on: Level wherewith is to be made a little *hole* to put the Fire. The *Outside* may be Plaistered all over with Lime and Hair.

Melons Order'd;
by M. Dela
Quintiny. n. 45.
p. 901.
Fig. 159.

XIII. The First thing appearing of *Melons* are two Leaves United, here call'd *Ears* (mark'd 11) Out of the midst of these two *Ears* there shoots some Days after, first One Leaf, which call the First Leaf or *Knot* (mark'd 2) and out of the same place, after some Days more, shoots a Second, call'd the Second *Knot* (mark'd 3) Out of about the midst of the Stalk of this Second *Knot* shoots the 3d. *Knot* (mark'd 4) And this 3d *Knot* it is, which must be Cut at the place mark'd 6 without hurting the Branch of the 2d *Knot*, whence this Third came; because that from that place will spring a Branch, which we call the First *Arm*, and this *Arm* will shoot forth first One *Knot*, then a Second, then a Third; and this Third it is, you are to Cut again in the same manner, as was said before. And you must be careful to Cut these Third *Knots*, without staying for the Shooting of the 4th or 5th ones. You'll see out of every *Knot* come forth *Arms* or Branches like to the First, spoken of before; and it is at those *Arms*, that the *Melon* will be produced. And they will be Good, if the *Foot* or *Root* be well Nourish'd in good Earth, and Cherish'd by a good *Hot-Bed* and the Sun. But let the *Foot* of the *Melon* never pass into the *Dung*, nor the Earth be *Watered* but moderately, when you see it grows too Dry; so as the Shoot might thereby suffer; which yet you must not delay, till it happen, least the Remedy come too Late. I *Water* twice or thrice a *Week* in very Hot Weather, and that about Sun-set; and I cover my *Melons* with a *Straw-Mat* from 11 of the Clock in the Forenoon, to 2 in the Afternoon; when the Heat of the Sun is too Violent, and too quickly Consuming that little Moisture which is necessary for the Root. And when it Raineth, I Cover also my *Melon-Garden*, least too much Wet hurt my Fruit.

If the *Root* produce too many Branches or *Arms*, Cut away the Weakest of them; and leave none but 3 or 4 of the Strongest and most Vigorous; and such as have their *Knots* nearest to one another. When I Transplant my *Melons* from the *Nursery-bed*, I put commonly 2 *Roots* together, except I find One very strong; which I then plant Alone, Cutting from it neither of the *Branches* that Shoot from each side (markt 77) betwixt the one *Ear* and the *Leaf* before spoken of. But when I joyn two *Roots* together, I quite Cut away both the *Branches* that shoot from the two *Ears*, standing one over against the other, to avoid the disordering abundance of Branches; which also would Wrong the *Foot*.

The *Melons* being *Rnit*, I leave but two of them upon each *Foot*; chusing those that are best placed, and next to the first and Principal *Stalk*, that is to the *Heart* of the *Foot*. I also take Care, to leave none but Fair ones and such as have a Short and Thick *Tail*. The *Foot* also of your *Melon* must be short, well Truss'd, and not far distant from the Ground. *Melons* of a Long stem, and having the Stalk of the Leaf too Long and Slender, are never Vigorous; and cannot yield Good *Melons*.

It happens sometimes, that at the very first, there shoot out from between the two *Ears*, two Leaves, though I above spoke but of One: But this happens

pens but seldom, and when it does, such two Leaves must be reckoned but for one *Knot*; and afterwards there will shoot out a second, then a Third &c. and so on to 25 or 30 if you be not careful to Cut in time. And it is at the Extremity of those *Branches* so Distant, that *Melons* will grow: But they cannot be Good, because they are so far from the Place, which affords them their Nourishment.

I must not forget to tell you, that from the Midst betwixt the two *Ears*, and the two First Leaves, there shoots out yet One Branch more, which ought to be kept if Vigorous, but Cut if Weak.

He that is Curious must every Day walk often in his *Melon-Garden* to Cut off all the Branches, which he shall observe to be Useless or Hurtful.

Whenever you have a *Melon*, which comes well, Knit on a Branch, you must not fail to Cut away the rest of that Branch, on this side of the Fruit: to the End that all the Nourishment, that would have been Dispersed into the whole Branch, may pass into that *Fruit*, which is found at the Extremity of the Branch; taking care notwithstanding, that the *Fruit* be Covered with some Leaves of the other Branches, for its better Growth under the Shade, in those Parts where 'tis very Hot. n. 46. p. 923.

There commonly needs no more than 40 Days from the time of a *Melon's* Knitting to that of its Ripeness.

For the keeping of the *Seed*, you must take no other *Seed* but such as is found in that part of the *Mellon*, which hath been towards the Sun: And at the same time you Eat the *Melons*, you must well Clean such *Seeds*, and Rub them with a Linnen Cloath, until they be very Clean and Dry; then putting them up in some convenient Closet till *Seed-time*.

Remember, not to Eat the *Melons* but some 24 Hours after they have been Gathered; putting them in the mean time in a Dry place, neither too Hot nor too Cold, and Free from any Dry Scents, Good or Ill.

Observe also, to Gather them seasonably, when they are neither too Ripe nor too Green which you may know by their Yellowish Colour, and by their Tail commonly Splitting, and their Smell. A *Melon* ordinarily requireth One Day from the time of its being *Smitten*, to that of its being Gathered. I call that the Time of its being *Smitten*, when it begins to shew its being Ripe by a little Yellowness, appearing in some part or other of it. A *Melon* that Ripens too fast, is never Good, such a Ripeness not being a Good One, but proceeding from the Poorness or sickness, of the *Foot*, which maketh it thus turn suddenly.

The *Melon* must be full, without any Vacuity, which, you know, is discerned by Knocking upon it. And the *Meat* must be Dry, no *Water* running out: only a little Dew is to appear, issuing out of the *Pulp*; which must be of a very *Vermilion* Colour.

Trouble not your self to have Big *Melons*, but Good Ones. Those who covet Great *Melons*, may have their Delires, either by Sowing Seeds of the Great Kinds, or by much *Watering* others: Which *Watering* is a thing, wherein

wherein great Care and Discretion is to be used. You may judge of the necessity of *Watering* by the Vigour, which is required in the *Foot* and *Leaves*, without which the *Fruit* cannot be Good for want of good Nourishment.

Dog-Mercury;
by Mr. T. M.
n. 203. p. 875.

XIV. 1. About 3 Weeks ago the Wife of one *W. Mathews* near *Salop* gathered some Herbs, and (having first boil'd them) Fryed them with Bacon for her own and her Families Supper, And after they had been about 2 *Hours* in Bed, one of the Children (which is Dumb, and about 7 *Years* Old) fell very sick, and so did the other two presently after; which obliged the Man and his Wife to Rise, and take the Children to the Fire, where they *Vomited* and *Purged*, and within *half* an *Hour* fell fast a Sleep. They took the Children to Bed as they were asleep, and they themselves went to Bed too, and fell Faster a sleep than ever they had done before. The Man waked the next Morning about 3 *Hours* after his Usual time, went to his Labour at Mr. *Newports*, and so by the Strength of his Constitution carried it off: But he says he thought his *Chin* had been all the Day in a Fire, and was forced to keep his Hatful of Water by him all the Day long, and frequently dipt his *Chin* in it as he was at his Work. The Woman Wakened a while after her Husband, and being forced to it, got up to look after her little Family Concerns: But she was very *Sick* and has continued so till within these Few Days; since which she is very well Recovered. One of their Children slept from that Night (which was *Thursday* 3 *Weeks*) till *Monday Evening* Following, and then (having just only Opened her Eyes and made two Sprunts, without speaking one Word) Dyed immediately. While she was asleep, endeavours were used to Waken her, but in vain. The other two Children *Slept* about 24 *Hours*, and upon their Wakening fell a *Vomiting* and *Purging* again, which I think saved their *Lives*. *Mathews* told me he never Eat so Pleasant an Herb in his Life: But 'tis observ'd that the Cattle never browse it. 'Tis Branched and Seeded like *Spinage* or *Mercury*, but Leaved rather like *Lake-weed*; The Leaves are *Dented* too.

By Dr. Sloan.
ib. p. 876.

2. Mr. *Will. Baxter* did me the favour to send for a Dry'd *Sample* or *Specimen*, and it proves to be *Dog Mercury*; the Stalks, Leaves and Spikes agreeing exactly in every thing with those of *Dog-Mercury* or *Mercurialis Perennis Repens*, *Cynocrambe dicta*. *J. R.*

Hemlock; by
Dr. Nath Wood.
n. 231. p. 636.

XV. A Gentleman of my Acquaintance having a Horse which was troubled with that stubborn Disease they call the *Farcy*, employed several usually Efficacious Medicines Insuccessfully. At length being in a place where grew a great Quantity of *Hemlock* he observed the Horse began to Feed thereon Greedily, eating it up. On which within 3 or 4 *Dayes* his Sores Dried up, and he Recovered very fast. From whence it appears, that the *Leaves* at least of *Hemlock* are not Noxious to some Animals, but rather Salutary. The *Seeds* also some Birds, as in our Observation *Bustards*, will Greedily eat.

XVI. 1. A certain Woman near *Kilkenny* in *Ireland* eating by Mistake some Root, I suppose of common *Hemlock*, among *Parsneps*, was immediately seiz'd with *Raving* and *Madness*, talked Obscenely, and could not forbear Dancing. Thus she continued for some time, till at length she was taken with *Epileptick Fits*: Of which Distemper being committed to my Charge, she was soon Cured by the common Method, and has now for several Years Lived in Perfect Health. What Quantity she eat is not known: But a piece of *Hemlock-Root* was found on her Trencher.

A Poysonous Root like Hemlock; by Dr. Nath. Wood. n. 231. p. 634.

2. I am in some Doubt whether it was really the *Root of Hemlock*, which this Woman did Eat, and which had this Effect upon her, and not some other: Because, 1. *Jo. Bauhine*, relating two Parallel Stories of the Effects of Roots which were taken for *Parsneps*, is of Opinion that they were the Roots of *Wild-Cicely*, *Cicutaria Vulgaris*, or *Myrrhis Sylvestris*: Because (saith he) the Roots of it are more like to *Parsneps*, than those of *Cicuta* or *Hemlock*. 2. Mr. *Ja. Petiver* assured me, that he saw one Mr. *Henly* eat 3 or 4 Ounces of *Hemlock-Root* without the least Harm: Whereupon he himself was Encouraged to do the like, eating about half an Ounce. They tasted somewhat like the Root of *Seleri*, or *Sweet Smallage*: And he perceived no Ill Effect, or Inconvenience from the Eating of them. 3. The Common People generally believe that the Roots which cause these Symptoms, are no other than *Old-Parsneps*, which have continued some Years in the Ground: and therefore call them *Madneps*.

By Mr. J. Ray. ib. p. 635.

Hist. Plant. Tom. 3. p. 181.

XVII. 1. Eight Young Lads (about 30 Years ago) went a Fishing to a Brook near *Clonmell* in *Ireland*, and there meeting with a great Parcel of *Oenanthe Aquatica Succo Viroso*, (in *Irish*, *Tahow*) they mistook the Roots of it for *Sium Aquaticum* Roots, and did Eat a great deal of them. About 4 or 5 Hours after going home, the Eldest of them, who was almost of Man's stature without the least Previous appearing Disorder or Complaint, on a sudden Fell down backwards, and lay kicking and sprawling on the Ground: His Countenance soon turned very Ghastly, and he Foamed at the Mouth. Soon after 4 more were seized the same way, and they all Died before Morning; not one of them having spoken a word from the Moment in which the *Venenate* Particles surpris'd the *Genus Nervosum*. Of the other three, One ran stark *Mad*, but came to his right Reason again, the next Morning; Another had his Hair and Nails Faln off; and the Third (who is my Brother-in Law, and from whom I had this Account) alone Escaped, without receiving any Harm. Whether he Eat Less of this Fatal Root, or whether his Constitution, which is to this day very *Athletick*, occasioned it, I cannot tell; Though I am of Opinion, that his speedy Running above 2 Miles home, after that he saw the First Young Man fall, together with his Drinking a very large Draught of Milk, Warm from the Cow, in his Mid-way, were of singular use to him. For his violent sweating did doubtless Expel and carry off many of the *Venenose* Particles, and had a better Effect than perhaps, the Best of our *Alexipharmicks* (which you know are generally *Diaphoretick*) might have produced in

Hemlock-Water-Dropwort; by Mr. Fr. Vaughan. n. 238. p. 84.

this Case Besides, I believe, the Draught of Warm Milk did act its part, by involving the *Acid* or *Acrimonious* *Poisonous* Particles, and rendring them Unactive, and preventing their seizing the *Genus Nervosum*, till they were expelled *per Diaphoresin*.

There was also a *Dutchman*, about 2 Years since, within 8 Miles of *Clonmel*, Poisoned by Boyling and Eating the Tops of this Plant shred into his Pottage. I believe he took it for *Apium Palustre*, which its Leaves much Resemble

By Mr. Ray. *ib.*
p. 86.

De Nox. Cicuta.
Aquat.

2. Several Parallel and no less Tragical Histories of Later Date, of the Miserable Destruction of divers Persons, by the Eating of the Roots of this Pernicious and *Deleterious* Plant, I find Recorded by *Jac. Wepferus*, and in the *Miscellanea Curiosa*, Dec. 2. An. 6.

The Horned
Poppy; by Mr.
Ja. Newton.
n. 242. p. 263.

XVI. I. Between *Pensants* and *Marketjew* in *Cornwall*, on the Sandy shore grows abundance of *Papaver Corniculatum Luteum*, or *Horned Poppy*, with a Yellow Flower, vulgarly call'd in *Hampshire* and *Dorsetshire*, *Squatmore*, or *Bruse Root*, (as I was there informed) where they use it against Bruises External and internal. One *Charles Worth*, dwelling at the Half way-House between *Pensants* and *Marketjew*, caused a Pye to be made of the Roots of the said *Poppy* supposing them to be *Sea-Holly* or *Eringo* Roots (for they had made Pyes thereof, which was very Pleasant to them) but he eating of the aforesaid Pye (whilst Hot) was presently taken with such a Kind of *Delirium*, that he call'd for a White Earthen Chamber Pot and after having Purged by Stool into it, he broke it into pieces, and bid the Bystanders to save them, for they were all *Gold*, the Man and Maid-servants, having also Eat of the same Pye, became *Delirious*, and fancied that most what they saw was *Gold*. A Child in the Cradle having also Tasted of the Pye, was much Dosed, and Turned its Mouth to and again. And thus they continued for some Days, and then became Well.

Perhaps the *Yellow* Colour of the *Flowers* running in their Minds (which the Eating of the *Roots* had now Deprav'd) might beget that Idea of *Gold* in them.

The Helmontian
Laudanum; by
Mr. Boyle.
n. 107. p. 147.

XIX. There are two sorts of the *Helmontian Laudanum*; the One used by the Elder *Helmont*, the other by his Son. The former was a great Secret communicated to me by an Expert Chymist about 15 Years ago: Which because I have not Leave to Publish, meeting about 2 Years ago with that obliging and very ingenious Person *F. M. Baron Van Helmont*, Son to the Famous *Johannes Baptista*, I obtained from him, by word of Mouth, some Directions about the *Laudanum* he uses; which though he Confessed, and I soon perceived, to be differing from his Father's, yet he seem'd to think it not inferior and more Parable.

I soon after committed it to Writing lest it should Slip out of my Memory, and I had his Permission to communicate it for the Publick Good.

Take of *Opium* a quarter of a Pound, and of the Juice of *Quinces* 4 Pound at the least; the *Opium* being cut into very Thin Slices, and then as 'twere

Minc'd

Minc'd to reduce it into smaller parts, is to be put into, and well mixed with, the Liquor, (first made Luke-warm) and fermented with a Moderate Heat, for 8 or 10 Days; rather more than less. Then *Filter* it, and having infused in it of *Cinamon*, *Nutmeg* and *Cloves*, of each an *Ounce*, or an *Ounce* and *half*, let them stand 3 or 4 Days more; if it be a full *Week*, it may be so much the better. Then *Filter* the Liquor once more, having let it Boil a *Walme* or two after the Spices have been put in. This being done, evaporate away the superfluous Water to the Consistence of an *Extract*, or to what other Consistence you please.

Lastly incorporate very well with it two *Ounces* of the best *Saffron* reduced to *Fine Powder*, or as much *Extract* as can be Obtain'd from that *Quantity* of *Saffron*.

According to the Consistence you desire to have your Medicine of, you may order it so, as either to make it up into a *Mass* of *Pills* (in which Form I have caused it to be given,) or keep it in a *Liquid* Form; but in this latter Case the Evaporation, must have been made more sparingly, that after the putting in of the *Saffron*, or its *Extract*, it may not grow too *Thick*. In this Form the *Dose* may be from 5 or 6 *Drops* to 10 or fewer, according to *Circumstances*; and of the *Pills* a somewhat less *Quantity* is required.

XX. One *Mustapha Shatoor*, an Inhabitant of *Sediqui*, a Village 6 Miles from *Smyrna*, by Trade a Coffee Man, about 45 Years old, a most Famous *Opium-Eater*, told me, that his constant Eating, was 3 *Drams* a day of *Crude Opium*, one half of which was his *Dose* in the Morning, and the other half in the Afternoon: But that he could safely take Double this *Quantity*.

The Use of Opium among the Turks, by Dr. Ed. Smith. n. 221. p. 288.

Resolving therefore to be an Eye Witness of what he could do, I provided the best *Opium* I could get, and weighed it nicely into *Drams*. He came to me at my Desire, at 9 in the Morning, but excused his having taken *half* a *Dram* before, because he wanted strength to Rise out of his Bed without it. I laid before him my *Opium* made up in *Pills*, each weighing a *Dram*, and desired him to Eat what he pleased. He took *one Dram* and a *half* making it up in 3 *Pills*, and Chewing it with a little Water: He commended the *Opium*, but was not willing to Eat More at that time, and I would not press him for fear of Accidents. He stayed with me about *half* an *Hour* after he had Eaten the *Opium*: The visible Effects it had upon him were to make his Eyes Sparkle, and to give a new Air of Life and Brightness to his Face. He told me that he was extremely Refresh'd by my Entertainment: and I found him *half* an *hour* afterwards Labouring heartily at cleaving Wood to burn. At 3 in the Afternoon he came to me again, and took the same *Quantity* as in the Morning, and appeared after it with the same Symptoms. He says that it has always the same Effects, giving him Vigour and Spirit, and is now become as necessary to him as any other part of his Sustenance; that it makes him Fitter for Procreation, for he has many Wives and Children; that it never Affects him with Sleep and Drowsiness, but rather hinders his Reposing, when

he happens to take to much of it; that he entered upon this Practice 25 Years ago, beginning with the bigness of a Grain; and so training up Nature gradually to Larger Quantities; and that the Want of it, and the Desire of taking more, grows Daily upon him.

The Alteration and Impairment which this Custom hath produced in him are Weakness, his Legs being small; his Gums Eaten away, so that the Teeth stand bare to the Roots; his Complexion very Yellow; and appearing Older by 20 Years, than he really is,

Opium is commonly taken by the *Messengers* in *Turkey*, who are employed in making Quick Dispatches; 'tis generally part of their Provision; they take it when they find themselves Tired, and it gives them Strength and Spirit to Proceed. I had the following Relation of one of them, that coming from *Constantinople* to Mr. *Sam. Bernardiston*, a Merchant of *Smyrna*, at entering into the Gentlemans House, he fell down for Dead: at which, when the whole House was Surprised and Concerned, one of the Servants rightly Judging that this Fainting away was occasioned, by the Stock of *Opium* laid in for his Journey being Spent, forced a little of it into his Mouth, and by this means he presently Recovered, and acknowledged the Servant had been his Physician.

The *Turks* use *Opium* made up with something that renders it Palatable, at their Feast call'd *Biram*, to make them Cheerful; which may be one Reason of its prevailing so much: For finding it then entertains them with Pleasing Fancies, they are Tempted to continue it, and so the Use of it becomes Necessary and Grows upon them.

Mackenboy; by
the Bp. of
Cloyne. n. 243.
p. 294.

XXI. The Famous *Irish* Herb call'd *Mackenboy*, or *Tithimalus Hibernicus*, is reported by the Natives to be so strong a *Purge*, that even the carrying it about one in their Cloaths is Sufficient to produce the Effect. But Dr. *Mullen* has lately proved this Story to be False, by carrying its *Roots* for 3 Days in his Pocket, without any Alteration of that sort.

The Snake-
Root; by Mr.
J. Banister.
n. 247. p. 467.

XXII. The *Pistlochia*, or *Serpentaria Virginiana* hath a Bushy Root, consisting of a Number of small Strings of a Yellowish Colour, and Hot Aromatick Scent and Taste: Thence grow One or Two Smooth, at least very little Hairy, *Stalks*; Round, and most commonly Upright, not Square nor Trayling. The *Leaves* grow Alternately on this Side and that, one at a Joint or Knee: They are Thin Long and Pointed, coming like a Heart at the *Foot-Stalk*; a little Hairy above, and Rough, with many Protuberant Veins underneath; and in handling, they stick a little to the Fingers. Near the Ground grow one or Two Hollow Flowers, each upon its proper *Foot-Stalk*, different in Form from the *Pistlochia Cretica*, or any other yet known: All whose Flowers resemble a *Cow's Horn*, the Top growing to the Rudiment of the *Seed Vessel*, and the Open end cut Slaunting like a *Drenching-Horn*, whereas this of ours Terminates with a *Heel*, which supports a Broad, Round, Galerniculated *Lip*, the Center of which Opens into the Hollow of the *Flower*.

The

The *Lip* is of a light Ruffet or Dirt Colour. The *Seed Vessel* is Hexagonal, shap'd like a Pear, when full grown near half an Inch in Diameter. It is not an *Ever green*, but after the *Seeds* are Ripe, the *Leaves* and *Stalks* begin to Wither and Decay. It *Flowers* in *May*, and its *Seeds* are Ripe in *August*.

XXII. *Succisa*, or *Devil's-bit*, is excellent for *Poysons*, especially the *Plague*; and it is so Powerful a *Sudorific*, laying the sick Person, whether of the *Plague* or other *Malignant Fever*, on a Bed of that Herb, moderately Hot, he shall *Sweat* till they take him off; and much more if he drink of the Decoction, or Juice of the Herb; which in Summer they take All, and in Winter of the *Root* only.

Devils-bit; by Sir Theod. Mayerne. n. 211. p. 166.

XXIV. *Alcanna* is the *Leaf* of a Plant. Dried and Powdered; which, when steeped a Night in Wine, will die the *Nails Red*.

Alcanna; by --- n. 243. p. 295.

XXV. An. 1656. An *Aloe Americana Serrati Folia*, being of a *Pale Green* Colour, and consisting of 11 *Leaves*, was bound about with a Red dry Cloth, and was hung up without *Oil*, as is usual, in the *Kitchin*: It Weighed,

Aloe Americana; by Dr. Merret. n. 25. p. 455.

	Weight.			Loss.			Weight.			Loss.				
	℥.	ʒ.	ʒ. gr.	℥.	gr.		℥.	ʒ.	ʒ. gr.	℥.	gr.			
Aug. 4.	21	6	0. 2	May 1.		May.	1.	20	7	0	0	1	0	
Aug. 19.	21	3	0. 24	3	27	May.	28.	20	5½	0	0	1½	0	
Sept. 6.	21	1½	0	1	14	June.	12.	20	4	0	4	2	26	
Feb. 20.	21	1	0	12	0	Jul.	1.	20	1	0	8	2	18	
Mar. 16.	21	0	2	0	0	32	Jul.	20	19	6	0	1	3	7
Apr. 8.	21	0	0	0	0	40	August.	4	19	3	0	12	2	49

So that in a Whole Year it *Lost* 2 Ounces, 3 Drams, 24 Grains. The succeeding Year, being Drier and Hotter, it *Lost* 3 Ounces 2½ Scruples; and more than double in the 6 Colder, than the 6 Hotter, Months. I kept it about 5 Years, and it *Decreased* much about the same Proportion. And in the Year 1660, Hanging it in a Colder Garret, it Perished.

These Observations I had about it, that every Year two of the Greater Leaves first Chang'd Colour, and withered; and in the Spring time, there grew out two very Fresh and Green ones, never amounting to the bigness of any of the precedent. Insomuch, that all this Time I had the same Number of *Leaves*. And then these New Leaves were more Fresh and Green, and not *serated*, and Thicker also in Proportion to their other Dimensions. Whence perhaps it may probably be inferr'd, *viz.* from the Growth of these *Latter Leaves*, that there is a *Circulation* in this Plant of the *Succus nutritius*: For how is it possible, that the *Roots*, continuing as firm and solid as at first, should supply so much Nourishment, as to Procreate *New Leaves*, unless it were

were from the Return of the said *Succus*, from the *Old* and *Decaying Leaves* into the *Root*, and there protruded for the Production of *New Ones*? For all *Bulbous Roots*, as *Garlick*, *Onions*, *Tulips*, and especially *Squills*, who Protrude their *Leaves*, placed in a Shop or House, have their *Roots* Lighter, and more Spungy; the *Leaves* being formed out of the Substance of the *Root*, as a Chick out of the *Albumen*: In the mean while the whole *Decreasing* in Weight, as in the aforesaid *Aloe*.

The Tartarian
Lamb. by Dr.
Hans Sloan.
n. 247. p. 461.

Fig. 160.

XXVI. Fig. 160, represents what is commonly, but Falsly, in *India*, called, The *Tartarian Lamb*, sent down from thence by Mr. *Buckly*. This was more than a *Foot* long, as Big as ones *Wrist*, having several *Protuberances*, and towards the End some *Foot Stalks*, about 3 or 4. *Inches* long, exactly like the *Foot-Stalks* of *Ferns*, both without and within. Most part of the Outside of this was cover'd with a *Down* of a Dark yellowish Snuff-Colour, shining like *Silk*, some of it a *quarter* of an *Inch* long. This *Down* is what is commonly us'd for *Spitting Blood*, about 6 *Grains* of it going to a *Dose*, and 3 *Doses* pretended to Cure such an *Hæmorrhage*. In *Jamaica* are many *Scandent* and *Tree-Ferns*, which grow on, or to the bigness of *Trees*, and have such a kind of *Lanugo* on them, and some of our *Capillaries* have something like it. It seem'd to be shap'd by Art to Imitate a *Lamb*, the *Roots* or *Climbing* Part being made to resemble the *Body*, and the Extant *Foot-Stalks* the *Legs*. This *Down* is taken notice of by Dr. *Merret*, at the latter end of Dr. *Grew's Mus. Soc. Reg.* by the Name of *Poco Sempie*, a *Golden Moss*, and is there said to be a *Cordial*. I have been Assur'd by Mr. *Brown*, who has made very Good Observations in the *East-Indies*, that he has been told there by those who have Lived in *China*, that this *Down* or *Hair*, is used by them for the *Stopping* of *Blood* in *Fresh Wounds*, as *Cobwebs* are with us: And that they have it in so great Esteem that few Houses are without it. I have known it much us'd for *Spitting* of *Blood*. But on *Tryals* I have seen of it, though I may believe it *Innocent*, yet I am sure 'tis not *Infallible*.

p. 386.

A sort of Seeds
which Clarify
Water; by Dr.
Hans Sloan.
n. 249. p. 44.
Fig. 161.
n. 43. p. 863.

XXVII. I have several times seen a sort of *Seeds* come from the Coast of *Cormandel* and *Malabar*, which are there used for *Clarifying* Water. They are about the Bigness of a small *Pea*, only broader and flatter, having *Striæ* run from their Center after the manner of the common *Nux Vomica*. The best Account I have had of the way of Using them, was from Dr. *Brown*, who lived in the *East Indies* some Time; he says they rub or grate them on the bottom of a small *Earthen Basin*, wherein is contained some *Water*: This *Water* and *Powder* is put into a large Quantity of *Muddy* or *Foul Water*, which is by this *Clarified*.

The True Amo-
mum, or Tugus
of the Phillip-
pine Isles; by
P. Geo. Camel-
li. n. 248. p. 2.

XXVIII. Racemoso *Tugus*, seu *Birao*, aliis *Caropi*, vise *Florum fasciculo*, degustato ejusdem *Uvæ Acinis*, seu oblongo *semine*; & facta collatione cum *Botanicorum Amomi Descriptionibus*; *Tugus Legitimum Dioscoridis esse Amomum* decrevi.

Est autem *Tugus* Planta quandoque ultra *Cubitos* assurgens. Folio simi; Plantæ *Tagbac*, seu *Bagongbonque*, excipe quod parte Prona suavi obtusum sit Lanugine; Venosius præterea, Longius & Suaveolens. Ad Plantæ Radicem seu *Caulis* Truncum, ex Folliacei *Caulis* Meditullio Racemiformis, & Pistillo seu *Amomonti* Florum fasciculo non adeo similis, prorumpit Florifera & Granigera Foliolorum sesquipalmaris Congeries, Flosculis exornata Rubicundis, quibus Uvæ in longiusculum protensæ Collum seu Floris Tubuli Reliquias subsequuntur; Dulci & paucò Cortice, unde à Muribus & Avibus unacum semine plerunque depastæ, pauca admodum & exigua colligi potest Quantitate. Quare & olim Rarum fuisse, nec passim nasci *Virgilius* insinuare videtur, dum spondet quod *Affirium* vulgo nascetur *Amomum*.

Hæ Uvæ Quina communiter, aut sena continent Subruffa, Oblonga, Inæqualia, Aromatica, *Amuyong* minus Acria, & *Cubebis* Officinarum Suaveolentiora Grana, seu Acinos; ex quibus trajecto Filo, nunc per se nunc Sociatis *Margaritis*, ac *Corallio*, nonnullæ Puellæ *Judicæ Caropi*, seu *Monilia* ac *Armillas*, concinnare solent. Aliæ ex his, & semine *B. musci*, iis *Mari-com*; Arundinis *Lithospermis*, iis *Tigbi*; *Cannæ* Floridæ, iis *Ticasticas*; *Pisti Coccinei*, iis *Saga*; *Amomonti* præterea, *Badiang*; & *Calanos* Seminibus; similia necere assueverunt. Ob gratum vero quem spirant Odorem Grana *Tugus* Collo appensa gerunt, ab Infecto etiam preservare Aere, & ictui medere *Scolopendriæ*, masticata si super imponantur, Experientia docuit, Radix similis est Radici *Tagbac* seu Calami Odorati Insipida, Alba Interne de foris Rubicundis & subodoratis Cæpaceis contacta obvolucris. Ex *Borongam* scripto accepi, in *Caulium* apicibus alium & hunc Inodorum ferre Fructum, quem nec dum vidi. Idem *Indi Indanenses* mihi affirmarunt: Sed eos hallucinari censeo, & Plantam *Tachac* (*Tagbac*) pro *Tugus* vidisse puto.

Provenit in *Borongam* & *Paranas* Caput ex aliis Insularum *Samar*, & *Leyte* locis. Nec dubito in *Luzone* quoque reperiri, maxime *Silani* in *Torrentium* profunditatibus.

Nota. Florum *Tugus* recentia & Tenella Germina; aliquantum *Pseudo Amomum* *Garcia*, *Pedem Columbinum* referens, exprimunt. Ne autem quidquam desideretur, mitto una cum his scriptis Plantæ *Delineationem*; & similiorem *Castaneam* esse Ovo non deerit qui objiciat, quam Folia *Tugus* Foliis *Mali Punici*, quod lubens concesserim. Sed quicquid *Dioscorides* & *Plinius* de *Amomo* tradidere solummodo de Florifero & semino turgente *Tugus* Racemo intelligenda esse censeo; utpote quibus Integra & ipsa Planta non innotuit. Hunc enim *Tugus Thyrsus* deprehendet. *B. L.* exigue fruticare. *Palmi* viz. pluve minusve Altitudine: Ex ligno subruffo, seu lignosa Materia, Flosculis & Folliculis *Mali Punici* similibus, sese in Racemi modum convolvere, sive ut *Barth. Merula* vertit esse Fructum similem Botruo inveniet semine Uvis parvis simili, si seminis carnosum spectet Tegumentum plenum valde Odorato & Aere Gustu, vim habente Calefaciendi, Adstringendi, & Exsiccandi, & cætera *Legitimi Amomi* signa, ut *Pedis Columbini* Effigiem si diligenter investigaverit. *Amomum* in *Turcomania*, *Armenia* Provincia, provenire scribit *Job. Botero Benes*.

The Ahmella
from Ceylon;
by Dr. Hotton.
n. 257. p. 365.

XXIX. Nuperis Annis magnam celebritatem nacta est, ob vim *Lithontrip-
ticam* quæ ipsi ascribitur, Herba quædam à *Ceylonensibus Ahmella* dicta. At
jam uspiam existet nescio; sed eam colui, cum versarer in Præfectura *Horti Am-
stelod.* Flores fundit in summis Caulibus persimiles *Chrysanthemum Curassau* elato
caule flo. Aurantiis Par. Bat. Semen ei Bidens, Caules Quadrati, Fol. *Lamie*
vel *Urticæ* (quæ subacria sunt) conjugatis amicti; unde manifestè liquet ad
Cannabinæ Genus, quod Bidens vocat *Cæsalpinus*, eumque sequutus *Tournefor-
tius*, spectare; neque forte inconcinne nuncupari posse *Cannabinam* aut *Biden-
tem Urticæ foliam Judicam Lithontripticam.*

Nux Pepita, or
Faba Sancti Ig-
natii; by Dr.
Sloan. n. 249.

XXX. I. *Nux Pepita*, seu *Faba S. Ignatii*, is about the bigness of a *Nut-
meg*, and Triangular. This Fruit is very much esteem'd in the *Philippine I-
slands* for the Cure of many Distempers.

P. 44.
Fig. 163.

By ----- n. 250.
P. 87.

2. I. Habet hic Fructus Virtutes illius Metallum quod *Tumbaga* dicimus,
& Compositi illius quod *Ilingo* dicitur; proficit enim contra *Spasmos* ac
Ventos Infectos, & contra quoddam Genus *Spasmi* quod nos dicimus
Sotan.

2. Proficit ut evomatur quodcumque *Venenum*, si Rasuræ ejus bibantur cum
Aqua Frigida, item contra Morsus Venenatorum, si simul applicentur Morsui
aliquæ Rasuræ ejus.

3. Item si aliquod Membrum laboret *Spasmo* proficit, si super partem in-
fectam applicentur supradictæ Rasuræ.

4. Deinde ante dictæ Rasuræ stagnant *Fluxum Sanguinis*, applicatæ cui-
cunque Vulneri. Et cum Anno præterito, 1692. daretur bibi Fæminæ La-
boranti *Profluvia Sanguinis* Diuturno, evasit incolumis.

5. Fugat *Febres*, nam me præsentem, eodem Anno datum fuit cuidam
Infantulæ laboranti Intensissimâ *Febre* ut biberet, & illico aufugit *Febris*.

6. Juvat *Parietes* Fæminas, ad hoc ut facilius, & felicius Creaturam ex-
pellant.

7. Venio tandem ad quotidianam Experientiam: mire proficit pro quacun-
que Repletionem & Cruditate *Stomachi*; & contra proficit pro *Dysenteria* & fre-
quenti Dejiciendi cupiditate temperanda.

Dividat quisque Granum in tres partes, & cum senserit necessitatem, immittat
in Os per quadrantem Horæ, vel per dimidium, & deglutiat *Salivas* quæ
distillaverint, ac postea bibat quasi 2 aut 3 *Uncias* Aquæ frigidæ & videbit
Effectum.

Aliter; Quærat Fragmentum durissimum Testaceum, ac in parte con-
cava ponatur parum Aquæ frigidæ, & ibi refricetur Fructus, & aqua illa po-
natur in Vâscula cum Rasuris; & iterum ter aut quater fiat similiter, usque-
dum habeas duas *uncias* illius Confectionis & Lotionis Fragmenti Testacei ac
Grani Fruticis; ac postea revolvatur & bibat Patiens.

Item; Divisum Granum in frusta si frigatur cum Oleo, (præcipue *Oli-
varum*) & Oleum illud Bibatur, aut plâgis applicetur, aut Membra *Spasmo*
laborantia cum eo unguantur, est Medicinale ut supra.

3 *Catolongay*, quam alii *Cantara* vocant, est *Nuces Vomicae* legitimas *Serapionis* ferens Planta, quæ Arbores quasvis Altissimas sese involvendo scandit. Truncus Lignosus, Levis, Porosus, & Brachialis quandoque Crassitudinis, Corticisque scabri, Crassi, & Cinerei: Folia Ampla, Nervosa, Amara, Folio ferme similia: Florem *Balaustiae* similem Fructus insequitur *Melone* major, qui delicatissima cuticula, quæ splendens, Lævis, & Viroris Luridi, seu *Alabastrini*, coopertus, subterquam aliis Cortex delitescit Substantiæ quasi lapidescentis. In hoc, Carne amaricante, flava, & Molli, qualis est Caro Fructus *Mangæ*, interjecta, nostræ seu Legitimæ *Serapionis Nuce Vomicae*, quæ recentes ab Argentea Lanugine splendent, juglandis vix non pares, inæquales, variæque formæ, non raro 24 coarctantur: quas *Indus Igasur*, & *Mananaog*, id est *Victoriosas*; *Hispanus Nucleos*, seu *Pepitas de Bysayas*, aut *Catbalogan*; alii *Fabas S. Ignatii* vocant. Hæ resiccatae *Avellana* Nuce cum putamine pares, aut etiam paulo majores: Nodosæ, Durissimæ, Diaphanæ, & quasi Corneæ Substantiæ sunt; Saporis Semine *Citri* multo intensius Amari; Coloris autem inter Album & Glaucum, prout & *Serapio* tradidit.

Multi, nescio quo Oraculo edocti, Nucem *Igasur* reticulæ Fructus *Salagsalag* immittunt, ex Collo suspensum gerunt, & ita ab omni *Veneno*, *Peste*, *Contagio*, *Incantationibus Magicis*, *Philtris*, & specialiter à *Sopto*, seu *Veneno* quod solummodo in sufflatum perimere narrant, imo & ab ipso *Dæmone* se liberos ac immunes esse imaginantur.

Quod *Ch. Miralles* in suis *Collectaneis* affirmat, scribens non tantum Virtutem habere depellendi Corporis Morbos, sed & *Malignis Spiritibus* speciali quadam Oppositione resistendi; *Magos* etenim, *Barangas* dictos, ad præsentiam hujus Nucis inquietari, conturbari, & Sudore suffundi, ac si in nescio quo Arduo Negotio, angustiis periculisque pleno, versarentur: Quod *Experientia* didicisse, insuper & id ipsum sibi alios fide dignos visos affirmasse, addit. Unde Pactum cum *Dæmone* habere dictos *Barangas*, seu *Maleficos Herbarios*, suspicatur: præsertim cum Rumor ferat, hosce Impios Medicos, si in *Simplicium* cognitione erudiri velint, *Consanguineorum* proximum interimere obligari.

Alii à jam dicto *Sopto*, seu *Toxici Insufflamine* quo *Malevoli Indi* passim quos male cupiunt perimunt, *Alexium Lopez* in *Guiguan*, & *Petrum Oriol*, præter alios hacce Nuce præmunitos, servatos fuisse ferunt. Sumunt autem, uti *Vulgus* narrat, supradicti Herbarii eis familiaria & nota *Aconita*, quæ faucium latere uno recondunt, *Bucca* altera vero *Contrayerbas*, prouti hujates loquuntur, id est *Antidota*, ne videlicet sibimet ipsis Mortem mastitent. His ita Ore detentis Arte, & Dexteritate Diabolica, sibi contrarios, & infensos *Viperarum* more intoxicato Halitu impetunt, quo perculsi ac perplexi mox humi prosternuntur, & Animam agerent, nisi eis jam experto Remedio hacce *Scil. Nuce* Opem ferant. Addunt, si quis hanc Nucem secum portarit, ipsum qui similibus Deleteriiis buccellis alterum interficere attentaverat pænas confestim luere *Talionis*, uti *Indus*, qui *Alexium Lopez* inter fictas amicitias de medio tollere cupiens, casualiter hanc Nucem secum habentem, expertus fuit; qua Occasione primum *Hispanis* innotuit *Igasur* Virtus, & Efficacia. Quomodo au-

tem Naturaliter, ut nonnulli volunt, *Igasur* Virtutem Toxici in distans agendo repellat, judicent alii.

Pulveris *Igasur* ℞. quondam *Vincentio Olzinae*, temperamenti Melancholici prædito, ad Vomitum ciendum propinavi. Hic *Dyspepsia*, *Diarrhæa*, & frequenti Vomitu, cum Ructibus Acidis, nec non Flatuum copia molestabatur: Sed statim ac sumpsisset, Tremore totius Corporis trium Horarum spatio persistente, una cum Pruritu, & Vellicationibus *Convulsivis* horrendis, ut Pedibus insistere nequiverit, quæ in *Maxillis* vehementiores erant, ac magis molestæ, ita ut quodammodo ridere cogeretur, correptus fuit; Nulla interim notabili Pulsus alteratione, Vomitu, aut alio quopiam insequente Symptomate. De reliquo dein non nihilum melius sensit.

Similem Tremorem, & *Convulsiones Spasmodicas*, quas *V. Olzina* expertus fuit sensit & passus est *Johannes Osaëta*, una cum summa Præcordiorum angustia, Vertigine, Animi Deliquio, & Sudoribus Frigidissimis. Hic *Melancholico-Hypochondriachus* Sanitatis cupidus, *Nucem* recentem integram devoraverat. Cui *Oximel* & *Oleum* cum tepida exhibendo, quo plurimum *Viscosi Phlegmatis* cum *Nucis Particulis* rejecit, opem tuli.

Joachinus Assin *Nucis* sumpsit partem Tertiam, & simili modo ut *V. Olzina* & *Johannes Osaëta*, ultra tres horas affectus fuit. Hic præter Motus Contractivos & Involuntarios, formicationis sensum, & specialiter in Capite expertus fuit Similes denique pænas, *A. Varaona*, *A. Giran*, & alii luere.

Vulgus autem *Nucem Igasur*, ad cuncta absolute Corporis Humani Mala amovenda, nulla habita Temporis, Morbi, Ætatis, aut Dosis ratione indifferenter exhibet, & adhibet: Miraculosque sublequutos affectus narrat, videlicet magnificiando suam *Panacæam*, & deprædicat Successus bonos, reticens infaustos. Nec dubium, quin aliquando à tam vehementi Spirituum Animalium Irritatione, ac alteratione Humorum, ab hac Nuce causata, Heterogenea ac Incongrua, una cum tam infesti Medicamenti Particulis elimentur: quibus rejectis, humoribusque Crassi meliori restitutis, Sanitas optata subsequatur.

Modus Ordinarius, & communis utendi Nuce *Igasur* est, imponendo eam integram aquæ Calidæ tantillo spatio donec amara reddatur, exhibendo dein distillatam Infusionem. Alii Pulveris modicum in substantia propinant. Alii unam alteramve offerunt deglutiendam frustulam. Alii *Nucem* integram, *Amuleti* ritu de Collo suspensam gerunt.

Vomitum pluries causare solet, *Dejectiones* nonnunquam, Motus *Spasmodico Convulsivos* ferme semper in *Hispanis*; *Indis* non. In Veneni periculo, & Spirituum inordinate tumultuantium conflictu, posthabita temporis ratione, usurpanda erit: In aliis accidentibus aut Morbis, Jejuno *Ventriculo* in Aurora; attamen *Vomitum* ciendi gratia convenientius una alterave post assumptum cibum Rora, *Dosi* ℞s. cum aliis levioribus *Vomitum* cientibus exhibebitur.

Qui *Nucem* Integram secum portarint, affirmant multi (fides sit penes *Autores*) præservare à *Peste*, *Incantationibus Magicis*, *Philtris*, *Sopto*, seu *Herbarum*

barum Venenatarum affiatu, *Aeris* præterea nescio quo ut volunt *Contagio*, *Hispanis*, *Malaire*, & *Pasmo*, id est Stupore, *Indis Sautan* (à quo similiter præservare ferunt *Corallium nigrum*, Ungulam *Rhinocerotis*, *Dumbagam*, *Ingo*, & *Testudinis Scutum*); *Catalepseos* attamen Species potius esse videtur, eo enim correpti Terrore veluti Panico perculsi corruunt, Sensibus & Voce privati obstupescunt, mortuisve sæpius similes obrigescunt; Revulsoria vero, & crudeli Musculorum in Tibiis, ac Brachiis Flagellatione, qua Sanguis inibi agestus dein *Scarificationibus* elicitur, revocantur & curantur.

Nucis frustulum, aut fragmentum (aut Rasuræ modicum) *Viperæ Basul* (est *Erucæ Pilosæ* atque *Nociferæ*, ad tactum vehementem pruriginem causantis, Species,) aut aliorum *Venenatorum* Animalium morsui; *Vulneri* Sagitta vel alio *Intoxicato* Telo factò, ad impositum, venenum *Lapidis Colubrini* instar ad hærendo extrahere communicavit *F. de la Zarza*. Alii in *Hæmorrhagia* *Narium*, & ad *Sanguinem* è *Vulneribus* profluentem sistendum, *Pulverem* recommendant.

In *Malviento*, *Malaire*, *Soutan*, & *Pasmo*, (*Catalepseos* Species est) *Stupore* *Apoplexia*, *Paralysi*, sive *Syderatione*, *Lethargo*, *Epilepsia*, *Morbo Caduco*, *Astmate*, & *Catarrho* *Maligno* ac suffocante, *Dentium* *Dolore*, & aliis *Defluxionibus*, frustellum supponitur *Lingux*, *Apophlegmatizandi* gratia: ita enim *Caput* à copia *Viscosi Phlegmatis* liberatum, *Ægripluries* levamen percipiunt, & sæpius jamjam *Agonizantes*, ut ita dicam resuscitentur, & aut *Confiteri*, aut alia quæ pro tunc conveniunt declarare, valent.

Pulverem, aut *infusum*, aut *Oleum* infra descriptum, propinant & dilaudant in *Febri Tertiaria* & *Quartana*. *Veneri* periculo, aut supradicto *Sopto*, *Buyasso*, (est *Buyo*, seu *Betele*, confectio mortifera, cum *Semine* ut opinor, *Stramonii*, aut simili *Narcotico*, quæ si assumptæ non perimit, *Hominem* perplexum, *Attonitum*, *Hebetem*, *Stupidum*, & *Torpidissimum* reddit; ab hujuscemodi dico *Confectione* devorata, aut *Masticata*, infra posito *Oleo* curata fuisse scio, & *Botete Sardinæ* *Nocivæ* comestæ *Suspicionem*.

Ad *Urinas* item, *Menses* & *Puerperia* suppressa provocanda, *Partum* *Difficilem* facilitandum, *Secundinam*, *Fætum Mortuum* & *Lumbricos* expellendos, efficacem reperi. In *Dolore Colico* præterea, *Cibi Indigestione*, *Cruditate Ventriculi* & *Concoctione Læsa*, *Diarrhæa*, *Tenesmo*, & *Obstructione Epatis*, ac *Lienis*, uti & in omnibus supra enumeratis *Morbis*, exhibent.

Oleum vero ex *Igasur* simpliciter infusione paratum *Emeticum* est efficacissimum; valet ad eadem ad quæ *Nux ipsa*; hoc ad *Magi Barang* præsentiam Effervesce, & *Vase* quo asservatur exilire, vir retulit fide Dignissimus. Idem & alii in suis *Scriptis* affirmant.

Hoc *Oleum* alii efficacius reddere cupientes componunt, ex *Igasur*, *Tambal de Garigara*, *Tambal de Sangil*, *Tambal de Bornei*, *Salagsalag*, *Camuesa*, *Manungal*, *Alegao*, *Salibutbut*, *Tambalisay*, *Marbar Molarvin*, *Borogtongon*, *Palyaccan Panambuc*, *Pancoro*, *Nolalasson*, *Bagatapon*, *Oringun*, & aliis; vulgo *Fazeite de Tambal*, à *Cortice Scil. Emetico Mananangtang*, appellatur, violentè *Purgat*, per *Superiora*, & *Inferiora*; *Dosis* ʒj. ʒij.

Lignum Sanctum Luzonis Quajaco utiliter substituitur; de reliquo *Concoctionem* adjuvat, & *Dejectam* *Ciborum* excitat appetentiam. *N. B. Pregnantibus* exhiberi non potest, quin *Abortum* patiantur.

Lignum Colubrinum Manungal, Decoctum ejus, venenis omnibus, venenatorumque Animalium moribus, succurrit; *Febrifugum* est, & *Anti-Astmaticum*, Obstructiones inveteratas referans, & Abjectam Ciborum restaurans appetentiam; *Ictero* præterea, octo dierum spatio in aurora haustum medetur, *Lumbricos* pellit, & *Colicos* Doloris mitigat. Decoctum ex ʒij. paratum, Dejectiones ferme quinas causare solet.

Cortex Vomitorius Mananangtang, datur in pulvere à ʒj. ad ʒiv. Pituitosa & Lenta, nec non Biliosa, per *Vomitum* & *Secessum* potenter evacuat: Unde in *Febribus*, *ventriculi* repletionem aut ex humoris Viscosi turgescencia, *Cachexia*, & *Hydrope*, feliciter exhibetur. In omni *Veneni* periculo c. decocto *Manungal*, & ad *Ventris Lumbricos* educendos, plurimum facit.

By Dr. Hotton.
n. 257. P. 365.

4. Novissime increbuit *Usus Fabæ*, quam vocant, *di S. Ignatio*; dicitur & *Higosur*, & *Faba di S. Nicholas*, & de *Carva Longa*. Semen est Amarissimum, quod nullam *Fabæ* præ se fert Similitudinem, ut ex ipso Semine videbis. Ad movendos Sudores & debellandos *Febres* præcipuum creditur: & *Diarrhææ*, *Dysentericæ*, *Colicis* Doloribus, Motibus *Convulsivis*, ipsique *Epilepsiæ* mederi; & externe admotum, *Scabiei*: celebratur cum primis & ejus *Virtus Alexipharmaca*. Provenit in *Philippinis*, quas vocant, iisque vicinis, *Insulis*. Cujus Generis Stirps sit ignoratur; id tantum didici ex *D. Rafaele de Roa*, *Hispano* viro Egregio & Erudito, qui in iis *Insulis* diu vixit, convolvulaceam esse plantam *Arbores altissimas scandentem*, fructumque ferre *Mali Punici* magnitudine, quo complura *Semina* reconduntur, ex quibus *Deciduis* novæ plantæ subnascantur.

Cherry's Recovered though almost Withered; by Dr. Chr. Merrett. n. 25. P. 455.

XXXI. I had three *May Cherry-Trees* (Planted in a Rich Mould) which lay to a South Wall, shaded from the Sun by a High Building, till the beginning of *March*; when being High, and shining somewhat Fiercely upon them, the Fruit constantly *Wither'd*. But this Year (1665) the Season being very Hot and Dry, I bared the Roots of one of them, by making a Hole about it, and watered it every Morning and Evening with about a Gallon of Water, for about a Fortnight before the *Cherries* came to Redness, and the Fruit was *Full and Good*. The other two Trees, left without this Ordering, had most of their Fruit *Withered*; having only Skins and Stones. Then I made a Hole round about one of the other Trees, and fed it with Water Daily, as the Former: In a Week's time, those that were quite *Withered*, fell off, and the rest that were not so, grew and increased exceedingly; the other Tree, that was not used after this Manner, had not any of its Fruit come to *Perfection*.

The Sorbus Pyriformis; by Mr. Edm. Pitt. n. 139. p. 978.

XXXII. I have lately found the *Sorbus Pyriformis* of *L' Obélius* or *Sorbis Procera* of *Baubinus*, growing wild in a Forest of *Worcester shire*. It resembles the *Ornus* or *Quicken Tree*; only the *Ornus* bears the Flower and Fruit at the End, this on the sides of the Branch. Next the Sun, the Fruit hath a Dark Red Blush;

Blush; and is about the bigness of a small *Juneting Pear*. In *Sept.* it is so Rough as to be ready to Strangle one: But being then gathered, and kept till *October*, they Eat as well as any *Medlar*.

2. Perhaps a *Verjuice* made of this Fruit, either ground with *Crabs*, or *Grapes*, or if plentiful, Alone, would, being kept for some time, prove one of the best *Acid-Astringent Sauces*, that Nature affords.

XXXIII. The last Autumn I met with a *Double-Pear*. One part growing over, and being fixt in the other; not unlike an *Acorn* in its *Cup*. From the Edges of the *Lower-Pear* there grew up 5 *Leaves* of various Magnitude, at distances almost equal from each other. The largest of them was one *inch* long, *half* an *inch* broad; as large again as the smallest *Leaf*. These *Leaves* grew out of the *Skin* of the *Lower Pear*, and had no *Fibres* rising from the Carnous part of it. One of the *Leaves* (the Largest of them) had a *Fibre* of the bigness of a small *Hair*, continued from the place where the *Leaf* rises down, just within the *Skin* and loose from it, to the *Pendunculus*. The *Outer Coat* of the *Pendunculus* was continued to the *Skin* of the *Lower Pear*, and this *Skin* to that of the *Upper Pear*. The *Inner Fibres* of the *Pendunculus* go through the *Lower* up into the *Upper Pear*, and disperse themselves in it. The *Upper Part* was twice as big as the *Lower*, and had several *Kernels* in it, but the *Lower* none at all.

A *Double-Pear*,
by ----- n. 260.
p. 470.

XXXIV. I have Planted here (in *Virginia*) 10000 *Mulberry-Trees*; and hope within 2 or 3 *Years*, to reap good *Silk* off them. I have Planted them in a way Unusual here, which advances them 2 or 3 *Years* Growth, in respect of their being Sown in *Seed*. I intend likewise to Plant them all, as if they were *Currants* or *Goose-berries*, so thick as *Hedges*. By this way of Planting them in *Hedges* they will be always Young Tender Plants; and consequently will be easily cut in great Quantities with a pair of *Garden-Sizzers*: Whereby one Man may gather as many of them, as otherwise, when they are Planted in *Trees* at Distance, 4 Persons can do. But perhaps it may be a better way to Sow some Acres with *Mulberry Seed*, and to Cut it with a *Sith*; and ever to keep it *Under*.

An unusual way
of Propagating
Mulberry-
Trees, in *Vir-*
ginia, for the
Silk-Work; by
----- n. 12.
p. 221.

XXXV. The Vulgar Husbandman (without the Expences, Curiosity, Care, or Trouble of *Grafting*) may Propagate the *Genet Moyles* by the *Knorred* Branches alone, in Ground that deserves not to be called *Fertile*; as they do in the *Rye-Land*, and *Gorsty* Ground in *Wales*; and the *Cider* made of the Fruit (which when perfectly Ripe hath a peculiar Fragrancy,) is Delicately Agreeable to Tender Palates, till the Heat of *July* does too often alter the *Cafe*.

Choice of Fruit
Trees, for Speedy
Propagation and
Pleasant Li-
quor; by Dr. J.
Beal. n. 71.
p. 2146.

There is a *Summer-Apple* Call'd *French Cornel*, early Ripe, and very richly full of a most Pleasing Liquor, which I dare Extol for a most Delicious Beverage before the Ordinary time for *Cider* comes in. 'Tis a small Tree all the Branches Crisped, and Curled full of *Knots* at every turning, and Apt to Grow by any Branch that is cutt off below the *Knot*. It prospers best in a Good Mould,
better

better than that of the Common Fields: yet in the Dry *Rye-land* it bears Plentifully every Second Year, and when one of these Trees fails, the next of the same Kind may have a full Burthen.

Some Soil which doth hardly bear *Apples*, does most kindly bear *Pears*; and there is a great Variety of *Pears* to humour every Palate. In the Confines between *Worcester* and *Hereford*, from *Powick* to *Bosbury*, the *Bareland-Pear* grows in the Common Arable Field. That, and some other *Pears* of uncertain Names, in *Powick* do yield a very strong and long Lasting Liquor. The *Horse Pears*, as there they call them, the *White* and the *Red* of several kinds, yield abundance of Pleasant Liquor. The *Ailets*, Great and Little, Wild and Gentle, the *Linten-Pear*, *Lullam-Pear*, *Squash-Pear*, have their peculiar Excellencies for Liquor, and some of them for the Largeness of the Tree; yielding constantly some *Hogsheads* of Liquor yearly.

Where the Soil hath not been Tryed and found Kindest for *Apples*, 'tis the surest way to Plant *Pears* alternatively, and where the Liquor of *Pears* is Weak, or less Lasting, this may be helped by a Gentle Mixture of *Crabs*, or of the Harshest *Apples*, to Humour all Palates, and for a Help to the Stomack, the Mixture being made in the time of *Grinding* the Fruit together: And thus, when the better Soil is too shallow for *Apples*, but receives *Pears* kindly at a greater Depth, a Hedge-row of *Crabs*, or Wild Austere *Apples*, Raised on the *Mounds*, and Ripening in the same Season, will by well ordering it, afford such a perfect Remedy, that judicious Palates may be deceived, and take it for the Best *Cider*. Sir *W. S.* recommends the *Hamlin-Apple* of *Devon* for *Cider* equal to the Best, if not Excelling.

An Easy Way of Raising Fruit-Trees; by Mr. Lewis. n. 95. p. 6067.

XXXVI. Take a Piece of the Root of any *Apple-Tree* or *Pear-Tree*, &c. about 6 inches Long, and *Tongue-Graft* a Graft of an *Apple* or *Pear* into the Root. The way of *Tongue-grafting* is, to Cut the Root Sloping about one Inch, and the Graft Sloping in like manner one Inch; Cutting both very Smooth. Then Cleave the Root and the Graft likewise about one Inch, and enter them into one another, that the Sap of the Graft may joyn to the Sap of the Root, as much as you can. Lap the Joynted place about with a little *Hemp* or *Flax-hurds*; set the Root so Grafted into the Ground about 10 or 12 Inches deep, so as the Joynt may be covered at least 4 Inches under the Earth, that it may not be Bared at any time, but kept Moist by the Earth.

The Root you Graft upon, must not be Less than your Graft; it is no Inconvenience if it is Bigger: But it is Best that the Root and the Graft be of the same Bigness.

About 29 Years since I Sowed a Bed of *Apple Kernels* in *March*; The Spring following I pluck'd up 40 of those *Seedlings*, grown to the thickness of a Fair Graft; I Grafted them in this manner of *Tongue Grafting*, and Planted them again. They all grew, and 4 of them bore Fruit to Perfection that Year; so that in a Year and half from an *Apple Kernel* I had Ripe Fruit. Some of these Trees will now Bear 2 *Quarters* of *Apples* upon a Tree; and are Bigger than most

most of those Trees amongst which they Stand, which cost 12 *d.* the Tree when these were *Kernels*.

I conceive that *Plumbs, Cherries, Apricocks, Peaches,* and all sorts of *Fruit Trees* may be thus *Raised*.

XXXVII. 1. I never begin to *Plant* till *Valentine's Day*: and I approve of *Late Planting* before *Early*; The *Cold* in the *Winter* kills more than the *Drought* in *Summer*. We impute it indeed to the *Drought*, because they *Languish* until *Summer*, and then *Die*: But they receive the *Fatal Stroke* by the *Cold* in *Winter*.

The best Season
of Transplanting;
by Mr.
Rich. Reed.
n. 70. p. 2130.

For either we take our *Stocks* out of *Woods*, or out of *Nurseries*; in either *Place* they lye *Warm*: And if you *Transplant* them in *October*, you expose them on a sudden to an *Open Air*, and adventure them, being *Weak*, to a *Long* and perhaps *Cold Winter*, which they cannot bear. Add hereunto, that I can relieve them against the *Drought*, by *Watering* and *Covering* the *Ground*, to keep it *Cool*: But there is no *Fence* against the *Frost*, which many times gets into the *Roots*, and *Kills*, so that they never *Spring*; or if they do, yet *Pulingly*, and *Dye* in the *Spring*; or if they *Survive*, as many do, yet come on very *Slowly* and *pitifully*. For, the *Bark* does *Cleave* to the *Wood* by Reason of the *Cold*, which *Dries* and *Clings* them together, that like an *Hide-bound Horse*, they will not admit the *Sap*, which the *Root* would send *Up*; and other *Suckers* grow out at the *Earth*; and the *Tree* grows *Dry*, and turns *Red*: All which discovers the *Obstruction* in the receiving the *Sap*, which would come from the *Root*; and then we are forced to *Score* and *Loosen* the *Bark*, as we can. Now on the other side, if the *Summer* prove *Moist*, the *Danger* and *Fear* of *Late Setting* is over, and they will *Thrive* and come forward a *main*; if otherwise, I seldom see but they always keep *Green* and *Fresh*, being maintained in *Life* and *Verdure* by the *Sap* they receive in the *Beginning* of the *Spring*, before they be *Transplanted*.

This therefore I do (which I submit to better *Judgments* and *Experience*;) In the *Dead* of *Winter* I *Prune* and *Cut* the *Tree* I intend to *Transplant*, as I would have it be, to the end to *Lose* Nothing of its *Strength* when I *Transplant*. Then I suffer it to abide *Untouched* by the *Spade* till *Valentine's Day*, and then *Remove* it after it hath taken in somewhat of the *Spring*: I am very careful to *Preserve* and *Set* the *Roots* as large as I may; supposing the *Larger Root*, the more of *Strength* and *Sap* it contains, and so will *Advance* the more the *Growth* of the *Tree*; since every thing *Grows* in *Proportion* to the *Root* beneath. But I have heard from some *Planters*, who had *Experience* therein, that *Roots* *Cut Short* do best, as sending forth *New Roots*, which *Draw Sap* and *Nourishment* best. And we see that *Moyles* set on *Slips* that have *No Roots*, come to a *Tree* soonest; And I have oft *Observed*, that a *Moyle*, *Transplanted* after it hath taken *Root*, does not *Live* so certainly, or *Thrive* so well, as a *Slip* newly set.

2. Dr. *Lauremburg*, a Person of much *Experience*, agreeth with Mr. *Reed*, that *Plants* which cannot well Bear the *Hardship* of the *Winter*, should be

By Dr. J. Beal.
n. 71. p. 2148.

Transplanted

Lauremb. de
Hort. Cult. l. i. c.
28.

Transplanted in the Spring; but that such as are Able to bear the Extremity of a Cold Winter, should be Transplanted in Autumn. In this only he Differs, that he saith, *Poma, Pira, Cerasa vulgaria, Coryli, Oxyocanthi, Pruna, &c, facile Frigus ferunt, & Autumno Transplantari Optimo Successu solent*: and then for the Spring he refers *Fuglandes, Persica, Abricoca, aliquot Cerasorum Genus*; and I think, where he wrote and Practised, it is as Cold a Country as England. I shall only Add that 'tis an Old English and Welsh Proverb, concerning Apples, Pears, and the Hawthorn Quick, Oaks, &c. Set them at Allhallontide, and Command them to Prosper; set after Candlemas, and Intreat them to Grow.

Blossoms do not
forthwith disco-
ver a Blast; by
Dr. Beal. n. 23.
p. 424.

XXXVIII. It is to be Noted that the Blossoms of Fruit-Trees do not Forthwith Discover the Blast: for an Old experienced Country-man having once given me Notice of a *Blasty* Noon, (it being then *Saltry* Weather, and somewhat *Gloomy* with the Thickness of Exhalations, almost like a very Thick Mist) and within a Day or Two shewing the proof upon the *Cherry-Blossoms*; then flagging, but not much altering their Colour till two days more were past.

Cider; by Mr.
Rich. Reed.
n. 70. p. 2128.

XXXIX. 1. I do commend for the advancing of Cider in Richness, both for Taste and Colour, a *New Cask*; provided it be made of Timber very well seasoned: otherwise it may spoil it utterly. I have often Tried it, and found that sort of *Cask* to improve the *Cider*.

The best Cider, I ever had, was *Redstrake* Grafted upon a *Gennet Moyle-Stock*, For, as those kinds do best agree, and the Trees so Grafted seldom *Canker* (as do the Old *Redstrake* upon a *Crab-stock*) so the Fruit is far more Ingenuous and Milder; and being Ripe, both Rich and Large, and Good to eat; and the Cider is more Smooth, and abates in Strength and Harshness of that on the *Crab*; and needs less of Mellowing before making; the Stock in Degree altering and Reclaiming the Nature of the Fruit. For, as an *Apple* doth Best Grafted on a *Crab*, which gives Acrimony and Quickness to the Fruit, so a *Crab* (and the *Redstrake* is no other) Grafted on an *Apple*, receiveth thence Gentleness, and Softness, and Largeness, and an excellent Alloy to the Sharpness, and (as Mr. *Evelin* calls it) the *Wickedness* of the Fruit.

An excellent
Drink, from
Apples and
Mulberries; by
Mr. Sam. Cole-
prefs. n. 27.
p. 501.

2. A Composition of the Juices of good *Cider-Apples* and *Mulberries* produceth the best Tasted and most curiously Coloured Liquor, that many ever Saw or Tasted.

Vines; by Mr.
J. Templer.
n. 93. p. 6016.

XL. I have lately seen a pretty and pleasant Culture of *Vines*, at the House of a Gentleman, who makes very good *White Wine* of his own *Grapes*. He lets *Vines* ascend by one single *Stem* to the Eaves of his House, (cutting off all the Luxuriant Branches by the way,) then gives them liberty to Spread upon the *Tiles*, all over one side the *Roof* of his House. Thus he furnishes his Dwelling House, and many out-Houses; by which Means the *Vines* are no Hindrance to his other *Wall Fruit*, and the Rays of the Sun being almost Di-

rect upon the *Vines*, he hath Riper, Sweeter and Greater Plenty of *Grapes*, than when their *Vines* are placed as *Wall Fruit*.

XLII. At *Frontignac*, they let the *Grapes* grow half Dry upon the *Vine*, and as soon as they are Gathered, they Tread and Press them immediately, and Tun up the *Liquor*, without letting it stand and *Work* in the *Fat*, the *Lee* causing its Goodness. Thus is made the true Genuine *Muscadine*, without Mixing any other sort of *Grape* with it. Lately a certain Person thought fit to pass *White-Wine* of another kind upon the *Mark* or *Husks* (which are wont to be Cast away) of the *Muscadine Grapes*: And hath made in this manner an Excellent *Wine*, which hath the Taste of *Muscadine*, and is more Pleasing to some, nor is so Heady, as the *Franc* or *True Muscadine*.

To make Muscadine-Wine; by M. de Martel. n. 58. p. 1183.

XLIII. They take two Great *Casks*, within each of which they put at the bottom a *Trevet*, which must be one *Foot* High, and as Large as the largeness of the *Cask* permits. Upon this *Trevet* they put *Vine-Twigs*; whereon they lay a substance called *Rape*, with which they fill both Vessels, within half a *Foot* from the *Top*. This *Rape* is nothing else, but the Wood or Stalks of the Clusters of *Grapes*, Dried and Freed from the *Grapes*. The *Trevet* and the *Vine Branches* are put at the Bottom of the *Casks*, only to keep the *Rape* from the settling at Bottom. It is this *Rape*, which alone Heats and Sowers the *Wine*. The two Vessels being almost quite Fill'd with the *Rape*, one of them is fill'd up with *Wine*, and the other only Half full for the time; and every Day they draw, by a Cock, Half the *Wine*, that is in the Full Vessel, therewith quite to fill up the other, that is but Half Full; observing Interchangeable turns of Filling and Unfilling the Vessels. Ordinarily, at the end of 2 or 3 Days, the Half-fill'd Vessel begins to Heat, and this Heat Augments for several Days successively, continuing to do so till the *Vinegar* is perfectly made; and the Workmen know, that the *Vinegar* is made, by the Ceasing of the Heat. In Summer it is a Work of 15 Days: In Winter it proceeds more Slowly; and that according to the Degree of Cold Weather.

The Way of making Vinegar in France; by M. . . . n. 61. p. 2002.

When the Weather is Hottest, the *Wine* must be drawn twice a Day, to put it out of one Vessel into the other. It is only the Half fill'd *Cask* that Heats, and as soon as you have done Filling up, its Heat is Choaked and Stopped for the time, and the other *Cask*, which is Unfill'd, begins to Heat.

The Full Vessel is quite Open at the *Top*; but a Wooden Cover is put on the Vessel, that is but Half-full.

The Best *Wine* makes the Best *Vinegar*; but yet they make good *Vinegar* of *Wine* that is Turned.

The *Wine*, in Changing leaves a certain Grease, which sticks partly to the sides of the *Cask* (and that they take care to do Clean away) and partly to the *Rape*; so that if they Cleanse not the *Rape* from it, almost every Year Once, the *Wine* Turns into a Whitish *Liquor*, which is neither *Wine* nor *Vinegar*.

At the time when they pour the *Wine* out of one Vessel into another, a *Scum* ariseth on the Top of the Vessel, which must be taken carefully away.

In the *Casks*, which have never served for this purpose before, the *Vinegar* is made more Slowly, than in such as have been used already.

ib. p. 2004.

The *Rape*, as soon as 'tis separated from the *Grapes*, (which is done immediately after *Vintage*) is carefully put up in *Barrels*, lest it take Air; without which it would *Heat* it self and be Spoiled.

There is no other way of Keeping the *Rape* that hath once served already, than to *Drown* it; that is to say, to Fill the Vessel wherein it is with *Wine* or *Vinegar*. *Rape* will serve a Year, more or Less, provided care be taken of Cleaning every Morning, with a piece of Linnen, the *Grease* that is on the Sides of the Vessel; and with a little Broom, that which Swims on the Top of the Liquor. The *Rape* may be freed from its *Grease* with Water, rubbing it between ones hands. No body, that I know hath hitherto examin'd what this *Grease* is.

I have been lately informed, that there have been Merchants here, who made *Vinegar* with *Phlegm* of *Wine*, remaining after that the *Aqua Vitæ* is Extracted from it.

Orange-Trees;
by ----- n. 29.
p. 554.

XLIII. A *Provencal* at *Paris*, pretends to keep *Orange-Trees* in that Town all the *Winter* long without any Fire, though they remain in the *Earth*, and not be put in *Cases* or *Boxes*. This is thought to be Effected by a peculiar sort of *Dung* used for that Purpose, and wrought deep into the Ground.

One Individual
Fruit half O-
range and half
Limon; by ----
n. 29. p. 553.
By Mr. ----- ib.

XLIV. 1. We have *Orange Trees* at *Florence* that bear a Fruit which is *Citron*, on One side, and *Orange* on the Other. They have not been brought hither out of other Countries, and they are now much propagated by *Engrafting*.

2. A very Ingenious *English* Gentleman asserts that himself not only had seen, but Bought of them *An. 1660*, in *Paris*, whither they had been sent by *Genoa Merchants*; and that on some Trees he had found an *Orange* on one Branch; and a *Limon* on another Branch; as also (constantly to the *Florentine* Information) one and the same Fruit *Half Orange* and *Half Limon*; and sometimes 3 quarters of One kind, and one Quarter of the Other.

By Pet. Natus.
n. 114. p. 313.

3. About 30 Years since a Tree was first met with in a Grove near *Florence* having an *Orange* Stock, which it seems, was so Grafted upon, that thence it became in its Branches, Leaves, Flowers and Fruit, *three formed*; some Emulating *Orange*, some *Limons* or *Citrons*, some partaking of *Both Forms* in One. And particularly as to the Fruit, some of this Tree are meer *Oranges*, yet some of them of an Oblong Shape like *Limons*, some Round like common *Oranges*, some between both: Others Taste like Genuine *Oranges*, others have an *Orange* Shell, but a *Limon* Pulp. Most are of a very strong Scent, and a Shell of a very bitter Taste. But then the same Tree bears also a kind of *Citron Limon*, yet not so many as of the former kind. And not only so, but it produces also a Fruit, that is in One both *Limon*, *Citron*, and *Orange*; so as you may see outwardly two sorts of Fruit represented in One Piece; one, *Citron Limon*, the other, *Orange*. But this Fruit is so diversified, that some of them are *Half Citron-Limon*, *half Orange*; others have *Two Thirds* of *Citron Limon* and

One

One of *Orange*; others the contrary: And of all these, some are Oblong, some Round, some Bunchy, some Smooth, some Rugged, some Small, some of the bigness of two Pound Weight. Their *Flesh* is so distinguished, that where the *Orange Pulp* Ends, that of *Limon* begins, and on the contrary. Again, the *Orange Pulp* is Narrower than that of *Limon*; but this is Tenderer than that; not so Agreeable to the Taste, as the Genuine single Fruit. They have either none, or very few, or Empty *Seeds*: Nature it seems, since this Tree is of the *Institious kind*, nor can be Repaired or Propagated by *Seed*, is not at all solicitous in the *Generation* of them.

The first Original of this Tree was by *Inoculating Orange* upon a *Citron-Limon Stock*, so that by the Marriage of these Trees, Repeated for many Years, it was come to pass, that by the closeness of the *Inoculation*, whereby in length of time the Mixed Nature of both Trees was grown together; which the Different Juyces, permeating the common Fibres, had for a long time Nourished: Whence Emerged at length a *Germen*, or *Graft*, perfectly retaining the Nature and Species of both; into whose Different Branches when sometimes *one*, sometimes *both* kinds of Juyces did pass, it Produced on one of those Branches, a meer *Orange*, on another a *Citron-Limon*, on a third a *Citron-Limon-Orange*, and even sometimes upon one and the same Branch, All the *Three* sorts of this Fruit together.

XLV. Mr. *Edw. Clyve* (and he is the first), who brought a Dry'd Branch of the *Coffee Shrub* AA. from *Moha* in *Arabia-Felix*, gives this account of it. This Branch was taken off a Tree 7. or 8. Foot High, is about 5 Foot Long, and Covered with a Gray almost Smooth *Bark*. The Wood is White, and the Pith not very Large, the *Twigs* are covered with a Darker-Colour'd very smooth *Bark*, and rise Opposite to one another by *Pairs*, standing Cross to one another coming out of Opposite sides of the Branch, or the two *Pairs* next to one another Cutting each other at Right Angles. After the same manner stand the *Leaves* on the *Twigs*, as the *Twigs* on the Branches, at sometimes an *Inch*, and sometimes 2 *Inches* distance, each *Pair* of *Leaves* from the other 1. The *Leaves* have $\frac{1}{4}$ *Inch* Foot *Stalks*, being about 4 *Inches* long, and 2 broad in the Middle where broadest; whence they Decrease to both Extreams, Ending in a Point. They are Smooth, Whole, and without any *Incisures* on their Edges, somewhat like the *Leaves* of a *Bay*. The Fruit comes *ex Alis Foliorum*, hanging or sticking to the *Twig* by $\frac{1}{2}$ *Inch* Long *Strings* or *Foot-Stalks*; and sometimes 1. 2. or more, at the same place.

These *Shrubs* are Planted in *Arabia Felix*, call'd *Faman*, every where in a Rich Ground or Mold in great Plenty, and are Watered in times of Drought as other Cultivated Vegetables there, by Artificial Channels from Rivers cut on purpose to Nourish them; and after 3; 4 or more *Years* Bearing, the Inhabitants are forced to Plant *New Shrubs*, because the *Old* ones become not so Fruitful after that time. They dry them in the Sun, and afterwards take off the Outward *Husk* of the *Berries* by means of *Hand-Mills*, as they do here

An Account of
the Coffee-
Shrub; by Dr.
H. Sloan.
n. 208. p. 63.

Fig. 165.

the *Husks* of several sorts of Grain, to fit them for Use: And the *Arabians*, in Summer Heats, use these *Husks*, Roasted after the manner of *Coffee-Berries*, esteeming that Drink more Cooling, it being sourish to the Taste.

Explication of
the Figures.

A. A. Represents the *Skrub*, wherein is observeable the *manner* of its *Branching*, and of the growing of the *Leaves* and *Fruit*.

aaaa. The *Fruit*, growing 2, 3, or more at a place on the *Twigs*.

B. One of the *Leaves*, of its Natural Bigness.

C. The *Fruit* of the true size and Figure.

c. The *Fruit* with the *Husk* on.

e. The *Fruit* with the *Outward Husk* taken off.

i. i. The *Berry* with *both Husks* taken off.

An Account of
Coffee; by Mr.
J. Houghton.
n. 256. p. 311.

XLVI. I cannot learn the Use of any part of the *Coffee-Skrub*, except the *Berries*; of which, boiled in Water, a Drink is made, and drunk much among the *Arabians* and *Turks*. Perhaps 'twas their *Succedaneum* for *Wine*, which *Mahomet* had Prohibited: For by its actual Heat it refreshes the weary, and does several other Services, as *Wine* that Acts by a Potential Heat.

It has not been in Use (as Mr. *Tavernier* tells us) much above 120 Years. However the Use of it quickly became General, and that made it a Trade in great Towns. Into the *Publick Coffee-Houses* they would come by Hundreds, and among them Strangers would venture, where they learned the Custom, and carried it into their own Countries. One Mr. *Rastall*, an *English* Merchant, (whom I knew) found a *Coffee-House* at *Leghorn* in 1651. The next Year Mr. *Dan. Edwards*, a Merchant, from *Smirna* brought into *England* a *Greek* Servant, call'd *Pasqua*, to make his *Coffee*: So that 'tis likely that this Merchant was the *First* who used it in *England*; (tho' I am informed that the famous *Dr. Harvey* did frequently Use it;) as his Servant *Pasqua* (whom he thought fit to set up) was the *First Coffee-man*.

The best *Coffee-Berry* is what is Large and Plump, with a *Greenish* Cast, and having on the thin parts a *Transparency*; the other has a *Yellowish* Cast, and is more *Opaque*; but when they are *Roasted*, 'tis hard to distinguish.

I put some *Berries* into a *Glass* of *Water*, about a *Week* since, to see if they will *Sprout*, but as yet there is no appearance, altho' they are tolerably swell'd, and look *White* and *Bright*.

I have made a *Decoction* of them, which has made them *Shoot*:

The common way of *Preparing* the *Berry* for the Drink *Coffee*, is *Roasting* it in a *Tin-Cylindrical Box* full of *Holes*, through the middle of which runs a *Spit*; under this is a *semicircular Hearth*, wherein is made a large *Char-Coal-Fire*: By the help of a *Fack*, the *Spit* turns swift, and so it *Roasts*, being now and then taken up to be shaken. When the *Oil* arises, and its grown of a *Dark-Brown* Colour, it's emptied into two *Receivers*, made with large *Hoops*, whose *Bottoms* are *Iron Plates*, these shut into, and there the *Coffee* is well shaken, and left till almost *Cold*, and if it looks *Bright*, *Oily*, and *Shining*, 'tis a Sign 'tis well done.

Of this, when fresh, if an *Ounce* be ground, and boiled in something
more

more than a *Quart* of Water, till it be fully Impregnated with the fine Particles of the *Coffee*, and the rest is grown so Ponderous, that it will Subside and leave the Liquor Clear, and of a *Redish* Colour, it will make about a *Quart* of very good *Coffee*.

The best way of keeping the *Berries* when *Roasted*, is in some Warm place, where it may not be suffered to Imbibe any Moisture, which will Pall it, and take off its briskness of Taste. 'Tis best to Grind it as Used; except it be ramm'd into a Tin-Pot well covered and kept dry, and then I believe it will keep good a *Month*.

There will swim upon the *Coffee* an *Oyl*, which the *Turkish* great *Coffee-Drinkers* will take in great Plenty, if they can get it. When the *Coffee* has stood some time to Cool, the gross parts will subside, the briskness will be gone, and it will grow Flat and almost Clear again.

I sent to the Chymists, 1 pound of Clean *Coffee*; 1 pound of Husked *Horse-Beans*, and 1 pound of pick'd *Wheat*; and I received back.

<i>Coffee.</i>				<i>Horse-Beans.</i>				<i>Wheat.</i>		
	℥	ʒ	℞	℥	ʒ	℞	gr.	℥	ʒ	℞
<i>Spirit</i> net.	VI.	VI.	o.	VI.	I.	o.	XII.	VIII.	II.	I.
<i>Oyl</i>	II.	IV.	II.	I.	III.	o.	X.	I.	o.	gr. VI.
<i>Cap. Mort.</i>	V.	III.	o.	V.	III.	o.	o	IV.	VI.	

By this Account it appears that *Coffee* yields, by *Distillation* in a *Retort*, almost Double as much *Oyl* as *Beans*, and almost Treble as much as *Wheat*.

The *Oyls* are very Thick, but they and the *Spirits* have all of them Ill Savours, as is usual from Burnt Materials.

By *Spirit* is meant the *Pblegm*.

The *Capita Mortua* have no Smell. They have been Calcin'd over and over, with all the Art my Chymist has; but he cannot reduce them to a *Calx* or *Ashes*, and concludes there is no *Salt* to be gotten from them.

From what is said, I note, that from the common Drink call'd *Coffee*, there is little good can come from any part but its *Oyl*, because its other Thin Parts are Evaporated, and its Thick subsides; but its *Oyl*, I suppose, to be Nutritive quasi-an *Oyl*, and Warm quasi a *Chymical Oyl*, for all the Warm parts are brought hither as to a Point, and thereby it may enliven and invigorate some heavy parts in the Fermentative Juyces; and nourish weak Parts within, as other *Chymical Oyls* do the Parts External when rubb'd, but being dilated, as it usually is, I question whether it does any more Good, than Hot Tea, Hot Broth, or any thing else that is Actually Hot; for I believe that Actual and Potential Heats are much of the same Operation.

It has been generally thought to be an *Anti-hypnotick*, or hinderer of Sleep, which I dare not gainsay, Dr. *Willis* and other Learned Men having declared it so: But now it is come into frequent Use, the Contrary is often observed; although perhaps Custom, as it does with *Opium*, Alters its natural Qualities.

I am told that our *Three Kingdoms* spend about 100 *Tun* a Year, whereof *England* spends about 70 *Tun*; which at 14 *Pounds* a *Tun*, (a middle Price now a Days) will amount to 20586 *ll. sterling*; and if it were to be all sold in *Coffee-Houses*, it would reach Treble, or 61740 *Pounds*, which at 10 *Pounds* a Head, will find *Imployments* for 6174 *Persons*, although I believe all the People of *England*, one with another, do not spend 5 *Pounds* each.

Coffee, when *Roasted*, loses about a 4th part; then there is spent about 52 *Tun* and a half of *Roasted Coffee*, which makes 117600 *Pound*, or 15252800 *Drachms*, which, if there be 8 *Millions* of People, is not 2 *Drachms*, or half a *Pint* of *Coffee* a piece for a Year.

Besides what we Use, we send a great deal *Abroad*; and, I doubt not but in short time, the *Gain* of what we send *abroad*, will pay the first *Cost* of all we shall spend at home; which is one of the best ways to make *Advantage* of *Foreign Trade*.

The Cacao-
Tree, by---
n. 93. p. 6007.

XLVII. The Body of a *Cacao-Tree* is commonly about 4 *Inches* in *Diameter*, 5 *Foot* in height, and above 12 from the *Ground* to the *Top* of the *Tree*. These *Trees* are exceedingly different amongst themselves; for some shoot up in 2 or 3 *Bodies*, others in One. Their *Leaves* are many of them *Dead*, and most discolour'd, unless on very young *Trees*. We reckon a *Bearing Tree* yields from 2 to 8 *Pound* of *Nuts* a Year; and each *Cod* contains from 20 to 30 *Nuts*.

The manner of *Curing* them is, to Cut them down when they are *Ripe*, and to lay them to *Sweat* 3 or 4 *Days* in the *Codds*; which is done by laying them on heaps. After this, they Cut the *Codds*, and take out the *Nuts*, and put them into a *Trough* covered with *Plantain Leaves*, where they *Sweat* again about 16 or 20 *Days*. The *Nuts* that are in each *Codd*, are knit together by certain *Fibres*; and have about them a white kind of *Pulp*, that's agreeable to the *Palate*. By the turning and sweating, their little *Strings* are broken, and the *Pulp* is imbibed and mingled with the Substance of the *Nut*. After this, they are put to dry 3 or 4 *Weeks* in the *Sun*, and then they become of a *Reddish-dark-Colour*.

The *Codds* grow only out of the *Body*, or great *Limbs* and *Boughs*, and at the same place, there are *Blossoms*, *Young*, and *Ripe Fruit*.

The greatest *Crop* at most of our *Cacao Walks* in *Jamaica*, is in *December* or *January*: But at one of *Collonel Modiford's Walks*, they bear most in *May*; yet its not above 5 *Miles* from those *Walks*, which bear always in *December*: But those that bear then, have some *Fruit* in *May*, as the other have in *December*.

It's *Planted* First in the *Nut*, always under *Shade*. Some do it under *Cassave*; others, under *Plantane-Trees*, and some in the *Woods*. The *Spaniards* used a certain large shady *Plant*, call'd by them *Madre di Cacao*; we, only the others. It must also be always *Sheltered* from the *North-East Winds*. We seldom *Transplant*, only where it fails: As it doth many times in *Open, Poor, and Dry Lands*; for this *Tree*

requires



Fig. 163.



Fig. 161.



Fig. 158.

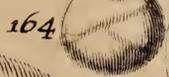
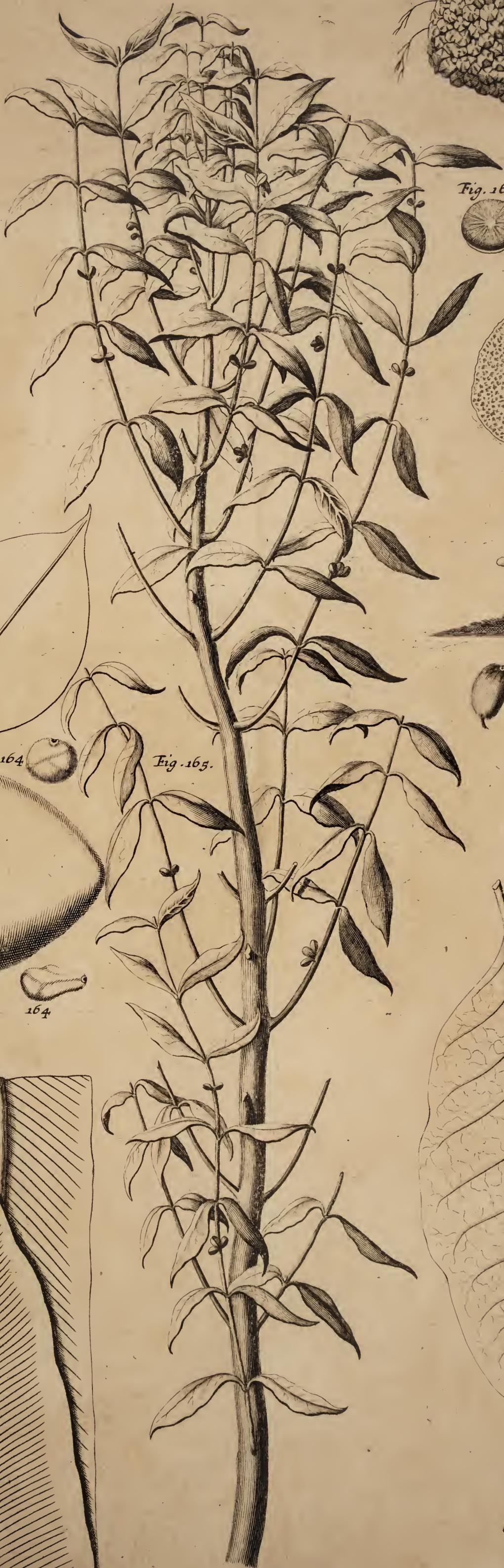
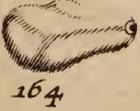


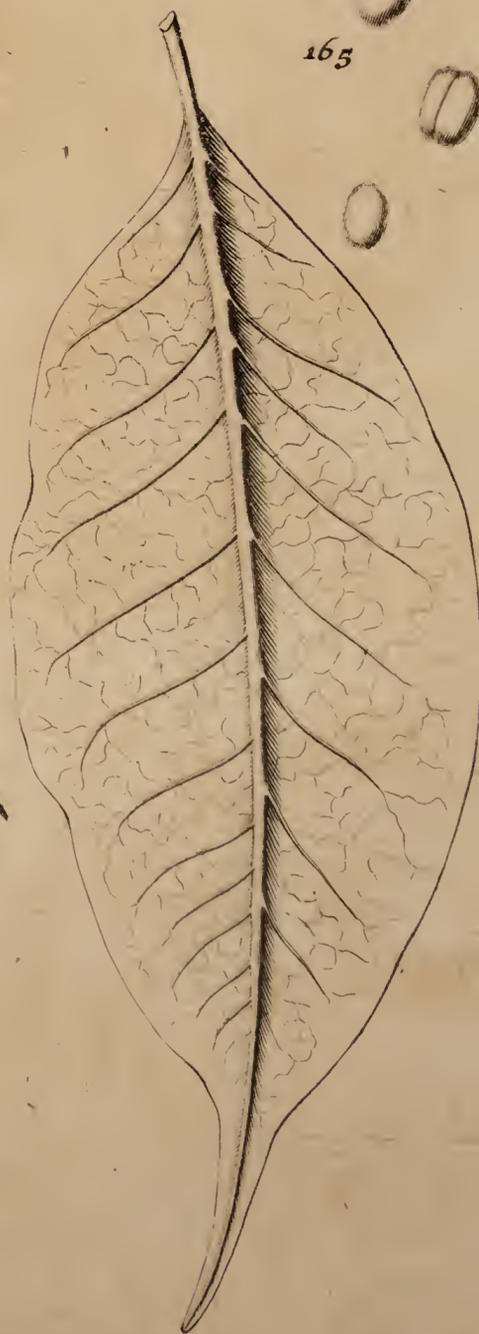
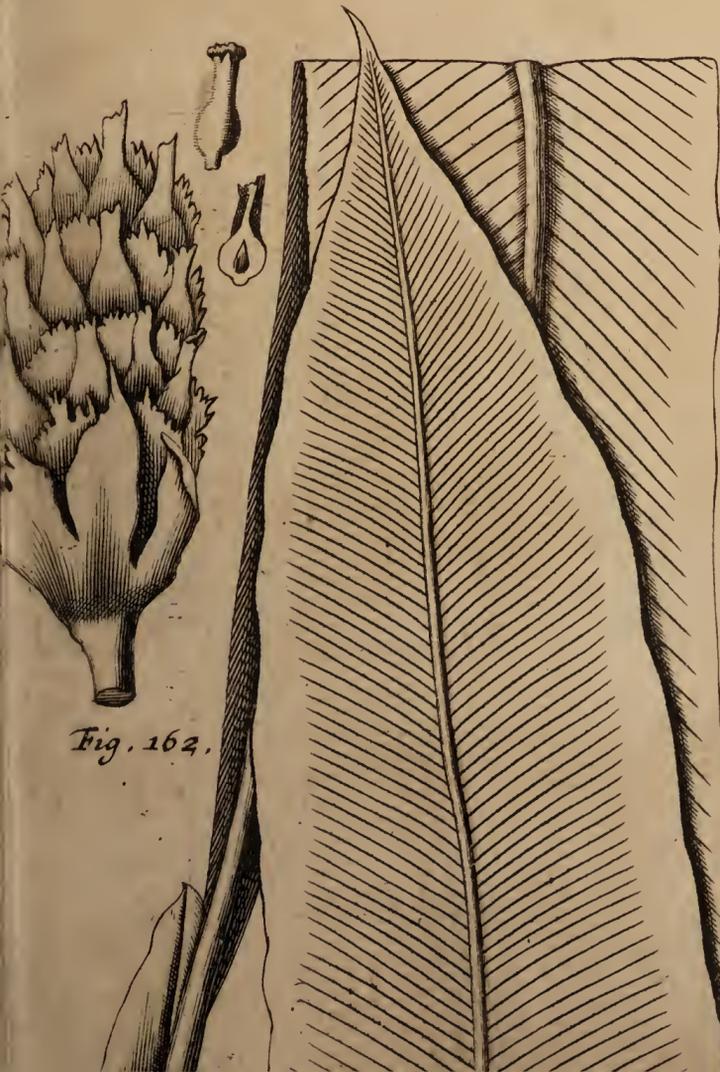
Fig. 165.

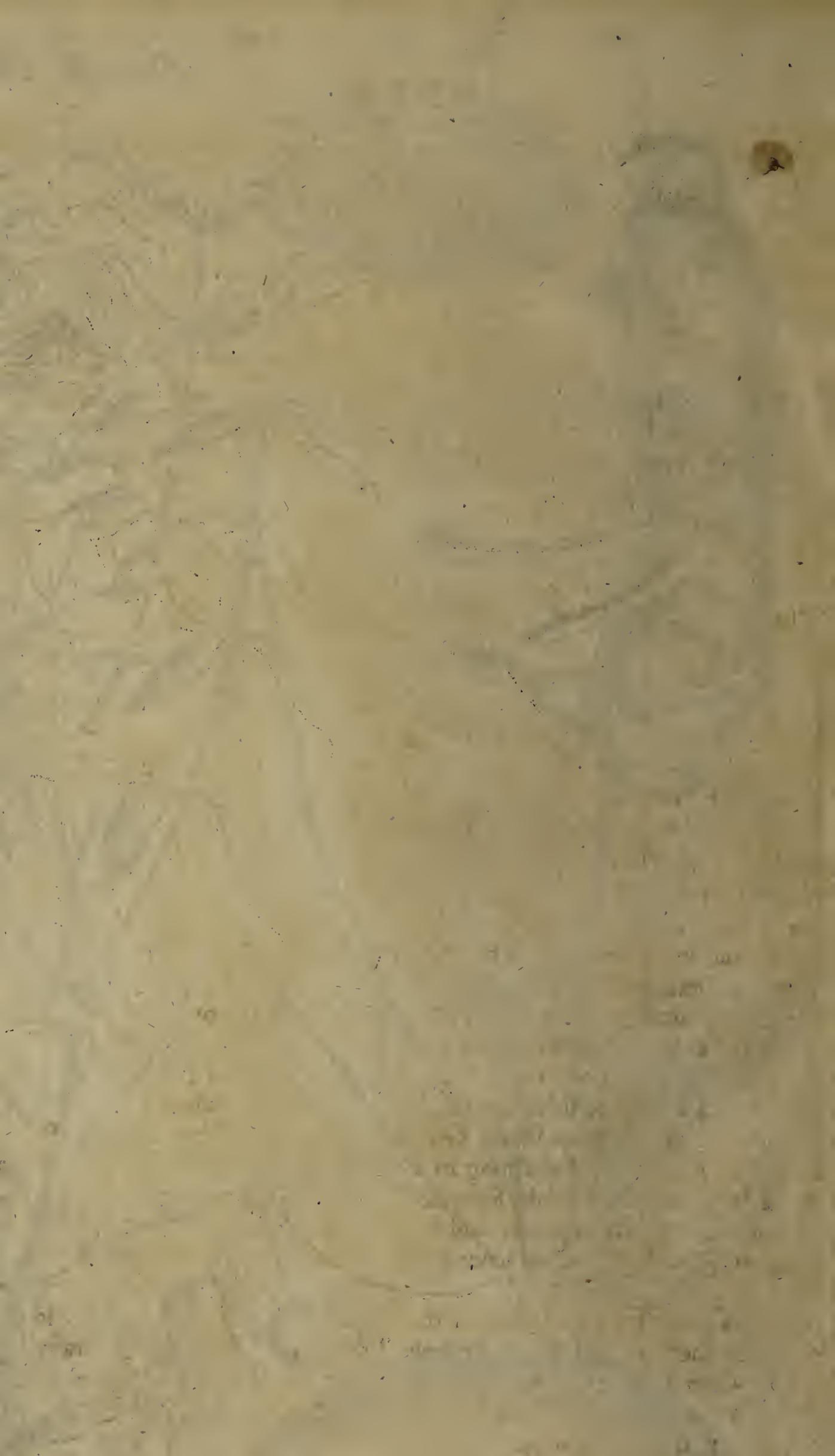


Fig. 164.



165





requires to have a Flat, Moist, Low Soil, which makes them to be Planted commonly by Rivers, and between Mountains; So that it is ill living where there are good *Cacao-walks*. In a Years time the Plant comes to be 4 Foot High, and hath a *Leaf* 6 times as big as an Old Tree, which, as the Plant grows bigger, falls off, and Lesser comes in their place.

The Trees are commonly planted at 12 Foot Distance: and at 3 Years old; where the Ground is good, and the Plant prosperous, it begins to Bear a little; and then they Cut down all or some of the Shade; and so the Fruit Increases till the 10th. or 12th. Year; then the Tree is supposed to be in its Prime. How long it may continue so, none with us can Guess: but it's certain, the Root generally shoots out *Suckers*, that supply the place of the Old *Stock* when Dead or Cut down, unless when any ill Quality of the Ground or Air kill both.

Cacao was Originally of these *Indies*, and Wild; Towards *Maracajo* are divers Spots of it in the Mountains: and I am informed, the *Portugueses* have lately discovered whole Woods of it up the River *Maranon*.

The *Cacao* passes by detail for Money in *New Spain*, and the Silver Countries:

XLVIII. The *Myrtus Arborea Foliis Laurinis aromatica*, *Pimenta*, or *Jamaica-Pepper-Tree*, has a *Trunck* as thick as ones Thigh, rising straight about 30 Feet high, covered with an extremely polite or smooth Skin, of a gray Colour, and branched out on every hand, having the ends of its *Twigs* set with *Leaves* of several Sizes; the largest being 4 or 5 Inches long, and 2 or 3 broad in the Middle where broadest, and whence it decreases to both Extreams, Ending in a point, Smooth, Thin, Shining, without any incisures, of a deep green Colour, and standing on *inch-long Foot-stalks*; when bruised very Odoriferous, and in all things like the *Leaves* of a *Bay Tree*. The ends of the *Twigs* are branched into *Bunches* of *Flowers*, each *Foot stalk* sustaining a *Flower*, made up of 4 Herbaceous or pale green *Petala*, bowed back, or reflected downwards, within which are many *Stamina* of the same Colour. To these follows a *Bunch* of *Crowned* or *Umbilicated Berries* (the *Crown* being made up of 4 *Foliola* or small *Leaves*) which are bigger when Ripe than *Juniper Berries*; at first when small, Greenish; but when Ripe, they are Black, Smooth, and shining; containing in a moist, green, aromatick and biting *Pulp*, 2 large *Acini*, or *Seeds*, separated by a *Membrane* lying between them; each whereof is a Hemisphere, and both Joyned, make a *Globe* or *Spherical* (appearingly one) *Acinus*, whence *Clusius* makes it One Seed divisible into 2 parts.

It grows on all the Hilly parts of the Island of *Jamaica*, but chiefly in the North side thereof: and wherever these Trees grow, they are generally left standing when other Trees are fell'd; and they are sometimes Planted where they never grew; because of the great Profit from the Cured Fruit, sent in great Quantities yearly into *Europe*.

It *Flowers* in *June*, *July* and *August*, but in several places sooner or later according to their situation and different Season for *Rains*: and after it *Flowers*,
the

The Jamaica-
Pepper-Tree; by
Dr. H. Sloan.
n. 192. p. 462.

Fig. 166.

the *Fruit* soon Ripens; but 'tis to be observ'd, that in Clear'd Open Grounds 'tis sooner Ripe than in Thick Woods.

There is no great Difficulty in the *Curing*, or preserving of this Fruit for use; 'tis for the most part done by the *Negro's*; they climb the Trees, and pull off the Twigs with the Unripe Green Fruit, and afterwards carefully separate the Fruit from the Twigs, Leaves, and Ripe Berries. Which done they expose them to the Sun, from its Rising to Setting, for many *Days*: spreading them thin on Cloaths, turning them now and then, and carefully avoiding the *Dews*, (which are there very Great.) By this means they become a little wrinkled or Rugous Dry, and from a Green change to a Brown Colour, and then they are fit for the Market; being of different sizes, but generally of the bigness of *Black Pepper*, something like, in Smell and Taste, to *Cloves*, *Juniper-Berries*, *Cinnamon*, and *Pepper*, or rather having a Peculiar Mixt Smell, somewhat akin to them all; whence the Name of *All-Spice*. The *Ripe Berries* are very carefully Separated from those to be *Cured*, because their wet and plenteous *Pulp* renders them Unfit for *Cure*. Whence these *Berries* always coming *Unripe* Dried into *Europe*, has been the Occasion of Naturalists thinking it to be *Fructu Umbilicato Sicco*. The more Fragrant and Smaller they are, they are counted the Better.

This Fruit with Water Distilled *per Vesicam*, yields a very Odoriferous *Chymical Oyl*, sinking to the Bottom of Water like *Oyl of Cloves*. It may deservedly be counted the best and most Temperate, Mild, and Innocent of *Common Spices*; and fit to come into greater use, and to gain more Ground, than yet it hath, of the *East India* Commodities of this kind; almost all of which it far surpasses, by Promoting the *Digestion* of Meat, Attenuating Tough Humours, moderately heating, strengthening the Stomach, expelling Wind, doing those friendly offices to the Bowels as we generally expect from *Spices*.

It is now commonly sold by Druggists for *Carpobalsamum*, which I suppose came from *Hernandez*, who says it may be its *Succedaneum*: But it is not that Fruit, but seems more Fragrant and less Adstringent and Balsamick. *Clusius* says, that it takes away, if Chewed, a *Stinking Breath*; *John de Barrios* tells us, 'tis one of the Ingredients of *Chocolate* in *New Spain*; and *Franciscus Vria*, who brought it from *New Spain* and gave it to *Redi*, said, it was there commended against the *Epilepsie* and *Gutta serena*, which he in divers persons tryed, but without Success; but he at the same time says, he thinks it a good *Stomachick* and *Cephalick* Medicine, moderately given.

It has been taken by *Clusius* for *Pliny's Garyophyllon*, and by others for *Amomum*: But it is not likely that it was known to the Ancients; not being known to grow in the *East*, but *West Indies*.

It is very likely that *Hernandez* does describe this under the Name of *Xocoxite*, *seu Piper Tavaſci*; his Description agreeing in every thing, only the Flower; which no ways agrees to this. And perhaps this is the Tree which *Piso* Describes under the Name of *Anhuiba Miri*.

Exper. Nat.
p. 132.

daloupe, which is *White*; and another sort, which comes from *Marragnan*, which is like that of *Ceilon*.

He has an *Ear* of the small *Milium* of *Guinee*, about 10 *Inches* long, made just like the great *Knob* of a *Cane*: the *Grains* are no bigger than a *Pin's Head*, and are very good to *Eat*; the *Negros* making their *Finer Cakes* of them.

L. Arbor Baccifera, Laurifolia, Aromatica Fructu Viridi Calyculato ramoso, The Wild-Cinnamon-Tree; by Dr. H. Sloan n. 192. p. 465.
or *Wild Cinnamon Tree*, commonly but *Falsly* call'd *Cortex Winteranus*, has a *Trunck* about the thickness of one's *Thigh*, rising to about 20 or 30 *Foot* high, having many *Branches* and *Twigs* hanging downwards, making a very comely *Top*. The *Bark* consists of two parts, one *Outward*, and another *Inward*. The *Outward Bark* is thin as a *Mill'd Shilling*, of a *Whitish Ash* or *Gray Colour*, with some *Whiter spots* here and there upon it, and several shallow *Furrows* of a *Darker Colour*, running variously through it, making it *Rough*, of an *Aromatick Taste*. The *Inward Bark* is much *Thicker* than *Cinnamon*, being as *Thick* as a *Mill'd Crown* piece; *Smooth*, of a *Whiter Colour* than the *Outward*, of a much more *Biting* and *Aromatick Taste*, something like that of *Cloves*, and not *glutinous* like *Cinnamon*, but *Dry* and *Crumbling* between the *Teeth*. The *Leaves* come out near the ends of the *Twigs*, without any order, standing on *inch-long Foot-stalks*; they are each of them 2 *inches* long, and *one inch* broad, near the end where *Broadest*; and *Roundish*, being narrow at the beginning, from whence it augments in breadth to near its end; of a *yellowish Green Colour*, shining and *Smooth*, without any *Incisures* about its *Edges*, and somewhat resembling the *Leaves* of *Bay*, or *Laurocerasus*. The ends of the *Twigs* are *Branched* into *Bunches* of *Flowers*, standing something like *Umbels*, each of which has a *Foot-stalk*, on the top of which is a *Calix*, made up of some *Foliola*, in which stand 5 *scarlet* or *purple Petala*, within which is a large *Stylus*. To these follow so many *Calyculated Berries* of the bigness of a large *Pea*, *Roundish*, *Green*, and containing within a *Mucilaginous pale-green thin Pulp*, 4 *black shining Seeds*, or *Acini*, of an *irregular Figure*.

All the parts of this *Tree*, when *Fresh* are very *Hot*, *Aromatick*, and *Biting* to the *Taste*, something like *Cloves*; which is so *troublesome*, as sometimes to need a *Remedy* from fair *Water*.

It grows in the *Low-land*, or *Savanna-Woods*, very frequently, on each side of the *Road* between *Passage-Fort* and the *Town* of *St. Jago de la Vega* in *Jamaica*; in *Antigua*; and other the *Caribbeen Islands*.

The *Bark* of this *Tree* is what is chiefly in use, both in the *Plantations* of the *English* between the *Tropicks* in the *West Indies*, and in *Europe*; and is without any *Difficulty Cured*, by only cutting off the *Bark*, and letting it *Dry* in the *shade*.

It is in use in the *West Indies* by the more ordinary sort of *People*, in place of all other *Spices*; being thought very good to consume the *immoderate humidities* of the *Stomach*, help *Digestion*, expel *Wind*, &c.

It is likewise, as well there as in *Europe*, thought a very good Remedy against the *Scurvy*, and to cleanse and enervate the Blood; being in *London-Druggists* and *Apothecaries Shops* used for those Purposes, under the Name of *Cortex Winteranus*; which it is not, but may very well supply its place. It is in the *West-Indies* mixed and given with *Steel*, and other Medicines: but if the Patient be any way of a Hot Constitution, it does more Harm than Good; being very Warm.

Rum, a *Vinous Spirit* drawn from *Molossus*, or bad *Sugar* fermented with Water, if it be Mixed with some of this *Bark*, loses in part its loathsome *Empyreumatick* Smell.

This *Bark*, if Mixed with Water, and *Distill'd per Vesicam*, yields an *Aromatick Oil*, sinking to the bottom of Water like Oil of Cloves; with some small Quantity of which it being mixed, has sometimes been sold for True Oil of Cloves. *Peter Martyr* mentions it under the Name of *Cortex Cinnamomi Saporem, Gingiberis Amaritudinem, & Caryophilli suavem Odorem præ se ferens*; *Nic. Monardes* describes it under the Name of *Lignum Aromaticum*; *Clusius* calls it *Lignum, seu potius Cortex Aromaticus*; And I question not but this is the same with the *White-Cinnamon*, or the *Canella Alba* in some other Authors. *Linschoten* in his Description of *America*, Translated into *French*, gives an Account of it under the Name of *Arbre ou les Pigeons nichent*; *Dr. Trapham* calls it *Winter Bark*, or *West-Indian Cinnamon Tree*; *Hernandez* and *Ximenes*, *Canninga*.

But it may be doubted whether this be the *Ascopo of Hariot*.

The true Cortex Winteranus; by Dr. H. Sloan n. 204. p. 922.

Ll. Capt. Winter, who went out with *Sir Er. Drake* when he went Round the World, at his Return brought with him from the *Streights of Magellan* an *Aromatick-Bark*, which had been very helpful to those of his Ship, both used instead of other *Spices* with their Meat, and as a Medicine very Powerful against the *Scurvy*. *Clusius*, from this Captain's Name, calls it *Cortex Winteranus*, and the Tree *Magellanica Aromatica arbor*. The Writer of the Journal of the *Dutch Ships* that went to the *Streights of Magellan* about 1599 calls it *Lauro similis Arbor, licet Procerior, Cortice Piperis modo Acri & Mordenti*. And *Sebald de Wert*, who was there, says, that both *Leaves* and *Bark* were used with their Meat and Muskles, to Correct them in so Cold a Climate *Caspar Baubine* calls it, *Laurifolia Magellanica cortice Acri*; *Johnston*, *Arbor Laurifolia Magellanica*.

Fig. 168.

Fig. 169.

But *Mr. Geo. Handyside*, who came from thence about 2 or 3 Years since, gives the Best Account of it; having brought with him a *Specimen*, or Sample of its *Leaves* and *Flowers* on the *Twig* and its *Seed*; by which I cannot Reduce it to any of our kind of Plants so well as the *Peryclemenum*: and therefore I shall call it, (tho' it Differs in many things from the *Hony-suckle*;) *Peryclemenum rectum Foliis Laurinus cortice Acri aromatico*.

He assured me that this Tree rose to be Higher and Larger than an *Apple-Tree*, spreading very much both in *Root* and *Branches*: The *Twigs* had on them *Leaves*, of a *Light-Green Colour* on their *Upper side*; standing

on half Inch-long Foot Stalks; are an Inch and half long and an Inch broad in the Middle, where Broadest, and whence they Decrease to both ends, ending Blunt. The Flowers come, *ex Alis Foliorum*, standing on $\frac{3}{4}$ Inch long Stalks; 2. 3. or more of them together, something like those of the *Periclymenum*; each of them are Milk-White, *Pentapetalous*, and smell like *Fassamine*; to which Succeeds an Oval Berry, made up of 2. or 3. or more *Acins*, or little-Berries, standing together on the same common Foot Stalk, of a Light Green Colour with some Black Spots; and in these Berries are contained several Black Aromatick Seeds, something like the Stones in Grapes.

It grows in the middle of the *Streights* of *Magellan* very plentifully.

The Leaves of this Tree were Used, with other Herbs, by Mr. *Handyside* for Fomentations in several Cases, with very good Success: But he admired most the Use of the Bark Inwardly, boiling half a Dram of it with some *Carminative Seeds*, and giving it so to those of the Ship who were under his Care very much Afflicted with the *Scurvy*. It usually Sweated them, and they were very much Relieved. The same Medicine likewise he administered to a great many of the Ship, who were very Ill by eating a Poisonous sort of Seal in those Parts, call'd a *Sea-Lion*, with which they had a very great amendment, although they had been so ill with feeding on this Creature as to loose most of their Skins, which Peel'd off their Bodies by Degrees, and in large Pieces; so that the Antidote, to this strange Poyson was to be had very near it, and was very much Extoll'd by this Gentleman, who was put to a stand to know what to do in this strange Case, although he very well understood the *Materia Medica*.

By Description of this Tree and that of *Wild-Cinnamon* it appears that the *Cortex Winteranus*, commonly sold in Shops, is not the True *Cortex Winteranus*. But I must needs say, tho' they are the Barks of two very Differing Trees; and growing in very Differing Places; and appear quite another thing in their Outward Faces: Yet their Taste is much the same, and I believe they may be used as a *Succedaneum* one for another; tho' the True be much to be valued beyond the False being much More Aromatick.

LII. I have discoursed a poor meer *Irish-Labourer*, (who, by having worked many Years under a Head-Gardiner in a Gentleman's Garden, has got a Genius of *Planting*,) who has follow'd the Propagating of *Elms* by the Seed; (a way if known, totally neglected among all *Planters*) which Seed he finds in the former part of the Year: and he has Raised in small Beds such vast Numbers of them, that he sells them, of 3 or 4 Foot long, at 2 *Sbill.* a Hundred, and will carry them any where within 5 Miles and Plant them into the Bargain.

An Account of the Propagation of Elms Seed; by Sir Rich. Bulkley. n. 265. p. 971.

A sort of Sugar
from Maple; by
----- n. 171.
p. 988.

LIII. The *Savages* of *Canada*, in the time that the *Sap* rises in the *Maple* make an Incision in the Tree, by which it Runs out: And after they have E-vaporated 8 pounds of the Liquor, there remains 1. pound, as Sweet, and as much Sugar, as that which is got out of the *Canes*; part of the same Sugar is sent to be Refined at *Roven*.

The *Savages* have practised this Art, longer than any, now living among them, can Remember.

There is made with this Sugar a very good Syrup of *Maiden Hair*, and other *Capillary Plants*, which is used in *France*.

Oak prepared
for Tanning; by
Mr. Ch. Howard
of Norfolk.
n. 105. p. 93.

LIV. Every part of the *Oak Tree*, of what Age or Growth so ever, and all *Oaken Copice-Wood* of any Age or Size, being Cut and procured in *Barking-Time*, will Tan all sorts of *Leather*, as well, at least, as *Bark* alone.

This Material being gotten in its Proper Season, it must be very well Dry-ed in the Sun, and more than *Bark*; then housed Dry, and kept Dry for Use; and when it is to be Used, the Greater Wood may be Shaved small, or Cleft, and the small Bruised with a *Hammer*, and Cut Small; which done, it must again be Dryed very well upon a *Kiln*, and then Ground, as *Tanners* usually do their *Bark*.

Such Wood as it is to be Used Presently after 'tis gotten, will require the better and more Drying upon the *Kiln*; otherwise it will Blacken and Spoil all the *Leather*.

Instead of an *Anvil*, to Beat and Bruise the *Tanning Stuff* upon, Fit into a Wooden Block a *Plate of Iron* about 4 *Inches* deep, 9 *Inches* broad, and 12 *inches* long. The *Hammer* for Bruising the *Stuff* may be of 6 *l.* weight, and have the *Head* about 3 *Inches* square, to Work with both Hands; but to work with one Hand or for a Youth to use, let it be of about 3 *l.* weight, and the *Head* about 2 *Inches* square. The Surface of one end of these *Hammers* is best to be Smooth; but that of the other, Dented; the better to enter into the *Stuff* for quicker Dispatch. They are to be well *Steel'd* at both Ends. The *Handles* of these *Hammers* may be about a *Foot* long; the Bigger ought to be somewhat longer.

The *Knife* to Cut the bruised *Stuff* may be 8 or 9 *inches* broad, and neer as much in Depth; made like a *Tobacco Knife*, with a *Handle* to work.

Where *Oak* is scarce, *Thorns* may indifferently well supply that Scarcity.

Birch ordered and used instead of *Oak*, is very fit for *Soal Leather*.

As these ingredients will Tan better than *Bark* alone, and that with far less Charge, so may this invention save the *Felling* of *Timber* when the *Sap* is up: Which, when 'tis done, causes the Outside of the *Trees* to Rot and grow *Worm-eaten*; whereas if the *Trees* had been *Fell'd* in *Winter*, when the *Sap* was Down, they would have been almost all *Heart* (as they call it,) and not so subject to *Worms*. Besides that, this Invention will greatly improve the Value of *Under woods*.

LV. There

LV. There is no such Dwarf-Oak in England, growing Wild, as was sent you out of New England; nor in any other Country where we have been; unless it be the *Ilex Coccifera*; which is a Low Shrub, bearing large *acorns*, and hath a Prickly Leaf like Holly. If it prove that, it will be a Lucrififerous Discovery.

A Dwarf-Oak from New-England; by Mr. Fr. Willoughby. a. 58. p. 1200.

LVI. Five Leagues from Marseilles are very high Mountains, which are (for the most part) covered with Forests of Pine-Trees, which there grow Wild; half a League out of the Road, you see the making of Pitch, Tar, Rosin and Turpentine; which is thus; viz. in the Spring time when the Sap runs most, they pare off the Bark of the Pine to make the Sap run down into an Hole, which they cut at the bottom to receive it; as it runs, it leaves a Cream or Crust behind it, which they take and temper in Water, and sell (by a Cheat) for White Bees-Wax, that they make Flambeaus of, and is a great deal dearer. Then they take up the Juice in Spoons from the bottom, and after they have so gotten a good quantity, they strain it through a Grocers Basket, such as they put their Malaga-Raisins in; that which runs through easily is the common Turpentine. Then they take that which remains above, and adding a sufficient Quantity of Water, distil it in an Alembick; that which is so Distilled is Oyl of Turpentine, and the Calx that remains is Common Rosin. Then they cut the Stock of the Tree into large Chips, and pile them hollow in a Cave; Covering it on the Top with Tiles, but so as to let some Air come in to feed the Fire; then burning them, there runs a Thick Juice down to the bottom, where they make a small Hole for it to run out at, (a larger Hole would set it all in a Flame,) and that which so runs out is Tar. Then they take off that, and Boiling it gently over again, to consume more of the Moisture, they set it to Cool, which when Cool is Pitch.

The Way of making Pitch, Tarr, Rosin and Turpentine; by Mr. Tho. Bent. n. 243. p. 291.

LVII. In Jamaica, the Neighbouring Isles, and Continent of America, grow many sorts of Mistletoe; Parasitical Plants, as they are called by some, or Epidendra by others; which grow on the Bodies or Arms of Trees, after the manner of Mistletoe, like to which they bring forth Roots, Leaves, Stalks, Flowers and Seed. From this likeness I have given the name *Viscum*, to all the several Families of them; tho' they Differ very much from it, and almost as much amongst themselves.

A sort of Mistletoe in Jamaica; by Dr. H. Sloan. n. 251. p. 113.

There is one Family among them which I call *Viscum Cariophyloides*, from having its Seed Vessel somewhat like that of Clove-July Flowers: and a particular one of that Family which I name *Viscum Cariophyloides Maximum*, *Flore Tripetalo pallide-Luteo Semine Filamentoso*, and which is commonly in that Island called, Wild Pine; whose Description follows. A great many Brown-Fibrils encompass the Arms, or take firm hold of the Bark of the Trunk of the Trees whereon they Grow: Not as Mistletoe, Entering the Bark or Wood, to suck Nourishment, but only weaving and matting themselves among one another, and thereby making to the Plant a firm and strong Foundation. From hence rise several Leaves on every side, as *aaaa*. after the manner of Leeks, Ananas, whence the name of

Catal. Jav. Plan.

Fig. 170.

Wild-

Wild-Pine, or *Aloes*, being folded or inclosed one within another; each of which is 2 Foot and a half long; from a 3 Inch breadth at Beginning, or Base, Ending in a Point; having a very Hollow or Concave Inward-side, and a Round or Convex outward One. So that by all of their Hollow sides, is made within a very large *Reservatory*, *Cistern*, or *Basin*, *b.* fit to contain a pretty deal of Water: which in the Rainy Seasons falls upon the Uppermost parts of the spreading Leaves, which have *Channels* in them, conveying it down to the *Cistern*, where it is kept, as in a *Bottle*; the Leaves, after they are swelled out like a *Bulbous Root* to make the *Bottle*, bending inwards, or coming again close to the *Stalk*, by that means hindering the Evaporation of the Water by the Heat of the Sun. They are of a *Light Green* Colour below, and like *Leeks* above. From the midst of these rises a Round, Smooth, Strait, Fresh *Green* Coloured *Stalk*, 3 or 4 Foot long, *c.* having many Branches; when Wounded, yielding a clear *Mucilaginous Gum*. The Flowers came out here and there on the Branches; they are made up of 3 long *Yellowish*, *White*, or *Herbaceous Petala*, and some *Purple-ended Stamina*, standing in a long *Calix*, or *Tubulus*, made up of 3 *Green* viscid Leaves, with *Purple Edges*, to which follows a long triangular *Capsula*, *d.* *Greenish Brown*, being somewhat like those of the *Cariophilli*; having under it three short *Capsular Leaves*, and within several long *Pappous Seeds*, the Seed it self being *Oblong*, *Pyramidal*, and very small, having very soft Hairs down, or *Tomentum*; much longer in Proportion to the *Seed*, than any *Tomentum* I know; being as long as the *Pod* or *Capsula*.

It grows on the *Arms* of *Trees*, every where in the Woods, as also on the *Barks* of their *Trunks*; especially when they begin to decay, their *Barks* receiving the *Seed*, and yielding then more easily to the *Fibrils* of this Plant's *Roots*, which in some time Dissolves them, and Ruins the whole *Trunk*.

The *Contrivance* of Nature in this Vegetable is very Admirable; the *Seed* has long and many *Threads* of *Tomentum*; not only that it may be Carried every where by the *Wind*, as the *Pappous* and *Tomentose Seeds* of *Hieracium* *Lisymachia*, &c. are, but also, that it may by those *Threads*, when driven through the *Boughs*, be held fast, and so stick to the *Arms* and extant parts of the *Barks* of *Trees*. So soon as it *Sprouts* or *Germinates*, altho' it be on the *Under* part of a *Bough*, or the *Trunk* of the *Tree*, its *Leaves* and *Stalk* rise *Perpendicular*, or *strait up*: Because if it had any other *Position*, the *Cistern* before mentioned (by which it is chiefly *Nourished*, not having any *Communication* with the *Tree*;) made of the *Hollow Leaves*, could not hold *Water* which is *Necessary* for the *Nourishment* and *Life* of the *Plant*.

In the *Mountainous* as well as *Dry Low Woods*, in scarcity of *Water*, this *Reservatory* is *Necessary*, and sufficient, not only for the *Plant* it self, but likewise is very *Useful* to *Men*, *Birds*, and all sorts of *Insects*; whither in scarcity of *Water*, they come in *Troops*, and seldom go away without *Refreshment*.

There are some *Contrivances* in *Plants* Growing in *Europe*, which come near those of this kind of *Vegetables*, in some *Particulars*. The *Virga Pastoris*,

ris, or *Wild Teasel*, (and most Plants call'd *Perfoliated*) has its *Leaves* inclining its *Stalk*, and so set by Pairs opposite to one another, and joined by their *Bases*, that they may make a Hollow place, fit to contain some Water, which, tho' Open, yet without doubt, contributes to the perfecting of the Plant.

Several *Fuci* are lately discovered to have *Seeds*, which, when Ripe, break out of their Places, and by means of a *Glewy Juice* fasten themselves to the Stones, or other Substances at the *Bottom* of the *Sea*, where they are to grow. The common *Viscum* had such a *Glewy Substance*, I suppose, for fastning its *Seed* to the *Barks* of *Trees*.

Small *Mosses*, heretofore thought to have no *Seed*, are now known to have great plenty: And that so small, as I have seen it rise up from the *Ripe-Head*, in form of *Smoak*; which is without Question, that it may be carried by the Air and Wind, to Walls, Trees, or other fit *Matrix* for its *Vegetation*.

There is a *Fungus*, call'd by *Clusius*, *Fungus Minimus Anonymus*; and by *Dr. Merret*, *Campaniformis Niger multa semina plana in se contingit*, (which I have shewn the *R. Society* many Years since) that when Ripe opens in the *Rain*, by which one filling a *Cup*, wherein lies its *Seeds*, they are Washed out on every hand, to Propagate its Kind.

There are many *Families* of Plants with *Pappous*, or *Tomentose*, *Seeds*; as *Dandelion's*, *Erigerum's*, *Lysimachia's*, *Clematis's*, *Anemone's*, &c. which being Ripe, their *Seeds* are by means of their *Feathers*, or *Wings*, scattered to all Neighbouring Parts by the Wind. This is so effectual a way, that the *Aster Canadensis annuus non descriptus*, *Brunyer*, or *Conyza, annua* Hort. Bles. P. 10. *Alba Acris, Morif.* (which came at first from *Canada*,) is now become a *Wild-Plant* in many Places of *Europe*, where it never was Observed to grow, and far from the Gardens where it was first Planted; from whence the *Seed* had been carried by its *Wings*; so that I have seen it in some parts of *France*, very many *Leagues* from such Places.

There are likewise many Plants, which have *Seed-Vessels* so Contrived, as with a *Spring*, and sometimes, smart noise, when they are Ripe, to throw off their *Seeds* several ways, to a considerable Distance. Most Plants having *Pods*, as *Furze*, &c. those called, *Noli me Tangere*, or *Herbæ Impatientes*, *Cucumis aspinus*, *Cranes-bills*, and many others, have this Artifice to sow themselves. Amongst those who have this Property, none is more surprising than one in *Jamaica*, called *Spirit-weed*, which when its *Seed* is Ripe, the *Vessel* containing it, on the least Touch of whatever is Wet, does instantly Open its self, and with a smart noise, throws its *Seed* Several Ways to a Considerable Distance; likely the Design of Nature being, that the *Rainy Season* being proper for Sowing, its *Seed* should be kept in its *Seed-Vessel*, the best Preserver of it from Injuries till then.

Lichnis's, *Poppies*, *Antirrhinum's*, and many others, have their *Seeds* in *Heads*, which when Ripe, are Open at Top; and by the Winds, and help of their *Partitions*, are scattered and Directed to all Quarters.

These.

These Instances, and many more, very Obvious and Wonderful, tho' not taken notice of, might be given to shew the great Endeavours of Nature to Perfect the *Individuum*, and Propagate the *Kind*; which for that Reason, I am apt to believe, are all (without the loss of *One Species*) Preserved to us, from the Creation to this Day.

The Silver-Pine
from the Cape
of Good Hope;
by Dr. H. Sloan,
n. 198. p. 664.
Fig. 171.

Fig. 172.

LVIII. A Branch of the Silver-Pine, or *Conifera salicis Facie, Folio & Fructu, Tomento sericeo candicante obductis, semine Pennato*, was lately brought into England from the Cape of Good Hope, by Mr. Goddard. The Twig of this Tree had a great many Leaves set round it very Close to one another, so as to hide the Twig it self there where they grow; each of the largest of them being about 4 Inches Long, and $\frac{3}{4}$ of an Inch Broad, in the middle where broadest, from whence they decrease towards both Extrems, ending in a Point; being like those of the *Osier Willow*, only broader, and all covered over with the Thickest, Finest and longest White Silken Hair or Down, that ever any Plant I remember to have seen has. The Cones are of the bigness of those of the Cedars of Lebanon, and of the same shape; the *Cuticula*, or small Skin of each Scale, being covered over with a White short Down or Wool, shining also like Silk; between the Scales is lodged the Seed C. which is almost as large as the Pine Nut, near the same shape, of a Dark Brown Colour, and having a rising Eminent Line or Belly running through the middle of it from End to End. This Seed lies in a thin Reddish Brown Membrane D. which has on its Top 4 Feathers, like those belonging to the Seeds of Clematis; which being between the Scales, and Rising above them, adds a very great Beauty to the Cone; and may likewise serve for Wings, by means of the Wind to loosen or carry the Seeds to Distant places, thereby propagating its self.

Dr. Plucknet has figur'd it under the Name of *Leucadendros Africana Arbor tota Argentea, Sericea Foliis integris; Atlas-Tree, D. Herman.*

Another Coniferous Tree, from the Cape of Good Hope; by Dr. H. Sloan. n. 198. p. 666.

Fig. 173.

LIX. *Conifera, Alypi folio, Seminibus pennatis pluribus in medio Coni conglomeratis, & non inter, Squammas, aliorum Conorum more, nascentibus.*

A Branch of this Tree with its Fruit was lately brought from the Cape of Good Hope, by Mr. Goddard. It had a Brown Colour'd smooth Bark, with a Whitish hard Wool, and small Pith. The Leaves (expressed to their Natural Bigness F.) were Round it without any Order, very thick set, having no Foot-Stalks, being about 2 Inches and $\frac{1}{2}$ long, and about $\frac{1}{3}$ of an Inch Broad, near the farther end where Broadest, Smooth, Hard, and of a Brownish or Dirty Green Colour. On the top of the Branch comes the Fruit, G. which is surrounded by 3 or 4 Twigs, H. I. K. Overtopping it, and with their Leaves almost Hiding it. It is about 5 Inches long, and is made up of many Scales, Hard and Red, enclosing one another: The Lowermost and Outwardmost being very short, the Inwardmost 4 Inches Long, each of them ending in a Point; some Scales having on their Outsides a Gummy Juice. In the Middle of these Scales were the first Rudiments of many Seeds as L. the same not being fully Ripe; each of which is set about with a great Quantity of $\frac{3}{4}$ Inch long, yellow, Fine, silken Down, M. having 2 Inches long stylus,

or string N. and yellowish Membranes O. enclosing the *Stylus* and *Tomentum*; being *Feathered* at Top with *Feathers*, like the *Silver-Pine*, and for the same Purposes.

LX. 1. There are several sorts of *Vegetables* that will Grow the Wrong End set downwards in the Ground: As *Elders*, *Briars*, *Sallies*, *Willows*, the *Black-Elder*, *Vines*, and most *Shrubs*; two or three of their *Joynts* being covered in the *Mould*, and the *Stem* cut off near the overmost *Joynt*, which should be half covered in the *Mould*, and the *Mould* somewhat raised, as it Spirts out and Grows. *Dr. B. Curran-Trees*, and such like as are of a *Soft-Wood*, and *Quick-Growers*, seem most apt to this Improvement. *Dr. T.*

Observations and Experiments concerning Vegetation and the Running of Sap; by Dr. J. Beal, and Dr. E. Z. Tonge, n. 43. p. 853.

2. The *Branch* of a *Plant* being laid in the Ground, whilst yet Growing on the *Tree*, and there taking *Root*, being Cut off whilst so Growing, will Grow on both Ends, if it be well *Rooted* in the Propagation; and the like Care had of the last *Knot* or *Joynt*, as was before prescribed. *Dr. B.* The *Layers* of those *Trees* and *Shrubs* mentioned in the former Observation, will Grow on both Ends: and aptly Parted when they have spread *Roots* both ways, make two *Plants* out of each *Layer*. *Dr. T.*

3. In the *Tapping* of *Trees*, the *Juice* certainly Ascends from the *Root*, and after it is Concocted to partake of the Nature of the *Plant* (which feeds as well on the *Air*, as the *Juice* furnished through the *Root*) it Descends (as the *Liquor* in a *Limbeck*) to the *Orifice*, whence it issues. *Ratray* the Learned *Scot*, affirms, that he hath Calculated Experimentally, that the *Liquor*, which may be drawn from the *Birch* in the *Spring* Time, is equiponderant to the Whole Weight of the *Tree*, *Branches*, *Roots*, and All together. And perhaps this kind of Large *Natural-Limbeck*, where it may be had, may sometimes prove more effectual, than our Little *Artificial*, and more Troublesome *Distillations*. And the Congeniality of the Sun in his Alternative Visits, and the Assiduous Intercourse of the Free Air with the *Spirit* of the *Plant*, yet Living and Growing, may have a more effectual Influence for a Specifick Virtue, than we are apt to imagine. Though we cannot See, nor Hear, the *Lungs* of Vegetable *Beating*, yet we may sometimes smell their *Breath*, strong enough, both to Please and Offend exceedingly; as in *Savin*, *Firrs*, *Cypress*, *Elder*, *Rosemary*, *Mirtles*, and generally in all *Blossomers*. And some that cannot be Smelt by us, may yet have a very Wholesome *Breath*. One Experiment I will here bestow on you. When both my Hands were mangled for many Years (and sometimes my Arms also) with Deep Corroding *Teaters*; to the Blush of my many friendly *Physitians*, and in Despight of many of the best *Medicines* and *Purgations*, all was suddenly Healed, and hath so Continued these 20 Years, by the Application of the *Gum* of *Plum-Trees* dissolved in *Vinegar*. I must not forget to Add, that I applyed *Vine-Leaves*, and sometimes Opened *Rasins* to draw a Moisture from these *Teaters*, some few Days before I used the *Gum*. *Dr. B.*

Dr. Tonge is of Opinion, that *Sap* always Rises, and never properly Descends, having only a kind of *Subsiding* or *Recidivation*, which he saith he cannot call a *Circulation*, nor resemble to the *Motion* of *Liquors* in a *Pellican*; but rather to the Sinking of *Liquors* in an *Alembick*, whilst the Thinner Parts are forced over the *Helm*; yet somewhat Imitating the *Motion* of *Blood* in *Animals*, for as much as

it continually supplies the Want and Expence of *Sap* in the *Exteriour* Parts, from the Stock of the *Sap* in the *Trunk*, *Root* and *Branches*.

He understands it thus; that the *Sap*, Necessary to the Growth of the *Leaves*, *Fruit* and *Upper Branches*, being Dispensed, and Converted into the Form necessary for these purposes, when the *Tree* is fullest of *Sap*, in such manner that the *Sap* in the innermost Coats feeds the innermost, and the *Sap* of the outward Coats, the outward Parts, of *Fruits*, &c. that which remains in the *Body* betwixt the several Coats, and betwixt the *Bark* and *Body*, begins to Condense there also, first into a *Gelly*, and after into *Wood*, *Bark*, *Roots*, &c. according to the several Places to which it hath subsided. And because it Condenseth faster in some parts than in others, according as they be Higher or Lower, (whether it be by Heat or Cold, or Exhalation of Thinner Parts) the *Sap* Condensed above or below, filling less Room, must needs cause the *Sap*, which is not yet Condensed, in appearance to Descend or Subside, and to Sink as it were Lower and Lower in the *Pores* of the *Timber* and *Bark*, *i. e.* to be less High, not Descend from any Place, to which it was formerly Risen, unless (as in *Blood-letting*) when some Lower Part is opened, all the *Sap* Above continually flows thither, till the *Tree* be Emptied, or the continual Flux of the *Sap* (the *Natural balsome* of the *Tree*) Heal the *wounds*, as that of the *Blood* does those of the *Body*; and so much Quicker and Easier, by how much the *Air* is more Favourable, or is better kept out; which he observes for their Direction, who are Curious in *Innoculation*, as the Ground of their Successes or Miscarriages. The *Trees* observed by the same *Dr. T.* to Run, are the *Vine*; the *Birch*, plentifully at *Body*, *Branches*, and *Roots*; the *Walnut-Tree*, at the *Roots* and Pruned *Branches*; some *Willows* and *Sallies*; and some sorts of *Maple*; the *Sycamore*, which is the greater *Maple* (some call it the *Plane*) at a *Gash* made on the *Bark* of his *Body*, and at the *Roots* and *Branches*; the *Poplar* and *Asp.* Some *Woodmen*, affirm that in such *Oaks* as are *windshaken*, that have large Hollownesses in their *Arms* and *Bodies*, they have found great Quantity of *Sap* in the Cutting of them, whereof having Drunk, they Quenched their Thirst without any prejudice. To these add the *Whitting* or *Quicking Tree* (*Lar Fraxinus Sylvestris*, and by some *Fraxinus Cambro Britannica*) which in its Season, as some affirm, will Run plenteously; and whence they would have us expect a Sovereign Drink against some Stubborn Distempers, especially such as are *Scorbutical* and *Splenerick*: I have kept (saith *Dr. T.*) some of the *Juice* of the *Berries* (which being expressed Ferments of it self) these 2 *Years* in *Bottles*, and it hath now the Taste of an *Austere Cyder*; And I suppose from its Grateful Smell, that it may be kept till it Ripen, and become a Strong *Vinous Liquor*. It is the Household Drink of some Families in these Parts, about *Wales* and *Herefordshire*; and some out of Curiosity have Brewed Ripe *Berries* with strong Beer and Ale, and kept it till it Transcended all the other Beer in goodness.

Dr. Tongue's attempts upon the *Poplar*, *Aspe*, *Elme*, *Oak*, *Ash*, *Elder*, *Whitting-Berrie* or *Quicking-Tree*, *Thorn*, *Buckthorn*, *Tile*, *Nut*, *Sloe*, *Briar*, *Bramble*, &c. have not succeeded; and he doubts, that they, and all *Apples* and *Pears* have some Degree of *Gumminess* in their *Juices*, so that they will not Run.

4. The *Sap* apparently *Riseth* by the *Inward Bark*, where you may see the *Quick* begin, and where the *Graft* first *Incorporateth*. *Dr. B.*

Dr. T. Observes that there are *Circles* in *Trees*, which are the *Distances* of those *Films* or *Coats* by which the *Tree* receives its *yearly Increase* in *Thickness*. Through these, looking full of *Circular Pores*, the *Sap* seems to *Ascend*, in the same manner between *Coat* and *Coat*, as between the *Bark* and the *Body*. Now the *Ascent* of *Sap* is by all *Parts* and *Pores* of the *Tree* in such small *Quantities*, as can hardly be *Discerned*, unless the *Tree* be quite *Sawed off*; especially near the *Root*: for then it will appear, how it *Ascends*. In *Birches*, and such like, the *Sap* issues very plentifully in all parts of the *Body*, when they are *Cut down* near the *Root*.

The *Bark* is *Double*, *Outward* and *Inward*. The *Outward* is *Dry*, and in some *Trees* *Rough*: The *Inner* is probably a *Superadded* *New Coat* of that *Years Growth*, or something like it, between the *Nature* of *Wood* and *Bark*. The *Sap* *Rises* within and without that *Superadded Coat*.

To perfect the *Experiment* about *Sap*, and to find, whether it *Ascends* more or less in the *Prickt-Circles* of the *Body*, than in those betwixt the *Body* and the *Bark*; let the *Tree* exempted from all its *Sap* the *Day* before, be first *pierced* with an *Auger*, only through the *Bark*, and the *Quantity* of *Sap* it yields in an *Hour* exactly *Measured* and *Weighed*: then, at the same time, let another *Hole* be bored into the *Body* of the *Tree*, above an *Inch* and an *half* deep; and so round about on every side of the *Tree*, some *Deeper*, and some *Shallower*, with a good *Large Auger*; and *One* quite through, *Sloaping*. From which *Experiment*, after various *Tryals*, may be found the *Difference* of the *Sap*, *Rising* on the *North* and *South*; and so likewise of that which comes from the *Bark* only peel'd off, and That which *Ascends* in the *Inner Part* of the *Tree*. The *Weight* may also be compared of That which issues from the *Bark*, with That which *issues* from the *Body*. The *Internal Heart Sap* may also be drawn apart, by *Boring* a smaller *Auger-Hole* in the *Middle* of a *Greater*, and fitting it with a *Long Pipe* adjusted to that *Inner Orifice*. n. 46. p. 913.

5. *Dr. Beal* saith, experimentally, that if a *Circle* be drawn round about any *Common English Tree*, as *Oak*, *Elm*, *Poplar*, &c. by *Incision*, to the *Timber* (how thin soever the *Knife* be) so that no part of the *Rind* or *Bark*, to the very *Solid Timber* be *Uncut*, the *Tree* will *Dye* from that *Part* *Upwards*. Only the *Ash*, (of all that I could *Try*) will *Grow* on, and *Prosper*, notwithstanding the *Incision*. My *Brother* (*T. B.*) shew'd me some *Old* and *Huge Ashes*, which were *Bared* of the *Bark* by the *Deer*, from the *Root*, 4 *Feet* upwards, quite round, yet they had, continued their *Growth* many *Years*; and some parts of the *Bark*, which were *Left* in *Few Places* not so *Broad* as the *Palm* of my *Hand*, had a *Fresh Verdure*, more *Lively* than the *Parts* of the *Bark* which remained above the *Baring*. Yet if some *Incisions* by *Hackings* be made, or if the *Branches* of some *Fruit-Trees* (especially the *Gennet Moyle*) be quite *Bared* under a *Knot* near the *Body* of the *Tree*, and that *Knot* and *Bare part*, be well *Cover'd* with *Loame*, or *Good Mould*, in *June*: that *Branch* will not only *Survive*, but will be apt to take *Root*, and become a *Young Tree*

Tree of Speedy Growth, if Cut off below the *Baring*, and set at a fit depth at the end of *Autumn*; or about *Candlemass* rather. Where such *Transverse Hackings* are made, or *Contusions* in the *Bark*, many *Vegetables* are apt to gather *Knobs*, and sometimes Small *Branches* will spirt out above, and sometimes about the Part *Contused*. To get the *Gum* of the *Plum Trees*, I have sometimes *Wrenched* the *Branch*, till the *Solid Timber* hath Crackt, and the *Rind* forced open in some Parts; so leaving it to Grow, but forced to continue in a Posture somewhat *Wreathed*, it hath not failed to yield me store of *Gum* next Summer.

Vid. inf. Sect.
LXIX.

Dr. T. A *Branch*, whose *Bark* of the breadth of about 2 or 3 *Inches*, is taken off round towards the *Bottom*, in some *Trees*, and particularly the *Lime-Tree*, will *Live*, and bear *Leaves* for many *Years*; and *Grow*, as other *Branches*, by means of the *Sap Ascending* through all the *Pores* of the *Inner Coats*, as was said in the 3^d *Observation*.

6. The *Juyce* which descends by *Tapping*, and which maketh the *Pulp* or *Coat* of any *Fruit*, *Ascends* by the *Bark* or *Rind* of the *Plant*, and not by the *Pith*. But I can affirm, by many *Experiments*, that the *Pith* and the *Timber* have some *Correspondence* with the *Seed* of the *Plant*, to convey an *Intercourse* of the same *Spirits* and *Nature* from the *Root* to the *Seed*. Dr. B.

Dr. T. saith, That *Piths* are of a very different *Nature* and *Substance*; In the *Walnut*, is a multitude of *Films* manifestly distant from one another; In Others, as in *Elders* and *Briars*, 'tis a continued *Soft*, *Loose*, *Dry Substance*.

7. The *Points* or *Ends* of the *Roots* being *Cut off*, they will in *Proportion Bleed* as copiously, as the *Branches*, and probably more; certainly *Longer*, because there is *Greater Plenty* of *Juyce* *Ascended* above Them, than the *Branches*, and consequently more will *issue* by Them, than by any part of the *Tree* *Higher* than Them. Dr. T.

8. From the *Latter End* of *Jan.* to the *Middle* of *May*, *Trees* will *Bleed*. Those that are said to *Run First*, are the *Poplar*, *Asp*, *Abele*, *Maple*, *Sycamore*; some, as *Willows*, and the *Birch*, tryed by my self, are best to *Tap* about the *Middle* of the 2^d *Season*; and the *Walnut*, toward the *Latter End* of *March*. They generally *Bleed* a full *Month* in the whole. Mr. *Midford* of *Durham*, a very *Expert* *Gatherer* and *Preserver* of *Saps*, affirms, that the *Saps* of the *Poplar* and *Asp* *Rise* so briskly in *January*, that they will *Bleed* before the *End* of that *Month*; the *Sycamore* will *Run* in *Hard Frost*, when the *Sap* *Freezes* as it *Drops*. Dr. T.

By. Dr. Tong.
n. 43. p. 862.
n. 44. p. 880.
n. 58. p. 1199.

9. The best *Time* of the *Day* for *Tapping*, is about *Noon*. In the *Latter Season*, when *Sap* is not very *plenteous* in *Trees*, they will neither *Run Morning* nor *Evening*, nor probably at any time of the *Night*; but when they are very *Full* of *Sap*, and *Emptied* but by small *Vents*, the *Sap* may *Run Night* and *Day*, till *Exhausted*; but never in large *Vents*. I have often observed, that when a large *Walnut* would yield no *Sap* any longer in the *Body* or *Branches* at any time of the *Day*; it would run longer at the *Roots* on the *South* or *Sunny* side, than on the *North* or *Shady* side, constantly governing the *Course* of its *Sap* in its beginning to *Rise*, and to stop daily at the *Rising* and *Setting* of the *Sun*.

10. *Trees* afford no *Juyce* at all (that has been Observed) in *Autumn*: But *Birch-Trees* Bored in the *Spring*, so late, in respect both of the Year and Day, that they have afforded no *Sap* at all at the *Body*, have been found some Time after, to have Issued such Plenty of *Juyce*, as hath Condensed in the *Hole* to a stiff *Gelly*.

11. *Rain* being scarce, the *Juyce* will be scarcer. Plenty of *Rain* can only give such Plenty of *Sap*, as the *Pores* will admit. And too much *Cold Rain* may, by *Over-cooling*, Hinder the *Sap*, by abating from the degree of *Heat* necessary to the *Pulsion* of *Sap* into the *Root*, and to the *Digestion* in the *Tree*: which is also in *Watering*. On this Ground it seems probable, that *Drawing Sap* constantly from *Trees* every Year, will not hinder their Growth, in *Body*, *Branches*, *Leaves*, nor *Fruit*, to any great *Prejudice*; for *Pulsion* will still supply *Juyce* into the emptied *Pores*, till their Capacity be Filled. It is also Possible, that *Trees* may grow better, and give more *Fruit*, if the Right Art of *Drawing Sap* be found out for that end; as some Persons grow *Fatter* by often *Bleeding*.

12. In the Change of the Nature of a *Tree*, the Application of *Juyces* is, n. 44. p. 877. in my Opinion, not otherwise considerable than from the Scarcity, Plenty, or Goodness, of the *Nourishment* of such *Juyces*; not from the *Taste*, or *Relish* in them. Yet probably *Hot Nourishments*, whether in *Juyces* or *Earths*, may digest the *Sap*, and consequently the *Fruit* better in *Trees* of *Flashy Fruit*, than in *Others*; and *vice versa*. In the mean time to change the *Taste* of *Fruit*, the probablest way may be thought not very *Hopeful* to *Bore* the *Roots* and the *Body*, downwards and *Transverse*, and to fill the *Holes* with Plenty of its Own or some other *Tree's Sap*, in which some *Aromatick Substances* have been strongly *Infused*.

13. If no *Rain* come to the *Roots* of *Trees* at all, nor other *Moisture*, they will not *Grow*: but if the *Points* of the *Roots* only be *Watered*, though all the rest remain *Dry*, (as it happens naturally in *Fir-Trees*) they may *Grow* very *Well*. For the *Points* of the *Roots* shoot out Yearly a sharp pointed tender Part, somewhat like the *Sharp Bud* on the End of a *Sprig*, by which the *Root* not only *Enlarges* it self in the *Earth*, as the *Branches* do in the *Air*, but also receives its *Nourishment*: And that tender part moves its self towards the *Best Moistned* and the *Tenderest Earth*. So that to promote the *Growth* of *Trees*, 'tis very *Effectual* to loosen the *Earth* about the *Points* of the *Roots*; and there also to *Minister Nourishment* or proper *Liquors*; and this intrenches where the *Amendment* may remain, rather than above; throwing out the *Dead Mould* out of the *Trenches*, and spreading it above to kill *Weeds*.

14. The *Roots* of *Plum* and *Lime-Trees* *Inoculated* upon, will shoot out their *Buds*; as I have experimented. I failed of *Success* in the *Walnut*, in regard I think I had not well provided for what was necessary to keep the part *Inoculated* from the *Moisture* of the *Earth* and *Rain*. To make a *successful Trial*, suppose in an *Alkermes-Oak* (a *Delicate Tree*, and *Difficult* to be otherwise *Inoculated* upon,) Let the *Root* to be *Grafted* on, be Bared in the *Fall* of the *Leaf*, taken out of the *Earth*, and at convenient *Distance* from the *Body* of the *Tree*, *Bow'd*, and *Raised* a *Foot* above the *Earth*; and then the *Points* and *Fibres* of the *Root* carefully laid about with *Fresh Earth*, and *Water'd* till they take

take well, and till the *Root* raised in the Air have a *Bark* like that of a *Branch* of a *Tree*; which probably it will get in the next Season of *Inoculation*. The *Inoculation* it self is made on the Part Raised after the ordinary way. When 'tis done, let it be carefully covered with some *Soft Wax* (as is known) to Defend it from the *Rain*; it is to be stopp'd, and order'd in all things, as in other *Inoculations*.

15. The *Arms* of the *Roots* of *Trees* are to be Cut for the Advantage of their Growth, according to the proportion they have to their *Head* and *Body*; or according to the Design you have to encrease *Wood* or *Fruit*. For such *Roots* as are more *Outward*, feed *Wood*; such as are *Inward*, the *Fruit*.

16. The *Depth* of *Trees* to be set, should never be below the reach of the *Sun's Heat*, nor the Goodness of the *Mould*; and rather too shallow than too deep; for as much as they are apter to sink lower, than to raise themselves *Upwards*, if they be out of the convenient reach of the *Sun's Heat*, the Cause of *Pulsion* and *Nourishment*.

17. The *Seeds* of *Fir*, *Pine*, &c. which bring up the *Shells* of their *Seeds* upon the *Heads* of the *First Shoot*, will either not grow at all, or difficultly, if the *Blunt End* be put *Downwards*; because in that Posture it must Turn it self, before it can Emerge into the Air, for the *Root* is shot downwards at the *Sharp end*: But it may very well Grow, if set *Horizontally*.

18. Such *Trees* as were mentioned in the *first* Observation, may Grow, though no part of the *root* be in the Earth. And all such as may be Propagated by *Short Sticks* cut off at both Ends, and laid in the Ground, as *Mulberries*, will do so. Some young *Plants*, if their *Heads* be kept moist, will live all Winter, if mild, though their *roots* be in the *Air*, as I tryed in Seedlings of *Apples* and *Crabs*. Their *roots* set afterwards in the *Spring*, Grew and Lived. The Reason why some *Plants* grow in *Sticks*, may be the softness of such Wood, apt thereby to receive *Nourishment* like a *root*, and to shoot out *roots* and *Fibres* from themselves. But in some *Slips*, taken from firmer Wooded *Trees*, as *Bayes*, a Moist Temperate Season is to be observed; and some Stone, or Chip of some Wood, to be closed to the end of the *Slip*, and set in the Earth with it, which helps its *rooting*.

n. 46. p. 913.

19. I am inform'd by a Curious and Intelligent Person, that the *Corruption* of *Timber* depends not upon the *Time* of the *Year*, and the *Ascent*, or the *Plenty* or *Scarcity* of *Sap*, so much as upon the Season of the *Moon* or *Wind*. And he affirms that *Timber Trees* Fell'd when the *Wind* is in the *West*, especially in the *Old Moon*, will keep them free from *Grubs* (as they call it) *i. e.* from being *Worm-eaten*; and on the Contrary, that when cut down in an *East Wind*, the *Worm* will seize on them, in what Season of the *Moon* soever it be fell'd. To prevent which *Corruption*, 'tis advised that such *Timber* should be forthwith Thrown into *Water*.

20. *Ethelbert Fay*, an Ingenious and expert Planter in *Lemster*, supposeth, that the fittest time to *Inoculate*, is presently after *Mid-Summer*, becaule (saith he) the *Sap Descends*; but I say, because 'tis then most plentiful, and begins to *Jelly*. The same ascribes it to the *Sap ascending*, to take the *Bud inoculated* before *Mid-Summer*; and to the *Sap Descending*, to take it after *Midsummer*.

The

The time he limits to a few Days before *Mid-Summer*, and to 8 or 10 Days after it. Mr. *Austin* limits 14 Days before, and as many after, and would have the *Bud* Unty'd after 14 Days, as I remember.

It is all one, whether the *Sap* be exhausted Below, by being converted into *Wood*, *Roots*, and other *Uses*; or by *Diversion*, as when the *Branch* is cut, or the *Bark* Opened Below: The *Sap* in both Cases *Descends*, or rather *Sinks* indifferently, to supply the *Defect*, and Heal the *Wound*, and so it comes to pass, that there being about *Mid-Summer* the Greatest Plenty of *Sap* in *Apple Trees*, a *Bud* then *Inoculated* will Thrive, especially Before *Mid-Summer*; for then it draws its Share in the *Sap Ascending*, and all the Necessary *Uses* of the upper *Branches* being served, it partakes of the *Flood* of the Abounding and Superfluous *Sap*, remitted to it from them.

21. My Friend informs me that to Cut off the *Head* of the *Stock*, Above the *Inoculated Bud*, will make a Better *Shoot*, than in the Usual *Inoculation*; if this be done a Few Days before *Mid-Summer*.

22. If the *Sap*, in its *Subsiding*, be Considerable in the matter of *Inoculation*; it seems, that *Inoculation* will hold best and Longest in Season, in the *Root*.

For I have Observed the *Sap* to *Subsile* unto the *Roots* out of the *Body* at such times of the Day and Year, when in the *Branches* I found none to Spare.

23. To make a *Barren Tree* Bear again, Cherish it with *Dung* in *Trenches*, and Pare and Renew the Extremities of its Longest *Roots*, and Cut off the Outermost and Shortest, nearest the *Body*. Hence it may seem, that *Plowing* helps *Fruit-Trees*.

24. *Cross-Hackings* promote Fruitfulness, Cure the *Phyllomania*, whereof the Reason seems to be, that (as was above intimated) *Outward Circles* and *Barks* feed the *Wood*, and the *Inner* onely reach out to the *Outermost Sprigs* of the Last Year, to which the *Fruit* is Appendant. For some *Trees* Bear Only on this Years *Shoot*; and some Only on that of the Last; possibly some Only on the 3^d. Years *Shoot*; and Cease *Bearing* when they Shoot no New *Sprigs*. Seasonable *Baring* the *Roots*, which they call *Ablaqueation*, probably hath the same Effect, because it hinders the *Nourishment* especially of the *Outward Coats*, and of *Bark*, *Leaves*, and *Suckers*: But because it seems that as some *Suckers* or *Shoots*, lately Sprung in *Outward Coats*, Robb the *Fruit* of the *Risen Juice*; so *Later Roots*, come from the *Outward Parts* of the *Main Roots*, Rob them also of their First *Nourishment* in the Earth. They ought to be *Pruned*, as well as all *Suckers* and *Not Bearing Branches* and *Sprigs*, every Year. For which Reason also *Dung* and other *Amendments*, as was said above, ought to be applyed in *Trenches* nigh to, and beyond the Farthest *Points* of the *Roots*; to Draw them out of the *Shade* and *Drops*. To this end, *Distance* and *Situation* is to be Observed.

25. One of the best Ways of obtaining the Greatest Store of *Sap* in the Shortest Time from the *Body* of any *Tree* is, not only to Pierce the *Bark*, nor to Cut the *Body* with a *Chizel* almost to the *Pith*, (as some have directed) but quite thorow all the *Circles* and the inner *Rind* it self, on both sides of the
Pith,

Pith, leaving only the Outermost *Circle* and the *Bark* on the North-East side Unpierced. But this *Hole* is to be bored Sloaping Upwards, as lar geas the Biggest *Auger* you can get will make; and that also thorough, and under a Large *Arm*, near the *Ground*. So will it not need any *Stone*, to keep Open the *Orifice*; nor *Spigot*, to direct the *Sap* into the *Receiver*. This way the *Tree* will in short time afford *Liquor* enough to *Brew* with: And with some of these *Sweet Saps*, One *Bushel* of *Malt* will make as Good *Ale*, as 4 *Bushels*, with Ordinary *Water*; though you should *Brew* even in *March*, held the properest time for *Brewing*, in regard of the Goodness of the *Water* at that Season. *Sycamore* I take to yield the Best *Brewing Sap*, being very Sweet and Wholsome.

26. To Preserve *Sap* in the best Condition for *Brewing*, what you Gather First, must be *Insolated* by a constant Exposure of it to the *Sun* in *Glasses* or other Fit *Vessels*, till the Rest be Gathered and Ready; Otherwise it will soon contract an *Acidity*. Having been thus Exposed to the *Sun*, till a Sufficient Quantity is Collected; put into it so much very thin Cut and hard Toasted, but no ways Burnt, *Rye Bread*, as will serve to *Ferment* it; and when it *Works* take out the *Bread*, and Bottle the *Liquor*, Stopping it up with *Waxed Corks*: If you Bake *Sage*, or any other *Medicinal Herbs*, in such Thin *Rye-past*, till they be very *Dry*, you may expect a very Wholsome *Drink*. If you put a few *Cloves* in every *Glass*, into which the *Sap* Runs from the *Tree*, it will certainly Keep a *Twelvemonth*: But I have Wondered, whilst I Observ'd how Speedily it Drew the *Tast* and *Tincture* of the *Clove*. In some Few Bottles I was so Happy as to draw out my *Cloves*, with a *Cloth* in which I ty'd them up, in such a Season, as not to change *Colour* nor *Tast*; and yet I preserved the *Birch-Sap* by that Slight *Fermentation*; above a *Twelve-month* without any Alteration; which else would have *Soured* in a Few Days.

27. Some propose *Oyl* of *Sulphur* to perfume the *Bottles* with.

28. *Spirit* of *Wine* Ferments the *Juyce* of some *Berries*, and possibly may not only Preserve but Advance the Vertue of *Saps*, a little being poured on the *Top* of them in the *Bottles*; or some other *Oily-Spirit*.

29. *Raisins* infused in the *Liquor* of *Birch*, is one ingredient of the *Durham Gardner*. I have been informed, that he uses *Sugar*: But I believe, he puts it not in till he opens a *Bottle* presently to be Drunk, because it maketh the *Liquor* Sparkle in the *Glass*.

30. A certain *Lady* Ferments it with *Rye-Toast*, not put in, but only hung Over it, in such Quantity and at such Distance, as may give some light Warmth, Motion and Alteration to the Surface of the *Liquor*.

31. I Fermented some with *Ale Barm*, which Converted my Delicate *Birch Juice*, kept in *Bottles*, into Pitiful *Small Beer*: Which I wondred at; for I knew One, who used, by the *Barm* of *Ale*, to improve *Small Beer*, and thereby to keep it the better in *Bottles*.

32. *Hony* will not mix with *Cyder* though Boyled therein to make *Meath*; but after a while the *Cyder* lets fall the *Hony*, and becomes Simple *Cyder* again.

33. Some affirm, that the *Tops* and *Leaves* of *Birch* Decocted in the *Sap*, will

will Preserve it from Sowing the Whole Year; and that any sort of Dried *Aromatick Herbs*, as *Sage*, &c. boyl'd in *Beer*, will keep it as well as *Hops*, *Ling*, (*Heath*) *Broom*, or *Worm-wood*. I had a Friend who used *Bay-Leaves* in his *Beer* and *Ale*.

34. The *Asps* Run only (as Mr. *Midford* relates) before *February*; the *Hopp*, about *Hopp Harvest*; *Withies*, in *April*. n. 58. p. 1199.

35. In those *Trees*, whose *Sap* seems to be of a *Gummy Nature* when condensed, as *Plums*, *Cherries*, &c. I know no Experiment, by which any Drop of *Sap* can be Collected. And I suspect, some other *Fruit-Trees* to be of that Nature, whose *Sap* I could not Draw out, at any Season, of *Hot* or *Cold* Weather, though they have not been observed to yield any *Gum*. Perhaps there may also be some *Fruit* and other *Trees*, whose *Saps* are *Viscous*, though not *Gummy*; and these, I doubt, will not yield any *Sap* to be Gathered in any Common or known Way. n. 68. p. 2072.

36. It is not *Feasible* to gather all the *Sap* of those *Trees*, whose *Juice* is *Fluid* and *Plentiful*, and *Condenseth* into a *Gelly*; because it seems at Most Seasons of the Year to *Ascend* imperceptibly; and that not Only in the *Outward*, but *Innermost* Parts and *Pores* of the Tree; not only betwixt *Bark* and *Wood*, but betwixt every *Coat* of the *Wood*, and even through the most *Solid* Parts of each *Coat*; as Mr. *Willoughby's* Observations have Discovered. Vid. inf.

37. An *Eminent Planter* in *Glocestershire* has discovered to us, that by *Binding* the *Trees* round about very *Closely* and *Strongly* with *Cords*, so as to *Intercept* what *Riseth* 'twixt the *Bark* and the *Body*, he *Retards* their *Blossom* and *Bearing*: And so may in some Years (when the *Open Weather* hastening *Blossoms* is like to *Destroy* the *Fruit*) *Prevent* a *Scarcity* of forward *Fruit*, usually *Nipped* by the *Late Frosts*.

38. I kept some *Sap* in a *Large Retort* of 2 or 3 *Gallons*, exposed *Night* and *Day* (without any other *Stop* than the *Obliquation* of the *Retorts* Neck, and a little *Paper* to keep out *Insects*,) many *Months*, and it *Contracted* a *Coat* on its *Top*; the *Tast* pleasing my *Palate*, I *adventured* to *Brew* with it at *Cider-Season*, and made a good *Quantity* of good *Cordial Drink*, with 8 *Bushels* of *Chopt Apples*, *Brewing* them like *Malt* with *Hot Water*, and putting my *Juyces* and *Saps* into my *Water Cyder* at the latter end of their *Boyling*. I filled a *Stand* with it, which contained half the *Quantity* of the largest *Rbenish-Wine* Vessel, viz. about 40 *Gallons*, as I remember. I had not half *Sap* in this *Liquor* (the greatest part of my *Brewing* being made with *Water*) yet I got 5 *Bushels* and more of *Warming Cordial* and *Pleasant Drink* for every *Bushel* of my *Apples*. If it had been all *Sap*, it would have been much more *Cordial* and *Strong*. There was in it a *Considerable Quantity* of *Juyce* of *Borrage-Roots* and *Herbs* (at that *Season* usually thrown out of *Gardens*,) which *Borrage Liquor* *Works* and *Purges* it self when *Tunned*, and *Turns* into an excellent *Clear Brown Liquor*. I drank my *Drink* in *Easter* following: So my *Sap*, Gathered at *Spring*, and *Brewed* about *Michaelmas* continued *Good* till *Easter*, and after it. ib. p. 2075.

39. Some affirm, that the *Dividing* of *Crab-Stock-Roots*, from the *Stem* left in the *Ground*, is the best way of *Multiplying Crab-Stocks*, or a *Com-mendable One* at least.

40. 1. I have heard that a *Chip* of *Soft-Wood*, laid to the end of a *Bay-Slip*, promotes its *Rooting*: And that *Mulberry Slips* are easily *Propagated*, set in the *Latter End* of *January*, or *Beginning* of *February*, in a *Moist* season, not in a *Dry March*. Such *Slips* *Root* best, if they be *Suckers*, and taken off with part of the *Old Bark*; or if they be *Last Years Shoots*, *Cut off* from *Arms*, taken with some *Older Bark* from the place where they shot *Out*. I have set many formerly, which all *Throve*. I affect to *Propagate* them for *Pear*, and other *Stocks*, namely *Quinces*, *Medlars*, *Plums*, to turn their *Pulp* and *Juice* *Red*, by taking *Grafts* from such *Trees*, as have been *Grafted* on *Mulberries*. Per-haps the *Blood Red Pears* and *Red-Redstrakes* were thus *Raised* at first, or may be thus *Propagated* to *Advantage*.

By Mr. Fr. Wil-
loughby and
Mr. Wray. n.48.
p. 963.

2. 1. In *Birch* *Trees*, the *Sap* issues out at the *Least* *Twiggs* of *Branches*, and *Fibres* of *Roots*, in proportion to their *Bigness*.

2. In all *Trees* the *Gravity* promotes the *Bleeding*; so that from a *Branch* or *Root*, that *Bends* *Downward*, there will issue a great deal *More Sap*; than from another of the same *Bigness* in a more *Erect* *Posture*.

3. *Branches* and young *Trees* *Cut* quite off when they are *Full* of *Sap*, and held *Perpendicularly*, will *Bleed*; as we *Experimented* in *Willow*, *Birch*, and *Sycamore*: And if you *Cut off* their *Tops*, and *Invert* them, they will *Bleed* also at the little *Ends*. Hence one may conjecture, that the *Narrow-ness* of the *Pores* is not the sole *Cause* of the *Ascent* of the *Sap*; for, *Water* that hath *Ascended* in the little *Glass Pipes*, will not fall out again by its own *Gravity*, if the *Pipes* be taken out of the *Water*.

4. *Roots* of *Birch* and *Sycamore* cut asunder will *Bleed* both ways, that is, from that part *Remaining* to the *Tree*, and from the part *Separated*: But a great deal *Faster* from the part *Remaining* to the *Tree*. But in a *Cold* *Snowy* *Day* the *Root* of one *Sycamore*, we had *Bared*, *Bled* *Faster* from the part *Separated*; and *Ten* times *Faster* than it did in *Warm* *Weather* before.

5. In *Birches* the *Sap* does not issue out of the *Bark*, be it never so *Thick*, but as soon as ever you have *Cut* the *Bark* quite through, then it first begins to *Bled*.

6. The *Bark* being quite *Pared* off above an *Hands* breadth *Round*, about several *Birches*, did much abate the *Bleeding* of the *Trees* above the *Bared* places, but did not quite stop it.

7. The *Sap* doth not only *Ascend* between *Bark* and *Tree*, and in the *Pricket* *Circles* between the several *Coats* of *Wood*; but also through the very *Body* of the *Wood*. For, several young *Birches* being nimbly cut off at one *Blow* with a *sharp* *Axe*, and white *Paper* immediately held hard upon the *Top* of the remaining *Trunk*, we stuck down *Pins* in all the points of the *Paper* as they appeared *Wet*: and at last, when the most of the *Paper* became *Wet*, taking it away, but leaving the *Pins* sticking, we found them without any *Or-*
der,

der, some in the *Circles*, and some in the *Wood* between. And to confirm this further, we caused the Body of a Tree to be cut off aslope, and then cut the Opposite side aslope likewise, till we brought the Top to a narrow Edge; ordering the matter so, that the whole Edge consisted of part of a *Coat of Wood*, and had nothing of a *Prickt Circle* in it, which notwithstanding, the *Sap* Ascended to the very Top of this Edge, and wetted a Paper laid upon it.

8. To find out the *Motion* of the *Sap*, whether it *Ascended* only; or *Descended* also, we bored a Hole in a large *Birch*, out of which a Drop fell every 4th or 5th Pulse. Then, about a Hand's breadth just under the Hole, we saw'd into the Body of the Tree, Deeper than the Hole: Whereupon the *Bleeding* diminished one *half*; and having Saw'd just Above this Hole to the same Depth, the *Bleeding* from the Hole Ceas'd quite; and from the Saw'd Furrow below Decreased about *half*: And it Continued *Bleeding* a great while after at both the saw'd Furrows, the Hole in the middle remaining Dry. We Repeated this with much the like Success upon a *Sycamore*

9. Some Trees of the Same Kind and Age *Bleed* a great deal Faster and sooner than others; but always Old Trees sooner and Faster than Young.

10. A *Wound*, made before the *Sap* Rises, will *Bleed* when it doth Rise.

11. While we were making these Experiments, the Weather Changed from *Warm* to *very Cold*; whereupon the *Bleeding* in the *Birches*, which begun to Abate before, Ceas'd quite: But all the *Sycamore* and *Walnut Trees*, we had Wounded, *Bled* abundantly; (some whereof *Bled* not at all, and those that did, did so but Slowly;) and so continued Night and Day, when it Froze so Hard, that the *Sap* congealed as fast as it issued out. The *Cold* Remitting, the *Birches* *Bled* Afresh, the *Sycamores* Abated very much, and the *Walnut Trees* quite Ceased.

12. We Pierced two *Sycamores* on the *North* and *South* sides, and both of them from equal Incisions *Bled* a great deal faster from the *North* sides, than the *South*; which is Consonant to the Preceeding Experiment.

13. We set several *Willows* with the *Wrong* Ends *Downward*, and cut off several *Bryars* that had taken Root at the small Ends. This 29th of *May* 1669. the *Willows* have shot out Branches near Two Foot Long; and from the Top of the *Sets*, which were a Yard high: the *Bryars* have also grown Backwards, from that part which we left remaining to the Roots at the *Lesser* Ends; they have great Leaves, and are ready to Flower.

14. Dr. *Tonge* found, by His Experiments in the Roots and Branches of Trees, that not only *Cold* Weather but *Cold* Wind and *Sunsetting* stopped or Abated the *Motion* of *Sap* in the *Sycamore*: But His Experiments were made in *February*, and Ours towards the End of *March*. The *Cold* which caused that increase of the *Bleeding* in the *Sycamore* and *Walnut*, happened upon the 23, 24, 25, 26. of *March*; and one *Sycamore*, which Ceased to *Bleed* from the 11th of the same Month, *Bled* afresh copiously from Wounds that had been made so long before. The Buds before the *Cold*, were just ready to open into Leaves, and the *Sap* had begun to Coagulate above Fortnight before. In *Jan.*

By Mr. Willoughby. n. 57. p. 1165.

16⁶⁹/₇₀ making Incisions in the *Sycamore* and common *Maple*, immediately upon the Relenting of the first Frost, we found that they both *Bled*, and faster, as the Weather grew *Hotter*; nor did the succeeding *Cold* Promote, but rather hinder their *Bleeding*. So that the Learned Dr. doth most ingeniously conjecture, that the *Ascent* of the *Sap* in Trees, depends upon a certain Degree of *Heat*, sufficient to Raise, but not to Coagulate their respective Juices. In those Months, wherein the *Heat* ordinarily falls short of that Degree, an Accidental *Heat* or *Warmth* of Weather Promotes the Bleeding; but in those Months, wherein the ordinary Temper of the Air Exceeds that Degree, an Extraordinary fit of *Colder* Weather makes them *Bleed* again.

15. In *Walnut-Trees*, we never yet found, that *Heat* Promoted their *Bleeding*, but always *Cold*. From a Wound, made in a *Walnut-Tree*, in *Jan.* and the Beginning of this present *March* 16⁶⁹/₇₀, in Mild Weather, nothing Issued: But the Weather Changing and growing *Colder*, it *Bled* plentifully.

16. *March* 11. 166³/₃ Roots of *Birch*, great and small, *Bled* both ways; and about the same time, *Sycamore* Roots also. The same *Birch* which first began to *Bleed*, *March* 3. 16⁶⁹/₇₀: *Bled* Three Weeks sooner the Year before.

17. It was observed in *Autumn* 1669. by Mr. *Mart. Lister*, that upon the first *Frost*, which happen'd in *November*, a *Sycamore* *Bled* copiously; so that the *Sap* cannot be said to Rise in *January*, but immediately after the *Fall* of the *Leaf*, in this Tree.

n. 58. p. 1199.

18. After the Leaves were Explicated in the Year 1670, we Observed the *Sycamore*, after several *Frosty* Nights to *Bleed* afresh in the Morning, soon after *Sun-rising*, when it had Ceased several Days before; though this must not be understood of all *Sycamores*, but of some only that are more sensible and Observant of the Weather.

April 3, and 4. all the *Sycamores* quite Ceased.

The 5th being after a *White Frost*, they began to *Bleed* about 8 a Clock, and Ceased towards Noon.

The 9, 12, 13, 15, they *bled* again.

The 16, they *bled* not, it being *Rainy*, and the Sun not shining.

From the Observations we have hitherto made, we think it may be certainly inferr'd, That a *Morning Sun* after a *Frost*, will make all the *Bleeding Tribe* *Bleed* Afresh, though they had before Ceased; and that this New *Bleeding* towards the latter end of the Season commonly Ceaseth before Noon. Possibly some may *Bleed* after a *Frost*, yet further in the *Summer*.

19. I observed in *August*, a Copious and spontaneous Exsudation, very like *Bleeding*, of a Viscous Yellow Juice out of the *Buds* of a *Black-Poplar*.

20. Our *Wallnut-Trees* *Bleed* here at *Middleton* in *Warwickshire* in *January*.

By Dr. Tonge.
n. 68. p. 2070.

21. I am very much confirmed in my Apprehensions, that Trees and other Plnts, if we could Contrive them, as I have (but slenderly) Projected in my *Sap-wiser* to that Purpose, would far better indicate the

Alter-

Alteration of *Weather*, as to Heat, Cold, Moisture, Drought, than any *Weather-Glasses* I have yet Experimented. For my *Weather-Glass* continuing at one and the same station, in a manner all this Day (April 13. 1670) my Trees have Altered their Temper so much, that 24 of them, that Ran tollerably this Forenoon, yield not a *Pint* of Sap this Afternoon; and though one of them Ran most part of the Day, the Rest Ceased about one or two of the Clock in a Fair, Clear, *Sun-Shiny* Season retarded (so far as I could Observe) only with a *Western* Wind, though that be Reputed Mild and Cherishing.

These Trees Ran above 2 *Quarts* in the Morning; the *Weather-Glass* continues the same, *viz.* about 11 *Inches* Water, these two Days. *Thursday* 14. it was $9\frac{1}{2}$ only.

Friday 15. My *Weather-Glass* at Noon was advanced from 9 to $10\frac{1}{2}$, yet the Quantity of *Birch Water* this Day Exceeded my former from these Trees; for I had above $2\frac{1}{2}$ *Quarts* before Noon.

But for Cold, I find that the Air, when any whistling Blast of *Cold* Wind stirs, stays my *Birches*.

Saturday Apr. 16. These 24 *Birches* began to run presently after *Sun-rise*, and ran about 3 *Quarts*, and Ceased about 2 a Clock after Noon; having till then continued to Run.

Sunday 17: It Rained so, that we could make no Observations what Sap these Trees might spend; neither did Rain and all amount to much above a *Gallon* and a *half*. *Monday* 18. They ran until Noon. *Tuesday* and *Wednesday* the 19 and 20, wherein was expected greater Store of Sap, after the Rain, the Trees spent not a Drop.

Saturday Apr. 23. My *Weather-Glass* stood at $7\frac{1}{2}$, it being a *Rainy* and Boisterous Morning, the Rain not allaying the Wind. At 9 a Clock of that Forenoon, my *Birch-Water* worked in the Barrel, *per se*, which seems to verify Mr. *Souton's* Relation from his Brother, a *Swedish* Merchant, importing that *Birch-Water* in *Sweden* worketh alone, (perhaps collected in great Quantity.) Only I put a very few *Cloves* into my Sap. Boil'd to a Third or less, it Keeps well, especially when Boil'd with the *Buds* or *Sprigs* of the same Tree, as I have been Informed.

April 16, 17, 18. In the Year 1670. *Birch-sap* mixed with *Rain Water* at the Tree, Fermented, with *Rosemary Sprigs* steeped in *Spirit of Wine*; which warmed the Stomack as strong *Wine*, and Pleas'd the Palate; though the Taste in the Mouth was somewhat Waterish.

22. We find that Branches of *Willow*, *Birch*, and *Sycamore*, Cut off and held perpendicularly, will Bleed without *Tipping*; and that the cutting off of their Tops does not sensibly Promote the *Bleeding*.

By Mr. Fr. Willoughby, n. 70. p. 2125.

We doubt not of Mr. *Lister's* Diligence and Veracity, and wonder our Experiments should Differ. The *Sycamore* Bleeds upon the first considerable *Frost*, after the *Leaf* is fallen, as it did plentifully *Nov.* 16. 1670. And both that, *Walnut*, and *Maple*, bleed all Winter long after *Frosts*, when the Weather Relents, and the Sun shines out; but *Walnut* and *Maple* Begin not so soon as the *Sycamore*. The *Birch* will not Bleed till towards the

Vid. Inf.

Spring

Spring. An. 167^o. it Began something sooner than ordinary about the Beginning of Feb.

Ib. p. 2142.

23. In a very sharp Frost the Bleeding is stopp'd till the Weather begins to Change; but in a Moderate Frost, though it stop in the Night, yet in the Day time, if the Sun shines out, the Trees will bleed, though the Frost continue. What we said formerly that Cold did not Promote, but Hinder bleeding; we find holds True, if the Cold be without Frost.

Ib. p. 2126.

24. We Cut off pretty big Branches of Birch, and having Tipp'd the Ends, Inverted them, and fastened a Limbus or Ring of soft Wax to the great Ends, which we held Upwards, making with the Plane of the End, a Vessel of about an Inch Deep, whereinto we poured Water, which in a few Minutes sunk into the Pores of the Wood, and running quite through the length of the Branch, Dropped out of the Ends considerably fast, continuing so to do as long as we poured on Water. The like Experiment we made by Fastening such Rings of Wax to the Lesser Ends, and pouring in Water, which ran through the Wood, and dropp'd out of the greater Ends as fast or faster. This we try'd Once upon a Sycamore without success: But afterwards I made Tryal both upon Sycamore and Walnut, and found that Water runs through both, but nothing so Fast as through Birch.

Ib. p. 2142.

By Dr. Lister.

n. 68. p. 2067.

n. 70. p. 2120,
2126.

3. 1. About the Beginning of November 1669. I pierced a Sycamore growing in a Sandy Soil at Nottingham; the Turgescence of the Buds inviting me thereto, and engaged my self in Keeping a Journal till the latter end of March following: from which Journal, I think I may note, 1. That the wounded Sycamores never bled, neither in November, nor December, nor January, nor February, nor March, (which yet they did above 40 several times, that is, Totally Ceasing and then Beginning a-new,) unless there Preceded a sensible and visible Frost; for I had no other way of recording the Temper of the Air. 2. That the Frosts did not always set a Bleeding the Wounds they found made before they came, though sometimes they did: But upon their Breaking up, or very much Relenting, the Wounds, either made at that Instant of time, or made many Months before, did never fail to bleed more or less. 3. That particularly upon the Breaking up of the Two great and long Frosts (the first of which happened that Year in that Country to be on the 3 of January; the second about the 12, 13 and 14 of February) all the wounds Ran most plentifully; so that such times may be looked upon as the most proper Season of Gathering great Quantities of Juice from this Tree.

2. In May 1670. I wounded some Sycamores in Craven, but they did not bleed, neither the remaining part of that Month, or the following Months of June and July: But had the Orifice of the Wounds, made with a small Auger, in a manner quite grown up, and would scarce admit a Pigeon's Feather. Wherefore the 30 of July, I cut out a square piece of about 2 Inches of the Bark of a large and well grown Sycamore, about my height, in the Body of it. This Wound began to Run the next Morning about 9 a Clock, so as to Drop, and that was all, and Dried up by 11 in the Morning. The like Cut I made in a young Sycamore the 8 of August, which in like manner bled the next Morning, but stopp'd before 9 a Clock. It did so for 2 or 3 Days; but then totally dry'd.

3. Nov.

3. *Novem.* 1. 1670. here at *York* I Pierced and otherwise Wounded 2 *Sycamores* growing in a Wet Clay, but they never Stirr'd, till the Beginning of *February* following. Yet *Mr. Wray* hath Assured me, that those of *Warwickshire* Bled the 16 of *Nov.* Copiously, and afterwards the *Walnut Tree* also.

I am apt to think that the *Sap* in all parts of the *Tree* at the times of this Anomalous *Bleeding* is some ways notably Altered in its Temper and Consistence: And this *Bleeding* by stress of *Weather* may in these *Trees* probably be look'd upon as a Violence done to their *Natures* from an Unkind Climate; considering the *Walnut* and *Sycamore* as *Strangers*, and not *Natives* of *England*. 'Tis indeed True, there are many sorts of *English* Plants, which will *Bleed* in *Winter*: but Note also, that such Plants never Refuse to do so at any time of the Year, no more than a Man, who may *Bleed* a Vein when he Pleaseth.

4. *Feb.* 1. 1671. It Froze, the Wind at *North*; the *Frost* and Wind Continued (some little *Snow* and *Rain* falling) the 2, 3, 4, 5, 6. until the 7. in the Morning, when the Wind came about to the *South East*, and the *Weather* broke up apace. The *Sycamores* Bled not all this while, but the 7 about Noon all *Trees* of that Kind Bled very Freely, both at the *Twigs* and *Body*, and I struck above a *Dozen*.

At this same *Critical* Season I also Struck the *Haw-thorn*, *Hazel*, *Wild-Rose*, *Gooseberry Bush*, *Apple-Tree*, *Cherry-Tree*, *Blather-Nut*, *Apricock*, *Cherry-Lawrel*, *Vine walnut*: yet None Bled but the Last named; and that Faintly in Comparison of the *Sycamore*.

Feb. 11. All was here Covered with a *white-Frost* betwixt 9 and 11 in the Morning.

The *Weather* Changing, I made the Experiments which follow, upon the *Sycamore*, *Wallnut*, *Maple*. A *Twig* cut asunder would *Bleed* very Freely from that part Remaining to the *Tree*: and, for the part Separated, it would be altogether Dry and shew no signs of *Moisture*, although we held it some pretty time with the *Cut-End* Downwards: But if this separated *Twig* was never so little Tipp'd with a *Knife* at the other *End*, it would forthwith shew *Moisture* at Both *Ends*; the same Day, late in the *Afternoon*, the *Weather* very Open and Warm, a *Twig* Cut off in like manner as in the Morning, would show no moisture at all from any Part. But I have since been convinced, that 'twas rather some Unheeded Accident which caused this *New Motion* of the *Sap*, than meerly the Striking off their *Tops*. ib. p. 2128.

5. Because *Sap* is said to *Ascend* from the *Root*; when it is found to Move in *Tapping*, I Lopp'd off certain *Branches* of a *Sycamore*, the Morning betimes of a *Hard-Frost* (*Feb.* 21.) before they would *Bleed*, or shew any Sign of *Moisture*. And not willing to wait the Change of the *Weather*, and the *Sun's* Heat, I brought them within the Air of the *Fire*: and by and by, as I expected, they Bled apace, without being Sensibly the warmer. ib. p. 2123.

This Experiment Repeated afforded me divers *Phænomena*, which follow; and proved almost an Universal way of *Bleeding* all sorts of *Trees*, even those, which of themselves would not shew any Signs of *Moisture*.

1. Poles of *Maple*, *Sycamore* and *Walnut*, Cut down in Open Weather, and brought within the Warmth of the *Fire*, did *Bleed* in an Instant. Also *Willow*, *Hazel*, *Cherry*, *Wood-bind*, *Blather nut*, *Vine*, *Elder*, *Barberry*, *Apple-Tree*, *Ivy*, &c. *Whicking* and *Edge-berrie Tree* (i. e. *Padus Theophrasti*) Tried in the same manner in *Craven*.

2. *Briar* and *Rasberry-rods* were more *Obstinate*; *Ash* utterly *Refused*, even *Heated Hot*.

3. *Branches*, that is *Poles* with their *Tops* Entire and *Uncut*, *Bleed* also when brought to the *Fire* side: but seem not so freely to *Drink up* their *Sap* again when *Inverted*, as when made *Poles*.

4. The same *Willow Poles* left all *Night* in the *Grass-plot*, and return'd the next *Day* to the *Fire* side, *Bled afresh*.

5. *Maple* and *Willow Poles* *Bleed* and *Cease* at pleasure again and again, if quickly *Withdrawn* and *Balanced* in the *Hand*, and often *Inverted* to *Hinder* the *Falling* and *Expencc* of *Sap*: Yet being often *Heated*, they will at length quite *Cease*, though no *Sap* was at any time *Sensibly* lost. And when they have given over *Bleeding*, that is, shewing any *Moisture*, by being brought within the *Warmth* of the *Fire*, the *Bark* will yet be found very full of *Juyce*.

6. An *Hard Ligature* made within a quarter of an *Inch* of the *End* of a *Wood-bind* Rod did not hinder its *Bleeding* at all, when brought within the *Warmth* of the *Fire*.

7. *Maple* and *Willow-poles*, &c. quite *Bared* of *Bark*, and brought to the *Fire*, will shew no *Moisture* at all in any *Part*.

8. One *Barberry* or *Pipridge-pole* *Bared* of its *Bark*, brought to the *Fire*, did shew *Moisture*, from within the more *Inward Circles*, though not any from the *Outward*.

9. *Maple* and *Willow-poles*, &c. half *Bared* of *Bark*, would *Bleed*, by the *Fire*, from the *Half* only of these *Circles*, which lay *Under* the *Bark*.

10. *Maple* and *Willow-poles*, *Split* in two and *Planed*, would not shew any *Moisture* on the *Planed Sides*, but at the *Ends* only.

11. A *Pole* of *Ivy* did of it self *Exsudate* and shew a *Liquid* and *yellowish Rosin* from the *Bark* and near the *Pith*; but when brought to the *Fireside*, it *Bled* a *Dilute*, *Thin* and *Colourless Sap* from the *Intermediate Wood Circles*.

12. A *Pole* of *Willow* (for *Example*) *Bent* into a *Bow*, will *Ouse* its *Sap* freely, as in *Bleeding* either *Spontaneously* or by the *Fire*.

13. One or Both *Ends* of the *Pith* of a *Willow pole* *Seal'd* up with *Hard Wax*, will yet freely *Bleed* by the *warmth* of the *Fire*.

14. *March* 23. 167^o. was the *Greatest Frost* and *Snow* we have had this *winter* in these parts about *York*; when some *Twigs* and *Branches* of the very same *Willow-Tree* as formerly, and likewise of many other *Willow-Trees*, taken off that *Morning*, being brought within the *Air* of the *Fire* would shew no *Moisture* at all; no not when *Heated* warm, and often and long *Turned*.

15. *March* 24. the same *Willow-Branches*, which the day before would not *Bleed*, and were thrown upon the *Grass-plot* all *Night*; did, both they and other

New cut down, by the *Fire* side freely shew Moisture and *Bleed* in the Morning upon the Breaking up of the *Frost*.

16. *Ash-Poles* and Branches that Day and the Day before, would by the *Fire* be no more Moist, than when I formerly Tried them.

17. The same Morning, a Twig of *Maple*, which had had the Top Cut off the 7 of *Feb.* (and which then *Bled*,) being quite taken off from the Tree, and brought within the Air of the *Fire*, and held with the Formerly-Cut End Downwards, did not run at all at that End, but held on in that Posture, it did run apace at the Other New-Cut End Uppermost, so as to spring and Trickle down.

Note, That this doth well Agree with my Experiments made the year before at *Nottingham* where I observ'd Wounds of some Months Standing to *Bleed* apace at the Breaking up of every Hard Frost. For *first*, in these Parts, there hath been no Hard Frost this Year; not comparable to that Year. *Again*, those *Nottingham Trees* I Wounded in the *Trunk*, and they stood against a Brick-wall, and the Wounds were on the side next it; and besides had Horse-dung stopp'd in all of them, for some Reasons, which things did undoubtedly Defend them much from the Air and Winds, and Keep the Wounds still Green and Open: Whereas the Tops of these *Maple-Twigs*, spoken of in the last Experiment, were expos'd in an Open Hedge to the Air and Winds; as also the *Sycamores* here at *York*, mentioned above to have been wounded in *Novem.* 1670 and not to have shew'd any Signs of Moisture, for that very Cause, that they were not Fresh Struck at *Bleeding* times.

LXI. I am inclined to think, that there is some kind of *Circulation* of the Juices of Vegetables; 1. Because I find, that all the Juice of a Plant is not Extravasate and Loose, and like *Water* in a *Sponge*, but that there are Apparent *Vessels* in *Plants*, Analogous to *Veins* in *Animals*: which thing is most conspicuous and clear in such *Plants*, whose Juice is either *White*, or *Red*, or *Saffron* coloured; for instance in each Kind of Juice we propose *Lactuca*, *Atractilis*, *Chelidonium majus*. 2. Because that there are very many *Plants* (and these last named are of the Number) whose Juice seems never to be at Rest, but will Spring at all times, freely as the *Blood* of *Animals*, upon *Incision*.

The Circulation of Sap: by Dr. M. List r, n. 70. p. 2122.

The way of *Ligature* by *Metalline Rings*, is an Expedient I have not used: but other *Ligatures* I have, upon a great Number of our *English Plants*, not without the Discovery of many Curious *Phænomena*. The success of an Experiment of this Nature upon *Cataputia minor Lobel* was as follows: I Tied a Silk Thread upon one of the *Branches* of this *Plant*, as Hard as might be; and not Break the *Skin*. There followed no greater *Swelling*, that I could Discern, on the one side of the *Silk* than on the other; although in often repeating the Experiment, some *Silks* were left hours and days Unloosed: and yet the Dimple which the *Thread* had made in the Yielding *Branches*, had a little Raised the immediate Sides, but both alike. The *Plant* in Like manner would *Bleed* very freely both above and under the *Tye*. This was also, I thought, very Remarkable, amongst other things, in this Experiment, that

in Drawing the *Razour* round about the Branch just above or below the *Tye*, the *Milky Juice* would suddenly Spring out of infinite *Small Holes*, besides the made *Orifice*, for more than half an Inch above and below the *Tye*: which seems to Argue, that though there was no Juice intercepted in appearance from any Turgescence, (as in the process upon the Members of a *Sanguineous Animal*) yet the *Veins* were so over-thronged and full, that a large *Orifice* was not Sufficient to discharge the sudden *Impetus* and Pressure of a some ways Streightned *Juice*.

The Descent of
Sap in Winter;
by Mr. Richard
Reed, n. 70. p.
2129.

LXII. 1. To Prove that the *Sap* does Descend in Winter, I have observed that the *Graft* hath influence either to *Corrupt* or to *Heal* the *Stock*; nay farther, to *Alter* and Change the very Nature and *VVay* of the Growing of the *Root* in the Earth: which I cannot see how it should do, but by sending *Down* its *sap* thither. I have by Certain Observation found; that *Crab-stocks* Grafted with some sorts of *Fruits*, which the Soil Liketh not, They not the Soil, will (not One or Two, but *All* of that Sort) *Canker*, not only in the *Graft* but the *Stock* also: which if you *Graft* Again, upon the Former *Graft* with a *Fruit* Liking to the *Soil*, will all *Heal*, and so become *Trees*. And further, Certain it is by my Observation, that 20 *Pear-stocks* being *Wild*, Grafted *Young* with the same sort of *Pear*, and 20 with another, the *Roots* of each of them of One sort will Grow alike: and so Those of the Other. Generally, those that Naturally Grow *High*, as the *Bare-Land-Pear*, Root Deep, and *All* do so: Those whose *Heads* are *Busby* and *Thick*, as the *Summer-Bonchrestien*, their *Roots* run *VVide*, and are Matted Below; and *All* are so. This Diversity of the *VVay* of Growing of the *Root*, must be by *Grafting*: and could not be but by the intercourse of *Sap* which it receiveth from the *Graft*, and that cannot be, but by the *Return* of *Sap*.

By Dr. J. Beal,
n. 71. p. 2144.

2. 'Tis no wonder if the Effects which Mr. *Reed* mentions do follow from that Correspondence in *All* Parts of the *Whole Plant* (which is by me acknowledged,) especially, since by the *Leaves* and all the *Pores* in the *Branches* and *Body*, the *Plant* draws a kind *Sustenance* from the *Sun*, *Air* and *Dews*, as by the *Roots* from the *Succulent Soil*. And as the *Channels* (which I may call the *Conduits* and *Strainers*) of several *Stocks* and *Cions* do Differ, so may some Change of the *Liquor* be made by several kinds of *Distillation*. And from the fore noted Difference of *Stocks*, and the Differing *Grains* of the *Shoots* and *Timber*, as also from the Differing *Leaves* (if accurately inspected, and consider'd,) we may in time perhaps Discover some Particular Causes of the Differing *Sap*, *Fruit*, and *Blossoms*.

'Tis about 15 Years since I published a Hint, how to Discover by the *Colour*, *Figure*, *Tenderness*, and *Asperities* of the *Leaves* of Young *Apple-Plants*, and *Crabs*, first appearing in the Spring, which *Plant*, would yield the more *Delicate*, and which the more *Austere Fruit* and *Liquor*, to several Kinds and Degrees of *Delicacy* and *Austerity*; *Flatness* and *insipidness*, and

and Vigour and Briskness. And this, I think, allows a Consideration for some Efficacy, or sign (at least) of Change or Operation in the *Descent* of *Sap*. But as far as I dare, or did, Deny the *Descent* of *Sap*, I meant it in the Vulgar sense of that Expression, *viz.* the Main Quantity of *Sap* which *Ascends* in the *Spring*, and is Gradually Hardened into *Leaves*, *Blossoms*, *Fruit*, *Timber*, in such manner as the *Ossification* in Young *Animals* is Described by Dr. Kerckringius. *Anthrop. Ichn.* 'Tis a large Quantity of *Sap*, which is Expended on the *Fruit* and Growth of some *Trees*, on *Acorns*, *Wallnuts*, *Chestnuts*; and this *Returns* not to the *Root* in *Winter*: Yet consists well with the Sentiment of the *Circulation* of the *Sap*, which in some Seasons may *Run* the Round more *Swiftly* than in Other.

LXIII. 1. Some Years ago I made a few Observations concerning the *Veins* or such *Ductus*'s, as seem to contain and carry in them the Noblest Juices of *Plants*: and I am of the Opinion that they will prove *Vessels Analogous* to our *Humane Veins*. Those Parts of a *Plant*, which *Pliny* calls by the Names of *Venæ* and *Pulpæ*, are nothing else in my Opinion, but what Dr. *Grew* calls *Fibres* and *Insertments*, or the *Lignous Body* interwoven with that which he takes to be the *Cortical*, that is, the several Distinctions of the *Grain*. But that these *Vessels* are not any of the *Pores* of the *Lignous Body* (to use the Doctors Terms) is plain in a Transverse Cut of *Angelica Sylvestris magna volgatio* F. B. for Example; the *Veins* there very clearly shew themselves to an attentive view to be Distinct from *Fibres*, observable in the *Parenchyma* of the same *Cortical Body* together with themselves; the *Milky Juice* still Rising besides, and not in any *Fibre*. Also in the like Cut of a *Burdock* in *June*, the like *Juice* Springs on this and on that side of the *Radii* of the *Woody Circle*, that is, in the *Cortical Body* and *Pith* only. Again, where there is no *Pith*, there is none of this *Juice* to be observed, and consequently none of these *Veins*; as in the *Roots* of *Plants*, and *Trunks* of *Trees*: but ever in the *Bark* of either. These Particulars are plainly observable in the *Spondylium*, *Cicutaria*, many of the *Thistle* kind, &c.

Further, neither are they probably of the Number of the *Pores*, described by Dr. *Grew* in the *Cortical Body*, or *Pith*: Not surely of those *Pores* extended by the *Breadth*, because the Course of the *Juice* in these *Vessels* is by the *Length* of the *Plant*; as I have sometimes very plainly traced in the *Pith* of a *Dryed Fennel Stalk*, following them by *Dissection* quite through the *Length* of the *Pith*. It remains, that, if *Pores*, they are of those *Pores* of the *Cortical Body*, that are supposed to be Extended by the *Length* thereof; which yet seems (to me at least) not enough: But we think them *Vessels* Invested with their own proper *Membranes*, Analogous to the *Veins* of our *Humane Body*; for these Reasons: 1. Because they are to be found in the *Pith*, and sometimes in the *Cortical Body* of a *Plant*, not included within the common *Tunicle* of any *Fibres*, as is above noted. That *Fibres*, or the *Seminal Root*, are *Cloathed*, is

Veins in Plants
Observed by Dr.
M. Lister. n. 79;
p. 3052.

Vid. Sup. S. LXI.

most plain in some Plants, as in *Fern* and *Geranium Batrachoides*; the *Fibres* of the former are *Coated*, at least in some Parts of the Plant, with a Black Skin, in the latter likewise with a Red one; and in these Cases, had they not, I say, their own Proper *Membranes*, we see no Cause, why the very Porous and Spongy Body of the *Pith* and *Cortex*, should not be in all places fill'd Alike with the Juice, and not Rise (as most plainly it doth) in a Few Determinate and set Places only; that is, according to the Position and Order of these *Vessels*. 2 Again the Experiment I made, concerning the Effect of a *Ligature* on *Cataputia minor Lobel. viz.* The suddain Springing of the *Milky Juice* out of Infinite *Pores* besides the *Incision*; (The Cause of which *Phænomenon* I take to be the Dissected *Veins* Impetuously discharging themselves of part of their Juice within the *Porous Parenchyma* of the *Bark*; whence it is Probable, that if there was no *Coated Vessel* to Hold this *Milky Juice*, we might well expect its Springing upon the bare *Ligature*, (as when we Squeeze a Wet Sponge) the External *Cuticle* of the Plant, as this Experiment shews, being Actually *Perforated*.

In the next place it is very Probable, that these *Vessels* are in all Plants whatsoever. For, as it is Truth-like of all the other Substantial Parts of Plants, that they are actually in, and common to all Plants, though specified by Divers Accidents in Figure and Texture; so of these *Veins*, which though they be Discernable mostly in those Plants where they Hold *Discoloured Juices*, yet we may very probably think, that they are not Wanting, where the Eye finds not that Assistance in the Challenging of them. And in these very Plants, where they are Least Visible, there is yet a Time when they are, if not in all yet in some parts of these Plants, plain enough to the Naked Eye. The Tender *Shoots* of the *Greater* and *Lesser Maple* in *May* are Full of a *Milky Juice*, *viz.* the known Liquor of these *Veins*. Again to this purpose, if you apply a Clean Knife Blade to a Transverse Cut of the like *Shoots* of *Elder*, the *Gummy Liquor* of these *Veins* will be drawn forth into Visible *Strings*, as is the Nature of *Bird Lime* of the *Bark* of *Holly*, or the *Milk* of *Cataputia minor Lobel*. Further, the *Leaf Stalks* of our *Garden-Rubarb* do sometimes shoot (by what accident we enquire not here) a Transparent and very Pure *Chrystalline Gum*, though the *Veins*, that Held this *Gummy Juice*, are by no ordinary means Visible in them, and yet by Comparing the Nature and Properties of this *Gum*, with that of the *Gums* of other *Vegetables*, we cannot doubt but this *Gum-Rubarb* is the *Juice* of those *Veins*, as well as we are assured, the *Gum* of other *Vegetables* to be of *Theirs*, by the same *Comparative Anatomy*. Lastly, we think, that even *Mushromes* (that seemingly Inferiour and Imperfect Order of *Vegetables*) are not Exempt and Destitute of these *Veins*, some of them yielding a *Milky Juice*, Hot and Fiery, not unlike some of the *Spurge-kind*, or *Euphorbium*;

The *Primary Use* of these *Veins* is, in my Opinion, to carry the *Succus nutritius* of Plants; Because, where they are not, there is no *Vegetation*; as it is seen if an *Engrafted Branch*, or *Arm*, be Bared and stripped off the *Clay*, &c.

in *June*, all the Course of *Vegetation* will appear to have been made only by the *Bark*, and not by the *Wood*, that is, in the Place only where these *Veins* are. A *Secondary Use* is the Rich Furniture of our Shops: For, from these *Veins* only it is, that all our *Vegetable Drugs* are Extracted, and an infinite more might be had by a Diligent Inquiry, and some Easy means which I have not unsuccessfully put in Practice.

To the foregoing Observations I shall here add others of Later Notice: as the *Skin* of a *Plant* may be Cut sheer off with Part of the *Spongy Parenchyma*, and no signs of *Milky Juice* follow, that is, no Breach of a *Vein*. Again, we have Stript the *Plant* of its *Skin*, by Pulling it up by the *Roots*, and exposing it to the *Wet Weather*, until it became Flaccid as a *Wet Thong*, without any Injury to the *Veins*, which yet upon *Incision* would Freshly Bleed. These Experiments, make against the General Opinion of *One* only *Sap*, Loosely Perwading the *Whole Plant*, like *Water* in a *Sponge*.

In the *Transverse Cuts* of *Plants*, we see as it were a Certain Order and Number of the *Bloody Orifices* of Dissected *Veins*.

We observe also in a *Leaf*, which we take to be the Simplest part of a *Plant*.

1. That the *Veins* keep Company with the *Ribbs* and *Nerves* (as we vulgarly call them,) and are Distributed into all the Parts of the *Leaf*, according to the Subdivisions of those *Nervous Lineaments*, and are Disposed with them into a certain *Net-work*; whether by *Inosculation*s or *Bare Contact* only, we pretend not to Determine.

2. That in a *Transverse Cut* of a *Leaf*, the *Midle Fibre*, or *Nerve*, for Example, seems to yield *One Big Drop* of a *Milky Juice*, Springing as it were from *One Vein*; yet the *Microscope* plainly shews us, that there are *Many Veins* which contribute to the making up of that *Drop*.

3. That if a *Fibre*, or *Nerve*, be carefully taken out of the *Leaf*, the *Veins* will appear in it, like so many small *Hairs*, or *Pipes*, Running along, and striping the *Nerve*.

4. That those many *Veins* are all of an Equal Bigness, for ought we have yet discerned to the Contrary.

5. That though we seem to be more Certain of the *Ramifications* of the *Fibres*, wherein those *Veins* are, yet we are not so, that those *Veins* do any where Grow *Less* and *Smaller*; though Probably it may be so. That which makes us Doubt it, is the exceeding *Smallness* of these *Veins* already; even where we might probably expect them to be *Trunk Veins*, and of the Largest size: And being there also in very great Numbers, and Running in *Direct Lines* along the *Fibre*, we guess that *One* or *More* of them may be Distributed and fall off on either Hand, with the Subdivisions of the *Fibres*, and not suffer any *Diminution* in their *Bulk*.

6. That we cannot Discern any where, throughout the whole *Plant* *Larger* or more *Capacious Veins*, than those we see adhering to the *Fibres* of the *Leaves*; which do also Appear, from Comparing the *Bleeding Orifices* in a *Transverse Cut*. I have found it a *Difficult* and *Laborious Task* to *Trace*, and *Unravel* them, throughout the whole *Plant*.

Our Opinion is, that these *Veins* do still keep Company with their respective *Fibres*. And as all the *Fibres* of the *Leaf* are joined in the *Stalk* of the *Leaf*, and that *Stalk* explicated in *Cloathing* the *Twig* or *Stem* of the *Plant*, (which we take to be the Reason of the Orderly breaking forth of the *Leaves*,) so do we think of the *Veins*, their Perpetual Companions.

And as we have said, the *Fibres* of the *Leaves* are joined in the *Twig*; so are those of the *Twigs* in the *Branches*; those of the *Branches* in the *Trunk* or *Body* of the *Tree*. The like also in an Inverted Order we seem to observe in the several *Coats* and *Ramifications* of the *Root*. This the several *Circles* of *Bleeding Orifices* in *Transverse Cuts*, seem to Confirm.

But moreover in the *roots* of *Plants*, if a *Simple Coat* be Separated and Exposed betwixt your *Eye* and the *Light*, the *Veins* appear to be strangely Entangled and implicate, and not in the same simple Order as in the *Leaves*. The like we think of the *Bark* of the *Bodies* of *Trees* which we cannot distinguish from the *roots* of *Plants*: Though there is indeed, something (at least at Certain Seasons of the Year) in the *Root*, which is not to be found in any Part of the *Plant* besides.

From what hath been said, it may well be Doubted, whether there is any *Sinus*, or *Common Trunk*, into which all the *Veins* are Gathered: But rather, that there are a Multitude of Equally big *Veins*, each existing a-part by it self. We indeed have found it very Difficult, to exhaust the *Plant* of its *Milky Juice* as to Kill it, though we have given it very many *Incisions* to that purpose. Diverse other Instances there are, which favour the *Discontinuance* of the *Veins*, and the little Relation and Intercourse they have with one another; as one *Branch* of a *Tree* having fair and well grown *Fruit*, before the other *Branches* of the same *Tree* and *Fruit Blossom*, or have *Leaves*; from the different Situation and other Circumstances of *Culture*; the Indefinite and perpetual Growth of a *Tree*; the *Cyon* governing, &c.

The Substance of these *Veins* seems to be as truly *Membranous*, as the *Veins* of *Animals*. A *Leaf* will not Give way and be Extended, but the *Veins* in a *Leaf*, if freed of all the *Woody Fibres*, will be stretched out to One Third Part at least, and Vigorously Restore themselves again, just like a *Vein*, *Gut*, or any other *Membranous Ductus* of an *Animal*. Again, these *Membranous Pipes* are exceeding Thin and Transparent, because they suddenly Disappear, and Subside after their being Exhausted of their *Juice*; and particularly, in that we see the *Liquor*, they hold, quite through them; no otherwise than the *blood* through our *Veins*: or (in *Chelidonium majus*, for Example) a *Tincture* of *Saffron* in *Cristalline Pipes*.

In the Keenest *Frost*, which happened the Other *Winter*, we Dissected the *Frozen Leaves* of the *Garden Spurge*. Here we observed, that all the *Juice* (besides that which these *Veins* hold) was, indeed, *Frozen* into perfect hard *Ice*, and to be Expressed out in the Figure of the *Containing Pores*; but the *Milky Juice* was as *Liquid* as ever, but not so Brisk as in Open Weather. This Experiment we take to be good Proof of the Perfection of this *Milky Juice*, and that it hath within it self so Great a Degree of *Fermentation*, that it preserves it self, and consequently the whole *Plant* from the Injuries

Injuries of the *Weather*; that is, the *Plant* owes its *Life* to it! Thus we have seen *Insects* (as *Hexapode worms*, &c. lie *Frozen* upon the *Snow* into very *Lumps* of *Ice*, and yet put under a *Glass*, and exposed to the *Warmth* of the *Fire*, they quickly *Recovered* their *Legs* and *Vigour* to escape; which we think could not be, unless the *Vital Liquor* of their *Veins*, as in this Instance of *Plants*, had been untouched, and little concern'd in the *Frost*. Further, we hence also urge the *Different Uses* as well as *Natures* of these *Juices*, and look upon the *Frozen Icicle*, or that *Copious Dilute* and *Limpid Sap*, as *Alimental*, the *Milky* and *Not Frozen Juice*, as the only proper *Venal*.

As to the *Motion* of these *Juices*, these Things are certain:

1. That the *Milky Juice* always *Moves* and *Springs* briskly upon the *Opening* of a *Vein*: The *Limpid Sap*, but at certain *Seasons*, as it were by *Accident*, and not (as I judge) from any *Vital Principle*, or *Fermentation* of its *Own*.

2. The *Venal Juice* hath a manifest *Intestine Motion*, or *Fermentation*, within it self. Witness (beside what hath been just now said of it) its *Contributing* (and the *Long Continuance* of) that *Motion* to the most *Insensible* of *Liquors*; and likewise its *Thick* and *Troubled Bleeding*, like the *Rising* of *Yeast*, which yet in a few *Hours* after *Drawing*, falls, and the *Juice* becomes *Transparent*, as the *Gum* of the *Virginian Rhus*, &c.

We think indeed, (according to the *Knowledge* we yet have of the *Parts* of *Plants*) that these *Juices* move by a far different *Contrivance* of *Parts* from that of *Animals*; not yet here *Discovering* any *Uniting* of *Veins* into one *Common Trunk*, or *Pulsation*, no sensible *Stop* by *Ligature*, no *Difference* in *Veins*, &c. All which *Difficulties*, notwithstanding, may, I hope, in time be *Happily Overcome*, and the *Analogy* betwixt *Plants* and *Animals*, be in all things else, as well as in the *Motion* of their *Juice* fully *Cleared*.

There seem to be in *Plants* manifest *Acts* of *Sense*: We instance in the sudden *Shrinking* of some *Plants*; the frequent *Closing* and *Opening* of *Flowers*; the *Critical Erecting* of the *Heads* of *Poppies* from a *Pendulous Posture*; and particularly the *Vermicular Motion* of the *Veins* when *Exposed* to the *Air*. Again, the *Veins* of *Plants* may indeed be different, though at present we cannot tell wherein they are so; the *Arteries* within our *Heads* are hardly to be known by the *Eye* from the *Veins*. Further, there are natural and *Spontaneous Excretions* or venting of *Superfluous Moisture* in *Plants*, *Visible* and *Constant*, in the *Crown Imperial*, *Rorella*, *Pinguicula*, &c. As to the *Ligature*, as it hath been hitherto applied by us, it is not to be relied on for the *Discovery* of this *Motion*; the *Veins* only of *Plants*, being the *Parts* probably *Distendable*.

Lastly, We must either take that away from the *Other Reasons* given of the *Necessity* of the *Circulation* of the *Blood* in *Animals*, viz. The *Hindring* of its *Breaking* and *Clodding*; or we must grant the same *Motion* to the *Venal Juice* in *Plants*. We have *Undeniable Experiments* to shew, that the *Venal Juice* of *Plants* and the *Blood* of *Animals* agree in this, That they *Both*, when they are once drawn from their *Respective Veins*, do forthwith
Break

Break and Coagulate; and that the *Serum* in the One, as well as in the Other, becomes a *Stiff-Gelly* by a little standing. And this Variety of Experiments hath Taught us, that Probably more Useful Preparations, and certainly a Truer *Analysis* and *Separation* of the Parts of *Vegetable Drugs*, may be Effected, whilst they are in *Bleeding* and *Liquid*, than after they are once become *Concrete*, and have lost their *Natural Fermentation*.

By Dr. Wallis.
n. 95. p. 6060.

Dè Cerebro
c. 15. 19.

2. The *Veins* of *Plants*, which Mr. *Lister* Observes not to be *Ramified*, but rather *Bundles* of them *Divaricated*, represent the *Nerves*, which (as Dr. *Willis* observ'd) go together in that which seems the *Common Trunk*, like a *Bunch* of *Threads*, which after *Separate*, and are variously *Divaricated*, and these *Nerves* being Cut, Shrink up as the *Veins* of *Plants*) as much, or more than do the *Veins* or *Arteries* of *Animals*.

Dr. *Willis* Observes also, that there are two Sorts of *Nerves*: One arising from the *Cerebrum*, Subserving to *Voluntary Motions*, which properly belong to the *Functions* of *Sense*; the other from the *Cerebellum*, subserving to the *Involuntary Motions*, which chiefly belong to the *Functions* of *Vegetation*. And to these latter seem Reducible those *Acts* of *Sense*, which Mr. *Lister* speaks of, in *Plants*.

The Nature and
Differences of
the Juices of
Plants; by Dr.
Lister.
n. 224. p. 365.

LXIV. We observe that Mostly, *Juices* of *Plants* *Coagulate*, whether they be such as are Drawn from the *Wounds* of a *Plant*; or such as do *Spontaneously Exsudate*: And yet even that *Exudation* seems to be often *Accidental* too, that is, by *Cancer*, or some Other such like *Chance*.

And yet I am Uncertain what to think of the small *Purple Blebs* and *Veins* to be Observed, more or less, on all the *Hypericum* Kind, and on the *Threads* of the *Flower*, and the *Hairs* which cover the *Leaves* of *Rorella* in like manner. I doubt much, whether this may properly be call'd an *Exudated* and *Coagulated Juice*, or no? Our Observations of those of this Tribe, are what follow.

Purple Juice.

The Small *Green Leaves*, next encompassing the *Yellow Flowers* of *Androsæmum Hypericoides Ger.* are set with very small *Round Blebs*, full of a *Purple Juice*; as are likewise, but with Two or Three only, the very *Points* or *Tops* of the *Yellow Leaves* themselves: Yet the *Stalk* Cut, doth not to the *Eye* discover any such *Distinct Vessels*, carrying that *Purple Liquor*, which makes me suspect it is separated by *Coagulation* from the rest of the *Juice*, and reserved in those small *Bags*.

Hypericum Ger. The *Purple Juice* yielding *Blebs*, in this *Point* are upon the *Edgings*, on the *Out-side* of all the *Leaves*. Also the *Stalk*, tho' *Round*, hath a *Double Edge*, on each *Side* One; and the *Blebs* or *Bags*, tho' but *Thinly*, are yet observable on these very *Riling Edges* too of the *Stalks*. As for the *Yellow Flowers* themselves, the *Outmost Green Leaves*, next and immediately encompassing them, have but a few *Purple Stripes*, but the *Yellow Leaves* or *Flowers*, are *Edged* with small *Purple Bags* on the *One Side*, and *Striped* with *Purple Juice* yielding *Veins* on the other. *Lastly*, On the very *Tops* of each *Thread* in the *Flower*, is one *Single Purple-Bag*.

Hypericum

Hypericum Ascyron dictum, Caule Quadrangulo, J. B. In like manner, all the Edges on the outside of all the *Leaves*, from one end of the *Stalk* to the other, of this *Plant*, are very Thick set with *Purple Bags*. Also in the *Flower*, all the *Threads* have One Single *Bag* on the Top; but the *Flowers* or *Yellow Leaves*, and the *Green* Ones encompassing them, have very few *Purple Spots* or *Streaks* visible.

Hypericum Pulchrum Tragi, J. B. Only the *Yellow Flower-Leaves*, and those *Green* ones which next encompasses them, are thick Edged with *Purple Blebs*.

Diverse parts of the same *Plant* have diverse *Faculties, V. C. P. A.* I add, that diverse Parts of the same *Plant*, yield from the same *Veins* different Coloured *Juices*. v. g. The *Milk* in the *Root* of *Spondilium Ger.* is of a *Brimstone Colour*; but in the *Stalk*, *White*.

Amonst those *Juices* that *Coagulate* and are *Clammy*, some there are which readily *Break* with a *Whey*.

In the middle of *July*, I drew and Gathered of the *Milk* of *Lactuca Sylvestris Spinosa, C. B.* which it freely and plentifully affords. It springs out of the *Wound* Thick as *Cream*, and *Ropes*, and is *White*; and yet the *Milk* which came out of the *Wounds*, made towards the *Top* of the *Plant*, was plainly *Streaked* or *Mixt* with a *Purple Juice*, as though one had dashed or sprinkled *Cream* with a few Drops of *Claret*. And indeed the *Skin* of the *Plant* thereabouts was *Purplish* also, perhaps with *Veins*. Again in the *Shell* I drew it, it turned still *Yellower* and *Thicker*, and by and by *Curdled*, that is the *White* and *Thick Caseous Part* did separate from a *Thin Purple Whey*. So the *Blood* also of *Animals*, whilst *Warm*, remains *Liquid* and *Alike*: But so soon as *Cold* it *Cakes*, and has a *Serum* or *Whey* Separated from it. Also the *Caseous* part of the *Milk* of *Animals* is *Glutinous* and *Stringy*. Further, this *Serum* came freely from the *Other*, by *Squeezing* betwixt my *Fingers*; and the *Curds* I washed in *Spring Water*, which became immediately like *Rags* and *Tough*, (draw this *Milk* immediately, or let it fall off the *Plant*, into a *Shell* of fair *Water*; or other *Menstruum*; as *Vinegar, S. V. Spirit of Vitriol, or Sulphur, &c.*) and remained still *White* and *Dry*. As for the *Purple Whey*, after a *Days* *Insolation*, it stified and became *Hard*, and was easily formed into *Cakes*; which *Cakes* were yet very *Brittle*, and would easily *Crumble* into *Powder*. About *December* following, I broke one of the *Cakes*, made of the *Caseous* part of the *Milk* of this *Plant*; it then proved very *Brittle*, and shined, upon *Breaking*, like *Rosin*: It was then of a *Dark Brown Colour*; moreover it *Burned* with a *Lasting Flame*, like *Rosin* or *Wax*; and that being *Melted* by *Heat*, it would draw out into *Long Tough Strings*, like *Birdlime*. On the contrary, the *Purplish Powder*, which was the *Whey*, if put into the *Flame* or a *Candle*, would scarce *Burn* with a *Flame* at all, but soon be turned into a *Coal*. Lastly, the *Purple Powder* did *Taste* very *Bitter*; whereas the *Caseous* part was *Inspid* as *Wax*.

The *Milk* which the *Trachelium* Kind plentifully yields is very thick, and presently *Curdles*; the *Serous* part, or *Whey* being of a *Brown Colour*. These

Juices smell *Sour*, something like the Slices of *Green Apples*, which have been long Cut.

The *Thin Milk* of *Tithymalus Helioscopius Ger.* Springs freely and plentifully; it is very *Clammy* upon the Fingers; it is very *White* in Drawing; it turns upon a Lancet, of a *Dark Blewish*: and indeed, it is both of the Colour and Consistence of *Blue Skim'd Milk*; made up with *Wheat Flower* into *Cakes*, it shews it self *Greasy* or *Oily*, and scarce ever Dries. It very hardly *Breaks* or *Coagulates*. I kept some of it pure and unmixt, in little *Essence Bottles*, stopp'd lightly with *Cork* only; in these it *Broke* in process of time, and the *Curds* were easily to be formed into *Cakes*; which *Cakes Burned* with a *Lasting Flame*, and being *Melted*, Drew forth into *Strings* like *Wax*; the *Whey* was *Clear* and like fair *Water*. This *Broken Milk* in all my *Bottles* was very *Corrupt* and *Stinking*: But the *Cakes* I made up of this *Juice*, with *Wheat Flower*, and a little *Gum Arabick*, *Dryed* well, and kept *Sweet*.

*Juices caking
and not letting
go their Whey.*

Other *Clammy Juices* there are, which do not let go a *Whey* when they *Coagulate*, but *Cake* altogether.

I made *Cakes* of the *Sole* or *Unmixt Juice* of *Sonchus Lævis & Asper*, without any *Addition*, and it parted not with any *Whey*.

Papaver Rheas Ger. Bleeds freely a *White Juice*, and the *Heads* or *Seed-Vessels*, when the *Flower* is gone, do yet *Bleed*. I observed, that in *Gathering* it into *Shells*, it presently turned its *white* Colour into a *Yellow* one, inclining to an *Orange*. At first *springing* it *Roaped*, or was but little *Clammy*, and seemed to be very *Liquid* and *Dilute*; yet it did not part with any *Whey*, but grew *Stiff* soon, and is very *Resinous* and *Oily*.

Note. The *Milks* or *Juices* of *Plants* seem to be *Compounded*, and mixt of *Liquors*, of *Different* and perhaps *Contrary Qualities*: So that it is probable, if the *Caseous* part shall be *Narcotick*; for *Example*, the *Whey* may not be so; or the *One* may be *Hurtful*, and the other a *Good* and *Useful Medicament*.

Tragopogon Flore luteo, F. B. Yields a *Juice*, which upon the *First Springing* from the *Wound*, is *white* and *Thick*, but immediately it turns *Yellow*, and then *Redder* and *Redder*; it is of no *Unpleasant Taste*; it is something *Glutinous*, and very *Oily*, and parts not with much, if with *Any Whey*, and therefore it is easily formed into *Cakes* alone.

Convolvulus major, F. B. Bleeds freely a *white Juice*, as I experienced in the *middle of August*; not only the *Stalk* and *Leaves*, but the *white Flowers* also in proportion, *Bleed* as plentifully as any part else. This *Milk* is very *Sharp*.

*Saffron Coloured
Juice.*

There is also a *Juice* of a *Saffron Colour*, which *Chelidonium majus Ger.* wounded, freely affords; this *Juice* breaks not with a *Whey*, but is easily formed into *Cakes*, and stiffens in the *Sun*; it is *thick*, and of the *Consistence* of *Cream*, upon the *Springing* forth of it, from the *Wound*.

There is another very *Clammy Juice*, which is of a *Golden*, or *Yellow Colour*, upon *Drawing*; and this the *Seed Vessels* of *Centaurium Luteum Perfoliatum, C. B.* in *July*, and after, even wherein the *Seed* therein contained
are

are turned Black and Ripe, yield plentifully and freely enough. (These Juices, which the *Heads* or *Seed Vessels* of Plants afford, may be thought of the same Nature with those Juices which the *Pulp* of *Fruits* afford; the *Pulps* of *Fruits*, and these *Exterior Vessels* being parts Equivalent; that is, *Apples*, for Example, are nothing else but the *Seed vessels* of their *Kernels*;) It is *Liquid* upon first Drawing, and after a while it Thickens, parting with No *Whey*; (N. B. I call this *Coagulating* too) and this is of the Colour of *Amber*; it sticks to ones *Fingers*, and pulls forth into *Threads* like *Bird-Lime*; it would never become Harder than very soft *Wax*, and that by being Dried in the *Shade* only, for if never so little exposed to the Heat of the *Sun* and *Fire*, it straightway became exceeding Soft. But as for the *Cakes* I made up of it and *Wheat Flower*, them I found in my *Cabinet* in *Winter* very Hard and Firm, and the *Unmixt Cakes* still soft. These *Burn* with no Unpleasant Smell; they Emit a *Lasting Flame*; they still keep their *Amber Colour*, and draw out in *Threads*, in *Burning* like *Wax*.

To this we may add the the *Yellow Juice* which the *Wounds* of *Angelica Sativa* *Park* yield; it will not harden by *Insolation*, or *Long Keeping* (for I have had an *Essence Bottle* of it by me this two *Years*) yet I perceive it Stiffens and will Draw into *Threads*.

The next sort of *Coagulate* and *Clammy Juices*, we have taken notice of are *Gums*; and some of them seem long to abide *Liquid*, and perhaps *Inflamable*; Others there are which grow *Hard*, and are not to be kindled into a *Flame*. They are easily to be dissolved in *Fountain Water*, (the *Gum* of *Rhubarb* and the *Leaves*, For Example) and do Sparkle when put into a *Flame*: Which two Natures Argue a *Serous* or *Watrish* Part in them. Again, put into a *Flame*, they *Melt* and become as it were *Liquid* and *Ductible*; which shews the *Caseous* Part in them. And because they will not *Flame*, it is an Argument of their *Leanness* and *Scarcity* of *Oil*. All three put together, plainly Evince, *Gums* to be *Coagulate Juices*.

In *August* I have observed the *Clusters*, both *Green* and *Ripe*, of *Periclymenum*, *Ger.* very *Leaky*; which upon *Nearer* and *Heedful* Inspection I found to be a *Thin Clammy Juice*, or *Liquid Gum*, which fell down upon the *Leaves*, and keeps its *Liquid* form there.

Here the *Purple Juice* seems to be a *Whey* separated from the *Liquid Gum*: But, I am of Opinion, it's a *Distinct Liquor*.

Again the *Red Threads* of *Rorella* End, or are *Topped*, with little *Bags*; which being *Compressed* do yield a *Purple Juice* (as we above noted in the *Hypericum*) and those small *Buttons* on the very *Tops* of those *Threads*, are encompassed with small *Transparent Pearls* or *Drops* of a *Liquid Gum*. They abide in this form the *Hottest* *Summers Day* like *Dew*, whence also the *Plant* has its Name; and upon the *Least Touch* Cleave to your *Fingers*, and Draw out into *Long Threads* like *Bird-Lime*.

In like manner a *Liquid Gum* (but that it stands not upon so *Long Threads*, and is much *Thicker* bedewed) you may observe upon *Pinguicula*. Note well, That the small *Drops* and *Threads*, or *Hairs*, in either of these

Two *Plants*, are to be seen upon the Uppermost or Inmost side of the *Leaf*; and the Utmost and Undermost is Smooth or Void of them; which is something contrary to all other *Plants* I have Observed.

Methought I observed about *Mid-August*, the *Chats* of the *Alder* to be *Gummy*. Perhaps it did Exudate from the *Plant* it self; as I guess the *Honey-Fall*, or *Gummy Dew* to be observed upon the Leaves of the *Oak*, &c. are Nothing Else.

Hard-Gums:

The *American*, or *Indian Rhubarb*, Sown in our Gardens, is the Only *Plant* that I have Met with, or ever Saw, which Yielded a *Gum*; and yet because it is of the very Kind with our Common *Sorrels* and *Lapathums*, I believe it not Impossible, that even from our own Store, *Herb-Gums* might Someways or Other be had. I say, that off the *Stalk*, or indeed off the *Leaves* of the *Indian Rhubarb*, I have gathered an *Ounce* at a time in *June*, of very *White*, and *Clear*, and *Hard-Gum*; in both Those Years I observed it to *Flower* with us, as 1670. and in that Year it did Not, 1669. It exudates from all Parts of the *Stalk* and *Ribs*, on (*Note well*) the Under side of the *Leaf* it self. I Gathered some in the Form of Good Big Drops; Others as though the *Stalk* had been Besmeared with it; Others shot into Long and Twisted Wires, or Icicles. Moreover I observed, that the *Cankered* Orifices or Places where the *Gum* had burst forth, might be followed into the *Stalk* with a Knife; and that through the *Skin*, in Certain Places, I could see that the *Juice* within the *Plant* was turned *Gummy*, and looked Clear like Ice.

Cat. Pl. Ang.
App. p. 325, 334.

It is the Experiment of Mr. Fisher; that the Clear and Defecated *Juices* of most *Plants*, have more or less *Redness* in them. Again, That the *Dryed Root* of *Acetosa* (a *Plant* of the Family with *Rhubarb*, which may Well be Called *The Indian Sorrel*, or *Sower Dock*) Boiled, doth Dye Water with a fair *Red Colour*. And I have observed, that the Unripe Seeds of *Rhubarb*, yield a very Fair and Deep *Purple*, I mean the *Husk* of them. Consider what hath been said above of *Rorella*, and the *Hypericum* Kind, concerning their *Purple-Juice yielding Blebs*. Note also here to this Purpose what we have set down above, that *Rhubarb*, and *Sorrel*, &c. do when they Decay turn *Red*.

The *Juice* Extracted from the *Roots* of our *English Rhubarb*, by a Tincture of Fair Water Steamed away, is Nothing else but a Lean *Uninflamable Gum*; and though it Differ in Colour (perhaps from the yet *Woody* Parts in it, as being of a Deep *Liver Colour*) from the Exudating *Gum*; yet in Other Natures, as this of being *Uninflamable*, *Ductible* in the Flame of a Candle, &c. it Agrees with it. I may not omit, that the Repeated *Cuts* I gave the *Stalk*, on purpose to have the *Gum* that way, failed my Expectation. This *Gum* is Sweet or rather of no *Tast* at all.

To this Purpose I Remember in Summer time to have seen, even the *Juice* of *Apples* spontaneously Gellied in *Languedoc*, and the *Apples* to look Clear and Hard like *Ice*, Whence they call that sort of *Apple Pome Gellée*, or the *Frozen Apple*: Though indeed, it be nothing else but the *Breaking* or *Coagulating* of the *Juice* in some Spots of it; for it is Rare to see one of them all over so.

We may here give a probable Reason, why a Gentle *Infusion* or *Maceration* of *Rhubarb*, is a very sure *Purge*; but the *Substance* or Powder of *Rhubarb*, or a *Decoction* thereof, will have a Quite Contrary Effect, and *Bind*. We may I say, think that the Sharp and Tart *Juice* in *Rhubarb*, wherein its *Purging Faculty* lies, is by a Gentle *Infusion* so Extracted, that it turns not to *Gum* in our *Stomach*; For I cannot think, that the *Sower Juice* of *Rhubarb*, is a specifically Distinct Liquor from the *Gum*, which I believe to be only an Accidental *Coagulation*.

Green Plumbs or *Sloes* do often break forth with a *Gum*, which is Clear and Transparent: and it seems to Hasten, if not Ripen, at least the Red Colour. I have Cut them; to the end that I might have Gathered *Gum* in the *Wounds*: which indeed I did, but yet long after, when the *Wounds* seem'd to be *Canker'd*, and that but in a small Quantity to what they voluntarily spend.

Lauro cerasus, a Beautiful *Winter-Green*, which we have adopted to adorn our *Courts Walls* with, yields a *Clear Gum* very plentifully: It is very *White* and very *Clear*.

There are Other Sort of *Juices*, which will not of themselves, that I have observed, Exudate out of the *Wounds* of their respective *Plants*.

I Wrenched and Wounded the *Holly* the latter end of *March*, and yet after some days of Warm and Open Weather, I could not perceive the least Stirring of *Juice*: The latter end of *May*, the *Bark* begins to be full of *Lime*, which you may Try, by Pressing a Piece of it between your Fingers, and when you would take them off, the *Juice* or *Lime* Draws out into *Hairs*, and follows your Fingers; Cleaving to them like small Threads.

This *Lime* or *Juice* is Separated or taken out of the *Bark* thus; Peel off the *Bark* the Months of *May*, *June*, or *July*; for it then Comes easily Away, and most abounds with *Juice*: Boil the *Bark* in Fair Water, until it be so Tender, that the utmost Thin *Grey Bark*, or *Membrane*, Peel easily off: lay it so Peel'd, and Cover it Over with *Green Nettles* or *Tern*, or such like, S S S. in a Cellar for about 10. Days, where it will Ferment or Rot, and become Mouldy: Take them out, and Beat them well in a Mortar to a *Paste*, and Roll them up into Small Hand-Balls; and in a Running Spring wash them Clean, from all the *Woody* or *Sticky Parts*; which is Effected by Pulling and Teasing them. But Note well, that Great Care is to be taken in the *Washing* of the *Balls*: for besides that they must, if possible, be forthwith washed, the *Lime* will all get from you, except you so order the matter, by engaging it with your Fingers that it Entangle. You would Imagine, that upon Breaking one of the *Balls*, that there was little or no *Lime* in them, so freely they Moulder and Crumble. After it is once Engaged thoroughly, it will endure washing; and the Clearer you take away the woody Parts, the Better it is.

In cutting the Tender Tops of *Elder*, the latter end of *May*, there will a *Stringy Juice* follow your Knife, and Draw out in *Threads*, somewhat like *Bird Lime*, or the *Juice* of *Holly*: It seems to be in certain *Veins* just within the *Circle* of *Teeth* or *Wood*.

Oily Juices.

Further the Dissected *Veins* of many *Plants* afford us *Oil*; that is such a *Juice* which being Rubbed betwixt one's *Fingers*, is not at all *Clammy*, but makes them *Greasy* and *Glib*. Some of it *Stiffens* not, as far as I have yet *Experienced*: yet I believe it to be *Coagulate* and *Mixt*

We will Instance in the *Juice* of *Helenium*, sive *Enulo Campana*, *J. B.* You may take it off with a *Clean Knife*, whereon it looks like *Oyl* mixt with *Water*; that is, the *Thin* or *Dilute Juice* of the *Plant*, Springing up out of the *Wound*, together with the *Oil*. The like *Experiment* may be made upon *Cicuta*. The *Juice* of *Angelica Sativa Park.* I found *Altered*, after a *Year's* keeping, and grown very *Limy*.

Tapsus Barbatus Ger. If you strip off the *Leaves* in *June*, it seems to yield an *Oily Juice*, but very much *Thinned* with the *Watery* One. It Springs freely enough; it is of a *Dark Green* Colour, and I took it in *wheat Flower* and made it up in *Cakes*.

Also the *Fruits* of many *Plants* afford *Oils*, as *Oliva*, *Bacci Lauri*, *Hederæ Juniperi Cornus Fæminæ*, &c.

The *Pulp* of Most *Seeds* seem to abound with this *Oily Juice*, and at some-time before their *Maturity*, it is *Liquid* and *Visible* in them, in the *Form* of a *Milk*.

Helleborus niger Syl. Adulterinus, etiam Hyeme Virens, J. B. The *Seeds* of this *Plant*, the latter end of *May*, is very *Milky*, and by *Insolation* is easily formed into *Cakes*, which are yet very *Oily*, and being long *Kept*, I have exposed to the *Flame* of a *Candle* which they received and *Burnt* freely; Sparkling not very much, and not then neither being *Clammy* at all. One thing I must not omit, that this *Milk* or *Juice* of the *Seeds*, is of a very *Fiery* and *Stinging* Nature: for when I *Cut* the *Seeds* out of the *Green Pods*, they struck my *Eyes*, no *Otherwise* than *Onion* is wont to do. Moreover the *Tops* of my *Fingers*, which were wetted with this *Juice* did *Boaken* and *Ake*, as when after *Extream Cold*, one has the *Hot-Ach* in them: and that *Pain* Continued in them for several *Days*, and at length the *Skin* of my *Fingers* End *Peeled* off.

Diacodium Album, is a *Medicament* of the *Seeds* of *Poppey*.

Rosins.

There are *Other Oily Juices* which after *Coagulation* Harden and are called *Rosin*: and such our *Ivy* yields abundantly. Hither also may be referred the *Juice* of *Juniperus Vulgaris Baccis Parvis Purpureis, J. B.* which is a *Hard Fat Juice* and not much *Gummy*.

In the *Chops* of *Ivy* made in *March*, there did *Exudate* a *Thick* matter like *Barm*; *Yellowish* and *Greasy*: It *Melted* like *Oil* betwixt my *Fingers*, not having the least *Clamminess* then perceivable. In *Process* of *Time* it *Hardned* and *Crusted* on the *Wounds* like *Course Brown Sugar*. It *Burns* with a *Lasting Flame*, and *Smells* very strong.

Also on the *Top* most *Leaves* of *Lactuca Syl. Costa Spinosa, C. B.* In *July* many small *Drops* or *Pearls* of an *Oily Juice*, *Coagulated* and *Hardned* *Rosin* like, are *Plain* to be *Discerned*, especially with a single *Microscope*: They are of an *Amber-Colour* and *Transparent*; easily to be *wiped* off,

as being an Oily Juice Exudated. And I am of the Mind, that even the *Blew Flower of Ripe Plumbs* is nothing else, but a Fine *Resinous Coagulation* of the *Transudated Juice*.

On the Under-side of the *Leaves*, and all over the *Stalk* of *Bonus Henricus*, *J. B.* do stick infinite small *Transparent Pearles*: Those clear *Drops* are *Hard* to the *Touch*, and feel like *Greasy Sand*; not *Clammy*, and therefore it was well called *Unctuose* by *C. B.* and we put this *Spontaneously Exudated Juice*, amongst the *Resinous Coagulations*.

The *Juices* of *Plants* are also *Varied* and *Distinguished* by *Fermentation*. And not only the *Juices* of *Fruits* are to be *Wrought*, or set a *Working*; as of the *Apple*, *Pear*, *Briar*, *Grape*, &c. as is well known: But there is an *Artificial Change*, viz. *Malting*, to be made even in the *Seeds* of *Plants* so as to make them *spend Freely*, or *Let go their Juices*, and *Communicate* them to *Common Water*, and receive a *Ferment*. Also the *Juice* of the *Roots Glycyrrhiza* will *Ferment*. Also the *Juice* of the *Cane*, as *Sugar*. Again the *Tapped Juices* of *Vegetables* (wherein my *Observations* are *Limited*) are susceptible of a *Ferment*. As for instance;

The 21. of *Apr.* 1665. about 8 in the *Morning* I bored a *Hole* in the *Body* of a *Fair and Large Birch*, and put in a *Cork* with a *Quill* in the *Middle*, after a *Moment* or two it began to *Drop*, but yet very *Softly*: Some 3. *Hours* after I returned, and it had filled a *Pint Glass*, and then it *Dropped* exceeding *Fast*, viz. every *Pulse* a *Drop*. This *Liquor* is not *Unpleasant* to the *Taste*, and not *Thick* or *Troubled*: Yet it looks as though some few *Drops* of *Milk* were *Spilt* in a *Bason* of *Fountain Water*. There are many *Ways* of *Fermenting* or setting this *Juice* a *Working*, that is, of keeping it from *Coagulating*.

The *Maple*, both that which is *Miscalled* the *Sycamore*, and the *Lesser*, *Bleed* a *Fermentable Juice* *Copiously*, in the *Breaking up*, of *Hard Frosts*.

Also the *Willow*, *Walnut*, *Poplar*, *Whicking*, are all said to *Bleed* in their *Seasons* a *Vinous Juice*.

To *Extract* the *Juice* of *Vegetables*, as *Opium* for *Example* (as is usual in the *Best Preparations* and *Methods* of making *Laudanum*) with *Spirit of Wine*, is not probably to *Separate* any *One part* of that *Coagulate Juice* from the *Other*, as the *Serum* or *Whey*, (for *Example*) from the *Caseous* part of the *Juice*; but only to *Depurate* or *Defecate* the *Opium*: For *S. V.* says *Mr. Boyle* will dissolve *Gum Lacc.* *Benzoin*, and the *Resinous* parts of *Fallap*, and even of *Guajacum*, which are *Coagulations* and *Mixt Juices*; and the same we may think of the *Juices* that are *Extracted* by *S. V.* from other *Herbs* that they are *Mixt*.

Also, those otherways of *Roasting* and *Drying Juices*, upon *Plates* over a *Gentle Fire*, until they will *Rub* to *Powder*, gives no great *Satisfaction* to me, that the *Narcosis* of *Opium*, for *Example*, is gone or *Separated*, because the *Dryed Juice* less offends the *Nose*; that is, *Smells* not so *strong*.

The *Whey* of *Lact.* *yl.* will be only *Dissolved* in *Cold Water*, the *Curds* *Wholly refusing* to *Mix* with it. So that *Simple Water*, perhaps is the *best Menstruum*, and *Really Separates*, what *S. V.* only *Depurates*.

Herbs of the
same Make and
Class for the Ge-
nerality have
the like, Virtue;
by Mr. Ja. Peti-
ver. n. 255.
p. 289.

LXV. That *Plants* of the same *Figure* or *Likeness*, have for the *Generality* much the same *Virtues* and *Use*, will not be thought an *Improbable Conjecture*, if we consider that the *Organs* and *Structure* of all *Plants* of the same *Family*, or *Class*, must have much the same *Vessels* and *Ductus's* to *Consummate* that *Regular Formation*, and *Consequently* the *Juices* *Circulated* and *Strained thro' them*, cannot be very *Heterogeneous*; and that as for the *Most part*, the *Scent* and *Tast* have great *Affinity*, so of *Course* their *Virtue* likewise cannot be very *Diffonant*.

1. As for instance, the *Tribe* of *Umbelliferous Herbs*. It's the *Property* of these *Herbs* to have the *Position* of their *Flower-Branches* to proceed from one *Basis* or *Center*, which expand themselves into an *Umbel*, whose *Flowers* consist of 5 *Irregular* or rather *Unequal*, (that is, *Differing* in *Shape* and *Bigness*) *Pentapetalose Leaves*, from whence their *Seed* are *Produced*, which are *Naked* or *Double*, or by their *Splitting*, seem so. This *Genus* I generally observe to be endowed with a *Carminative Tast* and *Smell*; they are *Powerful Expellers* of *Wind*, and are therefore *Good* in all *Flatulent Diseases*, and of *Great Use* in the *Chollick*, &c. To instance a *Few*, for *Example*, as *Annise*, *Caraway*, *Cummin*, *Angelica*, *Smallage*, *Parsly*, *Lowage*, &c. The *Greatest Virtue* of these *Plants* lies in the *Seed*, and *Next* in the *Roots*, and in the *Leaves* of some *Few*.

2. The *Plantæ Galeatæ* and *Verticillatæ* are a *Family* of *Plants* which bear their *Flowers* in *Rundels* or *Whorles*, at more or less *Distances* round the *Stalk*, whose *Monopetalose* *Flowers*, if we may so *Call* them being such at the *Bottom*, being *Tubulose*, *Contrary* to the *Last*, are generally *Divided* into 5 *Unequal Segments*, as the *Umbels*; but with this *Distinction*, that the two greater *Petala* or *Flower-Leaves* in this *Tribe* are sometimes above, and other times below, whereas the *Other* are constantly the same, that is, always *lye* in the same *Place*, being *Expanded* on a *Flat* or *Plain Surface*. The *Flowers* of our *Verticillated Plants*, from the *Different Position* of their *Petala*, are therefore *Distinguisht* under the *Floræ Galeatæ*, seu *Labiatae*. The *Calyx*, or the *Case* to the *Lower* or *Tubulose Part* of Each *Flower*, serves also for its *Seed Vessel*: In the *Bottom* of which is *Contained*, in all I have yet observed, 4 *Seeds* set *Close together* upon a *Plain*, which *Nature* lets *Fall out* when *Ripe*, the *Husk* being always *Open*, and commonly *Divided* into 5 *Points*, *Adequating* the *Segments* of Each *Flower*. The *Sovereign Balm* of these *Herbs*, *Chiefly* consists in the *Leaves*, and *Husks*, rather than the *Flowers*. My *Reason* for giving this *preference* to the *Husks* of this *Tribe*, before the *Flowers* (contrary to all *Authors*) are, because I commonly observe the *Calyces* are the *Chiefest*, if not the *Only Part*, on which I find its *Viscous* or *Sulphureous* *Particles* to *adhere*; This you may very *Easily Perceive*, not only by its much *Stronger* and *Penetrating* *smell*, but by the *Clamminess* of this, far beyond the *other Parts*, as is very *apparent* particularly in the *Husks* of *Sage* and *Clary*: And if with *Spirit of Wine* you make a *Distillation* of these alone, you will find them much *Stronger* than from a *Greater Quantity* of *Flowers* only; which being of *Finer* and *more Volatile Parts*, are only *Capable*

of retaining what the Vicinity of the Stronger and Thicker Texture which the *Calyces* are composed of, and can without Prejudice easily communicate to them.

I look upon the Generality of this *Tribe*, to be a Degree *Warmer* than the Last; and their *Heat* consequently to approach Nearer to the *Aromata* or *Spices*, than the *Carminatives*; and the Effects thereof to be more peculiarly appropriated to such *Nervous* Diseases, as are more Intense, and the *Umbelliferæ* cannot so quickly reach, *viz.* *Apoplexies*, *Epilepsies*, *Palsies* &c. in which Cases our *Lavender*, *Rosemary*, *Sage*, *Stæchas*, and some others, are *Simples* which all our Antient Physicians (in these Stubborn Diseases) have very much Applauded. And we ought not to forget *Mint*, *Barum*, *Pennyroyal*, *Savory*, *Time*, *Hyssop*, *Marjerom*, *Basil*, *Origanum*, *Dittany of Crete*, *Marum* or common *Mastick-Time*, with *Marum Syriacum*, and some Other.

3. We Proceed next to those Herbs which have a *Tetrapetalose Regular Flower*; (by *Regular* I mean, such as have 4 Equal *Petala* in each *Flower*.) These, in Relation to their *Seed Vessels*, are subdivided under two Heads, *viz.* *Siliquosæ*, and *Capsulatæ*; being such as have their *Seeds* contained in Long, or Short Receptacles, as *Podds*, or *Capsules*. The most Essential Virtue and Use of the Herbs of this *Class*, I observe are more particularly in the *Leaves* and *Seed*; and next them the *Roots*: And if any Parts are Slighted, its the *Flowers* and *Podds*.

The *Leaves* are more particularly used in the *Water* and *Garden Cresses*, *Sea* and *Garden Scurvy-Grass*, *Hedge-Mustard*, *Iberis* or *Sciatica Cresses*, *Lepidium*, *Piperitis Officinarum*, *Cardamine*, *Bursa Pastoris*, &c. To which may be added our *Cabbage*, *Coleworts*, *Savoys*, *Sprouts*, &c. which are of this *Tribe* also.

Others of this *Family*, that are more peculiarly Eminent for the Virtue contained in their *Seed*, are the Common *Mustard*, and *Rape*, the *Thlaspi Dioscoridis* or *Treacle Mustard*, the *Eruca* or *Rocket*, and *Sophia Chyrurgorum* or *Flixweed*; the *Seed* of which Last, I am informed, hath for some Years past been used by several People, in the North of *England*, for the *Stone* and *Gravel*, with very good Success.

We come now to the *Roots*. Two or Three of which, have gained no small Repute, as well in Diet as Physick, *viz.* the *Radishes*, both *Garden* and *Spanish*, (which is the Large *Black-rooted*) as also the *Wild* or *Horse-Radish*: and to these the *Round* and *Long-rooted Turnep* must be added.

Most of this *Tribe* I find, tho' they are very *Hot* like the two Last, *viz.* the *Umbelliferæ* and *Verticillatæ*, yet they Exert their Power in a much Different manner; to wit, by a *Diuretick Volatile Salt*; and are found most Prevalent, and Effectual in *Chronick* Diseases; as the *Scurvy*, *Dropsy*, *Gout*, *Faundice*, and other Ill Habits of the Body, where the Blood is Vitiated, rather in its Particles; than Irregular Motion; Carrying of its Impurity, by a *Diuretick Discrasis*, or Discharge of the Offending *Heterogeneous Salts* therein Contained; and Consequently by *Purification*, Disposing of it to a Better, or more *Sane* Disposition.

The Separated
Bark of a Tree
Reunited to the
Tree; by Dr.
Chr. Merret.
N. 25. P. 453.

LXVI. In the Midst of *March*, An. 1664. I made a Section of the *Rinds* of *Ash*; and of the Tree, falsely call'd *Sycamore*. The first Section of Each of the *Rinds* was Square, whereof 3 sides were Cut, the 4th. *Uncut*. The Success was; that the Whole *Bark* did *Unite*, by Binding it with Pack-Thred, leaving a Scar in Each of the sides Cut.

Then I Cut off, and Separated entirely from the Tree, several Parts of the *Bark*, some shallower, leaving part of the *Bark* on; Others, to the very *Wood* it self; both in the *Trunk* and *Branches*, from an inch square to less Dimensions; and some of them I bound close with Pack-thred: All which were Separated, a new *Rind* succeeding in their Place. Some I Covered over, beyond the Place of *Incision*, with *Diachylon Plaister*, and Tied them Fast with Pack-thred. All which, thus Bound and Plaistered, did within the space of 3 Weeks, Firmly *Unite* to the Tree; not without some Shrivelling of the Outward Skin of the *Bark*, and also with some Shrinking in Each side, where the *Incision* was made; where also appear'd in each of the interstices a Scar. But Tying the same about *Michaelmas*, and in the *Winter* season, at neither of these times any *Union* could be made of the *Bark* to the Tree; I suppose it was because the *Sap* Mounted not so Vigorously, and in such Plenty, as in the *Spring* season.

Some *Branches* of the forementioned Trees were *Decorticated* round: and where no *Union* was, there certainly followed a *Withering* of the *Branch* beyond the Place, where the *Section* was made.

I also Separated a *Twig* from the Branch, by Cutting of it sloping, for the better fastning of it to the *Branch* again. This *Twig* I exactly fitted to the *Branch*, from whence 'twas Cut, in the same Posture it before Grew in: I firmly Bound it, and covered it with *Diachylon-Plaister*. The Success was, that in 3 Days time, the *Twig*, that was Cut off, *Withered*.

Observations
concerning the
Barking of
Trees; by S.
Malpighi.
N. 161. P. 645.

LXVII. *Nutritii Succii Plantarum* Motum exploraturus, in multiplicibus variisque *Arboribus* *Corticem* Vinculo, vel Circumcisione, avulsa ejusdem Annulari portione, Tentavi: & *Plantæ* Superior Portio, ultra Scil. Sectionem perpetuo intumuit, debitumque sortita est Augmentum, inferior vero nullum adepta incrementum, solas interdum dedit *Gemmas*. Hanc eandem Sectionem in Humiliori *Trunci* parte, & in *Radicibus* ipsis excitavi, & perpetuo Superior *Trunci* vel *Radicum* pars insigniter intumuit, & ab hac *Radiculæ* copiose emanarunt; Inferior vero, reliquaque *Radicis* Portio frequenter gracilescendo, tandem Contabuit. Quare confirmari videtur *Nutritii Succii Refluxus Motus* ab Extremis *Ramis* ad ultimas usque *Radices*: unde intercepto Alimento, Compressione, vel Laceratione *Vasorum*, Remotiores *Plantæ* partes, solito non gaudent Alimento; Tumorque ex Relabente *Succo* excitatur. Propagatur autem à *Foliis* ipsis usque ad *Radicum* Extremos Apices. Quapropter *Florum* Cultores soluto in *Cyrum* *Cortice*, Tenellum *Ramum* à Paterno emancipant *Trunco*, circum-affusa Madida Terra, in qua erumpentes *Novæ Radiculæ* supra *Sectionem* Vegetare incipiunt: Alimentum enim inferiora versus propulsam, vel expressum, non solum prope *Corticis* *Sectionem* Stagnando Tumorem excitat,

excitat, sed foras irruendo in Radiculas absumitur; unde sui juris factus *Surculus*, Paterno tandem dissociatur Trunco. Non raro in *Radicibus* prope *Flumina*, quarum portio obtruncata Aperto gaudet Aere, ab ultimis *Libri* finibus *Gemmæ*, *Radicum* loco, erumpunt, quæ in *Ramos* sursum atolluntur.

LXVIII. I. An. 1671. A *Crab-Tree*, about 4 inches in Diameter was *Hackt* Round with a Hatchet, so as to Cut pretty Deep into the *Wood*; besides the Cutting off of the *Bark*, for about 4 inches Wide. After which it was the same year observed to encrease, *Above* the said *Hacking*, very considerably, and to shoot in length of *Wood* about one *Foot*: The *Next* year, it increased considerably, and shot in length about 9 *Inches*: but the 3^d year it *Dy'd* to the very *Root*.

Experiments of the Barking of Trees; by Mr. Tho. Brotherton. n. 187. p. 307.

Much the like was observed in another, part of whose *Bark* was Eaten off by a *Canker*, that the *Lower* part stood, without increasing, and by Degrees the *Wood* Rotted and Mortified: But the *Upper* Part Encreased to the 3^d Year, when it *Dyed* also.

A *Scotch-Fir* of 3 Years Growth, having a *Ring* of the *Bark* Cut off, of the Breadth of 3 *Inches*, near the Bottom of the *Stem* or *Stalk*, below the Uppermost *Knot* or *Foynt*, was Observed to Grow and shoot out its *Top* about half a *Yard*, and the parts all about the *Ring* to increase very much in *Thickness*, much more than it would have done, if the *Section* had not been Made. But all that part of the *Stock*, between the said *Ring* and the *Knot*, Next *Below* it, increased not at all: But that part which was *Below* the *Next Knot*, increased somewhat, yet not so much as if the said *Ring* of the *Bark*, had not been Cut off. The 2^d. Year it also Encreased considerably, but not so much as the *First*: but the 3^d. year it *Dyed*.

Fig. 174

A *Branch* of a *Tree* had a *Ring* cut off from it, *Apr. 1. 1686*, and the part *Above* the *Section* increased, and Grew till the 17th of *October* following when it was Cut off from the *Tree*. In this space of *Time* the part *Below* the *Ring* increased not at all, but stood at a *Stay*; but the part *About* the *Ring* shot out a *New Foynt* between a *Foot* and *half a Yard*, and increased in *Thickness* for the *Whole* length of it, and in all its parts, twice as much as it would have done, if it had not been Cut; as was apparent by a like *Branch* on the *Opposite* side of the *Knot*, which was not Cut nor Barked Round in the same *Manner*; the *Bark* also of the part *Above* the *Section*, swell'd or Grew *Downwards*, over the *Woody* part, (which was *Bare*) above half an *Inch* in *Breadth*.

The Usual *Time* for making this *Section*, was either in *March*, or the *Beginning* of *April*.

Tryal was made upon some young *Trees*, Cutting a *Helical Swath*, of the *Bark*, about *half an Inch* in breadth, by leaving a like *Helical Swath* of *Bark* to Communicate between the *Upper* and *Under* Part. In this *Tryal*, the *Difference* of *Growth* succeeded not, but the remaining *Swath*

of the *Bark* swelled *Downwards*, and by the End of the Year, Covered the *Bared Part* of the *Wood*.

The like Event, almost, followed upon making an *Indented Section* Round, of about *half an Inch* in Breadth; the *Upper Bark* quickly Swelling *Downward*, and Joyning again with the *Lower*.

It was also Observable, that as the *Upper Bark* Grew *Downwards*, so it Increased also in *Thickness*: whereas the *Bark Below* the Section, *Thickned* not at All.

A *Scotch Firr* of 3 Years Growth (which shoots forth every Year, both from the *Body* and the *Branches* a new *Joynt* and *Circumambient Sprouts*, to a determinate Length) was *Barked* with 3 *Rings*, of about $1\frac{1}{2}$ *Inch* broad, each about the Middle of the *Internodia* or Parts of the *Stock* between the *Joynts*. In a Year this *Stock*, which was about the bigness of a *Quill*, *Below* the *Ring* to the next *Joynt* continued of the same Bigness, but *Above* the *Ring* it Increased and Grew to the bigness of One's *Finger*: and from the *New Joynt* shot out *New Limbs* and *Stock* about a *Quarter* of a *Yard*, which was somewhat Bigger, than if there had been no *Ring* made. The *Branches* increased likewise Proportionably, by Swelling in Bigness, and from a *New joynt* shooting out *New Body* and *Limbs*, at the *Top* or *Body*. And the *Body* of the *Tree Below* the *Joynt* to the 2d. *Ring*, increased More than if the *Ring* had not been made: But the Part of the *Stock Below* the *Ring* to the next *Joynt*, increased not at all. The like shooting and increasing, was observed in the 2d. *Limbs Joynt* and *Stock Below*, it between which and the *Lowest Joynt*, it increased not.

On One of the *Lowermost Branches* of a *Young Scotch Firr*, of 2 Years Old, was made a *Ring Section* between the *Body* and *First Knot* of the *Limb*. The following Year, That Part of the *Limb Above* the *Ring*, increased twice or thrice as much as the *Corresponding Parts* of the *Other Limbs*, from the same *Knot*: but the Part *Below* the *Section* to the *Body*, increased not at all.

Fig. 175.

A *Young Hazell* was Cut into the *Body* with a deed *Gash*, and the Parts of the *Body*, *above* and *Below* Cleft *Upwards* and *Downwards*: and the *Splinters a.* and *b.* by *Wedges*, were kept off from *Touching* each other, or the rest of the *Body*. The following Year the *Splinter Above* the *Gash*, was Grown very much: but the *Splinter Below* stood at a stay and Grew not: but the rest of the *Body* Grew as if there had been no *Gash* made.

Four young *Poplar Trees*, all of *Equal Bigness*, *Growth*, *Situation*, and *Soyl*, as near as could be found, were thus Order'd. The *First* had *All its Branches* and *Top* Cut off. The *Second* had *All its Branches* Pruned off, but it was left with a small *Head* at the *Top*. The *Third* had the *Branches* Cut off *Half-way*, and *Those* of the *Upper half* left Growing. The *Fourth* was left Growing without being *at all* Prun'd or Lopped. In the following Years, the *first* shot out many *Twigs* round about, but the *Body* increased but little in *Height* or *Bigness*. The *Second* shot out likewise many *Twigs* where it had been Pruned, and the *Top Branches* and *Top* also increased Considerably; and the *Body* also increased much more in *Height* and *Bigness* than did the *Former*. The *Third* increased yet much more in *All its Parts* than the *Second*. But the *Third* increased in

Limbs,

Limbs, Height, and Bigness, *Most of All*; swelling in Bigness, and stretching in Height, and spreading in its Boughs, much more than the *Third*; and in about 10 Years, was more than 4 times as Big as the *First*.

In the *Great Frost*, 1684, of 25 *Poplars* that had been *pruned*, 19 were Kill'd by it; and the remaining were very Weak, and hardly able to Recover, and Increased very little in the following Years. These *Poplars* were about 30 *Foot* high, and had only a *Small Head* Left at the Top Unlopped, of about 4 or 5 *Foot*, and were *prun'd* the Spring before the *Great Frost*. Divers also of those which had been *pruned* two Summers before the Frost, were kill'd by it: But none of those which had not been *prun'd* at all, were Hurt by it: And both in *Lancashire* and *Cheeshire*, Trees of 60 *Foot* in Height, that had been *pruned*, and had only a *Small Top* left, were also Kill'd by the said *Frost*: Whereas those Trees of the same Kind and Height, which stood near to them, but had not been *pruned*, continued to *Flourish*, and suffered No Harm thereby. Several of those *Branches* of about an *Inch* Diameter, and *Trees*, that had been *Barked* round, (as above) the Spring before the *Great Frost*, Outlived the Violence of the same, and the preceding Winter.

Of the Growth
of Trees. 16.
p. 311.

Where these *Prunings* had been tryed upon Trees 20 *Foot* high, the Difference of their Increase was sensible the following Summer; but in 7 or 8 *Years* Time, the Difference is Prodigious; the *Unprun'd* Trees Growing several Times bigger than the *prun'd*, both in *Body* and *Branches*.

When the *Top Branches* would shoot out and Grow 2 *Foot*, or more in length, the lower *Branches* would not shoot above 4 *Inches*: And in the *Branches* of the *Scotch Firr*, the Joints *Above* the *Rings* *Barked* round, would Encrease and Grow much Bigger in 3 *Years*, than they would in 5 *Years*, if the said *Rings* were not cut off.

A very large *Pinafter* about 2 *Foot* and an *half* in Diameter, and of a Height proportionable (*viz.* of about 20 *Yards*; the lowest Boughs of which, were about 30 *Foot* above the Ground) did Spread and Flourish on every Side *Alike*, though it had no *Root* at all towards 3 *Quarters* of its Situation, but only toward *one Quarter*, into which it spread its *Roots* very far and Large; Divers of them reaching about 70 or 80 *Foot* from the *Body* of the Tree: The Reason of which Spreading was occasioned by its being Planted just within the Square Angle of the Corner of a Deep, Thick and strong Stone Wall, which was as a kind of *Banking* or *Wharfing* against a River that ran by it.

Upon Consideration of these, and divers other Observations, and Experiments, I am of Opinion. 1. That the *Sap* (most of it, if not all) *Ascends* in the Vessels of the *Lignous* Part of the Tree, and not in the *Cortical* part, nor Between the *Cortical* and *Lignous* Parts. 2. That the Increase and Growth of a Tree in Thickness is by the *Descent* of the *Sap*, and not by the *Ascent*. And if there were no *Descent*, a Tree would Increase but very little if at all. 3. That there is a Continual *Circulation* of the *Sap*, All the *Summer* Season, and during such time as the *Sap* is *Stirring*; and not a *Descent* at *Michaelmas* only, as some have held.

By R. H. 16.
P. 313.

2. To me it seems very Probable, that the *Bodies* of *Plants*, as well as those of *Moving Animals*, are Nourisht and Increased by a *Double Food*; the *One* an *Impregnated Water*, and the *Other* an *Impregnated Air*; and that without a Convenient Supply of these *Two*, the *Vegetable* cannot Subsist, at least not Increase. These do mutually Mix and Coalesce, and Parts of the *Air* Convert to *Water*, and parts of *Water* Convert to *Air*. And as some of this *Latter* are Rarified and Freed from their Chains, and become Spiritual and Airy, so others of the Forementioned are Clogg'd and Fetter'd and become Debased. To this Purpose all *Plants* as well as *Animals*, have a *Two fold* kind of *Roots*, *One* that Branches and spreads into the *Earth*, and *Another* that Spreads and Shoots into the *Air*: *Both* kinds of *Roots* serve to Receive and Carry their Proper Nourishment to the *Body* of the *Plant*, and *Both* serve also to Convey and Carry off the *Useless* Recrements; *Useless*, I mean, any further *Within* the *Body* of the *Plant*, though *Useful* to it when they are *Separated*, and *Without* it; the *One* for Seasoning the *Earth* and *Water* wherein it is Planted, and the *Other* for Seasoning and Preparing the *Air*.

The Communica-
tion of the Parts
of the Tree with
the Parts of the
Fruit; by Dr. J.
Beal. n. 43. p.
860. n. 46. p. 919.
Vid. Sup. S. LX.
6.

LXIX. I had an Excellent *Summer-Apple* containing Abundance of very Pleasing Juice; it was of that kind, which never grows Large. The *Body* by the Burthen of the *Fruit* always wreathed towards the Ground; the *Branches* were all Curl'd, and full of Knots at every Turning, and these *Branches* Apt to Grow, if a good *Knot* be set in the Ground, as soon as 'tis Cut off, especially about *Candlemass*. This Tree was *Hollow*, and very near all the *Timber* extremely *Rotten*, from the top of the *Stem* to the *Root*; and every *Sprig*, how small soever, appear'd *Cork-Colour'd* and *Rotten* at the *Heart* of the *Timber*. And so it was generally all over the *Roots*; and 'tis like it had been so many *Years* before. Yet the *Tree Bore* Abundantly, with *Alternative Rests* every *Second* or *Third Year*. The *Fruit* had scarce any *Core*; the *Kernels* were very *Small*, *Thin*, and *Empty*; nevertheless the *Branches* from the *Knots*, Grew well Enough to Replenish a *Nursery* for me. This Seems to Intimate the *Correspondence* between the *Pitby Part*, *Heart* or *Timber*, and the *Seeds*. And more to Confirm this; a *Young Tree* grew like a *Sucker* from the *Only Sound Root* of the aforesaid *Apple Tree*. This *Tree* grew *Straiter* than others of the same *Kind* Usually do; of which I conceive the *Cause* to be this: *Suckers* are commonly *Barren* a pretty long time; and this Continued *Barren* till the *Stem* was strong enough to bear the *Fruit* which Loaded the *Branches*. But that which makes to our Purpose, is this: All the *Fruit* of this *Young Tree*, had *Full* and *Sound Kernels*; and though it was the same *Fruit*, Growing from the *Root* of the *Same Tree*, yet it seem'd not altogether so *Tender*, *Delicious*, and *Juicy*, at the *Fruit* of the *Old Tree*; nor yet was the *Tree* so *Fruitful*. The *Sap* in the *Old Tree* was less *Diverted*, it seems, to sustain the *Life* of the *Timber*, which was now *Consum'd*, and thereby, was wholly appropriated for the *Leaf*, *Blossom*, and the *Pulp* of the *Fruit*. For I do not Underrake, that the *Sap* yields no *Relief* to Sustain the *Life* and *Growth* of the *Timber* Ordinari y, and whilst the *Timber* is *Entire*: But I rather Conceive, that there is a *more immediate* and *Peculiar Relation*, between the *Sap* and *Pulpous Fruit*; and the *Like* between the *Timber*,

or Whole Stock, and the *Root* of the *Tree*, to transmit the *Same Spirit* and *Nature* to the *Seed*, of what kind soever it be.

- Some are of Opinion, that there passes into the *Timber* no part of meer *Earth*, to Sustain the *Life* and Growth of the *Plant*; but it only feeds on the *Succulent Part*, *Ascending* by the *Roots*; and on the *Air*, and the *Moisture* which the *Dews* of Heaven, the *Rainy Seasons*, and the *Air* afford. And if we Consider, that some *Lofty Trees* Grow upon the *Rocks*, where little or no *Earth* can be found; as also, how largely the *Oak* and *Pear Tree* Grows and Spreads; and how many Years the One bears *Acorns*, the Other *Pears*; sometimes to the Quantity of yielding 5 or 6 *Hogsheads* Yearly (as I have known them do;) and, in Comparison, how little *Waste* of *Earth* about the *Roots* Appears; we may find more Cause to Attribute this Large Expence of Materials to the Perpetual Supply of *Moisture*, than of much *Earth*. I will give you an Experiment, which may seem to Determine the Point, though I yet suspend my Judgment.

I took the Largest of *Kentish Codlins*, *Pearmains*, *Pepins*, and *Deuxans*; I Withered them (which may be soon done many ways,) and then I Cut them in the Middle, quite through the Midst of the *Kernels*, having carried them some Days in my Pocket, all that saw them took them to be very *Wood*, and they were indeed like very Close *Cork*. And some Philosophical Persons (though I affirmed no Falshood, but conceal'd the whole Matter,) did upon the View, spread it abroad, that I had the Art of *Converting All Fruit* into *Wood*; *Pulp* and *Kernels* and all was *Wood*. The same may be done upon *Pears*, *Cucumbers*, *Turneps*, and all the *Grains* and *Vegetable Seeds*, that are stuck in them, and are Cherished by a Supply of *Marly Water*; thus I have had the *Blades* of *Wheat* and the *Halme* of *Pease* Grow out of them to the length of a Foot; and then, by hanging it in a Closet, all becomes Turned into *Wood*; and in some time After, all is Turned into *Dust* and *Earth*. And as we are Well Taught by Mr. Boyle, that Pure *Liquids* may be Converted into *Earth*: So These *Terrestrial* Parts of the *Fruit* may be, from the *Liquors* thither Collected, and Derived from the Mass of the *Earth*.

But to return to the Clearing of the *Affinities* above Claimed; I instance in *Barberry Roots*, Perforated by me, which bore *Berries* that had no *Stones* at all: And in Hollow'd *Apple-Trees* the *Kernels* will be very Thin, and empty Skins, and Uncapable of Growth. Gardeners tell me, that if you take the Hard Stick out of the *Root* of *Parsly*, it will bear no kind of *Seed*. But it may be Objected, that a very *Hollow Oak* and an *Hollow Elm* do bear *pregnant Seed*. I Answer, that an *Elm* is all *Timber* to the *Bark*; and an *Oak*, when 'tis All *Putrid* at the *Heart*, yet may have firm *Wood* enough to Convey the *Spirit* of the *Root* into the *Acorn*; and the *Roots* may be *Sound*, when the *Body* of the *Tree* is much Decayed by Rain beating in at the Lopp'd *Tops*, or by other Passages through the *Bark*. We see that *Beans*, *Wheat*, and other *Grains*, grow kindly, if the *Eye* and Parts next adjoining be Whole, though the *Beans* be full of Great Holes in other Parts, or the Main *Body* of the *Wheat* be Cut off with Scissars. However, let the Objection give us the More Caution; that, if we Design to have *Fruit without Stones*, the *Perforation* be the Bolder and the more Compleat. And

And to proceed Further; some Trees are *Less Fruitful*, or altogether *Barren* by the Excessive Growth and Firmness of the *Timber*: And these are Recover'd by Cross *Deep Hackings* through the *Bark*, and such injuries done to the *Timber*, both in the *Stem* and *Main Roots*; and they Cleave the *Roots*, and put a Stone in the Cleft, that it may not Close again too Hastily. If this Violence be not Done both to the *Stem* and *Roots*, the Remedy may Fail. We see also, that *Vines* are less *Fruitful*, when they are Permitted to Run out into many *Woody Branches*.

To shew also the *Proximity* between the *Sap* of the *Bark*, and the *Pulp* of the *Fruit*, I did in the Summer time make *Rests* for Water on the Body of the *Kentish Codlin-Trees*, and caused Water to be Frequently Poured into those Cavities. The Effect was this; the *Apples* Grew to an Extraordinary *Bigness*, and were very *Insipid*: and many of them had parts in appearance much like the *Pulp* of *Lemons*. Some I suffered to Hang on the Tree, as Long as they Would, and those became Full of Spots of the Colour of *Cork*, or like the Rottenness of an *Apple*.

I Omit the Rest, and Hasten to Redouble a Remark of the great use which may be made of the Chiefest Experiment. The *Graft* carries the Mastery from the *Stock* for the *Pulp* of the *Fruit*; so that we have little Hope of much Change by Meer *Graftings*, how oft soever iterated. But it after Many, and Strange, and Choice *Engraftings*, you set the *Kernel*, *Stone*, or *Seed*, of the *Grafted Fruit* in a Kind Mould, you may then expect some *New* or *Mingled* Kind of Plant, as *Semi-Apricocks*, &c. And thus the *Almond* and *Peach* may by many *Changes* in the *Graftings*, and by *Inteneration* of the *Stones* of the *Peaches*, and of the *Shells* of the *Almonds*, and by *Terebrations* of the *Stem* and *Root*, here and there, *Alter* their *Guises* so that the *Coat* of the *Almond* may Approach to the *Pulp* of the *Peach*; and the *Kernel* of a *Peach* be enlarged to a kind of *Almond*. And great store of Better *Contrivances* may from Hence take Rise.

Observations
concerning; Ve-
getation; by
Dr. J. Beal.
n. 56. p. 1131.

LXX. It is very difficult to determine whether *Salt* or *Water* be the Nearer and more Original Principle of all *Mixt Bodies*: or the more Copious, more Active, or more influencing, in this or that Body. But this we have before our Eyes, that, *Birch* and *Alder* Feed more kindly on a *Thin* Uliginous Moisture; the *Elme*, *Pine*, *Firr*, *Pitch*, and *Cypress*, chuse a *Stronger* Liquor: Yet these and many more of the Widest Difference, are sometimes seen to draw their whole Sustainance, Bulk, and Ornaments, whether Annual or Perennial, from the *Liquors* they find in the same piece of *Ground*; and from the *Ambient Air*, and *Dews*; when as yet by our best diligence we cannot Distinguish the *Liquors* or *Salts* closely Approaching their several *Roots*. And we may Change all the *Earth* totally from the *Roots* of Trees, whose *Barks*, *Sap*, *Fruit* and *Seed* have very much Differing *Salts*, and are of very Different Kinds: and yet see each Tree prosper the better by the *Exchange*. Hence we may suspect, that the very *Contextures* of their Bodies, from the First Spiriting of their *Seed*, and as they are Formed Gradually from the Invisible Principles or Spirit and Vigour of their *Seeds*, however small and imperceptible, are the *Natural Limbecs*, where the common *Rain-Water* and *Air*, are

Digested

Digested into very much *Differing* Leaves, Fruit, Seed, Resins, Gums, Cooling Juleps, &c. perhaps as the Cow's Belly Converts the common Juice of all sorts of *Grass* into *Milk*; or as the *Bee* ferments the *Dew* of all *Flowers* into *Honey* and *Wax*.

We see also, that an Handful of *Moss*, sometimes above a Span long, and resembling *Vegetables*, grows out of a small *Oyster-shell*, without *Earth*, *Dirt* or *Sand*, for the relief of the *Root*; *Trees* out of bare *Rocks*; and the Annual *Attire* of *Harts* and *Bucks*, out of their *Bony-Heads*. Whence we may easily apprehend, how the *Seeds* in their time, and afterwards the *Roots*, *Stems*, and *Leaves* of *Trees*, may be the Proper *Strainers* to Generate the *Peculiar Saps* and *Juices*; and perhaps to Ferment and Boil the *Liquors* into their several *Salts*. It may pass for a Resemblance, if not for an Instance, that the *Juice* of some *Sweet Pears* may be Dryed into a very *Sweet Sugar*; and the *Juice* of some other *Pears* is so fierce, that at the very opening of the *Rind* with the *Teeth*, it doth almost Suffocate, as if it would Kill dead immediately; and yet this *Juice* by Time and seasonable Maturation becomes *Sweet*, *Winy* and *Luscious*. And we hear of diverse *Exotick Fruits* that will Kill outright, and that so quick as may Challenge the Fiercest *Menstruum* of an Expert *Chymist*. Now as the *Horns* of a *Stag* have their whole Growth and Virtue from the protruding *Blood* and *Spirits* of the *Animal*; the *Moss* (as by the *Microscope* appears, when Withered) from the *Inward Shell* of the *Oyster* and the *Marine Water*: So in *Plants*, the *Sap* may by Heats and Coolers, and other Changes in Summer, Autumn, and Winter, by *Winds*, and Compressing *Air*, be Hardened into *Timber*, *Seeds*, and their *Stones* and *Kernels*. All seems to be but *Sap* at the first Draught, or little else besides Pure *Air* and *Water*, till these be Concreted into *Peculiar Salts* by more curious *Strainers*, and by more Subtile *Boylers* than *Art* hath hitherto devised. And this was my Aim in a former Paper, where by a slight and Cursory Allusion, I compared the *Motion* of *Sap* in *Vegetables* to the *Descent* of *Liquors* in an *Alembick*: I had no thought of squaring the Comparison to agree in all Circumstances. Neither had I any Phansy, that the *Sap* in Winter Descended to the *Root*, since I saw an *Apple Tree*, that yielded 4 or 5 *Hogsheads* of Strong *Cyder* yearly, and a *Pear-Tree* that yielded more *Perry*; yet both growing on a *Dry Ground*, where they could get no other *Liquor* than what the *Clouds* and the *Air* afforded. Yet I conceive, that these *Trees* have an Intercourse of *Peculiar Spirits* some way linked together, and vigorously Cooperating, from the very *Fibres* of the *Lowest Roots* to the *Top-Leaves*.

Vid. Sup.
§. LX. 1.

LXXI. The *Ancients* Generally Intituled the *Earth* to the *Production* of the *Animals*, *Vegetables* and *Other Bodies* Upon and about it: But several of the *Moderns*, and some of very Great Name too, both Here and Abroad, have given their *Votes* in behalf of *Water*. My Lord *Bacon* is of Opinion, That for *Nourishment* of *Vegetables*, the *Water* is almost *All in All*; and that the *Earth* doth but keep the *Plant Upright*, and Save it from *Over-Heat* and *Over Cold*. Others there are who are still more Express; and

Some Thoughts
and Experi-
ments concern-
ing Vegetation;
by Dr. J. Wood-
ward. n. 253.
p. 193.

Affert *Water* to be the *Only Principle* or Ingredient of all Natural Things. They Suppose, that, by I cannot tell what *Process* of Nature, *Water* is *Transmuted* into *Stones*, into *Plants*, and, in brief, All other Substances Whatever. *Helmont* particularly, and his Followers, are very Positive in this: and offer some Experiments to render it Credible; and Mr. *Boyle* discovers a great *Propensity* to the same Thoughts and Opinion they had

The Experiments they insist upon are chiefly Two; the *First* is, that *Mint* and several *Other Plants* Prosper and Thrive very greatly in *Water*. The *Other* is this; they take a Certain Quantity of *Earth*, and Bake it in an Oven; then they Weigh it, and put it into an Earthen Pot; having well *water'd* this *Earth*, they make choice of some Fit *Plant*, which being first Carefully weighed, they Set in it. There they let it grow, continuing to *water* it for some time, till 'tis much Advanced in Bigness. Then they take it Up, and tho' the *Bulk* and *weight* of the *Plant* be much Greater than when First Set, yet upon Baking the *Earth*, and weighing it, as at first, they find it Little or not at all *Diminished* in Weight; and therefore Conclude, 'tis not the *Earth*, but *Water* that *Nourishes*, and tis Turned into the *Substance* of the *Plant*.

I must Confess, I cannot see how This Experiment can ever be made with the Nicety and Justness that is Requisite. However Nothing like what these Gentlemen would Infer, can possibly be Concluded from it; unless *Water*, which they so Plentifully bestow upon the *Plant*, in this Experiment, be *Pure*, *Homogeneous*, and not Charged with any *Terrestrial Mixture*: for if it be, the *Plant* after all, may Owe its *Growth* and *Encrease* intirely to *That*.

Some *Waters* are indeed so very *Clear* and *Transparent*, that one would not easily Suspect any *Terrestrial Matter* were Latent in them: Yet that is far short of a Proof, that in Reality there is *None*. For they may be highly Saturated with such Matter, tho' the *Eye* be not presently able to Descry or Discern it. If *Pure* and Absolutely *Refined Silver* be Perfectly Dissolved in *Spirit of Nitre*, or *Aquafortis*, that is *Rectified* and thoroughly *Fine*, it does not *Darken* the *Menstruum*, or render it less *Pellucid* than before.

But, after all, I never met with any *Water*, that however Fresh, and newly taken out of the *Spring*, did not exhibit, even to the *naked Eye*, Great Numbers of exceeding Small *Terrestrial Particles*; Diffeminated through All Parts of it. *Thicker* and *Crasser Water* exhibits them still in Greater Plenty.

These are of Two General *Kinds*. The One a *Vegetable Terrestrial Matter*, Consisting of very Different *Corpuscles*; some whereof are Proper for the *Formation* and *Increment* of One sort of *Plant*, and some of *Another*; as also Some for the *Nourishment* of One Part of the *Same Plant*, and some *Another*. The *Other Kind* of Particles sustain'd in *Water*, are of a *Mineral Nature*. In some Springs we find *Common-Salt*, in Others *Vatriol*, in Others *Alum*, *Nitre*, *Sparr*, *Ochre*, &c. Nay frequently Several of these, or *Other Minerals*, all in the *Same Spring*. All *Water* whatever is much Charged with the *Vegetable Matter*; this being *Fine*, *Light*, and easily *Moveable*. As for the *Mineral*,

Mineral, the *Water* of *Springs* contains more of it, than that of *Rivers*; especially when at *Distance* from their *Sources*: and that of *Rivers*, more than the *Water* that falls in *Rain*.

If any One (who desires Further Satisfaction herein) put *Water* into a Clear *Glass Viol*, stopping it close, to keep *Dust*, and other *Exterior Matter* Out, and letting it stand without stirring it, for some *Days*: He'll then find a Considerable Quantity of *Terrestrial Matter* in the *Water*, however *Pure* and free it might appear when First put into the *Viol*. He'll in a very short time Observe, as I have frequently done, the *Corpuscles*, that were at First, while the *Water* was *Agitated* and kept in *Motion*, *Separate* and hardly *Visible*, by Degrees as the *Water* permits by its becoming more Still and at Rest, *Assembling* and *Combining* together: By that means Forming somewhat Larger and more Conspicuous *Moleculæ*. Afterwards he may behold these Joining, and Fixing each to other; by that means forming Large Thin *Masses*, appearing like *Nubeculæ*, or *Clouds* in the *Water*; which grow more Thick and Opaque, by the Continual *Appulse* and *Accretion* of Fresh Matter. If the said Matter be Chiefly of the *Vegetable Kind*, 'twill be sustained in the *Water*; and Discover at length, a *Green Colour*; becoming still more of That Colour, I mean an Higher and more Saturate *Green*, as the Matter Thickens and Encreases. But if there be any Considerable Quantity of meer *Mineral Matter* in the *Water*, This being of a Greater *Specifick Gravity* than the *Vegetable*, as the Particles of it *Unite* and *Combine* in such Number, till they form a *Molecula*, the *Impetus* of whose *Gravity* Surpasses That of the Resistance of the *Water*, Subsides a great deal of it, to the Bottom. Nor does it only fall down *It self*, but frequently *Intangling* with the *Vegetable Nubeculæ*, Forces them down along with it.

Upon the whole, 'tis Palpable and beyond reasonable Contest, that *Water* contains in it a very Considerable Quantity of *Terrestrial Matter*.

Now the Question is, to which of These, the *Water* or the *Earthy Matter* sustained in it, *Vegetables* owe their *Growth* and *Augment*.

For Deciding of which, I conceive the following Experiments may afford some Light: And I can safely say, they were made with due Care and Exactness.

An. 1691. I chose several *Glass Viols*, that were all, as near as possible, of the Same Shape and Bigness. After I had put what *Water* I thought Fit into every one of them, and taken an Account of the *weight* of it, I Strained and Tyed over the *Orifice* of each *Viol*, a Piece of *Parchment*, having an *Hole* in the Middle of it, Large enough to admit the *Stem* of the *Plant* I designed to Set in the *Viol*; without the *Confining* or *Straightning* it so, as to Impede its *Growth*. My Intention in this, was to prevent the *Enclosed Water* from *Evaporating* or *Ascending* by any other Way than only thorough the *Plant* that is to be Set therein. Then I made choice of several Spriggs of *Mint*, and other *Plants*, that were, as near as I could

possibly Judge, alike *Fresh, Sound, and Lively*. Having taken the *Weight* of Each, I placed it in a *Viol*, ordered as above: and as the *Plant* Imbibed, and Drew off the *Water*, I took care to add more of the same from time to time; keeping an Account of the *Weight* of all I added. Each of the *Glasses* were, for Better *Distinction*, and the more Easy keeping a *Register* of all Circumstances, *Noted* with a Different *Mark* or *Letter*, *A, B, C, &c.* and all set in a Row, in the same Window, in such manner that all might partake alike of *Air, Light, and Sun*. Thus they continued from *July 20th* to *Oct. 5th*. Which was just *77. Days*. Then I took them Out, *Weighed* the *Water* in Each *Viol*, and the *Plant* likewise, adding to its *Weight* that of all the *Leaves* that had fallen Off, during the time that it stood thus. And lastly, I *Computed* how much each *Plant* had *Gained*: and how much *Water* was *Spent* upon it: The Particulars are as follows.

Distinction of the Glasses.	The several Sorts of Plants and Water.	Weight of the Plant.		Weight Gained in 77 Days	Expence of Water.	The Proportions of the Encrease of the Plant to the Expence of W.
		when put in	when taken out.			
A.	Common Spear-Mint set in Spring Water.	gr. 27	gr. 42	gr. 15	gr. 2558	1, to $17\frac{8}{15}$.
B.	Common Spear-Mint, in Rain-Water.	$28\frac{1}{4}$	$45\frac{3}{4}$	$17\frac{3}{2}$	3004	1, to $171\frac{23}{35}$.
C.	Common Spear Mint, in Thames Water.	28	54	26	2493	1, to $95\frac{23}{28}$.
D.	Common Solanum, or Night Shade, in Spring Water.	49	106	57	3708	1, to $65\frac{3}{7}$.
E.	Lathyrus, seu Cataputia Gerb. in Spring Water.	98	$101\frac{1}{2}$	$3\frac{1}{2}$	2501	1, to $714\frac{4}{7}$.

The *Common Solanum* in the *Viol D.* had several *Buds* upon it when first Set in the *Water*: These in some Days, became fair *Flowers*, which were at Length succeeded by *Berries*.

Two other *Viols* *F.* and *G.* were Filled; the former with *Rain*, the other with *Spring Water*, at the same Time as those above mentioned were: and stood as long as they did. But they had Neither of them any *Plant*; my Design in these being only to inform my self, whether any *Water* Exhaled out of the *Glasses*, otherwise than thorow the *Bodies* of the *Plants*. The *Orifices* of these

two Glasses were covered with *Parchment*; each Piece of it being *Perforated* with an Hole of the same bigness with those of the *Viols* above. In this I suspended a Bit of Stick, about the Thickness of the *Stem* of one of the aforesaid *Plants*, but not reaching down to the surface of the included *Water*. I put them in thus, that the *Water* in those, might not have more scope to *Evaporate*, than that in the Other *Viols*. Thus they stood the whole 77. *Days*, in the same *Window* with the *Rest*: When, upon Examination, I found *None* of the *Water* in these, Wasted or gone off. Tho' I observed, both in these, and the *Rest*, especially after Hot Weather, small Drops of *Water*, not unlike *Dew*, adhering to the insides of the *Glasses*; that part of them I mean, that was above the *Surface* of the enclosed *Water*.

The *Water* in these two Glasses, that had no *Plants* in them, at the end of the Experiment, exhibited a *Larger* Quantity of *Terrestrial Matter*, than that in any of those that had the *Plants* in them did; The *Sediment* at the Bottom of the *Viols* was *Greater*; and the *Nubeculae*, diffused through the *Body* of the *Water*, *Thicker*. And of that which was in the Others, some of it proceeded from certain small *Leaves*, that had fallen from that part of the *Stems* of the *Plants* that was *within* the *Water*, wherein they Rotted and Dissolved.

The *Terrestrial Matter* in the *Rain-Water* was *Finer* than that in the *Spring Water*.

An. 1692. I Repeated the Experiment. The *Plants* were all *Spear Mint*, the most *Kindly*, *Fresh*, *Sprightly* shoots I could Choose. The *Viols* were set, in a *Line*, in a *South-Window*; where they stood from *Jun. 2.* to *Jul. 28.* which was just 56. *Days*.

Distinction of the Viols.	The several Sorts of Water	Weight of the Plant		Weight Gained in 56 Days.	Expence of Water.	Proportion of the Growth of the Plant to the Expence of Water.
		when put in.	when taken out.			
H.	Hyde Park Conduit Water.	gr. 127	gr. 255	gr. 128	14190	1, to 110 $\frac{110}{128}$
I.	Hyde Park Conduit Water.	110	249	139	13140	1, to 94 $\frac{74}{139}$
K.	Hyde-Park Conduit Water in which was Dissolv'd an Ounce and an half of Common Garden Earth.	76	244	168	10731	1, to 63 $\frac{147}{728}$
L.	Hyde-Park Water, with the same Quantity of Garden-Mould as in the Former.	92	376	284	14950	1, to 52 $\frac{182}{284}$
M.	Hyde-Park Water Distilled off, with a Gentle Still.	114	155	41	8803	1, to 214 $\frac{29}{41}$
N.	Residue of the Water which remained in the Still after that in M. was Distilled off.	81	175	94	4344	1, to 46 $\frac{29}{94}$

The *Plant* which was set in *H.* was all along a very *Kindly Plant*: And had run up to above 2. *Foot* in *Height*. It had shot but *One Considerable Collateral Branch*: but had sent forth *Many* and *Long Roots*, from which, Sprung very *Numerous* tho' *small*, and *short Lesser Fibres*. These *Lesser Roots* came out of the *Larger*, on two *Opposite* sides, for the most part: So that each *Root*, with its *Fibrillæ*, appeared not unlike a *small Feather*. To these *Fibrillæ* adhered pretty much *Terrestrial Matter*. In the *Water* which was at last *Thick* and *Turbid*, was a *Green Substance* resembling a *Fine Thin Conferwa*.

The *Plant* in *I.* was as *Kindly* as the *Former*, but had shot no *Collateral Branches*. Its *Roots*, the *Water*, and the *Green Substance*, all much as in the *Former*.

The *Plant* in *K.* tho' it had the *Misfortune* to be *Annoyed* with many *small Insects*, that happened to fix upon it, yet had shot very *Considerable Collateral Branches*: and at least as many *Roots*, as either that in *H.* or *I.* which had a much *Greater Quantity* of *Terrestrial Matter*, adhering to the *Extremities* of them. The same *Green Substance* here, that was in the two *Preceding*.

The *Plant* in *L.* was far more *Flourishing* than any of the *Precedent*; had several very *Considerable Collateral Branches* and very *Numerous Roots*; to which *Terrestrial Matter* adhered very *Copiously*. The *Earth* in both these *Glasses*, *K.* and *L.* was very *sensibly* and *Considerably Wasted*, and *Less* than when *First* put in. The same sort of *Green Substance* Here, as in those above.

The *Plant* in *M.* was pretty *Kindly*; and had two *small Collateral Branches*, and several *Roots*, tho' not so many as that in *H.* or *I.* but as much *Terrestrial Matter* adhering to them, as those had. The *Water* was pretty *Thick*, having very *numerous small Terrestrial Particles* swimming in it, and some *Sediment* at the *Bottom* of the *Glass*. This *Glass* had none of the *Green matter* above mentioned in it.

The *Water* in *N.* was very *Turbid*, and as *High-Coloured*, (*Reddish*) as *Ordinary Beer*; the *Plant* in it was very *Lively*; and had sent out 6 *Collateral Branches*, and several *Roots*.

O. Hyde Park Conduit-Water, in which was *Dissolved* a *Drachm* of *Nitre*.

The *Mint* set in this, suddenly began to *Wither* and *Decay*; and *Dyed* in a *Few Days*. As likewise did two more *Sprigs*, that were set in it, *successively*. In *Another Glass*, I *Dissolved* an *Ounce* of good *Garden Mould*, and a *Drachm* of *Nitre*, and in a *Third*, *half* an *Ounce* of *Wood-Ashes*, and a *Drachm* of *Nitre*, but the *Plants* in these succeeded no better than in the *Former*.

P. Hyde-Park Conduit-Water. In this I fixed a *Glass Tube* about 10. *Inches* long, the *Bore* about $\frac{1}{2}$ of an *Inch* in *Diameter*, fill'd with very *Fine* and *White Sand*, which I kept from falling *Down*, out of the *Tube* into the *Viol*, by tying a thin piece of *Silk*, over that *End* of the *Tube* that was *Downwards*. Upon immersion of the *Lower End* of it into the *Water*, this
by

by little and little *Ascended* quite to the Upper Orifice of the *Tube*. And yet, in all the 56 *Days* which it stood thus, a very Inconsiderable Quantity of *Water* had *Gone off*; viz. scarcely 20 *Grains*; though the *Sand* continued *Moist* up to the *Top*, till the very *Last*. The *Water* had imparted a *Green Tincture* to the *Sand*, quite to the very *Top* of the *Tube*. And in the *Viol*, it had *Precipitated* a *Greenish Sediment*, mixt with *Black*. To the *Bottom* and *Sides* of the *Tube*, as far as 'twas *immersed* in the *Water*, adhered pretty much of the *Green Substance* Described above.

Q. R. S, &c. Several *Plants* set in *Viols*, Ordered in like manner as those above, in *Oct.* and the following *Colder Months*. These *Throve* not near so much, nor did the *Water Ascend* in nigh the *Quantity*, it did in the *Hotter* seasons, in which the before recited *Trials* were made.

1. In *Plants* of the same *Kind*, the *Less* they are in *Bulk*, the *Smaller* the *Quantity* of the *Fluid Mass* in which they are *Set*, is *Drawn off*; the *Dispendium* of it, where the *Mass* is of *Equal Thickness*, being pretty nearly *Proportioned* to the *Bulk* of the *Plant*. Thus that in the *Glass* Marked *A.* which *Weighed* only 27. *Gr.* *Drew off* but 2558. *Grains* of the *Fluid*: And that in *B.* which *Weighed* only 28 $\frac{1}{4}$ took up but 3004. *Gr.* whereas that in *H.* which *Weighed* 127. *Gr.* spent 14190. *Gr.* of the *Liquid Mass*.

Some Reflections
on the foregoing
Experiments.
ib. p. 207.

The *Water* seems to *Ascend* up the *Vessels* of *Plants* in much the same manner as up a *Filtre*: And 'tis no *Great Wonder*, that a *Larger Filtre* should *Draw off* more *Water* than a *Lesser*; or that a *Plant* that has more and *Larger Vessels* should take up a *Greater Share* of the *Fluid*, in which 'tis *Set*, than one that has *Fewer* and *smaller Ones*, *Can*.

2. The *much Greatest part* of the *Fluid Mass* that is thus *Drawn off*, and *Conveyed* into *Plants*, does not *Settle* or *Abide* there: But *Passes* through the *Pores* of them, and *Exhales* up into the *Atmosphere*. That the *Water* in these *Experiments*, *Ascended* only through the *Vessels* of the *Plants* is *Certain*. The *Glasses F. and G.* that had no *Plants* in them, tho' *Disposed* of in like *Manner* as the *Rest*, remain'd, at the *End* of the *Experiment*, as at *First*: And *None* of the *Water* was *Gone off*. And that the *Greatest Part* of it *Flies off* from the *Plant* into the *Atmosphere*, is as *Certain*. The *Least Proportion* of *Water Expended*, was to the *Augment* of the *Plant*, as 46. or 50. to 1. And in some the *Weight* of the *Water Drawn off*, was 100. 200. nay, in *One* above 700 times as much as the *Plant* had received of *Addition*.

This to *Continual* an *Emission* and *Detachment* of *Water*, in so *Great* *Plenty* from the *Parts* of *Plants*, affords us a *Manifest Reason* why *Countries* that *Abound* with *Trees* and the *Larger Vegetables* especially, should be very *Obnoxious* to *Damps*, *Great Humidity* in the *Air*, and more *Frequent Rains*, than *Others*, that are more *Open* and *Free*. The *Great Moisture* in the *Air*, was a *Mighty inconvenience*, and *Annoyance* to those who *First* settled in *America*; which at that time was much *Overgrown* with *Woods* and *Groves*: But as these were *Burnt* and *Destroyed*, to make way for *Habitation* and
Culture

Culture of the Earth, the Air Mended, and Clear'd up apace; Changing into a Temper much more Dry and Serene than before.

Nor does this *Humidity* go off *Pure* and *Alone*: but usually bears forth with it many parts of the Same Nature, with Those whereof the *Plant*, through which it passes, Consists. The *Crasser* indeed are not so easily *Born up* into the *Atmosphere*; but are usually Deposited on the *Surface* of the *Flowers, Leaves* and other *Parts* of the *Plants*: Hence comes our *Manna's*, our *Honies*, and other *Gummos Exudations* of *Vegetables*. But the *Finer* and *Lighter Parts*, are with *Greater Ease* sent up into the *Atmosphere*. Thence they are Conveyed to our *Organs* of *Smell*, by the *Air* we draw in *Respiration*; and are *Pleasant* or *Offensive*, *Beneficent* or *Injurious* to us, according to the Nature of the *Plants* from whence they Arise. And since these owe their Rise to the *Water* that *Ascends* out of the *Earth*, through the *Bodies* of *Plants*, we cannot be far to seek for the Cause why they are more *Numerous* in the *Air*, and we find a *Greater Quantity* of *Odours* exhaling from *Vegetables*, in *Warm Humid* Seasons, than in any Others whatever.

3. *A Great Part of the Terrestrial Matter, that is Mixt with the Water, Ascends up into the Plants as well as the Water.* There was much more *Terrestrial Matter* at the End of the Experiment, in the *Water* of the *Glasses F.* and *G.* that had *No Plants* in them, than in those that had *Plants*. The *Garden Mould* Dissolved in the *Glasses K.* and *L.* was Considerably *Diminished*, and Carried off. Nay the *Terrestrial* and *Vegetable Matter* was born up in the *Tubes* filled with *Sand, Cotton, &c.* in that *Quantity* as to be Evident even to sense.

If I may be permitted to Look abroad a while, towards our *Shores* and *Parts* within the *Verge* of the *Sea*, these will present us with a *Large Scene* of *Plants* that, along with the *Vegetable*, take up into them Meer *Mineral Matter* also, in a great abundance. Such are our *Sea Purslains*, the several sorts of *Alga's*, of *Sampires*, and other *Marine Plants*. These contain *Common Sea-Salt*, which is all one with the *Fossile*, in such Plenty, as not only to be Plainly Distinguish'd on the *Palate*, but may be Drawn forth of them, in Considerable *Quantity*.

How Apt, and how much Disposed this *Vegetable Matter*, being so very *Fine* and *Light*, is to Attend *Water* in all its *Motions*, and follow it into each of its *Recesses*, is Manifest, not only from the instances above Alledged, but Many Others. Percolate it with all the Care imaginable; Filter it with never so many *Filtrations*; yet some *Terrestrial Matter* will remain. 'Tis true the *Fluid* will be *Thinner* every time than other, and more *Disengaged* of the said *Matter*: but never wholly *Free* and *Clear*.

I have *Filtred Water* thorow several *Sheets* of *Thick Paper*; and after that, through very *Close Fine Cloth*, 12 times *Doubled*; Nay I have done this *Over* and *Over*: and yet a Considerable *Quantity* of this *Matter*, Discover'd it self in the *Water* after All. 'Tis true *Filtring* and *Distilling* of *Water* intercepts, and makes it *Quit Some* of the *Earthy Matter* it was before *Impregnated* withal, but then that which *Continues* with the *Water* after this, is *Fine* and

and *Light*, and such consequently, as is in a peculiar Manner fit for the *Growth*, and *Nourishment* of *Vegetables*. And this is the Case of *Rain Water*. The Quantity of *Terrestrial Matter* it bears up into the *Atmosphere* is not Great: But that which it does bear up, is mainly of that *Light Kind* of *Vegetable Matter*; and that too, perfectly Dissolved, and Reduced to Single *Corpuscles*; all fit to enter the *Tubules* and *Vessels* of *Plants*. On which Account 'tis, that This *Water* is so very *Fertile* and *Prolifique*. But the *Mineral Matter*, is a great deal of it, not only *Gross* and *Ponderous*, but *Scabrous* and *Inflexible*: and so not Disposed to enter the *Pores* of the *Roots*. And a great many of the *Simple Vegetable Particles* by *Degrees Unite*, and *Form*, Some of them, small *Clods* or *Moleculæ*; such as those mentioned in *H. K* and *L*. Sticking to the *Exremities* of the *Roots* of Those *Plants*; Others of them Intangle in a Looser Manner, and form the *Nubeculæ*, and *Green Bodies* so Commonly Observed in *Stagnant Water*. These also, when thus *Conjoyned*, are too Big to enter the *Pores*, or Ascend up the *Vessels* of *Plants*; which Singly they might have done. They who are *Conversant* in *Agriculture*, will easily *Subscribe* to This. They are well aware that, be their *Earth* never so *Rich*, so *Good*, and so *Fit* for the *Production* of *Corn*, or Other *Vegetables*, Little will Come of it, unless the *Parts* be *Separated*, and *Loosened*. 'Tis on this Account, they bestow the *Pains* they do in *Culture* of it: in *Digging*, *Plowing*, *Harrowing*, and *Breaking* of the *Clodded Lumps* of *Earth*. 'Tis the same Way, that *Sea-Salt*, *Nitre*, and Other *Salts*, *Promote Vegetation*, They *Loosen* the *Earth*, and *Separate* the *Concreted Parts* of it: by that means *Fitting* and *Disposing* them to be *Assumed* by the *Water*; and *Carried* up into the *Seed* or *Plant*, for its *Formation* and *Augment*. There's no *Man* but must *Observe*, how apt All Sorts of *Salts* are to be *Wrought* upon by *Moisture*; how easily they *Liquate* and *Run* with it: and when these are *Drawn off*, and have deserted the *Lumps* wherewith they were *Incorporated*, Those must *Moulder* immediately, and *Fall Asunder* of Course. The *Hardest Stone* we meet with, if it happen, as frequently it does, to have any sort of *Salt* intermixt with the *Sand* of which it *Consists*, upon being exposed to a *Humid Air*, in a short time *Dissolves* and *Crumbles* all to *Pieces*: and much More will *Clodded Earth*, or *Clay*, which is not of near so *Compact* and *Solid* a *Constitution* as *Stone* is. The same Way likewise is *Lime* serviceable in this *Affair*: It is well known, how apt it is to be put into *Ferment*, and *Commotion* by *Water*, Nor can such *Commotion* ever happen, when *Lime* is mix'd with *Earth*, however *Hard* and *Clodded* That may be, without *Opening* and *Loosening* of it.

4. The *Plant* is more or less *Nourished* and *Augmented* in *Proportion* as the *Water* in which it *Stands*, contains a *Greater* or *Smaller Quantity* of *Proper Terrestrial Matter* in it. The *Truth* of this *Proposition*, is so eminent-ly *Discernible* through the *Whole Process* of these *Tryals*, that I think No *Doubt* can be made of it. The *Mint* in the *Glass C*. was of much the *Same Bulk* and *Weight* with Those in *A*. and *B*. But the *Water*, in

which that was, being *River Water*, which was apparently Stor'd more copiously with *Terrestrial Matter* than the *Spring* or *Rain Water*, wherein they stood were, it had Thriven to almost Double the Bulk that Either of them had: and with a Less Expence of Water too. So likewise the *Mint* in *L.* in whose Water was Dissolved a Small Quantity of Good *Garden Mould*, tho' it had the Disadvantage to be Less when first Set, than either of the *Mints* in *H.* or *I.* whose Water was the very Same with This in *L.* but had None of that *Earth* mix'd with it: yet in a short time, the *Plant* not only Overtook, but much Outstripp'd Those, and at the End of the Experiment, was very Considerably Bigger and Heavier than Either of them. In like manner, the *Mint* in *N.* tho' Less at the Beginning than that in *M.* being Set in that Thick, Turbid, Feculent Water, that remained behind, after that, wherein *M.* was placed, was Still'd off, had in fine more than Doubled its Original weight and Bulk: and Received above Twice the Additional Encrease than that in *M.* which Stood in the Thinner Distill'd water, had done; and, which is not less Considerable, had not Drawn off Half the Quantity of Water that That had.

Why in the Beginning of this Article, I Limit the Proportion of the Augment of the *Plant* to the Quantity of Proper *Terrestrial Matter* in the *Water*, is because All, even the *Vegetable Matter*, to say Nothing of the *Mineral*, is not Proper for the Nourishment of Every *Plant*. There may be, and Doubtless are, some parts in Different Species of *Plants* that may be much Alike, and so owe their Supply to the Same Common Matter: but 'tis plain, All cannot. And there are other Parts so Differing, that 'tis no ways Credible they should be Formed All out of the Same Sort of *Corpuscles*. So far from it, that there want not Good Indications, as we shall See by and by, that Every Kind of *Vegetables* Requires a Peculiar and Specifick Matter for its Formation and Nourishment. Yea, Each Part of the Same *Vegetable* does so: and there are every Many and Different Ingredients go to the Composition of the Same Individual *Plant*. If therefore the *Soil*, wherein any *Vegetable* or *Seed* is Planted, contains All or Most of These Ingredients, and Those in Due Quantity, will Grow and Thrive there: so otherwise will Not. If there be not as many Sorts of *Corpuscles* as are Requisite for the Constitution of the Main and more Essential Parts of the *Plant*, will not Prosper at all. If there be These, and not in a Sufficient Plenty, will Starve and Never arrive to its Natural stature. Or if there be Any the Less Necessary and Essential *Corpuscles* wanting, there will be some Failure in the *Plant*; it will be Defective in Taste, in Smell, in Colour, or some other way.

But tho' a Tract of Land may happen Not to Contain Matter Proper for the Constitution of some One Peculiar Kind of *Plant*, Yet it may for several Others; and those much Differing amongst themselves. The *Vegetative Particles* are Commixt and Blended in the *Earth*, with all the Diversity and Variety, as well as all the Uncertainty Conceivable.

It is not Possible to Imagine how One Uniform, Homogeneous Matter, having its Principles or Original Parts, All of the same Substance, Constituti-

on, Magnitude, Figure and Gravity, should ever Constitute Bodies so egregiously *Unlike* in All those Respects, as *Vegetables* of *Different Kinds* are: nay even as the *Different Parts* of the *Same Vegetable*. That One should carry a *Resinous*, Another a *Milky*, a *Third* a *Yellow*, a *Fourth* a *Red Juice* in it's *Veins*; One afford a *Fragrant*, another an *Offensive* smell; One be *sweet* to the *Taste*, Another *Bitter*, *Acid*, *Acerb*, *Austere*, &c that One should be *nourishing*, another *Poyscnous*; one *Purging*, another *Astringent*: in brief, that there should be that *Vast Difference* in them, in their *Several Constitutions*, *Makes*, *Properties*, and *Effects*, and yet All arise from the very same sort of *Matter*, would be very *strange*.

The *Cataputia* in the *Glass E.* received but very *Little Increase*; only $3\frac{1}{2}$ gr. all the while it stood, tho' 2501 Gr. of *Water* were spent upon it. I will not say the Reason was because That *Water* did not contain in it *Matter Fit* and *Proper* for the *nourishment* of that *Peculiar* and *Remarkable Plant*. No, it may be the *Water* was not a *Proper Medium* for it to *Grow* in: and we know there are very many *Plants* that will not *Thrive* in it. Too much of that *Liquor*, in some *Plants*, may probably *Hurry* the *Terrestrial Matter* thorow their *Vessels* too *Fast* for them to *Arrest* and lay *Hold* of it. Be that as it will, 'tis most *Certain* there are *Peculiar soils* that *Suit Peculiar Plants*. In *England*, *Cherries* are observed to *Succeed* best in *Kent*; *Apples* in *Herefordshire*, *Saffron* in *Cambridgshire*, *Woad* in *two* or *three* of our *Midland Counties*; and *Teazles* in *Somersetshire*. This is an *Observation* that hath held in all *Parts* of the *World*. But that *Soil* that is *Once Proper* and *Fit* for the *Production* of some *One sort* of *vegetables*, does not *Ever Continue* to be so. No, in *Tract* of *Time* it *Looses* that *Property*: but sooner in some *Lands*, and later in *Others*. If *Wheat* for *Example* be *Sown* upon a *Tract* of *Land* that is *Proper* for that *Grain*, the *First Crop* will *Succeed* very *Well*; and perhaps the *Second*, and the *Third*; as long as the *Ground* is in *Heart*, as the *Farmers* speak: But in a *Few Years* 'twill *Produce* No *More*, if *Sowed* with That *Corn*. Some *other Grain* indeed it may, as *Barley*; and after this has been *sown* so *Often*, that the *Land* can bring forth No *More* of the same, it may *Afterwards* yield *Good Oats*; and perhaps *Pease* after them. At length 'twill become *Barren*; the *vegetative Matter*, that at *First* it abounded withal, being *educed* forth of it, by Those *Successive Crops*, and most of it *born Off*; *Each Sort* of *Grain* taking forth that *Peculiar Matter* that is *Proper* for its *Own Nourishment*.

After all which, that very *Tract* of *Land* may be brought to produce *Another Series* of the *Same Vegetables*: but *Never* 'till it is *Supply'd*, with a *New Fund* of *Matter*, of *Like sort* with That it, at *First* *Contained*. This *Supply* is made *several Ways*; By the *Grounds Lying fallow* some time, 'till the *Rain* has poured down a *Fresh Stock* upon it; Or by the *Tiller's* *Care* in *Manuring* it.

And for *Further Evidence*, that This *Supply* is, in *reality*, of *Like sort*, we need only *Reflect* a while upon Those *Manures* that are found, by *Constant Experience*, best to *Promote* *Vegetation*,

and the *Fruitfulness* of the *Earth*. These are Chiefly, either *Parts* of *Vegetables*, or of *Animals*; which indeed, either Derive their own *Nourishment*, immediately from *Vegetable Bodies*, or from *Other Animals* that do so. In particular the *Blood*, *Urine*, and *Excrements* of *Animals*; shavings of *Horns* and of *Hoofs*; *Hair*, *Wool*, *Feathers*; *Calcined Shells*; *Lees* of *Wine* and of *Beer*; *Ashes* of all sorts of *Vegetable Bodies*; *Leaves*, *Straw*, *Roots*, and *Stubble*, Turned into the *Earth* by *Plowing* or *Otherwise* to *Rot* and *Dissolve* there: These I say, are our *Best Manures*, and being *Vegetable Substances*, when *Refunded* Back again into the *Earth*, serve for the *Formation* of other *Like Bodies*.

We meet with still further *Confirmations* of the same things in our *Gardens*. The *Trees*, *Shrubs*, and *Herbs*, Cultivated in these, after they have *Continued* in one *Station*, till they have *Derived* thence the *Greater Part* of the *Matter* fit for their *Augment*, will *Decay* and *Degenerate*, unless either *Fresh Earth*, or some *Fit Manure*, be applied unto them. 'Tis true, they may *Maintain* themselves there for some time, by sending forth *Roots*, further and further to a great *Extent* all *Round*, to fetch in more *Remote Provision*: But at *Last* all will *Fail*, and they must *Either* have a *Fresh Supply* Brought to them, or they themselves be *Removed* and *Transplanted* to some *Place* Better *Furnished*, with *Matter* for their *Subsistence*. And Accordingly *Gardeners* Observe, that *Plants* that have *Stood* a *Great While* in a *Place* have *Longer Roots* than *Usual*; Part of which they *Cut off* when they *Transplant* them to a *Fresh Soil*, as now not of any further *Use* to them.

All these instances, to pass over a *Great many Others* that might be *alleged*, Point forth a *Particular Terrestrial Matter*, and not *Water* only for the *Subject* to which *Plants* Owe their *Increase*. Were it *Water* Only, there would be no need of *Manures*, or of *Transplanting* them from *Place* to *Place*. The *Rain*, falls in all *Places* alike; in this *Field*, and in that, indifferently; in *One Side* of an *Orchard* or *Garden* as well as another; Nor could there be any *Reason*, Why a *Tract* of *Land* should yield *Wheat* *One Year*, and *Not* the *Next*; since the *Rain* showers down alike in *Each*.

5 *Vegetables* are not *Formed* of *Water*; but of a certain *Peculiar Terrestrial Matter*. The *Plant* in *E*. drew up into it 2501. *Gr.* of the *Fluid Mass*; and yet had *Received* but 3. *gr.* and a *half* of *Increase* from all that. The *Mint* in *L* tho' it had at *First* the *Disadvantage* to be much less than that in *I* Yet being *Set* in *Water* wherewith *Earth* was *Plentifully Mixed*, and that in *I* only in *Water* without any such *Additional Earth*, it had *Vastly outgrown* the *Other*, *Weighing* at least 145 *Gr.* More than that did, and so having *Gained* above *Twice* as much as that had. In like manner that in *K*. tho' it was a *great deal* less when put in than that in *I*. and also was *Impaired* and *Offended* by *Insects*, yet being *Planted* in *Water* wherein *Earth* was *Dissolved*, whereas the *Water* in which *I*. stood had *None*, it not only *Overtook* but *Considerably Surpassed* the *Other*; *Weighing* at least 29. *Gr.* More than that in *I*. and yet had not *Expended* so much *Water* as that, by above 2400 *Gr.* The *Plant* in *N* tho' at *First* a *great deal* less than that in *M*. Yet being *set* in the *Foul Crass Water* that was *Left* in the

Still, after that in which *M.* was set was Drawn off, in Conclusion had Gained in Weight above Double what that in the *Finer* and *Thinner Water* had. The Proportion of the Augment of that Plant that Throve Most, was to the Fluid Mass Spent upon it, but as 1. to 46, In others it was as 1. to 60. 100. 200. Nay in the *Cataputia* 'twas but as 1. to 714. The *Mint* in *B.* took up 39 Gr. of *Water* a Day, One Day with another; which was much more than the Whole Weight of the Plant Originally, and yet, with all this it Gained not One Fourth of a Grain a Day in Weight Those that in *H.* took up 253 Gr. a Day of the Fluid; which was near Twice as much as its Original Weight, it Weighing when first set in the *Water* but 127 Gr. And after all the Daily Increase of the Plant was no more than $2\frac{2}{3}$ grains.

6. *Spring and Rain Water* Contain pretty near an Equal Charge of Vegetable Matter: *River Water* more than Either of them. The Plants in the Glasses *A. B. and C.* were at First of much the Same Size and Weight. At the End of the Experiment, the *Mint* in *A.* had Gained 15. Gr. out of 2558 Gr. of *Spring-Water*; that in *B.* $17\frac{1}{2}$ gr. out of 3004 gr. of *Rain-Water*, but that in *C.* had got 26. Gr. out of only 2493. Gr. of *River-Water*. So that these Proportions will hold for the Main: Yet I make no Doubt, but the *Water* that Falls in *Rain* at sometimes, contains a Greater Share of *Terrestrial Matter*, than that which Falls at Others. A more Powerful and intense Heat must needs Hurry up a Larger Quantity of that Matter along with the *Humid Vapours* that form *Rain*, than one more Feeble and Remiss ever possibly Can. The *Water* of One *Spring* may flow forth, with an Higher Charge of This Matter, than that of Another: This Depending partly upon the Quickness of the *Ebullition* of the *Water*, and partly upon the Quantity of that Matter, latent in the *Strata*, through Which the Fluid passes, and the Greater or Less *Laxity* of those *Strata*. For the same Reason, the *Water* of One *River* may abound with it more than that of Another. Nay the Same *River*, when much Agitated and in Commotion, must bear up more of it, than when it Moves with Less Rapidity and Violence. That there is a Great Quantity of this Matter in *Rivers*, and that it Contribute Vastly to the Ordinary Fertility of the *Earth*, we have an illustrious instance in the *Nile*, the *Ganges*, and other *Rivers*, that Yearly Overflow the Neighbouring Plains. Their Banks shew the Fairest and Largest Crops of any in the Whole World. They are even Loaded with the Multitude of their Productions: and those who have not seen them, will hardly be induced to Believe the Mighty Returns those Tracts Make, in Comparison of Others that have not the Benefit of like Inundations.

7. *Water* serves only for a Vehicle to the *Terrestrial Matter*, which Forms Vegetables; and does not it self make any Addition unto them. Where the Proper *Terrestrial Matter* is wanting, the Plant is not Augmented, tho' never so Much *Water* Ascend into it. The *Cataputia* in *E.* took up More *Water* than the *Mint* in *C.* and yet had grown but very Little, having received only $3\frac{1}{2}$ Gr. of Additional Weight: Whereas the Other had received no less than 26. Gr. The *Mint* in *I* was Planted in the same Sort of *Water* as that in *K.*

was;

was, only the Latter had *Earth Dissolved* in the *Water*; and yet that Drew off 12140 Gr. of the *Water*, Gaining it self no more than 139 Gr. in *Weight*: Whereas the other took up but 10731. Gr. of *Water*, and was *Augmented* 168. Gr. in *Weight*. Consequently, that spent 2109 Gr. more of the *Water* than this in K. did: and yet, was not so much increased in *Weight* as this by 29. Gr. The *Mint* in M. stood in the very same Kind of *Water* as that in N. did. But the *Water* in M. having much Less *Terrestrial Matter* in it, than that in N. had, the *Plant* bore up 8803. gr. of it gaining it self only 41. gr. the While: Whereas that in N. Drew off no more than 4344. gr. and yet was *Augmented* 94. gr, so that it Spent 4459. gr. of *Water* More than that did: And Yet was not it self so much increased in *Weight* as that was, by 53. gr. This is both a very *Fair*, and a very *Conclusive* instance.

'Tis Evident therefore, that *Water* is not the *Matter* that *Composes Vegetable Bodies*: But 'tis the *Agent* that *Conveys* that *Matter* to them; that *Introduces*, and *Distributes* it to the several *Parts* for their *Nourishment*. That therefore there is that *Plentiful Provision* and *Vast Abundance* of it, *Supplied* to all the *Parts* of the *Earth*, is a *Mark* of a *Natural Providence*, *Superintending* over the *Globe* we inhabit.

This *Fluid* is *Capacitated* for the *Office* here assigned it, several *Ways*: By the *Figure* of its *Parts*; Which, as appears from many *Experiments*, is *Exactly* and *Mathematically Spherical*; the *Surfaces* being perfectly *Polite*, and without any of the least *Inequalities*. It is evident *Corpuscles* of such a *Figure* are easily susceptible of *Motion*, yea far above any others whatever: and Consequently the most *Capable* of *Moving* and *Conveighing Other Matter* that is not so *Active* and *Voluble*. Then, the *Intervals* of *Bodies* of that *Figure* are, with respect to their *Bulk*, of all others the *Largest*; and so the most fitted to *Receive* and *Entertain Foreign Matter* in them. Besides, as far as the *Tryals* hitherto made inform us, the *Constituent Corpuscles* of *Water* are Each, *Singly Considered*, *absolutely Solid*; And do not yield to the *Greatest External Force*. This *Secures* their *Figure* against any *Alteration*; and the *Intervals* of the *Corpuscles* must be always *Alike*. By the *Latter* it will be ever *Disposed* to *receive Matter* into it; and by the *Former*, when once *received* to *Bear* it on along with it. *Water* is further *Capacitated* to be a *Vehicle* to this *Matter*, by the *Tenuity*, and *Fineness* of the *Corpuscles* of which it *Consists*, We hardly know *Any Fluid* in *All Nature*, except *Fire*, whose *Constituent Parts* are so exceeding *Subtile* and *Small*, as those of *Water* are. They'l *Pass Pores* and *Interstices*, that neither *Air*, nor any *Other Fluid*, will. This *Enables* them to enter the *Finest Tubes* and *Vessels* of *Plants*, and to introduce the *Terrestrial Matter*, *Conveying* it to all *Parts* of them; whilst Each, by means of *Organs* it is *Endowed* with for the *Purpose*, *Intercepts* and *assumes* into it self such *Particles* as are *Suitable* to its *Own Nature*; Letting the rest *Pass* on, through the *Common Ducts*. Nay, we have, almost every where, *Mechanical Instances* of much the *Same Tenor*: 'Tis *Obvious* to every one, how *Easily* and *Suddenly Humidity*,

dity, or the *Corpuscles* of *Water* sustained in the *Air*, *Per-vade* and *Infiltrate* themselves into *Cords*, however tightly *Twisted*; into *Leather*, *Parchment*, *Vegetable Bodies*, *Wood*, and the like. This it is that *Fits* them for *Hygrometers*: And to *Measure* and *Determine* the different *Quantities* of *Moisture* in the *Air*, in *Different* *Places* and *Seasons*. How freely *Water* *Passes*, and *Carries* with it *Terrestrial Matter*, through *Filtres*, *Colatures*, *Distillations* &c. hath been intimated already.

8. *Water* is not *Capable* of performing this *Office* to *Plants*, unless *Assisted* by a *Due Quantity* of *Heat*: And this must *Concur*, or *Vegetation* will not *Succeed*. The *Plants* that were set in the *Glasses* *Q. R. S* &c. in *October*, and the following *Colder Months*, had not near the *Quantity* of *water* sent up into them, or so *Great an Additional Increase* by much, as those that were Set in *June*, *July*, and the *Hotter*. That the *Concourse* is of *Heat*, in this *Work* is really *Necessary*, appears, not only from the *Experiments* before us, but from *All Nature*: From our *Fields* and *Forrests*, our *Gardens* and our *Orchards*. We see in *Autumn*, as the *Sun's Power* grows gradually less and less, so its *Effects* on *Plants* is *Remitted*, and their *Vegetation* slackens by little and little. Its *Failure* is first *Discernible* in *Trees*. These are raised highest above the *Earth*; and *Require* a more *Intense Heat* to *Elevate* the *Water*, *Charged* with their *Nourishment*, to the *Tops* and *Extremities* of them: So that for want of *fresh Support*, and *Nutriments*, they shed their *Leaves*, unless secured by a very *Firm* and *Hardy Constitution* indeed, as our *Ever Greens* Are. Next the *Shrubs* part with theirs; and then the *Herbs* and *Lower Tribes*: The *Heat* being at length, not sufficient to *Supply*, even These, tho' so near the *Earth*, the *Fund* of their *Nourishment*. As the *Heat* returns the succeeding *Spring*, they *All Recruit* again; and are furnished with *Fresh Supplies* and *Verdure*. But *First*, those which are *Lowest* and *Nearest* the *Earth*, *Herbs*, and they that require a *Lesser Degree* of *Heat* to *Raise* the *water* with its *Earthy Charge* into them; *Then* the *Shrubs*, and *Higher Vegetables*, in their *Turns*; and *lastly* the *Trees*. As the *Heat* increases, it *Grows* too *Powerful*, and *Hurries* the *Matter* with too *Great Rapidity* thorow the *Finer*, and more *Tender Plants*. These therefore *Go off* and *Decay*; and Others that are more *Hardy*, and *Vigorous*, and require a *Greater Share* of *Heat*, *Succeed* in their *Order*.

The same is *Observable* in *Distant Climates*. The *Hotter Countries* yield *Ordinarily*, the *Largest* and *Tallest Trees*; and Those too, in *Much Greater Variety* than the *Colder* ever do. Even those *Plants* that are *Common* to both, attain to a *much greater Bulk*, in the *Southern* than in the *Northern Climes*. Nay, there are some *Regions* so *Bleak* and *Chill*, that they *Raise* No *Vegetables* at all, to any *Considerable Size*. This we learn from *Greenland*, from *Iceland*, and *Other Places* of like *Cold Site* and *Condition*. In these, *No Tree* ever *Appears*; and the very *Shrubs* they afford are *Few*, *Little* and *Low*. Again, in the *warmer Climates*, and such as do furnish forth *Trees*, and the *Larger Vegetables*, if there happen a *Remission* and *Diminution* of the *Usual Heat*, their *Productions* will be *Impeded* and *Diminished* in *Proportion*. Our *Late Colder Summers* have given us *Proof Enough* of this. For though
the

the Heat we have had was sufficient, to Raise the *vegetative Matter* in the *lower Plants*; into our *Corn*, our *Wheat*, *Barley*, *Pease* and the Like; and we have had Plenty of *Strawberries*, *Rasberries*, *Currans*, *Goosberries*, and the *Fruits* of such other *Vegetables*, as are *Low* and *Near the Earth*; yea, and a moderate Store of *Cherries*, *Mulberries*, *Plumbs*, *Filberts*, and some Other that Grow at a somewhat *Greater Height*: Yet our *Apples*, our *Pears*, *Walnuts*, and the Production of the *Taller Trees*, have been *Fewer*, and Those not so *Kindly*, so *thoroughly ripen'd*, and brought to that *Perfection*, they were in the former more *Benign* and *warm Seasons*. Nay even the *Lower Fruits* and *Grains* have had *Some Share* in the *Common Calamity*; and fallen short, both in *Number* and *Goodness*, of what the *Hotter* and *Kinder Seasons* were wont to shew us. As to our *Grapes*, *Apricots*, *Peaches*, *Nectarins*, and *Figs*, being *Transplanted* Hither out of *Hotter Climes*, 'tis the *Less Wonder* we have of *Late* had so *General a Failure* of them.

Nor is it the *Sun*, or the *Ordinary Emission* of the *Subterranean Heat*, only, that Promotes *Vegetation*, but any other indifferently, according to its *Power* and *Degree*. This we are taught by our *Stoves*, *Hot Beds*, and the like. *All Heat* is of *Like Kind*; and wherever is the *Same Cause*, there will be *Constantly* the *Same Effect*.

There's a *Procedure* in *Every Part* of *Nature*, that is *perfectly Regular* and *Geometrical*, if we can but find it out; and the *Further* our *Searches* Carry us, the more shall we have *Occasion* to *Admire* this, and the better 'twill *Compensate* our *Industry*.

Ground Fertiliz'd by Frost; by Dr. J. Beale. n. 56. p. 1140.

LXXII. I do often ask *Gardeners*, and *Skilful Husbandmen*, whether all sorts of *Land* are more *Fertiliz'd*, or more *Speedily*, by the *Solar Influence* in our *Climate*, or by *Frosts*; and they generally answer, that *Frost* and *Snow* make the *Quicker Dispatch* amongst us, and the more *General* and *Richer Fertility*.

Ground improv'd by Brine; by Dr. Jackson. n. 54. p. 1079.

LXXIII. All the *Ground* (at *Namwych*) where *Salt* or *Brine* is spilt, is when dug up, *Excellent Muck* for *Grazing-Ground*; and even the *Bricks* that are throughly *Tinged* with it, are very good *Muck*, and will *Dissolve* with other *Muck*, and *Fertilize Land* considerably (especially *Grazing Ground*) for at least *4 Years*.

Improvements with Salt, by Dr. J. Beale. n. 56. p. 1135.

LXXIV. In the *West* of *England*, some *Husbandmen* make use of *Brackish Sand*, and do find a good *Reward* when they be at the *Charges* of *Carrying* it far, for the *Enriching* of their *Inheritances*: whilst other *Rusticks* will not be intreated to *Accept* of the *Brine* they have in the *midst* of their own *Grounds*. Certainly the *Saline Steams* are carried by the *Air* and *Wind* much farther from *Salt* it self in *Heaps* or *Vessels*, than from the *Sea-water*; from whence the *Dews*, which arise in *Vapours*, do descend as *Sweet* and *Pure* as the *Dew*, which *Ascends* from the *Earth*; and the *Rain* shews no *Difference*. And I gave you once an *Experimental Proof*, that either the *Saline Steams*, which *Ascend* from a *Heap* of *Salt*, do *Pierce* through very thick

Thick Stone-Wall : Or (which I did much rather conceive,) they generate more Salt, to a great depth of Thickness, in the Lime and Mortar of the Walls.

LXXV. The Sea-sand made use of in the Agriculture of Cornwall is commonly at or near the Sea-shore ; which, to distinguish from what is Useless, know, That the Wash of the Sea Rolls and Tumbles Stones and Shells, &c. one over another ; whose grating makes this Sand. If the matter be shelly, (as we call it) that is, the Grating of Stones, it is of small Value : But if it be notably Shelly, then it is what we desire. And of this shelly Sand are Three Colours in our County ; about Plymouth and the Southern Coast, the Sand is Blewish, or Gray, like Ashes : which I conceive to be from the Breaking of Muscles chiefly, and Oyster shells, mixed with it. Westward, near the Lands-end, the Sand is very White ; and in Scilly, Glistening : This I think comes from the Mouldring of Moor-stones, or a kind of Free stone mingled with very White Shells, such as are call'd (when the Fish is preserved) Scallops. On the North Sea about Padstow, and Eastwards to Lundie, the Sand is Rich, and of a Brown-Reddish Yellowish Colour, and is mostly of the Broken Shells of Cockles ; which I guess to be of that Colour there, from the Wash of Severn, which falls very Dirty into the Severn Sea ; and perhaps that Accretion of the Shells may be Tinged thereby. This we know, That though there be little or no Sea-Fish near the Mouth of the Severn, because of the Muddiness thereof ; and therefore Fish is carried to be sold as far as from Loo on the South-sea to Barnstable on the North ; yet Lower down in the North-Sea, though there be not so Much, yet that which there is, is Fatter and Better than that which is Taken in the South Sea.

Improvements in
Cornwall, with
Sea-Sand ; by
Dr. Dan. Cox.
n. 113. p. 295.

Now besides These Colours of Sands, there is also a Difference in the Bigness of the Grain ; Even in the same Harbour of Plimouth, in some Caves 'tis very Small, in others Greater Grain'd. 'Tis said, that the small is best for the Tenant who only takes to Tillage for 4 Years : because it works sooner, and Yields its speedy Return. The Larger Grain'd (they say) is better for the Landlord, and the Land, because it abides longer in the Ground, and makes the Pasture afterwards the Better.

In Falmouth Haven, near St. Mause Castle, there is a sort of Sand, or rather Coralline, that lies a Foot under the Ouse ; which Ouse being removed and the Bed Opened, this Sand is taken up by a Dredge, and is used about Truroe, Probus, &c.

West of the Mount in Portcuthnoe-Cove is a Large Shelly Sand: In White-sand-Bay, and about St. Ives, it is very White and Small. Vid. Cap. III
§. XI

About Minver, Peninsand, and Lelant, the Sands are Blown up by the Wind, and Drown abundance of Good Land ; some Houses, yea, and some Churches and Chappels are even Buried with it ; nor has any Art been hitherto thought of, to prevent its Devastation.

Now of all these Sands the Best are accounted, as to Colour, first the Reddish, next the Blew, then the White ; as to Kinds, the most shelly and the

Coralline are Best, and that which is taken up from under the *Salt water* either by *Dredges*, or being left open by the *Ebbing* of the *Tide*. The *Blown Sand* is accounted of *No Use*. And generally, if *Sand* be well *Drained* of the *Salt-water*, so that it may be more conveniently carried, 'tis *Better* than that which has lain long *Drying* in the *Sun* and *Wind*, which take off much of its *Vertue*.

These *Useful Sands* are carried by *Lighters* as far up into the *Country* as the *Tides* will serve to that *Purpose*, and there they are *Cast* on *Shoar*; from whence they are fetched in some *Places* by *Wheels*, but in most (by reason of the *Hilliness*, *Narrowness*, and *Badness* of the *Ways*) on *Horseback*; one *Horse* carrying about 13 or 14 *Gallons*. *Seven* or *Eight* of these *Horses* tail'd together, are call'd a *Train*, which *One Man* drives to 9 or 10 *Miles* from the *Sand-place*; where each *Seime* (or *Horse-load*) with the *Carriage*, comes to about 8 *d.* or 9 *d.* in some *Places*, though not so much in *Others*. For where it is *Dredged* out of the *Sea*, it *Costs* 12 *s.* or 13 *s.* the *Lighter* (containing *Sixscore Seime*) at the *Landing Key*, or *Sand-Place*: But where 'tis *Loaded* from the *Dry Beach* after the *Ebb*, it is not above 4 *s.* the *Lighter*; and all this *Charge* of *Lighterage* is besides the *Land-Carriage*. This *Land-Carriage* I have computed to amount, in the whole *County*, to about 32000 *l.* per *Ann.*

When this *Sand* is brought *Home*, it is spread on the *Ground* intended for *Wheat*; or usually in the *First Crop* of *four*, whatever be the *Grain*. For after 4 *Crops*, 'tis our *Custom* to leave our *Land* to *Pasture* for 6 or 7 *Years* before we *Till* it again. And indeed the *Grass* will be so *Good*, immediately after *Tillage*, that we commonly *Mow* it the *First Year*. This is called *Mowing of Gratten*.

The *Cornish Acre* is 8 *Score Yards* of 18 *Foot* to the *Yard*; in one of which *Acres*, good *Husbands* bestow, according to the nearness or distance: Near the *Sand* 300 *Sacks* (that is *Horse Seime* or *Burthen*;) where *Men* go 3 *Turn* a day about 200; where 2 *Turn* 150; and where but *one Turn*, 80, or 100. And so *Proportionably* in greater *Distance*, even to 20 or 30 *Sacks* on an *Acre*, rather than *None*.

The *Effect* is usually where much *Sand* is used, the *Seed* is *Much*, and the *Straw* *Little*. I have seen in such a *Place* *Good Barly*, where the *Ear* has been even *Equal* in length with the *Straw* it grew on. But where *Less Sand* is used, there is *Much Straw*, and but *little*, and that *Hungry Grain*.

After the *Corn* is off, the *Grass* becomes mostly a *White Clover*; with some *Purple*, if the *Land* be *Deeper*. And this *Grass* of well *Sanded Ground*, though it be but *Short*, yet as to *Feeding*, giving good *Creams*, *Plenty* of *Milk*, and all other *Good Purposes*, it far exceeds the *Longer Grass*, where *less Sand* is used. *Yea*, *Garden Herbs* and *Fruits*, in those *Places*, are more, and those better in their kind. In those well *Sanded Places*, also *little* or *no Snow* lies; there is a *Continual Winter Spring*; an *Early Harvest*, (a *Month* or 6 *Weeks* before what is within 6 or 7 *Miles* off the *Place*;) yea such a *Vast Difference*

Difference of the *Air* is found in so little a Distance, that a Man may in an Afternoon Travel as it were out of *Spain* into the *Orchades*.

We have in this *County* almost all kinds of *Soils*, and *Sand* agrees very well with Each of them.

There is the same sort of *shelly Sand* in most of the *Coasts* of *England*, which lies wholly neglected. In the *Thames* about *Erith* is taken up a sort of *Sand* not much unlike *Plymouth Sand*, made use of only by *Brick makers*: But one of them told me, that by the sides of his *Sand-beap* the *Grass* did better spring than elsewhere, and turned to a *Clover-Grass*.

'Tis well known that *Sandwich Carrots* and *Pease* are well esteemed, and they grow there, where the *Sea Sand* has a little *Over-blown* and mixed with the *Soil*.

LXXVI. There are some *Towns* in the *North-Riding* of *Yorkshire*, standing upon a *Light Sandy Soil*, viz. *Tollethorp, Tollerton &c.* which do all of them *Manure* much of their *Ground* by *Clay*. This *Clay* is dug hard by, in the *Declivity* of a *Hill*. After having bared away two *Yards* deep of *Sand*, they sink a square *Pit* 6 *Yards* Deep, and 8 or 10 *Yards* Square. The *Clay* is of a *Blewish-brown Colour*, not *Sandy* at All, but *Close* and *Fat*, and very *Ponderous*; it *Burns* well for *Bricks*. They lay 100 *Load* of *Clay* upon an *Acre* of *Ground*. They dig it at *Midsummer*, and only in a *Dry Summer*. They observe that for 3 or 4 *Years* it continues yet in *Clods* upon the *Land*; and that the *first Year* the *Land* so *Manured*, bears *Rank, Ill-coloured* and *Broad Grained Barley*; but afterwards a *Plump Round Corn* like *Wheat*. This *Clay Manuring* will by certain *Experience* last 42 *Years* in the *Ground*; and that of *Tollethorp* 48 *Years*: And then the *Ground* must be *Clayed* again.

A Sandy Soil
Manured with
Clay; by Dr. Li-
ster. n. 225.
P. 413.

This *Sandy Ground*, unless *Clayed*, will Bear nothing but *Rye*, whatever other *Manure* or *Lime* your *Compost* be; but once *Clayed*, it will bear *Oats, Barley, Pease, &c.*

LXXVII. The greatest *Improvement* of our *Husbandry* in *Suffolk*, hath been by *Marling*: For 50 *Load* of *Marle* to an *Acre* of *Dry, Barren, Lingy Heath* make, (as they say) a very *Great Improvement* both for *Corn, Turneps, Clover-Grass, Nonsuch, and Cole-seed*. Of the 3 *first*, I suppose, I need to say nothing: But of the *two Last*, (which are late *Experiments*) I have received a very good *Account* from some *Northfolk Gentlemen*; One of whom, the last *Year*, had of 7 *Acre* of *Non-such*; or *Hopp-Clover*; 70 *Combs* of *Seed*, besides a great *Crop* of good *Hay*, which was twice as much worth as the *Best Crop* of *Wheat* in this *Country*. 'Tis *Sown* (as the *Common-Clover*) with *Corn*; and when it once *Takes*, it will hold 4 times as long in the *Ground*. About a *Bushel* and an *half* Soweth an *Acre*: and the *Seed* is now brought to 12 s. the *Comb* (for 4 *Bushels*) which was lately at 40 s. The same *Gentleman* had the last *Year* 10 *Combs* per *Acre* of *Cole-Seed* upon a very *Dry Heath*, (only *Improved* by *Marling*).

Improvements by
Marling; by Mr.
Tho. Wright.
n. 37. 725.

*Improving and
Draining the
Bogs & Loughs
in Ireland; by
Mr. Will. King,
n. 170. p. 948.*

Origine of Bogs.

LXXVIII. There are few Places in our Northern World, but have been Famous for Bogs, as well as Ireland; every Barbarous, Ill-inhabited Country has them. I take the *Loca Palustris*, or *Paludes*, whither the Ancient Galls, Germans, and Britains, Retired, when Beaten, to be the very Same We call Bogs; And one shall find, those Places in Italy, that were Barbarous, such as *Liguria*, were Infested with them; and therefore I believe the True Cause of Bogs is want of Industry. There are many Bogs of Late Standing in Ireland; when O Donal and Tirone came to the Relief of Kingsale, they Wasted the Country, especially as they came through *Connaught*, which by the Means of the Earl of *Clanrichard*, was generally Loyal: and there is a great Tract of Ground now a Bog that was then Plowed Land; and there remains the Mansion House of my Lord ——— in the midst of it.

But to shew how want of Industry Causes Bogs, it must be remembered, that the Springs (with which Ireland abounds) are generally Dry or near Dry in the Summer time, and the Grass and Weeds grow Thick about the Places where they Burst Out. In the Winter they Swell, and Run, and Soften and Loosen all the Earth about them: now that *Swerd* or *Scurff* of the Earth, that consists of the Roots of Grass, being Lifted up and made Fuzzy by the Water in the Winter, (as I have at the Head of some Springs seen it lift up a Foot or two,) is Dried in the Spring: and doth not fall together, but Wither in a Tuft, and New Grass Springs through it; which the next Winter is again Lift up. And so the Spring is More and More Stopt, and the *Scurff* grows Thicker and Thicker, till at first it make that which we call a *Quaking Bog*: and as it Grows Higher and Dryer, and the Grass Roots, and other Vegetables become more Putrid, together with the Mud and Slime of the Water, it acquires a Blackness, and Grows into that which we call a *Turf Bog*: I believe when the Vegetables Rot, the Saline Particles are generally Washed away with the Water, as being apt to be Diluted in it: But the Oily, or *Surpbureal*, are those that chiefly remain, and Swim on the Water; and this is that which gives Turf its Inflammability.

To make this appear, 'tis to be Observed:

1. That in Ireland our Highest Mountains are covered with Bogs, as well as the Plains; because our Mountains abound more with Springs than can be Imagined.

Now no Body Living on our Mountains, and no Care being taken to Clear the Springs, the whole Mountains are over run with Bogs.

2. It is to be observed that Ireland doth abound in *Mosse* more than, I believe, any other Kingdom.

Now this Moss is of Divers Kinds, and that which Grows in Bogs is Remarkable; your Light Spungy Turf is nothing but a Congeries of the Threads of this Moss, as I have frequently observed, before it be sufficiently Rotten (and then the Turf looks White and is Light:) I have seen it in such Quantities,

ties, and so Tough, that the *Turf-Spades*, could not Cut it: in the *North* of *Ireland*, they call it *Old-wives Tow*, being not much unlike *Flax*. The *Turf-Holes*, in Time, grow up with it again: and all the little Gutters in *Bogs* are generally filled with it. And truly I chiefly impute the *Red*, or *Turf Bog* to it: and from it even the *Hardned Turf* when broken, is Stringy; though there plainly appear in it Parts of Other *vegetables*. And I am almost (from some Observations,) tempted to believe, that the *Seed* of this *Bog moss*, when it falls on Dry and Parched Ground, begets the *Heath*. However the *Moss* is so Fuzzy and quick growing a *vegetable*, that it mightily Stops the *Springs*; and contributes to Thicken the *Scurf*, especially in *Red-Bogs*, where only I remember to have observed it.

3. It is to be observed, that the Bottom of *Bogs* is generally a kind of *white Clay*, or rather *Sandy Marle*: a little Water makes it exceeding *Soft*, and when it is Dry it is all *Dust*. So that the *Roots* of the *Grass* do not stick fast in it: but a little Wet Loosens them, and the *Water* easily gets in between the Surface of the Earth and them, and Lifts up the Surface, as a *Dropsy* doth the Skin.

4. 'Tis to be observed, that *Bogs* are generally *Higher* than the *Land* about them, and *Highest* in the *Middle*; the Chief *Springs* that Cause them being Commonly about the *Middle*, from whence they Dilate themselves by Degrees. If you cut a Deep Trench through a *Bog*, you will find the *Original Spring*, and Vast Quantities of Water will run away, and the *Bog* Subside; The *Bog* at *Castle Forbes*, (as I was informed,) Subsided 30 *Foot*. I could hardly believe that: but found by Computation, that it could not be much Less than *Half* of it.

I must confess there are *Quaking Bogs* Caused otherwise; when a Stream, or Spring, runs thro' a Flat, if the Passage be not Tended, it fills with Weeds in *Summer*, Trees fall a cross it and Dam it up: then in *Winter*, the Water Stagnates farther and farther Every Year, till the Whole Flat be Covered. Then there grows up a Course Kind of *Grass*, peculiar to these *Bogs*: this *Grass* grows in *Tufts*, and their *Roots* consolidate together, and yearly Grow Higher; in so much that I have seen of them to the Height of a Man.

This *Grass* Rots in *Winter*, and falls on the *Tufts*, and the *Seed* with it, which Springs up next Year: and so still makes an Addition. Sometimes the Tops of *Flags* and *Grass* are inter-woven on the Surface of the *Water*, and this becomes by Degrees Thicker, till it lye like a Cover on the Water: then Herbs take Root in it, and by a *Plexus* of the *Roots* it becomes very strong, so as to bear a Man. I have gone on *Bogs* that would Rise, before and behind, and sink where I stood to a Considerable Depth; Under which was *Clear Water*.

The *Inconveniencies* of These *Bogs* are very Great.

1. A Considerable Part of the Kingdom is rendered Useless by them; *Inconveniencies of Bogs.* they keep People at a Distance from One Another, and consequently hinder them in their Affairs, and Weaken them: for it is Certain, that if suppose a Thousand Men Live on 4. *Contiguous Acres*, they

they can both better Assist, and Defend one another, than if they Liv'd on 4
not Contiguous.

2. The Land which generally should be our *Meadows*, and Finest Evenest
Plains are Covered with *Bogs*. This I observed through all *Connough*, but more
especially in *Longford*, and likewise in *West Meath*, and in the *North of Ire-*
land.

3. The *Bogs* are a great Destruction to *Cattle*, the chief Commodity of
Ireland. In the *Spring* time, when the *Cattle* are Weak and Hungry, the
Edges of the *Bogs* have commonly *Grass*: and the *Cattle* Venturing in to get
it, fall into Pits or Sloughs, and are either Drowned, or (if they are found,)
spoilt in the Pulling out.

4. They are a Shelter and Refuge to *Torys*, and *Tnieves*, who can hardly
Live without them.

5. The *Fogs* and *vapours* that Rise from them are commonly Putrid, Stinking
and very *Unwholsome*. For the *Rain*, that falls on them, will not sink into
them; there being hardly any Substance of its softness, more impenetrable by
Water, than *Turf*: and therefore *Rain water* stands on them, and in their Pits;
it Corrupts there, and is all Exhaled by the Sun, very little of it Running a-
way, which must of Necessity Affect the *Air*.

6. They Corrupt our *water*, both as to its *Colour*, and *Tast*: for the *Colour* of
the *Water* that stands in the Pits, or lyes on the surface of the *Bog*, is *Tinctu-*
red by the *Reddish Black colour* of the *Turf*; and when a shower comes,
that makes these Pits to overflow, the *Water* that runs over *Tinctures* all
it meets, and gives both its *Colour* and *stink*, to a great many of our
Rivers.

Advantages:

1. The *Natives* nevertheless had heretofore some *Advantage* by the *Woods*,
and *Bogs*. By them they were Preserved from the *Conquest* of the *English*,
and I believe it is a little Remembrance of this that makes them still *Build*
near *Bogs*. It was an advantage then to them to have their Country Un-
passable, and the fewer Strangers came near them, they Lived the easier:
for they had no *Inns*; every House where you came, was your *Inn*
and you said no more, but put off your *Brogues* and sat down by the
Fire.

2. They are also now of some Use to us. For most of *Ireland* have their
Firing from them: *Turf* is accounted a Tolerable sweet Fire; and we having
very impolitically Destroyed our *Wood*, and not as yet found *Stone-Coal*, save
in Few Places, we could hardly Live without some *Bogs*. I have seen *Turf*
Charked: and then it serves to *Work Iron*, and as I have been informed, will
serve to make it in a *Bloomery* or *Iron work*. *Turf charked* I reckon the sweet-
est and wholsomest Fire that can be; fitter for a Chamber and consumptive
People, than either *Wood*, *Stone-Coal* or *Char-coal*.

3. A *Turf Bog* Preserves things strangely; a *Corps* will lye intire
in one, for several Years. I have seen a piece of *Leather* pretty Fresh,
Dug out of a *Turf Bog*, that had never in the *Memory of Man*,
Been Dug before. *Butter* has been found, that had lain above

20. *Years*: And tho' not fit to be Eaten, yet it served well enough to Greaz^e Wool.

Trees are found intire in them; and those *Birch*, or *Alder*, that are very subject to Rot. The *Trees* are supposed by the ignorant vulgar to have lyen there ever since the *Flood*: but the Truth is, they fell on the Surface of the Earth, and the *Bog*, as I shewed above, swelling by Degrees, at last Covered them; and being of an *Oily Vegetable Substance*, it, like a *Balsam*, Preserves them. These *Trees* Burn very well, and serve for *Torches* in the Night. I have seen of the *Trees* Half sunk into the *Bogs*, and not Quite Covered.

All the Inconveniencies of our *Bogs*, may be Remedy'd, and they may be made Useful to us, by *Draining*: for I never observed One *Bog* without a *Fall*, sufficient to *Drain* it, nor do I believe there is Any. But the Great and Weighty Objection against this *Improvement* is the *Charge*; an *Acre* of *Good Land* in most parts of *Ireland*, is about 4 s. per *Annum*, and the *Purchase* 14. or 15. *Years*, and therefore 3. l. will *Purchase* an *Acre* of *Good Land* and it is very Doubtful with Most, whether that Sum will *Reduce* a *Bog*. This Reasoning passes Current, and is the Great Obstacle and impediment of this Work: But if these things Following were done, and Considered, I verily believe, it would be Remov'd.

The Inconveniencies Remedy'd, by Draining.

1. An *Act of Parliament* should be made, that who did not in such a Time make some Progress in *Draining* their *Bogs*, should Part with them to Others that Would: and Allow a *Passage* to them thro' their Lands.

2. 'Tis to be Considered, that in *Quaking Bogs* One *Trench* Drains Many *Acres*: And when Dry, it is Generally *Meadow*, or the best *Grazing Ground*.

3. Every *Red-Bog* has about it a Deep, Marshy, Sloughy Ground, which they call the *Bounds* of the *Bog*. One Deep *Trench* Round the *Bog* keeps out the *Cattle*, and turns the *Bounds* into *Good Meadow*.

4. I Remember a *Red-Bog* of 60. *Acres* which a Gentleman Reduced to *Good Grazing Ground*, worth 3 s. an *Acre*, for 25 l. which is less than 3 *Years* *Purchase*.

5. Gentlemen ought to Consider, that what they lay out this Way, goeth by *Degrees*, and they are not *Sensible* of it; it goeth among the *Tennants*, and enables them to pay their *Rent* the Better; 'tis a Work of *Charity*, and employs *Hands*; and Conduces to both the *Ornament* and *General Profit* of the *Kingdom*.

6. To make the *Red-Bogs* fit for *Grazing*, These *Rules* may be Observed.

1. A *Deep Trench* must be made Round the *Bog*. This not Only *Reduces* the *Bounds* of the *Bog* as before, but goes a great way to *Dry* the *Bog* it self. It serves likewise as a *Common Sink*, into which all your *Drains* vent themselves.

2. Observe which way the *Little Sloughs* Run in the *Bog*, and be sure to Cut your *Drains* a cross them.

3. The

3. The *First Drains* on the *Bog*, ought not to be above 2. or 3. *Foot Deep*, or *Wide*: For the *Bog* is so *Soft* that *Deep Trenches* will not stand but *Fill up Again*. When the *Surface* of the *Bog*, is *Cut* in *Little Trenches*, suppose at 20. 30. 40. *Perch Distance*, it will be so *Dryed*, that *Cattle* may *Graze* on it all *Summer*.

4. A *Year* or two after the *Little Trenches* are made, and the *Bog* a little *Dry*, they are to be made 6 *Foot Wide*, and as *Deep* as the *Softness* of the *Bog* will *Permit*. And this will *Certainly* make the *Bog* *Useful* for *Grazing*. A *Year* or *Two* after this, you may attempt to *Cut* One or *Two* of the *Trenches* to the *Bottom* of the *Bog*; for till that be *Done*, I do not reckon the *Bog* *Secured*.

5. A *Gentleman* ought to oblige all his *Tenants*, to *Cut* their *Turf* in these *Trenches*: and likewise *Cut* his own so.

6. Where a *Bog* is *Pitted*, he is to *Cut* a *Passage* from one *Pit* to the next for the *Water*, and so make a *Communication* to the *Common Drain*: and if his *Pits* be once *Dryed* there will grow *Grass* or *Heath* at the *Bottom*, fit for *Grazing*, and they will be a *shelter* for *Cattle* in *Storms*.

7. When his *Bog* is *Dryed*, it is thereby made *Better Turf*, and then he is to set out a part of it for that *Use*, and to *Oblige* them to *Cut* it *Clear away*: And the *Bog* being removed, the *Bottom* will make a good *Meadow*.

8. He may *Cut off* the *Surface* of the *Bog* and *Burn* it: Or else *Bring Earth* and lay on it. *Sanding* or rather *Gravelling* is a great *Improvement* in this *Country*; the *Land* so *Manured* will bring *Corn* 12 or 14. *Years*. They say *Gravelling* is bad for *Grass*: But the contrary is apparent; especially in *Bogs*. I have observed by the *Way side*, where the *Ways* pass thro' *Bogs*, if a little *Earth* hath fallen on the *Bog*, as some times there doth fall a little of that which they bring to mend the *High-way*, it has turned the *Bog* into a *Green-Sod*, with a very fine *Scutch Grass* on it: And I doubt not but the same *Charges*, that *Sands* or *Gravels Land*, would *Reduce* a *Dryed Bog*, even to be *Arable*.

Improvements of
Loughs.

The *Natural Improvements* of *Loughs*, or *Lakes*, is first to *Drain*, them as *Low* as we can; and then turn the *Residue* of the *Water* into *Fish Ponds*: by *Planting* a few *Trees* about them, and ordering them thus, they may be made both *Useful*, and *Ornamental*.

And Turloughs.

Vid. Sup. Cap. II.
§. XIX.

As to those *Places* we call *Turloughs*, *quasi Terreni Lacus*, or *Land-Lakes*, they answer the *Name* very well; being *Lakes* One part of the *Year* of *Considerable Depth*, and very *Smooth Fields* the *Rest*. There are in these *Lakes Holes* out of which the *Water* *Riseth* in *Winter*, and *Goeth away* towards *Summer*: Many *Hundred Acres* being *Drowned* by them, and those the most *Pleasant* and *Profitable Land* in the *Country*. The *Soil* is commonly a *Marle*, which by its *Stifness* hinders the *Water* from *Turning* it into a *Bog*: and immediately when the *Water* is *gone*, it *Hardens* so that you ride thro' an *Even Grassy Field*. These, if they could be *Drained*, would be fit for any *Use*; would make *Meadow*; or *Bear* any *Grain*, but especially *Rape*, which

is very Profitable. They are Chiefly in *Connaught*: and their Cause is Obvious enough. It is a *Stony Hilly* Countrey, and the *Hills* have *Cavities* in them through which the *Water* Passes; it is Common to have a *Rivulet Sink* on one side of a *Hill*, and Rise a *Mile* or *half a Mile* from the Place. The *Brooks* are Generally Dry in *Summer*; the *Water* that should be in them, *Sinking* between the *Rocks*, and running *Under Ground*: in so much as that in some Places where they are *Overflow'd* in *Winter*, they are forced in *Summer* to send their *Cattle* many *Miles* for *Water*. There is one Place on a *Hill* near *Tuam* between two of these *Turloughs*, where there is a *Hole* the Superstitious People call the *Devil's Mill*; and make *Fables* concerning it: If you stand by this Place, you will hear a *Great Noise*, like that of *Water* under a *Bridge*. When there is a *Flood* in *Winter*, one of the *Turloughs* *Overflows*, and *Vents* it self into the *Hole*: And the *Noise* doth, in all likelyhood, proceed from a *Subterraneous Stream*; which in *Summer* has Room enough to *Vent* all its *Water*, but in *Winter*, when *Rains* fall, the *Passages* between the *Rocks* cannot *Vent* the *Water*, and therefore it *Regurgitates*, and *Covers* the *Flats*.

These *Turloughs* are *Hard to Drain*: Often they are *Encircled* with *Hills*, and then 'tis not to be expected; often they have a *Vent* by which they send out a considerable *Stream*, and then it is only making that *Passage* as *Low* as the *Bottom* of the *Flat*, and that will *Prevent* the *Overflowing*; it sometimes happens that the *Flats* are as *Low* as the *Neighbouring Rivulets*, and in all Probability are *Filled* by them, and then it is not only *Necessary* to make the *Passage* from the *Flat* to the *Rivulet*, but likewise to *Sink* the *Rivulet*, which is very troublesome, commonly the *Passage* to be *Cut* being *Rocky*: And therefore a good *Computation* (upon a *Survey*) ought to be made, whether it be worth the while to *Attempt* it. However the *Holes* ought to be *Opened* that the *Water* in its *Ordinary Course* may get sooner away: And they are to be *Eaten* very *Bare* towards the *End* of *Summer*, that as *Little Grass* as is *Possible* may be *Spoilt* by the *Water*:

LXXIX. I. *Jun. 7. 1697.* near *Charleville*, in the *County of Limerick* in *Ireland*, a *Great Rumbling* or *Faint Noise* was heard in the *Earth*, much like unto the *Sound* of *Thunder* near spent; for a little *Space* the *Air* was somewhat *Troubled* with little *Whisking Winds*, seeming to meet *Contrary* ways; and soon after that, in the *Bog* of *Kapanibane*, upon the *Estate* of *Brook Bridges Esquire*, stretching *North* and *South*, the *Earth* began to *Move*, viz. *Meadow* and *Pasture Land* that lay on the side of the *Bog*, and *Separated* by an *Extraordinary Large Ditch*, and *Other Land* on the *Further* side adjoining to it; and a *Rising*, or *Little Hill* in the middle of the *Bog* hereupon *Sunk Flat*.

This *Motion* began about 7. of the *Clock* in the *Evening*, fluctuating in its *Motion* like *Waves*, the *Pasture Land* *Rising* very *High*, so that it *Over* run the *Ground* beneath it, and *Moved* upon its *Surface*, *Rowling* on with great

The Motion of a
Bog in Ireland;
by p. 233.
p. 714.

Pushing Violence, till it had covered the *Meadow*, and is held to remain upon it 16 Feet Deep.

In the *Motion* of this *Earth*, it drew after it the Body of the *Bog*, part of it lying on the place where the *Pasture Land*, that *Moved* out of the place it had before, stood; leaving great *Breaches* behind it, and spewings of *Water*, that cast up *Noisome Vapours*.

By Mr. J. Hono-
hanc. *ib.*

Fig. 176.

2. The Line *AB*. is the *Meridian*; *C*. a *Meadow*, containing 3. *English Acres*, and 32. *Perches*; *D*. firm *Pasture-Land* (but of a Course *Boggy Substance*) containing 4. *Acres* 3. *Roods*. The Line 1 2 was a *Hedge* of a large *Ash* and *Willow-Trees*, between the *Meadow* and the *Firm-Land*; 3 4 was the *Edge* of the *Bog* next to the *Pasture*. The *Prickt Lines* from 3 to 5 and from 4 to 6 shew the *Limits* or *Bounds* of the *Bog*. The *Meadow C.* was *Lower*, by a *Descent* of 5 *Foot*, than the *Pasture D.* and the *Pasture D.* was *Lower* by 6 *Foot* than the *Surface* of the *Bog*. And there was yet a considerable *Rising* and *Hill*, as at *E*, the *Height* whereof was more than 10. *Foot* above the *Surface* of the *Bog*; so that there was a *Descent* from *E.* to the *Meadow*.

The *Cause* of the *Motion* I presume was this; a more than *Ordinary Wet Spring* occasioned a *Prodigious swelling* of the *Height* of the *Bog* at *E.* and at length *Moistened* the *Whole*; but chiefly the *under part* thereof; the *Water* soaking to the *Bottom*. By this means the *Turfy Hill E.* being as it were *undermined*, naturally *Sunk* down and consequently *Pressed* the *Bog* on all *Hands*, chiefly towards the *Descent*, till the *Pasture D.* was *Forced* on the *Meadow C.* *Overturning* the *intermediate Hedge*; so that the *Line 3 4* is now become 1 2 and the *Meadow* and the *whole Bog* are *Level*; only there are *Chasmes* and great *Cracks* throughout the *Whole Surface* of the *Bog*, represented by the *Stroaks* about *E.* The *Bog* contains 40 *Acres*.

The Spanish
Sembrador and
its Uses; by the
E. of Sandwich.
n. 60. p. 1056.

LXXX. In the *Description* of this *Sembrador*, (*Publisht* by *Don Joseph de Lucatello Knight*, *Inventor* of the *Engine*, and *Dedicated* to *Signor Don Geronimo de Camargo*, *Counsellor* of the *Consejo Real de Castilla* and of the *Hazienda Real*;) it is *Represented*;

First, that both the *Ancient* and *Modern Husband-Men* have *Agreed*, that the *Perfection* of *Agriculture* *Consisted* in *Setting* the *Plants* in *Proportionable Spaces*, and giving *sufficient Depth* to the *Roots*, that they may *Spread* enough, to receive that *Nourishment* from the *Ground* which is *necessary* to *Produce* and *Ripen* the *Fruit*.

2. That *Care* hath not been had, in the *Practice* of this *important part* of *Husbandry*: since even at this *Day*, all sorts of *Seeds*, of *Corn* and *Grain*, are *Sown* by *Handfulls*; throwing them out by *aim*, *Heedlessly* and by *Chance* (counting it too *Tedious* and *Chargeable* to *Set* them *one by one* in *Large Fields*). Whence we see *Corn* *Sowed* in some places too *Thick*, in Others too *Thin*, and the *Greater part* of it not *Covered*, nor *Deep enough*; whereby it is not only *Exposed* to be *Eaten* by *Birds*, but also in *Cold Countries* to be *Spoiled* by *Frost*, and in *Hot Regions* by the *Sun*. Upon these *Considerations*, *D. Joseph de Lucatello* hath after much *Experience* *Perfected* an

Instrument

Instrument, which being fastned to the *Plough*, at once *Ploughs*, *Soweth*, and *Harrow*s; whereby is saved the Labour of the *Seeds man*; and the *Grain* falling in *Order*, and in the *Bottom* of the *Furrow*, all of it remains in One and the Same Distance under Ground, so that of 5 parts of *Seed*, 4 parts are Saved; and then in the *Crop* is Gained Incredible Abundance.

3, That the *Inventor* presented it at the Feet of his *Catholick Majesty*, who caused Tryal to be made thereof in the *Buen Retiro*, where it did Answer Expectation, notwithstanding the *Drought* of the *Year*, then much Damnifying all *Corn*: an ordinary Husband Man from a measured space of Ground there, Sowed in the Common manner, Reaping 5125. where he by his Contrivance from an Equal space of Ground there also, Reaped 8175 besides the *Seed* saved in the *Sowing*.

4 That thereupon his said *Catholick Majesty* did Grant to the *Inventor*, the *Privilege*, That He Only and his Assignes may *Make* and *Distribute* these *Instruments*, in all the Kingdoms and Provinces of that Monarchy in *Europe*, at the Price of 24. *Rials Plate* Each, and out of *Europe* 32 *Rials Plate*, of which the 5th part should be paid to the *King*: Prohibiting to all others the *Making* and *Using* this *Instrument* under several *Penalties*.

5. That before the *Inventor* came to the Court of *Spain*, He made a Great Tryal of it before his *Imperial Majesty*, in the Fields of *Laxemburg* in *Austria*, where the Land usually yields *Four* or *Five fold*: But the *Crop* from the Ground Sowed with This *Instrument* was *Sixty Fold*; as appears by a Certificate given in *Vienna Aug. 1. 1663. st. n.* by an Officer of the *Emperor* appointed to see the said Ground Sowed and Reap'd.

6. That this *Privilege* being Dispatch't, he Publish't his *Contrivance* and *Instructions* as follows.

1. Fig. 177. Is a *Box* of *Wood*; *a. b. c. d.* the Cover of that part where the *Corn* is Put in; (which is Open in Fig. 178. at *W.*) And *e. f. h. g. k. l.* the two Sides which Cover that part of the *Box*, where the *Cylinder*, which is Stuck round with 3 *Rows* of little *Spoons*, is Moved about to Throw out the *Corn*; (which Sides are Taken off in Fig. 178, to make the *Cylinder R. S.* with the *Spoons x. x. x.* appear). The inner Shape of these Sides is expressed in Fig. 179 where may be seen four *Triangular* pieces *p. p. p. p.* leaving *Triangular* Interstices *q. q. q.* which serve to Conveigh the *Corn* Carried up in the *Spoons*, and Discharged at the Top of the *Cylinder*, so as they may just Run out, at the *Holes* Underneath the *Box*; (the Parts of Which Answer to the Parts of Fig. 177. according to the Letters.) *T* is one of the *Wheels*; *V.* the Other End of the *Cylinder*, upon which, the Other *Wheel* is to be Placed.

2. This *Sembrador* must be Tied fast to the *Plough*, in the Manner as is seen in Fig. 180. so that the *Corn* may fall in the *Furrow*, and at the Turning of the *Plough*, the *Ears* of the *Plough* may Cover the *Corn* of the Last *Furrow* with *Earth*.

3. Because the *Seed* sow'd by this *Instrument* is placed in a Convenient Depth, *viz.* in the Bottom of the *Furrow*, whereas the *Seed* scattered the Common way, remains nearer the Superficies of the Earth, or quite Uncovered, therefore it must needs shoot forth somewhat *Later*: So that it is Requisite, the Husband-man, using this *Instrument*, should Sow 8 or 10 *Days* sooner than the accustomed *Seed time*; *viz.* Beginning to Sow in the Middle of *Septemb.* and making an End at the Middle of *Novemb.*

4. In *Stiff Ground* the *Furrows* ought to be 5 or 6 *Inches* Deep; in *Middle* sort of *Ground*, 6 or 7; and in *Light* and *Sandy Ground* 7 or 8 *Inches*; and according to this Proportion, the Husband-man must Govern himself, Deepning or *Shallowing* the *Plough*, as the Condition of the Land shall Require.

5. Special Care must be had, that the *Wheels* on the Sides of the *Instrument* do always *turn round*, and never *Drag* along, *without Turning*; as also, that the *Ears* of the *Plough* be made somewhat Bigger than the Ordinary Ones.

6. 'Tis also Convenient, that the *Seed* be well *Sifted* and *Cleaned*; that so the little *Spoons* may every time take up a *Grain* and the *Seed* be the better *Distributed*.

7. In *Barley* 'tis to be well observed, that it be made *Clean* in that manner, that the *Straw* and *Beards* be broken off, as near the *Grain* as may be: That so they hinder not the Issuing of the *Grain*, out of the *Instrument*.

8. After *Seeds-time* done, *Furrows* must be made to *Drain* the Land of Water, according to the Use of Each Country, without doing any thing more Extraordinary, until the *Harvest*.

The following *Instructions* were also Publisht.

1. Before they Sow the Ground, they must give it so many *Tilths* as is accustomed in that Country where the Land lyeth.

2. When they go about to Sow, the *Ploughman* must begin to open a *Furrow* with the *Plough* for One or Two Paces; and when the *Plough* is in the Ground in a Convenient Depth, then they must Tye the *Sembrador* to the *Plough-Beam*, so that the Nails in the *Wheels* may stand upon the Ground to make the *Wheels* turn round.

3. The *Ears* of the *Plough* are to be made *Larger* than hitherto: Whence Two Advantages will arise. 1. It will better Cover the *Furrows* when Sown; and make *Wider Furrows* to receive the *Seed* when they do Sow. 2. Those *Larger Ears* will prevent the Blows, the great *Clods* and *Stones* will give the *Sembrador* (if the *Clods* be not Broken, and the *Stones* pickt out.) But when there are such *Great Stones* in the Land, as the *Plough* cannot Penetrate, then the *Plough man* by Lifting up his *Plough* must pass over it, until he meets with *Mould* again; and so must the *Sembrador* also be Lifted up, the Weight thereof being but very little, and no Considerable Trouble to the *Ploughman*.

4. When the *Clods* and *Stones* cannot be Mastered with only one pair of *Ears*

Ears, you must add Another Pair of them to the *Plough*, 4 or 5 Inches Higher than the First (chusing a fit place in the *Beam* to place them in) although behind the Others a Little; for so, the *Sembrador* will be perfectly Saved and Defended. And the *Second Ears* are to be of the same Bigness with the *First*. And this is found, by Experience, to be the Best Remedy against the *Stones* and *Clods*.

5. The time of *Sowing*, according to the most experienced Farmers; is when the *Mould* of the Land is *Dry*, or but a little enclining to *Moi-
sture*: In either of which Conditions of the Land, this *New Sembrador* works without *Clogging* the *Wheels*, or stopping up with *Dirt*, those *Holes* through which the *Grain* is to Issue forth.

6. When this *Sembrador* Works as it ought to do, it will Sow three *Celamines*, or about a *Peck* of *Wheat*, and 5 *Celamines* (or $1\frac{1}{2}$ of a *Bushel*) of *Barley*, on as much Land as would take up about $1\frac{1}{2}$ *Bushel* after the Common Way of *Sowing*. And if it much Exceed or Fail of this Proportion, it noteth some *Fault* in the *Instrument*, or *Carelessness* in the *Plough-
man*.

7. The *Spoon* must be made for *All Seeds*, Proportionably to their *Big-
ness*.

8. You must *Plough* the *Furrows* very Close One to Another, that so the *Plough*, when it Turns back, may the better *Cover* the Last *Furrow*, which is left *Open*, and *Sowed* as it came along.

9. After having sown the Land, in the said manner, the Land should be made as *Plain* as can be, and no such *Furrows* made to Carry away the *Wa-
ter*, as Hitherto hath been used: But it will be sufficient, that at every 4 *Yards* Distance (one from the Other) *Furrows* be made. For Experience hath taught us, that the Land laid up *without Furrows*, bears more *Corn*, than that which hath *more Furrows*, because the *Wheat* and *Barley*, and *Other Plants*, receive greatest *Damage* by *Drought*. And therefore this ought more especially to be observed in *Spain*, one of the *Dryest* Countries of *Europe*.

10. In many Parts of *Spain*, in 1664, it was found, that Land Sown in *September* hath yielded a Better *Crop*, than that which was Sow'd in *October*; and that Sown in *October* better than that Sown in *November*. Which Proves, that 'tis more Advantageous to Sow *Early*, than *late*.

11. They have observed also, That it is very Profitable to sow in the *New
Moon*, because it will *Shoot* forth, and *Thrive*, and *Ripen* sooner. In *Spain*, *Italy*, and the *Islands* of the *Mediterranean*, they may begin the *First New
Moon* in *September*, and so go on, and End with the *New Moon* in *Novem-
ber*. But in *Germany*, and the *Low Countries*, they begin in the End of *Au-
gust*, and End with the *New Moon* of *October*.

LXXXI. It is vulgarly known, that the surface of some Ground is so hol-
low, light, and swoln by a *Hot* and *Working Ferment*, that it must needs
send up a *Warming steam*; as appears by the *Quick Riddance* of all the *Snow*
that

Agrestick Ob-
servations and
Improvements;
by Dr. J. Beale:
n. 116. p. 359.

that falls on it, and (in many places within my Knowledge) Dissolving the *Snow* before it falls on the ground; that some *Stones* by an Innate *Warmth*, and some *Waters*, do *Impregnate* the Earth, and that other *Stones*, by their contrary *Qualities*, or by their *Positions*, have a quite contrary *Operation*; that streams of *Water* running over *Lime-stones*, or through *Veins* of *Marle*, or of that sort of *Chalk* which is kind for *Manure* (for there is a sort of *Chalk* which is *Barren*) doth *Fertilize*; that some other *Waters* are *Hungry*, *Uliginous* and *Corrosive*; and that those *Rivers* which are filled with a *Black-water*, by *Rain* running over *Heaths*, do much *Mischief* where they overflow, begetting *Heath* all over the *Pastures*.

In the sharpest *Frost* that I have known these many years, the *Ground* having been also some days *Covered* with *Snow*, I saw a small *Stream* (no bigger than might run from the Mouth of an ordinary *Quart Glass-Bottle*) sliding *Merrily*, and *Smoaking* all the way over the *Lawns*. I could not discern, that any *Snow* had fallen within 5 or 6 foot on each side; (if it did, none Remained there;) and so far the *Grass* at that time, about *Christmas*, was as *Green* as any *Leek*, and the *Frost* (so far) apparently *Dissolved*. Of this I then wrote to our worthy Friend Mr. *Evelyn*, not for any wonder, (for perhaps there are, or may be *Thousands* of such *Smoaking streams* in *England*;) but only *Representing* how such a *Stream* may *Warm* a *Mansion*, and *Cherish* *Tender Evergreens* well sheltered from *Winds*, and *flowry Gardens*, all the *Hard Winter*, and do us better service in an extream *Hot Summer*. I have been *Perplext* in *Observing* my self, an hundred times, the *Difference* of *Heat* and *Cold* between two *Villages* within a *Mile* of each other, where we could observe no disparity of *Hills* or *Rivers*; only the *Springs* in the one were all shallower, in the other some were *Deeper*. In a large *Tract* of *Land* the *Surface* was of so *Hot* a *Ferment*, that at every step I trod up to the *Ankles*. I caused it to be examined by the *Spade*, and found it, as far as I tried here and there, at a foot depth, as thick set with *Pibble-stones*, as if a *Causey* had been *Pitch'd* there; yet was it a *Quick* and *Pregnant* *Land* for *Flowers*, *Fruit-Trees*, and *Vines*, these *Pibbles* being dislodged, and some of them *Carried* away. I have seen *Fields* where the *Surface* did seem *Covered* with *Pibbles*, not *Flinty*, nor *Limestone*, yet they bore full *Burthens* of the best and cleanest *Rye* and *Oats*: The *Husbandmen* took away the *Pibbles* from off the *Surface*, and then the *Land* bore as strong *Wheat*, *Pease*, and *Barley*, as before it bore *Oats* and *Rye*. In other parts where I have been, the *Husbandmen* took away the *Stones* which seemed to *Cover* the *Fields*, and sustain'd great *Loss* for their costly *Labour*; their *Corn* was much *Weaker* for some *Years* after. I can *Attribute* these *Differing* *Events* to nothing, but the *Difference* of *Stones*: Some *Intrinsically Warm*, and *Impregnating* above *Ground*; some *Cold* and not *Impregnating*, whilst in that *Position* or *situation*. Yet some *Experience* forbids me to *Deny*, that even such *Stones*, when *Covered* with *Earth*, at a certain *Depth*, may *Increase* the *Fertility* of the *Land*. And the *Hot* and *Bibulous* *Land*, which *Drinks* up the *Rain* and *Snow* as soon as it falls, seems to have some *Cooling* *Refreshment* from *Under* *ground-Pibbles*, which are of a *Cold*, *stiff*, and *sullen* *Nature*.

What I have to say of *Warming* and *Fertilizing Rocks*, I shall deliver with an aspect towards *Scotland*, for *Horticulture*. I had several times Conference with Sr. Robert Morray B. M. (who was an Honour to his Country, and a Blessing to the place where he Abode) concerning *Esculent* and *Olitory Gardens*, and (under one) *Nurseries* of *Fruit-Trees*, and other Useful Vegetables in *Scotland*. I Represented, that, almost within my memory, they are become the Chief Relief of *England*; that 'tis lately found, that *Austere Fruit* yield the *Strong* and *Sprightful* Liquor, which Resembles the *Wine* of the *Grape*; that the Return of *Gain* from *Gardens* is Great and Speedy; *Nurseries* neither a Chargeable nor a Burthensome Addition, but a Congruous Engagement of the Multitude to Persevere in the Noblest kind of *Agriculture*. Sr. R. M. granted all that I said; and I am sure, he Acted and Executed all that he could for the Good of his Own Country, and for *England*, &c. But, saith he, there are so many *Rocks*, and such *Bleak winds* in *Scotland*, that they can hardly draw in the same Yoke with *England* for *Gardens* and *Orchards*. I Replied that in *Devon* and *Cornwall*, they Fenced their *Gardens* and *Orchards* with *Flanders Furr*s and *Tall Holly* from the *Sea-winds*; and they have *Lofty Firrs* and goodly *Pines* in *Scotland*: and *New England*, (where the *Winds* are as *Keen*, and the *Snow* and *Frosts* as *Deep*, and as *Long* lasting, as in many parts of *Scotland*) is yet full of *Fruitful Orchards*. And if *Scotland* be farther in the *North*, yet *Norway* is rich in *Boscage*; and the Seeds of the *Hemlock-Tree*, *Spruce* and *Cedars*, from *New England*, *New found-Land*, and *Virginia*, may perhaps rejoyce in the Exchange of *Northern America*, for the *North* of This Island.

This I told Sr. R. M. I Durst undertake, that when *Edinburgh* and their Chief *Towns* and *Universities* shall plant *Kitchen Gardens*, as we do now in *England*, they shall Receive their Grateful Reward the First Year; and bear the Charges of their *Nurseries* abundantly; and so hold on; and within 7 Years, secure their Posterity of the Benefit, and Delight themselves with the *Fruit* of their Pleasing Labour.

Now for *Fertilizing Rocks*, I made bold to Repeat it often, That within a days Journey of the Heart of *England*, I could shew 3 *Gardens*, the Best that I have seen for *Flowry Beauties*, *English Evergreens*, and *Sallads* all the *Winter* long; all these on a *Hard Rock*, in most places but One Foot deep under Earth; in some Two, in few places Three Foot Deep; very *Lofty Hills* close on the *South side*, the *Declivity* of the *Gardens* due *North*; and the *Rock* perfectly *Bare* next to the *Walls* on the *North side*. And I saw *Rich Hop Yards* in the same Case, but in *Deeper Ground*, next to the *Garden* on the *South side* of the *Garden*: And these *Northern Hop Yards* Escaped many *Blasts*, which seiz'd on the *Hop Yards* on the *South side* of the *Hill*. On the *Steep Ascent*, on the *North-side* of one of these *Rocky Hills*, where no *Plough* could come, I saw a Gentleman *Ploughing* up the shallow *Turf* with a *Hand Plough* for *Flax*, and I saw good *Flax* Grow there, to the largeness of a *Village-Field*. His *Hand Plough* had a stem of *Ash* or *Sally* about 7 foot long, and a *Plate* on one side near the *End*, to *Turn* the *Turf*; a *Coulter* to be let out shorter

or Longer, to Cut the Turf 4. or 5. or more Inches Deep, as the Land affords it; and a Small Iron Wheel. This Hand Plough, the Master and his Man by turns, Drove before them with a Walking Speed; having Leather Aprons before them to save their Cloaths. For the Causes of this Hardy Fertility, *Viderint Philosophi*. I am sure of the Truth of what I write; And I am willing to Apprehend, that if in Scotland they did, in Fit Places, Sow the best Flax Seed of Flanders as many here do, they would make good Holland-Linnen, Laune, and Cambrick, as now they do Scotch-Cloth.

It is no Hard Task to shovel down the Shallow and Mossy Turf, from the Steepest Declivities of Rocks, into places where it may have some Receptacle or Stay: and there to Impregnate it with the Spade and Compost, for Gardens or Vineyards. And there the Tenth Part of an Acre in Gardening may yield More Profit, than Ten Acres of Ordinary Tillage in a Corn-Field.

I am so much a Stranger to Scotland, that I cannot say, whether Saffron, Licorice, Hops, Madder, Oade, or what other Rich Commodities do Prosper there: but this I know, that our English Saffron and Licorice, do far excel all the Forreign, which our Druggists do sell us from the South. And since Vines and Mulberries have Travailed from the Remotest East, through all the Hottest Countries, and have abundantly Enriched our next Borderers, and have received Acceptable Hospitality, as far they have been Tried, in this our Island: We have encouragement enough to adventure the Cheap and Easie Trial.

Some of my Correspondents Tried the Mulberrie and Silkworm as far in the North as Huntingtonshire and Cheshire; and Sr. James Craig tried them in the Moistest place of Ireland, in the County of Cavan in Ulster: and all boasted their success, An. 1651, 1652, 53, 54, 55. Wherever Mulberries grow, I am apt to expect, that the Worms will Live, and Spin, and Furnish the Silken-Trade.

In Devonshire they Mingle Black Mulberries fully Ripe, with a Full-Bodied Cyder in the time of Grinding or Pressing the Apple, with Discretion for Tincture and Relish: And they Esteem it a very Wholsome and Stout Wine.

'Tis strange, that in 9 or 10 Years since this was Published, the practise hath not been spread into other Countries, where they abound with strong and Winy Cyder; many being willing that their Cyder should in Tincture resemble Claret, Tent, or Alicant Wine. But it may seem, that we do yet Retain somewhat of our Fathers aversness from Planting Mulberries, which they shewed near the Beginning of King James his Reign, to our great Loss and shame.

The Mulberrie requireth a Rich, succulent and Rank Ground, which is not wanting in the approaches of any of our Cities and Towns. And Mr. Evelyn hath written as well as can be written, both to Instruct and to Encourage the Planting of them.

The White Mulberries (as we call them) are for the Finest Silk; but to Mingle with Cyder, and for our Funkets, (as Palladius hath Hinted tous) we should send for the most Delicious Black Mulberries which may be had in
Naples,

ib. p. 364.
a. 133. p. 816.

Vid. Sup. §.
XXXIX. 2.

Naples, Sicily, Virginia, or any of the *East or West-Indies*: Not trusting to the *Seed*, but by all means, to have *Young Plants*, of the Best sorts, sent in Boxes, containing some of the *Connatural Soil*. Thus if the Gardens about *London* were well Furnisht they might easily be dispersed into other parts, without more adoe: For, few *Plants* may be more Easily *Propagated*, when they are *Young*. A Few Rooted *Mulberries*, being pressed down, and Covered with Earth in fit places, so that the *Eyes* may be very Lightly Cover'd and the *Sprouts* or *Branches* (if there be any) may be Cut very near to the Ground; or a *Good Branch*, after due depth of the Bigger End in the Rich mold, thus ordered as before; will soon become a *Perpetual Nursery*. And if the Worst *Mulberries* were well Dispersed, they may be soon Amended by putting the *Largest Black Mulberrie* upon that of the *Small* kind; it being certain, that it takes better upon that, than upon the *White Mulberrie*.

Vinous Shrubs are now coming into *Fashion*; of these do some make *Sugar Wines* by Art, to be Compared (for Wholesomness and Pleasantness to many Palates) with Rich *Wines* of the *Grape*. For the *Sugar-Cane* doth hardly yield to any *Vine* in the World: and we Hope that *Meath, Methleglin*, and other *Hony-Drinks* will in a short time give place to these *Sugar-Wines*, when perfectly well made.

Besides 'tis good *Employment* for the Poor Women and Children to Gather the *Fruit*: and a Special *Improvement* of our *Waste-Lands* and *Heaths*, only by Turning the *Turf* and *Burnt-Heath* (if there be any) into the Trenches and Pits made by the Plough or Spade, for *Banks* or *Beds*.

Many Discourage themselves from *Planting Cider-Orchards*; saying that if they had the *Fruit*, they should yet want many matters too Costly for them. For their Sakes, I shall here instance, that in all the Neighbourhood round about *Yeoville* in *Somersetshire*, they that make 20 *Hogheads* of *Cyder* yearly, and much more, do Pound all their *Fruit* in *Troughs*, made for the purpose Deep and Strong, with *Broad-Feeted-Pounders*, one, two, or three (as their need requireth) Pounding together in the Same *Trough*. And to me they hold the Paradox stoutly, That, without more Cost or Trouble, this is the Best and Cheapest way. Workmen are cheaper in the Country at some season, than in some Cities. And 'tis a Charity to Employ Men that want *Employment*, rather than Beasts; and sometimes 'tis Unsafe to trust, either to the *Wind* or to the *Water*.

n. 134. p. 846.

Cyder (you know) Costs no Fewel to Brew it, and the Labour is but once in the Year.

'Tis drawn by Divine Chymistry; so many *Trees*, so many huge *Alimbecks*, which attend to that Divine Work constantly all the Year; They need no *Furnaces*, to send forth a *Corroding Smoak* to Choak all the City, to Strangle them into *Consumptions*, and to Corrupt all Beauties and Amenities. Neither *Iron*, *Steel*, nor *Marble*, can resist the Fumes of Brewing Houses: whereas *Cyder* is of a Thousand kinds, Proper to Cure many Diseases; and a kind *Vehicle* for any Healing Vegetable or other Medical Matters.

The *Cyder* of the best *Pepins* duly Ripen'd and kindly Fermented, is a Peculiar

Peculiar Remedy for the Consumption: And generally all Strong and Pleasant *Cyder* Exciteth and Cleanseth the *Stomach*; it strengthneth *Digestion* and infallibly frees the *Kidneys* and *Bladder* from breeding the *Gravel* and *stone*. This is (above all) the Peculiar Excellency of the right *Red strake* of *Irchin-Field*, when it escapes all *Sophistications*. But that which makes *Cider* Fit to Accompany the *Trades Men's Granary* is, that if it be made of Right *Cider Fruits*, so that it will be Full Bodied, and Strong, it will hold Good without Decay, and will Yearly be much *Improved* for some Years, to the next *Plentiful Year*, as usually it falls out; and best of all in Large Vessels, the Larger the better. *Trades men* should not be for *Bottled Cider*, which is commonly more Windy than Healthful. It hath been tried from my Childhood in Vessels of 14. 15. or 16. *Hogsheads*, of the Free Household Measure, containing between 60. or 70. *Statute Gallons*; I have been Often told, thar Sr. *John VVinter* had a Vessel which contaned 30. or at least 28 *Hogsheads*.

When the Citizens shall Ordinarily Drink *Cider* well *Diluted*, as the *French* drink *VVine*, and as the sober People in all our *Cider-Countries* Drink their *VVashings* of *Cider* (as they call it) or *Cider* well *Diluted* in the *Grinding-Time*, and as they Drink in *London* their *six shilling Beer*, I am perswaded it will much Conduce to their Health; and I have often heard *Labouring* People affirm that they are more strengthned for Hard Work by *Cider* largely *Diluted*, than by very Good *Beer*.

Yet I have much more to say for *Housshould-Gardens*, as a fit Match for *Granaries*. *Coleworts* and *Cabbages*, with a little care, hold out 7. or 8. Months in the Year. *VVe* have them all the Year round; good sauce for *Bacon* as Red as any *Rose*, as they have it in *Herefordshire*, where the *Swine* will get a share of the *Fruit*, which fall from their Hedges; and the *Bacon* of *New Forest* is generally Commended. These are in Good Houses always at hand, and may be easily Dressed without Waste of much Time. But *Roots* of all sorts, *Rapes*, *Turneps*, *Carrots*, *Parsneps*, *Skirrets*, *Potado's*, do challenge the Precedence Before *Granaries*: They are a kind of *Under Ground Granaries*, and do often times hold out, when *Corn* faileth; especially the *Potado's*, of *Barbados*, or of *Virginia*.

Vid. Sup. S.
VIII.

The *Potado's* of *Barbados* (in our fresh Memory) relieved *Ireland* from 2. Years *Famine*, when their *Corn* failed there; as *Chestnuts* relieved *France* in the extremity of their *Civil VVar*, when their *Ploughs* were forsaken. These *Potado's* cost little or no *Culture*, for 10. Years together: being only covered with *Fern*, or other *Light Muck*, and that Turned in with the Earth, and 2. or 3. *Roots*, as often as there is Occasion to take any of them up for Use; and they should be taken up, here and there, (by small parcels) where they grow Thickest. A Few *Acres* of these will run far to Furnish a *City*, and the Country round about. They have been sold in the Markets of *Bristol* and *VVells*, at the price of 4 *shillings per Bushell*: Dear enough in respect of their *Easie Propagation* and *Culture*, and Cheap enough in respect of their Use. Children of Poor people thereabout Eat them *Raw* (instead of *Bread* and other *Food*) without Hurt; some do *Rost* them in Embers, as they do *VVardens*; some do *Boyl* them, peel them, and eat them with *Butter* and *Pepper*, either served

ved Whole, or Chopt, as they do *Parsneps*; some do Strengthen their *Beer* or *Ale*, or make Good Drink with them; so they are to them, instead of *Corn* and *Malt*, and an Acceptable Treat. Every way they are a Strong and Wholesome Nourishment for Labourers. Some do *Parboyl* them slightly, Peel them, and Mince or Cut them in small bits, Mingle them with Slices of Fat Flesh, Seasoning all to their Palate, and *Bake* them in *Pyes* or *Pastyes*: and they Esteem them a Restorative Delicacy, not much Inferior to *Artichoaks*. I observe them to Grow and Prosper abundantly in much Differing kinds of Soil, from the *North* of *Shropshire* to the *Sea-Coast* of *Dorsetshire*. But they like not a stiff and strong Land: I tried them 2 Years in a strong Wheat Land, and could get no good of them There; all the Roots, which were there generated, were little bigger than the *Bulbs* of *Saffron*. In Light and Hollow Land of the *Hottest Ferment* (which is commonly of Little Worth for *Corn* or *Pasture*) there *Potado's* Thrive best and Taste best. But now I am at a Difficulty whether the Great Difference which we find in the *Relish*, be from the Differing Kinds of the *Potado's* of *Barbados* and *Virginia*, (for both have the same Resemblance above ground:) or whether the Difference, which we find, be only from the Diversity of the *Soyl*.

That the *Soyl* makes a Great Difference, and that all may be Careful to Choose a fit *Soyl* for their *Garden-Diet*, I shall here Offer some Notable instances to prove it. All the people here, (the very *Vulgar*,) do find the *Carrots* and *Turneps* or *Rapes*, from the *Common Fields* of *Meriot*, 8 Miles from hence Westward; far to Excel other very Good *Turneps* and *Carrots* in Fatness and pleasing *Relish*. And *Cabbage-Plants* from the *Wide Fields* of *Lydiard*, Westward of *Taunton*, (where they have a *Rich Reddish Soy*) do so far Excel all other the Best *Cabbage Plants*, that these *Lydiard Plants* are Bought in all places at 80 Miles Distance, and *Garden Plants* are sometimes much Altered in Taste and properties, by the Accidents of the Year. In a Droughty *Summer*, (the *Plague* then being *Hot* in *London*,) we had *Carrots* in *Northamptonshire* from a Kind *Soyl*, where they were wont to be very good; but then so Rank, Dry, and Earthy, that we could not endure to see them on the *Table*.

I hear that the *Turneps* of *Hackney* are better than other *Turneps* about *London*. We have here very good *Turneps*, White and Yellow, which are Fatter and Esteemed more Restorative. But all *England* wants the *Bobemian Turneps*, *Blood Red* on the Outside, which are Extolled by *Muffet* (as he found them in *Prague*) to be so Restorative and Delicate, that the Emperour himself Nurseth them in His Garden.

The *Spanish Potado* requires Diligent Culture, much *Sun* and a Light and pregnant *Garden Soy*. In the *Modern Latin* they are called *Glandes Malacenses*, being brought into *Spain* from *Volez Malaga*, a Province in *America*. They report that more than a Dozen of their Huge *Spanish Ships* were brought at One Time to *Sevil* in *Spain*, fully Fraighted with these *Potado's*, and were soon disperst all over *Spain*. We say the *Spaniard* is Slow at every thing: But they may say, the *Englishman* in many parts of *England*,

is more Slow at the best improvements of Our own Country; Witness our Want of *Vineyards*, of *Groves* of *Mulberries*, of the best *Chestnuts*, *Wallnuts*, *Figs*, *Almonds*, which are Wanting in most Parts, and do not Refuse to Grow in Our Climate.

Improvements of
Agriculture; by
Dr. M. Lister.
n. 225. p. 412.

LXXXII. For the Improvement of *Sandy*, *Light*, *Ground*, or any *Clay* well *Sanded*, I Recommend upon Experience *Vicia Multiflora Nemorensis Perennis*, *five Dumetorum*. I. B. It hath these Qualifications, beside those mentioned in the Title of *J. Baubine*, (*viz.* of its being *Perennial*, Thriving even in *Woods* and among *Bushes*, and being of the *Pulse* or *Pea* kind) that it Shoots 1000 *Roots* far and wide, and spreads it self Under-Ground like *Quick-Grass*: Above-Ground it is so Rampant, that it will Climb a *Fathom* and half upon Measure, and will preserve it self in Spite of *Weeds* or *Drought*. Again, it may be Set as well as *Sown* in *Furrows*: And for this Purpose the *Roots* may be Dug up in *Sept.* as well as the *Ripe Seed* then Gathered; by this means the Growth of it would be mightily Advanced, for the Older the *Roots* are, the Stronger, and Fuller of *Buds* and *Shoots* they are. I Sow'd the Latter End of *March* the *Seeds* I had Gathered in *Sept.* and had that Year a very Great Increase; the *Bed* being thick Covered over with *Grass* above 2 *Foot* high; but it did not *Flower* that Year. I Reckon'd that *One Pea* had put forth that Year above 30 *Shoots* in *August*: In the *Second Year* it *Flowered* by the Middle of *June*, and Bore a Wonderful *Crop*, the *Roots* being innumerable. I have observed this *Pea* very Common in all the *Mountains* as well as *Plains* of *England*, where *Bushes* or *Hedges* are. Both the *Pea* and *Grass* are very *Sweet*, and very Agreeable to *Cattle*, as I have Tried.

Agriculture may be also Considerably Advanced, by the great Choice of *Plants*, even of those of our Own Growth, of the *Pulse Kind*; of which I Recommended this List.

Lathyrus major Latifolius. Ger.

Lathyrus Luteus Sylvestris Dumetorum. I. B.

Astragalus Sylvaticus Ger.

Vicia Sylvestris Semine Rotundo Nigro C. B.

Orobis Sylvaticus Nostras. C. B. P. in Append.

Vicia Sylvatica Multiflora maxima. P. B.

I also Recommend as *Substitutes* of *Hemp* and *Flax*, of our *English* Growth *viz.* *Perennial Plants*;

Linum Sylvestre Angustifolium. I. B.

Linum Sylvestre Floribus Cæruleis. Ger.

Corona Fratrum; of the *Thistle Kind*. This Plant is generally a *Yard* Tall; its *Fibres* are exceeding *Tough* and *Strong*, beyond any I ever tryed; it puts forth many of these Tall and very Thick *Stalks* Yearly; it naturally Grows to this Bulk in most *Barren Soils*, as the *Dry Woods*, and High *Pastures*, in *Yorkshire* and *Lincolnshire*.

It may be Objected, that as *Annual Plants* require more *Labour* and a *Fatter Soil*; so they Recompense it in Largeness of Growth and *Fruit*: And also, that *Plants* of *Lasting Roots*, are more *Harsh* and *Bitter*, and not *Palatable*

for

for *Man* or *Beast*. I answer, that the *Compendium of Labour*, in *Husbandry*, is all in all; and that therefore the *Durable Plants* will turn to Better Account: I refer to the Wonderful Examples of Such as have already been made Use of, as *St. Foin*, &c. And it is Probable that by some *Tillage*, even *Harsh Plants* may be improved and brought to be Kinder Food. The same *Asparagus* which we Eat, Grows *Wild* in the *Marshes* of *Lincolnshire*, very Fair, and not to be Distinguished by the Eye from that in our *Gardens*: but is intollerable *Bitter*, which *Garden Culture* alone has Civilized, and made Pleasant to the *Taste*. For this Purpose *Liming* of *Pasture Ground* makes it Palatable to *Cattle*: For Cast *Lime* over the One Half of a *Pasture*, the *Cattle* will not Bite any where else Willingly, and will Eat here to the Bare Ground, much Neglecting the Other Half. I did use when I Lived in the *North*, to *Lime* my *Asparagus* and *Lettice Beds*, and this did so far *Meliorate* them, that they far Exceeded in *Tenderness*, and Pleasant *Taste*; Covering the *Asparagus* in *Winter* with *Clean Wheat Straw*, instead of *Nasty Litter*, and *Sowing* the Bed thick with the Powder of *Burnt Oyster-Shells*.

Perhaps *White Briony*, of all our *English Plants*, would best Succeed both for *Hay* and *Corn*; as giving the *Most Grass*, if we would that way Use it; and also Yielding a *Root* of a Prodigious Bigness, which Seasonably taken up, is little else but a *Mass* of *Fine Flower*. 'Tis true, it is a *Churlish Purge*, and not fit *Food* for *Man*, or any Other *Animal* we keep: But such and much Worse is the *Callava Root* of which the *Indian Bread* is made, and which by *Exsuccation* and *Baking* alone, proves *Innocent* and *Wholesome*. If the *Vast Shoots* it makes be Designed for *Hay*, they are to be Cut when *Tender* and in the *Flower*.

LXXXIII. Sow all Sorts of *Grains*, and *Plant* *Kernels* in Beds of *Earth*, at the very Time when the *Sun* Enters into the *Vernal Equinox*; and take them Up, when they are Strong enough to be *Transplanted*, at the Time of the *Full Moon*: Which time is always to be observed, if you will take them Up, and *Replant* them again.

To make Plants Grow to an Extraordinary Bigness, by M. . . . : n. 116. p. 356.

But now to know the *Moment*, or very Near the *Moment*, of the said *Equinox*, take some *Ashes* of *Vine-wood*; put them in an *Earthen Pot* *Leaded*, or in a Pot of the *White-Earth* of *Tayence*, very Clean; Pour upon it *Common Water*, or *Fountain*, or *Rain Water*, that is very Clear, from the $\frac{2}{3}$ of *March* to the $\frac{1}{4}$ of the same; and at the Time when the *Sun* Enters into the *Equinoctial Point*, you will see the *Ashes* make the *Water Turbid*, and then is the Time of *Sowing* your *Grains* and *Planting* your *Kernels*.

LXXXIV. I am of Opinion, that one Considerable Way to improve *Gardening*, and the *Culture* of *Plants*, would be to give a *Description* of the *Plants* themselves, then the *Soils*, *Climates*, and *Countries*, where the *Vegetables* to be Cultivated *Naturally* Grow; and what *Seasons*, *Rains*, and *Meteors* they have: Which being *Imitated*, as much as Possible, perhaps Some *Plants*

Gardening Improved; by Dr. H. Sloan. n. 251. p. 119.

Plants might Thrive Better, than now they do in the Fattest Ground. And to this purpose I have been assured by an Honourable and very Ingenious Person, that he has known some *Plants*, particularly *Centaurium Minus*, which not Growing the Ordinary Way, was Tryed by Dropping the *Seed* on the Surface of the Ground amongst the *Grass*; by which Artificial Imitation of Nature, it came to Perfection, which No Other way could be brought about.

The Success of a
New Stove; by
Sir Dudley Cul-
lum. n. 212.
p. 191.

LXXXV. I have made a *Stove* for my *Green-House*, according to Mr. *Evelin's* Late Invention, Publisht in the *Calendarium Hortense*. I laid my *Pipes* (of *Crucible Earth*) not too near the *Fire-Grate*, which is about 16 *Inches*; and I made a *Trench* the whole Length of my *House*, under the *Paving*, about 18 *Inches* in Breadth and Depth (Cover'd with an Arch of Bricks) and at the Other End of the *Trench*, having an Iron Plate about 18 *Inches Square*, to Take Off, and put on, with a Round Hole at Each Corner of about 3 *Inches Diameter*, with a Lid to slide open and shut, so that by Opening any of these Holes, or all of them, more or less, or taking off the whole Plate, I can Release such a Quantity of *Air* out of the *House*, to Blow the *Fire* so as to Increase or Diminish the Blasts; and as Mr. *Evelin* was pleased to Inform me by a Letter, concerning Distributing the *Air* at its Admission, more Equally through the *House*, I inserted my *Pipes* into a *Channel*, all along the *Wall*, at the End of the *House*, with those several *Overtures* he mentioned; all which, prove most admirably well.

To make Fruit
and Flowers
Grow in Winter;
by Sir Rob. South-
well. n. 237.
p. 44.

LXXXVI. Take up *Trees* by the *Roots* in the *Spring*, just as they put forth their *Buds*, preserving some of their *Own Earth* about the *Roots*; set them standing Upright in a *Cellar*, until *Michaelmas*; then put them into *Vessels*, with an Addition of more *Earth*, and bring them into a *Stove*, taking care to moisten the *Earth* every Morning with *Rain-water*, in a *Quart* of which, you must Dissolve the bigness of a *Walnut* of *Salt Armoniack*, and about Lent *Fruit* will appear.

As to *Flowers*, Take Good *Earthen Potts*, and therein sow your *Seed* at *Michaelmas*, Watering it in the same manner with the like *Water*, and by *Christmases* you will have *Flowers*, as *Tulips*, *Lillies*, &c.

This and the Other may be done in a Good *Warm Kitchen*; and such Days as the *Sun* Shines, you may set them forth for some Hours.

To keep Fruit, or
Flowers the
whole Year; by
Sir Rob. South-
well. n. 237. p. 44.

LXXXVII. Take *Salt Petre* one *Pound*, *Bole Armoniack* two *Pounds*, Ordinary Clean *Sand* 3 *Pounds*; Mix all together; and Observe This *Proportion* in other *Quantities*.

Then in *Dry Weather*, take *Fruit* of any sort that is not fully *Ripe*, Each, with its *Stalk*; put them in, One by One, into an *Open Glass*, till it be full; and then Cover it with *Oil'd Cloth*, close Tyled down; Then in a *Dry Cellar* put each of these *Glasses* 4 *Fingers* under *Ground*, and so as that quite round each *Glass*, and Above and Below, there may remain 2 *Fingers Thick* of the said *Mixture*.

Flowers also may be Used in the same manner.

LXXXVIII. I would advise such as suffer Detriment in their *Green Houses*, not to Despair, when they see the *Leaves* of their *Myrtles*, *Oranges*, *Oleanders*, *Jasmines*, and other *precious Fruits*, *Russet*, or altogether *Shrivelled* and *Falling*; but to *Cut* them to the *Quick*, *Plaster* the *Wounds*, and *Plunge* their *Cases* and *Pots* (*Trimmed* with *Fresh Mold*, &c.) in a *Warm Bed*, *Carefully Refreshed*, *Shaded*, *Aired* and *Treated* as *Sick Patients*, and as the *Prudent Gardener* best knows how. But above all, that he be sure, not to *Expose* them, 'till the *Eastern Winds* (which I call our *English Etesians*, and which make our *Springs* so uncomfortable, when we think *Winter* and all *Danger* past,) be *Qualified*; for they are *Deadly* to all our *Plants* *Abroad*, and frequently do us *More Prejudice* than the *Most Churlish Winters*; as *Commonly* finishing the *Destruction* of what the *Frosts* have spared. Nor are we to be flattered with a *Warm Day* or *Two*, which are apt to *Tempt* *Gardeners* to *Set out* their *Plants*, before the *End* of *April*, or that we find the *Wise Mulberry* put forth which is *Certainly* the *most Faithful Monitor*; nor should we indeed, *Cut*, or *Transplant* any of the *Perennials*, till of themselves they begin to *Sprout*.

Remedies for Decayed Ever-Greens; by Mr. J. Evelyn. n. 158. p. 561.

LXXXIX. In the *Spring*, being *Flattered* with some *Warm glances* and *Refreshing Days*, many are apt to *Expose* their *Choice Greens*, which upon a *sudden Change* to its *Former Cold*, with *Sharp Eastern Winds*, proves more *Pernicious* to *Such Strangers*, than all the *former Winter*, and seems to finish the *Destruction* of what the *Former Cold* had *Spared*; a *Matter* too frequently seen among us, we *Enjoying* no certain *Steady Summer* till after the *Solstice*. But these *tender Exoticks* losing their *Leaves*, having received *Detriment*, with their *Tops shrivelled* and the like, are oftentimes not *Capable* of *Enduring* the *interposing Scorching Heat* of the *Sun*, which oftentimes happens by *Fits* in the *Spring*; when the *Prudence* and *Care* of the *Gardener* is especially *Tried*, *Gradually* to *Help* and *Recover* his *Sick Patients*, sometimes by *Due Trimming*, *Earthing* with *Fresh Sustainance*, *Loosening* the *strait Bound Earth*, and sometimes with the *Help* of a *Warm Bed*, and *Gentle Watering* and *Shadowing* and the *Like*, *patiently* and *Carefully* *Waiting* the *Return* of the *Bounty* of the *Heavens* to help his *Endeavours*.

Cautions about Exposing Ever-Greens; by Mr. Jac. Bobart. n. 165. p. 777.

In the *Flower-Garden*, especial, *Observance* ought to be *Taken* of the *Choiser Roots* of the *Asian Ranunculi*, *Aulmoneys*, *Tender Narcissi* and *diverse Others* of the like *Tenderness*, and *Strangers* to such *Entertainments* as our *Northern Countries* afford; that if *Hard Frost* should happen, they should be *securely Covered* and *Kept* from the *Frost*, if possible, till the too *Frigid Moisture* of the *Earth* be *Digested*, which would prove *Pernicious* even to the *Death* and *Rottenness* of many such *Roots* and *Plants*.

Vid. Sup. Cap. I. §. LIII.

XC. Papers of less General Use, Omitted

- n. 40. p. 793. 1. **D**irections for Transporting Vegetables.
- n. 220. p. 239. 2. **D**Phytologia Tingitana; or, an Alphabetical Catalogue of Plants, Growing within the Fortifications of Tangier, 1673. by Mr. Spotswood.
- n. 232. p. 677. 3. A Catalogue of some Guinea Plants, with their Native Names and Virtues; sent by Mr. J. Smith from Cabo Corso: with Remarks on them; by Mr. James Pettiver.
- n. 244. p. 313. 4. An Account of 46 East Indian Plants, Collected at Unanercoonda, about 12 Miles from Fort St. George; by Mr. Sam. Brown; with their Names, Descriptions, and Virtues; by Mr. James Pettiver.
- n. 236. p. 1.
n. 264. p. 579.
n. 267. p. 699. 5. An Account of Part of a Collection of Curious Plants and Drugs, gathered by Mr. Sam. Brown, a Physitian at Fort St. George in the East-Indies, and lately given to the Royal Society, by the East-India Company: With Remarks, by Mr. Pettiver.
- n. 193. p. 504. 6. Quæries concerning Indico; by——
- n. 40. p. 797. 7. Quæries concerning Vegetation, especially the Motion of the Juices of Vegetables; by——
- n. 43. p. 858,
862. n. 46. p. 919. 8. Quæries concerning the Circles of Wood in the Bodies of Trees, and the Motion of Sap: by Dr. Ez. Tonge.
- n. 44. p. 881.
n. 46. p. 914. 9. Quæries concerning Vegetation, and the Motion of Sap in Fruit-Trees; by Dr. Ez. Tonge.
- n. 57. p. 1165. 10. Quæries concerning Vegetation, and the Motion of Sap; by Dr. Ez. Tonge.
- n. 68. p. 2073. 11. Inquiries, about Retarding the Ascent of Sap, and the Motion of Sap: by Dr. Ez. Tonge.
- n. 68. p. 2074. 12. Some further Enquiries concerning the Running of Sap in Trees; Colouring the Fruit and Leaves; Multiplying Crab stocks; and Propagating Trees, by Layers, &c. by Dr. Ez. Tonge.
- n. 70. p. 2121. 13. Inquiries relating to the Circulation of the Sap in Trees; by Dr. Martin Lister.
- n. 74. p. 2218. 14. An Enquiry suggested from Italy, whether it be likely to find something in Plants, Analogous to the Heart in Animals
- n. 40. p. 801 15. An Invitation to make further Trial of the Juices of Trees by Tapping them; by Mr. H. Oldenburgh.
- n. 252. p. 186 16. Two Problems concerning the Texture of Plants; and the Discovery of Poyson by Opium; Proposed by——
- n. 5. p. 91. 17. Enquiries concerning Agriculture; by the Committee of the Royal Society for Considering of Agriculture.
- n. 40. p. 799. 18. Enquiries concerning the Use and Culture of the Kitchen Garden, and Winter Greens: by——

XCI. Accounts of Books, and Additions,
Omitted.

1. **B**asis Botanica: Seu brevis ad Rem Herbariarum Manuctio, omnes Plantarum Partes, una cum earundem Virtutibus secundum Novissima Botanicorum Fundamenta, Generali quadam Methodo demonstrans; a D. Christiano Ludovico Welschio. Lips. 1697. in 12o. n. 243. p. 304.
2. Abr. Coulei Angli, sex Libri Plantarum, Poemate Latino conscripti. Lond. in 8o. n. 36. p. 716.
3. Prælua Botanica Roberti Morison, Scoti Abredonensis, Lond. 1669 in 8o. n. 46. p. 934.
4. Dr. Morison's New Universal Herbal. n. 114. p. 327.
5. Cl. Salmasii Præfatio in Librum de Homonymis Hyles Fabricæ. Eiusdem de Plinio Judicium. Divione. An. 1668. in 4to. n. 46. p. 935.
6. Quadripartitum Botanicum Simonis Pauli, Med. Reg. in Dania. Argentorati, in 4to. n. 76. p. 2291.
7. Waare Oeffening der Planten, door Abraham Munting. M. D. Amsterd. 1672. in 4to. n. 111. p. 247.
8. Memoires pour servir a l'Histoire des Plantes; dressez par M. Dodart. M. D. Paris. 1679. Ph. Col. n. 1. p. 39.
9. Historia Plantarum, species hæctenus editas, aliasque insuper multas noviter inventas & descriptas complectens. Auth. Joh. Rai. è Soc. Regia. Lond. 1686. in Fol. n. 186. p. 283.
10. Phytographia; by Leonard Plukenet. M. D. Lond. 1691. in Fol. n. 193. p. 528. n. 196. p. 618.
11. Almagestum Botanicum; S. Phytographiæ Plukenetianæ, Onomasticon, &c. Lond. 1696. in Fol. n. 225. p. 434.
12. Catalogus Plantarum Angliæ, & Insularum adjacentium tum Indigenas, tum in Agris passim Cultas complectens. Opera Jo. Raii. M. A. 1670. in 12o. & 1677. in 8o. n. 63. p. 2058. n. 133. p. 834.
13. The American Physitian; or a Treatise of Roots, Plants, Trees, Shrubs, Fruit, Herbs, &c. growing in the English Plantations in America: Whereunto is annexed, a Discourse of the Coco Nut-Tree, and the Use of its Fruit. By W. Hughs. Lond. 1672. in 12o. n. 83. p. 4078.
14. Catalogus Plantarum quæ in Insula Jamaica sponte proveniunt, vel vulgo coluntur; cum earundem Synonymis, & Locis Natalibus; adjectis aliis quibusdam quæ in Insulis Maderæ, Barbados, Nieves, & Sancti Christopheri, nascuntur. Seu Prodromi Historiæ Naturalis Jamaicae Pars prima. Aut. Hans Sloane. M. D. 1696. in 8o. n. 221. p. 293.

- n. 104. p. 87. 15. *Icones & Descriptiones Rariorum Plantarum Siciliae, Melitae, Galliae, & Italiae*; Auth. Paulo Boccono 1674.
- n. 247. p. 462. 16. *Museo de Piante Rare della Sicilia, Malta, Corsica, Italia, Piemonte, & Germania, &c.* di Don Paolo Boccone, &c. To which are here Added some Remarks by Mr. J. Ray.
- n. 145. p. 100.
n. 198. p. 682.
n. 200. p. 762.
n. 214. p. 276. 17. *Hortus Indicus Malabaricus*, continens Regni Malabarici apud Indos Celeberrimi, omnis generis Plantas Rariores; *Amstel. An.* 1678. 1679. 1682. &c. To which here are Added some Remarks by Tancred Robinson, M. D.
- n. 236. p. 29. 18. *Hortus Medicus Amstelodamensis*, sive Plantarum tam Orientalis quam Occidentalis Indiae, aliarumq; Peregrinarum Descriptio & Icones; Autore Johanne Commelino; Latinitate donatus, Notis & Observationibus illustratus a Frederico Ruyschio, M. D. Botan. Profefs. &c. et Francisco Kiggelario. *Amst.* 1697. Here are many Additional Remarks by Mr. James Petiver.
- n. 249. p. 63. 19. *Paradisus Batavus*; continens plus centum Plantas, &c. With Additional Remarks by Mr. Jo. Ray.
- n. 199. p. 729. 20. *Catalogus Plantarum Horti Academici Argentiniensis*: in Usum Rei Herbariae Studiosorum; adcurante Marco Mappo, M. D. *Argentorati.* 1691. in 12o.
- n. 245. p. 385. 21. *Histoire des Plantes qui Naissent aux environs de Paris*: avec leur Usage dans la *Medicine*; per M. Pitton Tournefort, M. D. a Paris 1698. in 8o.
- n. 265. p. 651. 22. *Flora Noribergensis*; &c. Being a Catalogue of such Plants as not only Grow Spontaneously about Nuremburg, but also of such Exoticks as the Physic Garden of that City hath lately Raised: with the Figures and Descriptions of many of the most rare; by Jo. George Volkamer, M. D. 1700 in 4o.
- n. 81. p. 4027. 23. *Plantarum Umbelliferarum Distributio Nova* per Tabulas Cognationis & Affinitatis, ex Libro Naturae Observata & Detecta; a Rob. Morison, Med. & Prof. Bot. Regio, &c. *Oxonii*, 1672.
- n. 74. p. 2235. 24. *De Absynthio* Analecta; per John Michael Febr. M. D. *Lipsiae*, 1668. in 8o.
- n. 74. p. 2236. 25. *Crocologia*, Auth. Joh. Ferdinando Hertodt. M. D. *Jenae* 1671. in 8o.
- n. 125. p. 621. 26. *Cochlearia Curiosa*; or the Curiosities of Scurvygrass: written in Latin by Dr Andr. Molimbrochius of *Leipsig*; and English'd by Dr. Tho. Sherly *Lond.* 1678. in 8o.
- n. 167. p. 870. 27. Joh. Nicholai Pechlini. M. D. *Theophilus Bibaculus*; sive de Potu Theae *Dialogus Franc.* 1684 in 4to.
- n. 211. p. 150. 28. *Epistola de Generatione Plantarum ex Seminibus*; a Josepho de Aromatariis. *Frankf.* 1625.
- n. 78. p. 3037. 29. *The Anatomy of Vegetables* begun: with a General Account of Vegetation founded thereon; by Neh. Grew. M. D. F. R. S. *London* 1671. in 12mo
- n. 97. p. 6131. 30. *An Idea of a Phytological History* propounded: together with a Continuation of the *Anatomy of Vegetables*, particularly prosecuted upon Roots, and an Account of the *Vegetation of Roots*, grounded chiefly thereupon; by Neh. Grew. M. D. & F. R. S. *Lond.* 1673. in 8vo.
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33. *Marcelli Malpighii Anatome Plantarum*; cui subjungitur Appendix, iteratas & auctas ejusdem de *Ovo Incubato* Observationes continens. Lond. 1675. n. 117. p. 401. Ph. Col. n. 1. p. 38. & 1679. in Fol.

34. *The Posthumous Works of S. Malpighi*. In this Account of them, *S. Jean Marie Lancisi* gives an *Encomium* and *Character* of the *Author*. n. 226. p. 320.

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36. A *Philosophical Discourse* of *Earth*, relating to the *Emprovement* of it for *Vegetation* and the *Propagation* of *Plants*; By *J. Evelyn*, Esq; Lond. 1676. in 8vo. n. 119. p. 454.

37. *The Epitome* of the whole Art of *Husbandry*: with additions of *New Experiments* thereto belonging; Written by *J. B.* Lond. 1675. in 8vo. n. 114. p. 320.

38. *Systema Horticulturæ*: containing in *English*, the *Art of Gardening*, in 3 Books; by *J. W. Gent.* in 8vo. n. 136. p. 922.

39. *Sylva & Pomona*; by *J. Evelyn*. Esq; Lond. 1669. in Fol. n. 22. p. 398.

40. *Dr. Richard Sharrock's History* of the *Propagation* and *Improvement* of *Vegetables*, by the *Concurrence* of *Art* and *Nature*. Oxon. 1672. in 8vo. n. 53. p. 1071. n. 84. p. 5002.

41. A *short and sure Guide* in the *Practice* of *Raising* and *Ordering* of *Fruit-Trees*; by *Fran. Drope*. B. D. Oxon. 1672. n. 86. p. 5049.

42. *The Garden of Eden*: or an Account of the *Culture* of *Flowers*, and *Fruits* now Growing in *England*; with particular *Rules*, how to advance their *Nature* and *Growth* as well in *Seeds* and *Herbs*, as in *Ordering* of *Trees*; by *Sr. Hugh Platt*. in 8vo. n. 113. p. 302.

43. *The Planters Manual*: being *Instructions* for the *Raising*, *Planting*, and *Cultivating* all sorts of *Fruit-Trees*; whether *Stone-Fruits*, or *Pepin-Fruits*; with their *Natures* and *Seasons*. Very Useful for such as are *Curious* in *Planting* and *Grafting*; By *Charles Cotton* Esq; Lond. 1675. in 8vo. n. 116. p. 373.

44. *Nurseries*, *Orchards*, *Profitable Gardens*, and *Vineyards* encouraged; the *Present Obstruction* removed; and probable *Expedients* for the better *Progress*; proposed, for the *General Benefit* of his *Majesties Dominions*, and more particularly *Cambridgshire*, the *Champaign Countries*, and *Northern Parts* of *England*: In several *Letters* out of the *Country*; by *Dr. J. Beal*, and *Mr. Anth. Lawrence*. n. 129. p. 748.

45. *The art of Pruning Fruit Trees*: and a *Tract* of the *Use* of the *Fruits* of *Trees* for *Preserving* us in *Health*, or for *Curing* us when we are *Sick*. Translated from the *French*. Lond. 1684. 4to. n. 163. p. 733.

- n. 15. p. 262.
n. 126. p. 646.
46. *The English Vineyard Vindicated*; by Mr. J. Rose.
47. *The French Gardiner*, Reprinted: To which is annexed the *English Vineyard Vindicated*; and the *Way of Making and Ordering Wines in France*. in 8°
- n. 93. p. 6019.
48. *Vini Rhenani*, imprimis *Baccaracensis*, Anatomia Chymica; a Job. Davide Portzio Phil. & Med. D. Heidelbergæ. 1672. in 12°.
- n. 69. p. 2116.
49. Joh. Henr. Meibomii de Cerevisiis, Potibusque & Ebriaminibus extra Vinum aliis Commentarius; annexo Libello Turnebi de Vino. Helmestadii. 1668 in 4°.
- n. 123. p. 574.
n. 135. p. 352.
50. *Vinetum Britannicum*: Or a Treatise of Cider, and such Other Wines and Drinks, as are extracted from all manner of Fruits, growing in this Kingdom: With the Method of Propagating all Vinous Fruit Trees; and a Description of a New Invented Ingenio or Mill, for the more Expeditious and Better Making of Cider. Also the Method of Making Metheglin, and Birch-Wine. With Copper Plates; by J. W. (Author of the *Systema Agriculturæ*) in 8°. *Advertisements on this Book are here added by Dr. Beale.*
- n. 124. p. 583.
n. 126. p. 644.
51. *The Manner of Raising, Ordering and Improveing Forest Trees*: Also how to Plant, Make, and Keep, Woods, Walks, Avenues, Lawns, Hedges, &c. With several Figures Proper for Avenues, and Walks, to End in; and Convenient Figures for Lawns: Also Rules and Tables shewing how the Ingenious Planter may Measure Superficial Figures; with Rules how to Divide Woods and Land; and how to Measure Timber and Other Solid Bodies, either by Arithmetick, or Geometry. &c. by Mr. Cook. in 4°.

C H A P. VI.

Zoology.

Observations in the Ordering of Silk-Worms; by Mr. Edw. Digges. n. 2. R. 26.

1. I. I Have Kept Leaves 24 Hours after they were Gathered, and Flung Water upon them to Keep them from Withering: Yet when (without Wiping the Leaves) I Fed the Silk Worms, I observed they did as Well, as those Fresh Gathered.
2. I never Observed that the Smell of Tobacco, or other Smells that are Rank, did any ways Annoy the Worm.
3. Our Country of Virginia is very much Subject to Thunders: And it hath Thundered exceedingly when I have had Worms of all Sorts; some Newly Hatch-ed; some half way in their Feeding; others Spinning their Silk; yet I found None of them Concern'd in the Thunder, but kept to their Business as if there had been no such Thing.
4. I have made many Bottoms of the Brooms (wherein Hundreds of Worms Spun) of Holly: and the Prickles were so far from Hurting them, that even from those Prickles they First began to make their Bottoms.

If *Silk*, which is the *Spittle* of a *Worm*, hath its Good or Bad Quality from the *Nourishment* the *Worm* Receives either from a Good or Bad *Leaf*. When the *Spring* proves Delightful and Sweet, the *Worm* Feeding on a good and Tender *Leaf*, Free from the Prejudices of an Unkind Season, (which sometimes Spoil the *Leaf*, by giving it a Rough, Gross, and Heavy Nature) then one may Expect a *Profitable Harvest*: and in such Years 'tis best to make a Good Provision, for *Silk* will then find Good Sale when most Abundance, and the Buyer meets with that of a good Substance, which the Advantageous Season very much Contributes to; but not Knowing how long it may Last, about *Mid summer* (or *St. John's Tide*) they begin, in *Piedmont* to Draw the *Silk* from its *Cocon*, to see What it Yields, and Judge of its Increase or Scarcity, as well as the Estimate of its Goodness and Perfections; those most Desirable are, that it proves Clean, Light, and Strong.

The Nature and Qualities of *Silk*; by Mr. Will. Aglionby. n. 252. p. 123.

In case the Season should not prove Plentiful, then they Buy as Fast as they can *Old-Silk*, and Keep as much as they Can of the Other, for the *Best Fabricks*; that so they may not be Obligated to Hazard all their Good, at the price of the Worst; which is commonly Practised: But if the Season promises a great and Satisfactory *Harvest*, they take the *New*, and put it apart for the *Best Fabrick*; not Despising the *Old*, but only Laying it aside till *Proof* be made whether the *New* be Better or Not.

The Goodness of *Silk* is Distinguished by its *Lightness*, as the most Essential Quality: which every Body knows Carries a Considerable Profit along with it, when Bought by *Weight*, and sold by the *Yard* or *Aune*. It is to be Noted, that the *Organcine* is *Superfine*, it being the Best Sort, and N^o. That the *Two Threads* are Equal in *Fineness*, that is to say, both alike in Smoothness, Thickness and Length, for the Thread of the *First Twist*: For the *Second*, it matters not whether the Single Thread be Strong before the *Two* are Joyned, unless to see whether the *First Twist* Prove Well. It is necessary the *Silk* be Clean; the *Straw Colour* is Commonly the *Lightest*, and the *White* the Heaviest of all. It is likewise Convenient, that the *Skeans* be *Even*, and All of an *Equality*, which shows they were Wrought together: otherwise with great Reason one may Suspect that it is *Refuse-Silk*, and cannot be *Equally Drawn* Out and Spun; for One *Thread* will be shorter than the Other, which is Labour and Loss. It will be also Requisite to Search the *Bale* more than Once, and take from out of the *Parcels* a *Skean* to make an *Essay*: for unless one Buys that which one knows by *Tryal*, there is a Hazard of being *Cheated*; and so for one sort have Another.

To know the Best *Silk*.

To Estimate the *Silk* by *Essay*, Fix the *Essay* upon One *Eighth* of a *Portée* Hand of *Silk*, of 110. *Aunes* of *Lyons* in Length, and see what it Makes of *Aunes* by the *Eighth* Part; the *Skean*, which is of 80. *Threads*, must be Multiplied by 110. which is the Length of the 110. *Aunes*, [from which Number must be Deducted one *Eighth*; as for Example, 110. by 80. makes 8800. the *Eighth* Part of which is 1100. which is the *Eighth* Part of a *Portée*. Now to Calculate what these 1100 *Aunes* weigh, which is the *Eighth* Part of a *Portée*, or of 110. *Aunes* of *Lyons*, it will be Proper to take a *Skean* out of the

To Estimate it by *Essay*.

the *Parcels*, which you take from Out of the *Bale*, which you judge may Contain at least 1100. *Aunes*, to make the one *Eighth Part* of a *Portée*; which *Portée* must be Divided on 2. *Bobbins*, half on Each; then Fix the 2. *Bobbins* on the *Cantre* (*Beam*;) and from thence pass it through the (*Combe*) *Hourdissoir*; this done, you Cut off your *Silk*, and Weigh it, and Multiply the *Weight* by *Eight*, it will Weigh just as Much as a *Portée* of 110. *Aunes* of *Lyons*: Which is the General Rule of Calculating, when they Draw the *Silk* Out. By this Means one may Learn to Adjust the *Weight*. There are *Silks* of *Piedmont* which are very *Light* and *Clean*, and to be Preferred before any in *Sale*. The *Portee* of *Silk* of the *Lightest* Weighs near 24 *Penny Weight*, to 25 and 26. Others 27 and 28 which *Weight* may be *Dispensed* with, on Condition the Other Qualities be as Good, to wit, well Wrought, Even, Fine, and Clean; but above these *Weights* they cannot be, unless they Abate of their Profit, Proportionable to what they Want in *Lightness*.

The Connought
Worm; by Mr:
Will. Molyneux.
n. 168. p. 876.

III. The *Connought-Worm*, which I find in *Godartius* of *Insects* Described by the Name of the *Elephant-Caterpillar*, is reported to be the only *Poysonous Animal* in the Kingdom of *Ireland*. One of them was sent *Alive* to me from the Country, about 40 *Miles* from *Dublin*: The Gentleman that sent it, had Kept it above 6 *Weeks* in a Large Box on a *Grassy Sod*, now and then Giving it a *Fresh Sod*, and *Ragwort* to Eat, besprinkling them with *Dew*. Some of these *Worms* are as Thick as a *Man's-Thumb*, and above 3 *Inches* Long: and some *Live* so long, as to have *Fine Hair*, thinly Dispersed over their *Bodies*.

The Ingenious Gentleman who sent it me is of Opinion, that the *Animal* is indeed *Pernicious*, if Eaten by a *Beast*. For first, the *Disease*, imputed to this Creature, seldom or Never affects the *Cattle* but in *Autumn*, and then, only this *Insect* is to be Found; Secondly it seldom or Never Attends Any *Cattle* but what Feed in *Low Marshy Grounds*, and there only this *Animal* Frequents; Thirdly, *Cows* who are Greedy Feeders by Great Morsels (by reason of their *Chewing* it afterwards in their *Cud*) but especially *Swine* that feed in *Low-Grounds*, are the Only Creatures troubled by this *Worm*; Fourthly, the *Worm* is very Rare, and scarce to be Found in 7 *Years*, and so Likewise is the *Distemper* that Proceeds from it; being Rare to have a *Beast* Affected by it. As to the *Symptoms* that attend its *Venom*, they are *Swelling* in the *Head*, and (as a Peculiar *Characteristick*) the *Swelling* and *Procidencia Ani*, in so much that the *Rectum* will Hang out above half a *Foot*. The Effectual Cure applyed to this Malady in *Black cattle*, is a *Drench* of the Herb *Bears-Foot*, *Rue*, *Garlick*, *Butter* and *Beer*; but for *Swine*, *Raddle* pounded small mingled with *Butter-milk*. These only are used by the *English Husbandmen*. But the *Irish*, as they certainly impute the *Malady* to this *Insect*, so they Draw the *Remedy* therefrom: For they assert, that if a *Hole* be Bored in a *Tree*, and this Creature stopt up therein, so as to Starve and Dye, the *Leaves* and *Bark* of that *Tree*, ever after, infused in *Water*, and given as a *Drench*, Cures the affected *Beast*; and several will repair to such a *Tree*, 10. *Miles* for a Cure. Another *Fancy* (and as ill Grounded) they have, that if a *Man* Bruise this *Worm* between his

his Hands, and let the *Expressed Juice* dry thereon, ever after the *Water* he *First Washes* in in the Morning, given to the *Beast* to drink, *Cures* it.

But I am very apt to suspect, That this *Worm* is no more *Poyson* than other *Caterpillars*. But the *Ugliness* of the *Worm* (it being of a *Dark; Fuscous,* and as they say, *Poisonous Colour,*) together with its *Largeness* beyond *Common Caterpillars*, has wrought so upon the *Fearful* and *Ignorant Vulgar People*, that they have given it the Name of *Venomous*. Yet I will not conceal, what I have from another Gentleman, (but with some *Diffidence* of the *Experiment*) he Gave the *Juice* of One of these *Worms* to One *Dog*, which shewed No Alteration thereon, but *Another Dog*, to whom he gave the *Skin* of the *Creature*, was found *Dead* 3 Days after.

But whether his *Death* proceeded from the *Poysonous Skin*, he could not *Affert*, for the *Dog* ran at *Liberty*, and might have been *Kill'd* (for ought as he knew) by some other *Accident*; tho' no *External Sign* of any *Violence* Offered to him did appear.

AB. is the *Worm*, lying on its *Belly*, long $2\frac{1}{2}$ *Inches* almost; c. his *Head*; dd. Two *Variegated Spots*, mistaken by the *People* of our *Country* for *Eyes*; e. a small *Protuberance* towards its *Tail*, from Whence arises a Part in Shape of a *Horn*, mistaken for a *Sting*.

Fig. 181.

Fig 182 Represents the *Worm* Reclined almost on his *Back*; F. his *Mouth* formed like that of Other *Caterpillars*, as it appeared in the *Microscope*; ggg. Six small *Horny Feet* or *Claws*, three on each side, as in other *Caterpillars*; hb. *Eight Papillæ*, with which he Fastens himself to what he goes or hangs on, as *Childrens Suckers* are Fastened to *Wet Stones*; ii. Two Larger *Papillæ*, with Which he does both *Suck* himself Fast, and most commonly therewith, he Grasps the *Stems* of *Grass* and *Herbs*, to which he clings with the Other.

Fig. 182.

IV. The *Bearers* of *Fruit-Trees* are full of *Asperities*, and not so smooth in their *Bark* as the other Parts of the *Tree*. If after the *Harvest*, and any *Time* all the *Winter* over, you look upon these *Bearers*, through an *Ordinary Microscope*, you will find the *Cavities* there full of *Eggs*, of an *Oblong figure*, and *Citron Colour*; especially in those *Years*, and *Trees*, wherein the *Caterpillars* have been numerous: Out of these they are *Hatcht* in the *Spring*. The *Seasons* which usually destroy them are, when there comes an *Early Heat*, such as is sufficient to *Hatch* them, before the *Coming Forth* of the *Buds* and *Blossoms*, and when immediately there succeeds a *Nipping Frosty Air*, which soon *Kills* them.

The True Origin
of Caterpillars;
by Dr. George
Garden. n. 237.
P. 54.

The *Discovery* of this *Manner* of their *Propagation*, seems to give *Light* to These *Conjectures*. 1. That we ought not to *Conclude*, that any *Insects* are *Bred* of *Corruption*, and Not *Ex Ovo*, because we cannot *Discern* the particular manner of their *Propagation*: For, the *Discovery* of this, you see, is by *Accident*, and not *Discernible* by the *naked Eye*. 2. That the *Female Insects* of all *Kinds* of *Flies* and *Butterflies* do probably put their *Spawn* Near those *Places* where the *Eruca's*, which are *Hatcht* of them, are to have their *Food*:

The Generation
of Insects.

Vid. Inf.
S. IX.

So that they are to be searched for in such Places, by Those who Enquire into the Manner of their Propagation. 3. They seem to be fixed into the Cavities of the Bearers by a Gluten, so as that Rains do not Wash them off. 4. The Greatest Frosts, it seems do No Hurt to the Small Eggs of Insects; for I have seen the Caterpillars Hatch, after most Cold and Frosty Winters, of those Eggs which I have observed on the Bearers all the Winter over.

Observations on
a Glow-Worm;
by Mr. J. Tem-
pler. n. 72.
p. 2177.

V. May. 27. 1671. I put a Glow-worm into a Small Thin Box (such as Pills are sent in;) between 11 and 12 at Night, I saw her Shine, through the Box, very Clearly on One side, the Box Shut; putting White Paper into the Box, and the Worm into the Paper, it shined through the Paper and Box both.

28. In the Morning about 8 of the Clock, she seemed Dead, and holding her in a very dark place, I could perceive but very little Light, and that only when she was Turned upon her Back, and by Consequence put into some little Voluntary Motion. After Sun-set that Night, she Walked Briskly Up and Down in her Box, shining as Clearly as the Night before; and that, when there was so much Day-Light, that I could Read without a Candle.

29. In the Morning she seemed Dead again; at Night Recovered her self, and shined as well as ever, through the Box, and holding a Large Candle in my Hand, the Light of it did not Sensibly Diminish that of the Glow-worm.

30. 10. h. v. I set the Box with the Worm in it, about 4 Yards from me, in a Window, where I perceiv'd it shine through the Box, for almost an Hour.

31. 4. h. m. I found it shining, and observed it in plain Day Light, for about $\frac{1}{2}$ an Hour, and then wholly ceasing. At 5 in the Evening, the Worm shined pretty Clear, in a very lightsome Room; at which time the Sun shined gloriously into the Room. Some time after she shined little, having Contracted her Body into a Bending Posture, the Light scarcely so big as a Great Pin's Head: But upon Touching of her, she Extended her self, walked in her Box, and at first Extent shined as gloriously as ever.

N. B. I never saw her Shine without some Sensible Motion, either in her Body or Legs, in her Clearest Shining she Extends her Body a 3d. part beyond its Usual Length; and, if my Senses Fail me not, she Emits a Sensible Heat in her Clear Shining.

Jun. 1. Upon several Tryals of Different Positions, I find her not to Shine sometimes when in Motion: But I could never yet, see her Shine, when not in Motion of some part.

Jun. 8. Putting her into an Urinal of White Glass, at 9 a Clock at Night, she Crawled Nimble in it, and Extended her self beyond an Ordinary Length, yet her Shining was not so Clear, as in her Box when Opened: Putting the Urinal into the Water for about $\frac{1}{2}$ an Hour, it gave a very Delightful Irradiation of the Water. When this Light seemed Wholly Extinct, although she was in Motion, if I Depressed the Urinal into the Water, till the Bottom almost touched the Bottom of the Basin, I could (upon looking in at the Top of the

the *Urinal*) see a very fair *Light*: but upon Lifting the *Glass* out of the *Water*, I could Discern very little *Shining*. Then Putting her into her *Box*, she did in about a *Minutes* time (for I tryed it twice Over,) by a *Watch*, almost 10. times increase her former *Shining* in the *Urinal*.

14. The *Worm* seem'd *Dead*, and being Shut in a *Box*, would give *No Light*, though it was betwixt 9 and 12 a *Clock* at *Night*: But in the *Uncovered Box*, or in the *Urinal*, she did *shine faintly*, and the *Light* was of a far *different Colour* from what it was formerly.

15. I Touched her with a *Needle* Gently; whereupon she stretched out one of her *Legs*, and by it (when I inclined the *Position* of the *Box*) she stayed her whole *Body* from *Falling*. Before I *Prickt* her, she did give a little *shining* in her *Uncovered Box*, but none through the *Urinal*: Only if you looked in at *Top*, a little *shining* was seen: Upon *Pricking* her, I did not see her *Shining* Encreased.

16. I discerned a little *shining* only within her *Box*: Upon *Pricking* I could Discern *No Motion* in her; but the *Scale* next her *Tail*, was sensibly more *Extended* a $\frac{1}{4}$ of an *Hour* after I *Pricked* her, than *Before*.

NB. These last 3 *Days*, she lay continually upon her *Back* with her *Legs* *Contracted*, except only the *Time* mentioned *June* 15. of my *Pricking* Her. I am afraid to *Conclude* her *Dead*, *June* 16, having been informed by *Mr. Th. Hallebeck* of *Cald-Newton* near *Melton Mowbury*, that he kept a *Glow-Worm* near 6 *Months* in his *Parlour Window*, which would sometimes seem *Dead* for many *Days* together (if I mistake not, he said *Weeks*) and afterwards both *walk* and *shine* again.

VI. The *Cicindela Volans*, or *Flying-Glow-Worm*, is very *Rare* in *England*, yet I have happened to *Catch* of them twice at *Northaw* in *Hertfordshire*: *First* about *Midsummer* 1680, and for a *Fortnight* in *June* 1684. They flew about the *Candle* as soon as it grew *Dark*; at both which *Times*, the *Weather* was very *Hot*; and it may be it *shines* only at such *Seasons*, tho' the *Animal* be easie enough to be *Met* withal *Winged*, when it *shines not*, and *without Wings* *shining*, which is the *Common Glow-worm*.

The *Description* of it by *Aldrovandus* agrees very well with the *Animal*: But both *Moufet* and *Tho. Bartholin* are *Mistaken*, in allowing the *Male Only* to have *Wings*. The contrary was known to *Julius Scaliger*: And I once *Caught* the *Male* and *Female* *Coupled*, and could observe no difference between them, except in *Size*, (the *Female* being a little the *Larger*) for they Both *Shined* alike. It's *Light* was very *Vivid*, so as to be seen plainly when a *Candle* was in the *Room*: but the *Vibrations* thereof were *Unequal*, and the *Colour* *Greenish*, like that of the *Creeping Glow-worm*. The *Luminous Part* was two small *Specks* on the *Underside* of the *Tail*, at its *End*. The *Shining* continued for a little while after the *Tail* was cut off, tho it sensibly *Decayed*, till at last it went *Quite out*. Possibly, the *Use* of this *Light* is, to be a *Lanthorn* to the *Insect* in catching its *Prey*; and to direct its *Course* by, in the *Night*: Which is made probable, by the *Position* of it

The Flying
Glow-worm; by
Mr. Rich. Wal-
ler. n. 176. p. 841.

Lib. 4. c. 8.
c. 15. p. 108.
De Luce Ani-
malium. Lib. 2.
c. 12.

on the *Under Part* of the *Tail*, so that by Bending the same Downward (as I always observed it to do) it gives a *Light* forward upon the *Prey* or *Object*, the *Luminous Rays*, in the mean time, not being at all incommodious to its Sight, as they would have been, if this *Torch* had been carried before it. This Conjecture is also favoured by the placing of the *Eyes*, which are on the *Under Part* of the *Head*, not on the *Top*. I observed also, that it could, and did, by some Contrivance, cover its *Light*, and make a kind of *Dark-Lantern*.

Fig. 183.

Fig. 183 shews the *Insect* upon its *Feet*, with the *Back* Upwards; where it appears to be of the *Beetle-kind*. It is of a *Dark-Brown* Colour, Unpolisht: when the *Case-wings* are Opened, it Extends two very *Large Membranous Wings*, fastened to the Upper part of the *Thorax*. Its *Head* is Covered, as it were, with a *Shield*, or *Broad-brimm'd Hat*.

Fig. 184.

Fig. 184. Represents it laid on the *Back*, to shew the *Two Eyes* under the *Broad Covering*. They are *Black*, and very *Large*, making almost the whole *Head*; there being little else to be seen. These are *Moveable*, so that the *Animal* can thrust them forward to the Edge of its *Hat*. From between These, are Discovered the 2 *hairy Feelers*, or perhaps *Brushes* to Cleanse the *Eyes*. Between these *Eyes* and the *Thorax*, lies the *Mouth*. On the *Thorax* are 6 *Legs*, almost all of a Length. The *Tail* is made of Seven *Shelly Rings*; at the *Last* of which are Visible, the two *Shining-Points*.

Fig. 185.

Fig. 185. Shews the *Insect* on its *Back*, as it was seen through a *Microscope* when *Dead*; where *A A*. Represents the two *Long Horns*, *Feelers*, or *Brushes*, consisting of Ten *Roundish Joints*, besides the *first*, which is as long as Two of the rest; they are all *Hairy*, and like Those of some *Butter-flies*; for all have them not. *B B*. The *Broad Covering*, or *Hat*, over the *Head*, which shewed of a *Speckled Brown*, and *Yellowish* Colour, like *Tortois shell*. *C C*. The two *Eyes* Composed of Innumerable small *Glassy Hemispheres* in *Rows*; as hath been observed by the Ingenious Mr. *Hook*, in his *Micography*, to be the Make of *Insects Eyes*, so to supply the Defect of *Motion* in their *Eyes* by the Number of *Pupilla's*. I have seen these *Spherical Bodies* in the *Eyes* of some *Butterflies*, set in *Circles* not *Rows*; with *Long Hairs* growing out of each space, left by the Connexion of Three *Hemispheres*. *DDDDDD*. The *Legs* of a *Shelly-make* like *Lobsters*, and so *Jointed*. As well in This as other *Flyes*, they are Covered with many *Stiff Hairs*, tho' not so Full as those of the *Blew Fly*, Figured by Mr. *Hook*. The *Mechanism* of the *Feet*, as I take it, are much the same; Only what is there call'd the *Pattens*, were here wanting (if not Broken off, as I believe they were not,) and their Use supplied by the *Gibbous Part*, Represented by *d d d*. The *Talons e e e e e*. of the feet were shining, and very *Sharp Pointed*. The *Legs* were of two *Long Joints*, and the feet of 4. more, beside that which was Armed with the *Talons*. These seemed to be *Jointed* One into Another, and were all Thick beset with *Hairs*,

Microg. Sch. 26.

or *Bristles* E The *Thorax* of but one *Shell*, of a *Polisht Copper Colour*, Stuck full of *Tapering Bristles*, a small *Dent* being Discernable in the *Shell* wherein Each Grew. F. The *Tail*, Consisting of 7 *Rings* of the same *Brownish Colour*; without *Hairs* except on their *Edges*, which were set with them like a *Thin Fringe*, as the *Tails* of *Lobsters*, &c. are. These *Rings* were of an Unequal *Shining Shell Cover*. f. f. The *Back*, or Upper Part, of two or three *Rings*, of the *Tail*, turned Up to shew the *Work* of the *shell* on That Side. On the Inside of the *Last* of These, was the *Light* placed, tho' there was now Nothing to be seen, except that Part being a little *Lighter Colour'd* than the Rest of the *Tail*. G G G. The *Membranous wings*, in every particular like Those of the *Blew-fly*, with *Hairs* upon the *Veins*, or *Quilly Parts*. H H. The *Insides* of the *Cases wings*, which were *Hairy*, pointing all *Downwards*; The *Outside* of these *Cases* is also very *Bristly*.

VII. In the *Harvest Time*, 1666. (the *Sickness* raging then at *Cambridg*) at *Bassenburn* in *Cambridgshire* there were Millions of *Maggots* on the *Corn Lands*; and in their *Barns* too, the *Floor* would be *Cover'd* with them that Fell from the *Carts*. The *Maggots* were about *half an Inch Long*, no *Thicker* than a *Pigeons Feather*, of a *White Colour*, somewhat shaded with an *Isabella*, or *faint Yellowish stripes*, the *Length* of the *Worm*; they had 14. *feet*, after the manner of many *Caterpillars*, and I was almost *Confident* would have produced some sort of *Moath*. I took up about a *Score* of them, and put them into a *Box*: but they immediately *Offended* me with an *Ungrateful* and strong *Stink*; which yet is not *Usual* to the *Caterpillar-Kind*. After *Two Days* I *Rid* myself of them, and Only *Observ'd*, that the *Excrements* which they *Voided*, were little *Hard Pellets* of pure *White flower*, like that of *Barley*.

An odd Sort of
Maggots; by Dr.
M. Lister, n. 162.
p. 595.

VIII. Some Few Years since there was such a *Swarm* of a certain sort of *Insects* in *New England*, that for the space of 200 *Miles* they *poysoned* and *destroyed* all the *Trees* of the *Country*; there being found innumerable little *Holes* in the *Ground*, out of which those *Insects* broke forth in the form of *Maggots*, which *Turned* into *Flyes* that had a kind of *Tail*, or *Sting*, which they stuck into the *Tree*, and thereby *Envenomed* and *Killed* it.

Swarms of
Strange and
Mischievous In-
sects, in New
England; by ...
n. 8. p. 137.

IX. The *Libella* is a *flying Insect*, called in *France*, *Demoiselle* from the *Variety* of its *Colours*, *Transparency* of *Wings*, and its *Stately Flight*. They also call it *Pearle*, from the *Figure* of its *Head*, or rather from the *Roundness* and *Colour* of its *Eyes*. It is divided from space to space into *Rings*, by means of Which it *Composes Angles* with its *Body*, whose *Lines* it can make *Longer* or *Shorter* as it finds *Occasion*.

The Libella; by
M. Poupert, n.
266. p. 673.

These different *Sections* serve to the *Motion* of this *Insect*, as we know the *Tail* doth in *Birds*, and as they are *Lengthned* or *Contracted*, they *Carry* themselves according to their *Various Inclinations*, the *Point* or *Center* being *Fixed* between their *Wings*. All *Modern Naturalists* know

the Greater sort of *Libellæ* are Generated Under Water, Wrapt up in a *Membrane*, which at length Dissolves and Turns to Nothing.

When the Young *Libella* is ready to Quit its *Case*, it Dilates its *Belly*, that the *Water* may Enter in at the *Anus* upon the *Intestines*; then it Compresses it self to Circulate the *Water*, which it Expels, and shoots out a Great way. It Receives more *Water* into its *Intestines*, and Ejects it after the same Manner. It Continues this Action with great Force for some time, and makes the *Water* Circulate in the *Vessel*.

To satisfy my self that it Took the *Water* in at the *Anus* and Not at the *Mouth*, I put a *Libella* upon my *Finger*, which I held fast by the *Legs*; I dipt it Under Water with its *Head* Downwards, the *Anus* being even with the *Water*, so that it might get into the *Intestines*, which it Cast out a good Way; I Drew my *Finger* a little further Out, so that the *Water* could not Enter at the *Anus*, and the *Fly* Continued its *Motion*, but Ejected No *Water*. My Opinion is, she does this in order to Cleanse her self from all *Excrements* in that Element, where she Leaves her *Old Robes*, to appear in a more *Glorious* and *New Form* in the *Open-Air*.

There are a great Number of Small *Vessels* which Closely Unite the *Body* of the *Libella* to its *Case*: It is necessary that these be *Dry*, that they may the sooner Break when it makes its Efforts to Get out of its *Case*, which cannot come to pass as long as there is any *Aliment* in the *Intestine* to afford *Nourishment* to the *Case*, and its *Strings*. And perhaps this is the Reason, why no *Insects* will take any *Food*, when they are going to Change their *Forms*: And if they do not Cleanse themselves, as the *Libella's* do, yet they Stay a great While Longer, before they Change, without any *Aliment*; the *Libella* is no Longer than *Half a Day* in Quitting its *Case*, and taking its *Flight*.

To know the Cause of its exceeding *Swift* and *Whirling Motion*, we must Cut the *Skin* of the *Libella* (which is very *Fine*) all along the *Back*, and be sure to bear the *Point* of the *Scizzars* Upwards, lest we Cut the *Interiour Parts*. We must also Draw the *Skin* to the *Right* and *Left Hand*, and Fix it with *Pins* upon a *Table*, that we may Discover the 16 *Muscles*, which lye between the *Wings* and the *Legs*, (8. of Each Side) of the *Thickness*, *Length*, *Colour*, and almost *Figure* or *Shape* of a *Grain of Barly*, *Contiguous* to one another, and without *Adherence*. We may observe that Each *Muscle* is Composed of many *Fleshy Fibres*, which do not seem to be Joyned together, but Terminate Round at the Ends of the *Muscle* where they Compose a *Common-Tendon*; so that one might Discern any of these *Fibres* to be a *Small Muscle*, of which the *Chief* is Composed. The use of these *Muscles* seem to me very *Particular*: For the same *Muscles* which Flutter the *Wings*, serve also to Stir the *Legs*. The *Upper Tendons* of the *Muscles* enter into the *Wings*, I believe the same which the *Fibres* Compose, and the *Lower* Enter a good Way into the *Legs*; yet the *Contrary Motions* of these *Organs* are not at all *Hindred*, for as long as the *Wings* Play, the *Feet* lye Still, and serve for a *Prop* to the *Muscles* which Stir the *Wings*; and when the *Feet* are

in Action, the *Wings* are Quiet, and in their turn serve to support the *Tendons* which Direct the *Feet*.

The *Eyes* are like two Thick Oblong *Pearls*, which begin at the Forepart of the *Head*, and End in the Hinder Part. Their *Outer Membrane* is Dry, Thin, Transparent, and incloses a Small Soft Ball, filled with a very *Black Liquer*: Two small Canals, fill'd with *Air*, enter into Each of these *Eyes*, and Run along to the great *Channel*, also furnished with *Air*, which accompanies the *Intestine* from the *Head* to the *Tail*. This *Structure* made me think, that the *Libella* could Drive the *Air* Contain'd in these *Canals* into the *Eyes*, to give it a greater *Convexity* to behold Objects that are Very Near: And on the Contrary, the *Air* is Forced out of the *Eyes* again to Flatten them, when they look at Remote Objects. And my Conjecture is not altogether Frivolous: for having Blown into the Thick-Canals which are about the Middle of the *Body*, the *Eyes* became Considerably *Tumified*, and by Letting the *Air* Return they became *Flat* Again. If we leave a *Libella* Dead for some *Days*, the *Internal Parts* will *Putrify*, and come to Nothing: But these *Canals* will Remain Entire, and as Solid and Firm as they were Before.

X. Whether there be any *Spontaneous*, or *Anomalous Generation* of *Animals*, as hath been the *Constant Opinion* of *Naturalists* Heretofore, I think there is Good Reason to Question. It seems to me at present most probable, that there is *no such Thing*: but that even all *Insects* are the *Natural issue* of *Parents* of the same *Species* with themselves.

Of Spontaneous Generation; by Mr. Ray. n. 74. p. 2219.

Fr. Redi hath gone a good Way in Proving this: Having Cleared the Point concerning *Generation ex Materia Putrida*. But still there Remain two Great *Difficulties*; the *First* is, to give an Account of the *Production* of *Insects* Bred in the *By-Fruits* and *Excrescencies* of *Vegetables*, which the said *Redi* Doubts not to ascribe to the *Vegetative Soul* of the *Plant* that Yields those *Excrescencies*; But for this, I refer you to *Mr. Lister*. The *Second* is, to render an Account of *Insects* Bred in the *Bodies* of other *Animals*.

Gener. degl' Insetti.

XI. I. *M. Verney*, a *French Apothecary* at *Montpelier*, having Described the *Grain* of *Kermes* to be an *Excrescence* Growing upon *Wood*, and often upon the *Leaves* of a *Shrub* Plentiful in *Languedock*, and Gathered in the End of *May* and the beginning of *June*, full of a *Red Juice*; Subjoyns two *Uses*, which that *Grain* hath, the One for *Medicine* the other for *Dying* of *Wool*. For the *Latter Use*, they take the *Grain* of *Kermes*, when Ripe, and Spread it upon *Linnen*; and at *first*, whilst it abounds most in *Moisture*, 'tis Turned Twice or Thrice a Day, to Prevent its *Heating*; and when there appears *Red Powder* amongst it, they Separate it, Passing it through a *Searce*; and then again they Spread abroad the *Grain* upon the *Linnen*, until there be perceived the same *Redness* of the *Powder*; and at the End, this *Red Powder* appears about, and on, the Surface of the *Grain*, which is still to be passed through a *Searce*, till it Render no more.

The Grain of Kermes, its use, and the Fly form'd Out of it; by M. Verney. n. 24. p. 362.

In the Beginning, when the *Small Red Grains* are seen to *Move* (as they will do) they are *Sprinkled* over with *Strong Vinegar*, and Rubb'd between ones *Hands*. If this *Red Powder* should be let alone, without *Pouring Vinegar* or some Other *Acid Liquor* upon it, out of *Every Grain* there would be Formed a *Little Fly*, which would Skip and Fly up and Down for a Day or Two, and at Last, Changing its *Colour*, fall down Quite Dead, Deprived of all the *Bitterness*, the *Grains*, whence they are *Generated*, had before.

The *Grain* being altogether Emptied of its *Pulp* or *Red Powder*, 'tis wash'd in *Vine*, and then *Exposed* to the *Sun*; being Well *Dried*, 'tis Rubb'd in a *Sack* to render it *Bright*, and then 'tis Put Up in *Small Sacks*, putting in the *Midst*, according to the *Quantity* the *Grain* has afforded, 10 or 12 *Pounds* (for a *Quintal*) of the *Dust*, which is the *Red Powder*, that came Out of it. And accordingly, as the *Grain* affords More or Less of the said *Powder*, *Dyers* buy more or less of it

'Tis to be *Noted*, that the *first Red Powder*, which appears, issues out of the *Hole* of the *Grain*, that is on the side, where the *Grain* adhered to the *Plant*; and that that which about the end appears Sticking on the *Grain* hath been *Alive* in the *Husk*, having Pierced its *Cover*, though the *Hole*, whence it commonly issues remains *Close*, as to the *Eye*.

2. Some Years ago, I Gathered off our *English Oak*, Round *Worm-Husks* very like *Kermes Berries*; And I have Often Observed on *Plumb Trees*, and *Cherry-Trees*, also on the *Vine* and *Cherry-Laurel*, certain *Patellæ*, or *Flat-Husks*, containing *Worms*, which, (or at least the *Husks*) will Strike a *Carnation* with *Ly* and *Stand*. In *May*. 1671. I observed the same *Patellæ*, or *Husks*; indifferently on *Vine-Branche*s, *Cherry-Laurel*, *Rose-Bushes*, *Plumb-Trees*, and the *Cherry-Tree*. The *Figure* of the *Husks* is *Round*, save where it *Cleaved* to the *Branch*; for *Bigness*, somewhat more than *Half a Gray Pea*: These, I say, *Cleave* to their *Branche*s, as *Patellæ* do to *Rocks*; for *Colour*, they are of a very *Dark Chesnut*, extreamly *Smooth*, and *Shining Membrane-like*. They Adhere most commonly to the *Underside* of a *Branch*, or *Twig*, and so are Best secured against the *Injuries* of the *Weather*; as too much *Sun* and *Rain*. They are well *Fastened* to the *Branche*s single, and sometimes many in *Company*. They are seldom found without *Vermine*, as *Pismires*, &c. which I guess, Pierce them, and *Prey* upon them. If you Cut off *Dexterously* the *Top* of the *Husk* with a *Razor*, you'll find sometimes 5 or more *Small White Maggots* of the *Wasp*, or *Bee Kind*, that is, *Sharp at Both Ends*. If when you have *Clear'd* the *Husk*, you Rub the *Empty Membrane* upon *White Paper*, it will *Freely* and *Copiously Tinge* the *Paper* with a *Beautiful Purple*, or *Murrey*.

Jun. 10. 1671. I found several of these *Patellæ Kermiformes* Hatched in a *Box* where I had Purposely put them; they prove a sort of *Bees*, but certainly the *Least* that ever I yet saw of that *Tribe*, as not much exceeding in their whole *Bulk* the *Half* of a *Pismire*. They are very compact and *Thick* for the *Bigness*; of a *Cole-Black Colour* There is a *Remarkable Spot* on their *Backs*, *White* or *Straw colour*, *Large* and *Round*. The *Upper Pair* of their *Wings* are *Shaded* or *Dark spotted*, the *Undermost Pair* are *clear*. We may Entitle them, according to our *cultom*, *Apiculæ Nigræ*, *Maculâ super Humeros subflavescente insignitæ*,

The Insect-
Husks of the
Kermes-Kind;
by Dr. M. Lister.
n. 71. p. 2165.
n. 72. p. 2177.

n. 73. p. 2196.
n. 76. p. 2294.

Patellis sive Favis membranaceis, veri Kermes similibus, suaque itidem Purpura Tingentibus, Cerasi aut Rosæ aliarumve Arborum Virgis adtextis, Exclusæ.

It is to be further Observed

1. That those that look the *Blackest* yield the *Deepest* and *Best Purple*

2. That as the *Bees* come to *Maturity*, the *Dye* seems to be spent, and the *Husks* Grow *Dry*.

3. That the *Young Ones* make their *Way Out* at *Several* small *Holes*; that *Hole* in some of the *Shop Kermes*, being *Accidental* only and *Ever* on the *Bottom Part* Cleaving to the *Branch*; and the *Time* of *Gathering* them for *Colour*, is without *Doubt* before they are *Pierced*, and whilst the *Animal* is yet in *Vermiculo*, and *Consequently* the *Husk Entire*.

We *Compared* these *Purple-Kermes* with the *Scarlet Kermes* or *Grains* of the *Shops*, and found them in every *Point* to agree, save in the *Colour* of their *Juices*: and *Particularly* (finding in some *Parcels* of the *Shops*, many yet sticking to little *Twigs* of the *Ilex*) we confidently affirm, that *Those* as well as *Ours*, are only *Contiguous* to the *Ilex-Banches*, and are not *Excrescencies* of the *Tree*, much less *Fruit* or *Berries*, (by which abusive *Names* they have been too long *Known*;) but that they are the *Artifice* and *sole Work* of the *Mother Bee*, in order to the more *Convenient Hiving* and *Nourishment* of her *Young*.

These things are also *Certain*; viz.

1. That we have seen the very *Gum* of the *Apricock* and *Cherry Laurel Trees* *Transudated*, at least standing in a *Chrystal-drop* upon some (though very *Rarely*) of the *Tops* of these *Kermes*.

2. That they *Change colour* from a *Yellow* to a *Dark Brown*: and that they seem to be *Distended*, and to *Wax Greater*, and from *soft* to become *Brittle*.

3. That they are filled with a sort of *Mites*: Concerning which I am pretty well assured by my *Own*, and also by *Dr. Johnson* of *Pomfret's* more *Accurate Microscopical Observations*.

4. That the *Bee Grubs* actually *Feed* on *Mites*: there being no other *Food* for them.

5. That there are other *Species* of *Bees*, or *Wasps*, besides those by me *Describ'd*, which are sometimes found to make *These Mites* their *Food*: *Dr. Johnson* having opened *One Husk*, with *One only Large Maggot* in it.

6. That there are *Probably*, *Different* sorts of *Mites* in these *Husks*, Making *Possibly* *Different Species* of *Kermes*: For some I have found to hold *Carnation Colour'd Mites* Enclosed in a *Fine White Cotton*, the *Whole Husk* starting from the *Twig*, shrivelling up, and serving *Only* for a *Cap* or *Cover* to *That Company* of *Mites*. Other *Mites* I have seen *white*, and (which is most *Usual*) the *Husks* *Continuing Entire*, and not *Coming* away from the *Twig* they adhere to, and but little *Cotton* at the *Bottom*.

7. That the shrivell'd *Cap*, to be found upon the *Mites*, Inclosed in the *Cotton*, as also to the *Whole Husk* it self, if taken *Early* in *April*, While *Soft*, will

will (Dried in the Sun) shrink into the very Figure of *Cochineel*: Whence we Guess, that *Cochineel* may be a sort of *Kermes*, taken thus Early and Sun-Dried.

I conceive that the small *Scarlet Powder*, mentioned by M. Verney, is to be understood of Those *Mites*; and that they are to be Distinguish'd from the *Bee-Grubbs*, which are *Changed* into the *Skipping-Fly*, that is, the *Bee*, (for Kind at least) here Describ'd by us.

Observations on
Vegetable-Ex-
crecencies, and
Insects Genera-
ted in them; by
Dr. M. Lister, n.
75. p. 256.

XII. 1. The Account I have given of the *Purple-Kermes*, both gives a Clear Light to the Discovery of the Nature of the *Scarlet-Kermes*, a thing wholly Unknown to the *Ancients*) and also is an Evident Instance, that some Things Confidently Believed *Vegetable Excrecencies*, are No such Matter, but *Artificial Things*, meerly *Contiguous* to the *Plant*, and which have No Other Relation to it, than the *Patella Shell-Fish* to the *Rock* it Cleaves to.

n. 76. p. 2284.

2. Generally, *Insect Eggs* Laid upon the *Leaves* of *Plants*, or their Respective *Worms*, Feeding on them, do not Occasion or Raise *Excrecencies*.

n. 77. p. 3003.

Thus, for Example, the *Eggs* of the *Common-Red-Butter-Fly* Laid upon the *Nettle*, are thereon *Hatched* without *Blistering* the *Plant* into an *Excrecence*; and the *Stiff Haired*, or *Prickly Caterpillers*, Hatched from these *Eggs*, Feed upon the *Leaves* without any ill Impression, Puncture, or Prejudice, save that they make Clean Work, and Eat all before them.

3. Some *Insect Eggs*, Laid upon the *Leaves* or other part of *Plants*, do as soon as *Hatched*, Pierce and Enter within the *Plant* to *Feed*. I had a Convincing Instance to the Truth of this *Propositton*.

May 22. 1671. when I observ'd on the Back or Underside of the *Leaves* of *Atriplex Olida*, certain small Milk-White Oblong *Eggs*; on some *Leaves* 4. on others fewer, or more. These *Eggs* were on some *Plants* yet *Unhatched* but on many of the same *Plants* I found the *Egg shells*, or *Skins*, yet adhering to the *Leaves*, and the little *Maggots* already *Entered* (through I know not what Invisible Holes) within the *Two Membranes* of the *Leaf*, and *Feeding* on the *Inward Pulp* or Substance of the *Leaf*: in other *Leaves* of that *Plant* I found those *Maggots* Grown very great, and yet the *Two Membranes*, that is, the *Uppermost* and *Undermost* skin of the *Leaf* Entire, but *Raised* and *Hollow* like a *Bladder*. Note, 1. That those *Maggots* were of a *Conick* shape. 2. That in *July* they shrunk into *Fly Chrysalis's*, and accordingly came to *Perfection*; And to this Unobvious way of *Feeding*: we think we may Refer all *Worm Eaten Fruits*, *Woods*, &c.

4. *Worms Feeding* Within some of the Parts of some *Plants* do Cause *Excrecencies*; Thus the *Heads*, or *Seed Vessels*, of *Papaver. Spart. Sylv. Ger. Emac.* &c. are *Disfigured* for having *Worms* in them, and *Grow* thrice as big as the not *Seised* ones. This is also plain in the *Excrecencies* of *Pseudo Teucrium*, and *Barbarea*, &c.

5 The *Substance* or *Fibrous* part, of many *Vegetable Excrecencies* seems not to be the *Food* of the *Worms* found in them; that is, the *Worms* in those *Vegetable Excrecencies* which produce *Ichneumons*, (to which Kind of *Insect* we would Limit this *Proposition*;) do not seem to *Devour* the *Substance* or
Fibrous

Fibrous part of them, as other *Worms* Eat the *Kernels* of *Nuts*, &c but whatever their manner of *Feeding* is (and we doubt not but they are Nourisht in and upon some Part of them,) the *Vegetable Excrecencies* still mightily Encrease in Bulk, and Rise, as the *Worms* Feed. And it is Observable (to endeavour a *Solution*) that some of the *Ichneumons* Delight to Feed on a *Liquid* Matter, as the *Eggs* of *Spiders*, and the *Juices* (if not *Eggs*) within the Bodies of *Caterpillars* and *Maggots*. Whence we Conjecture, that those of the same *Genus*, to be found in *Vegetable Excrecencies*, may in like manner Suck in the *Juices* of the Equivalent parts of *Vegetables*. And this the *Dry* and *Spongy Texture* of some of those kind of *Excrecencies* seems to Evince. For if you Cut in pieces a *Wild Poppy Head*, for Example, (or the great and soft *Balls* of the *Oak*,) you'll find, in those Partitions wherein these *Worms* are lodged, nothing but a *Pithy Substance* like that of *Young Elder*: and if there chance to be any *Cells* yet *Unseised*, (which I have sometimes Observ'd) the *Seeds* therein will be found yet Entire and Ripe; Whence 'tis very probable that they Feed upon, or Suck in by little and little, the yet *Liquid Pulp* of the *Tender Seeds*, and leave the *Substance*, or *Fibrous* part, to be Expanded into an *Excrecence*. vid. inf. §. XIV.

XIII. In some *Aleppo Galls*, which the *Insects* had not Eat their Way out of, I found a sort of *Bee* resembling the small sort of our *Wild-Bees* which *Earth*: they have Long Wings, a Deep Belly, and on the Back, near the Comisure to the Body, it is of a *Greenish Black*, the rest *Reddish*, near a *Cinnamon-Colour*. The Gall-Bee; by Mr. Benj. Allen n. 245. P. 375.

These *Galls* were very *Gummy*, and the Cavity round them was so extremely *Gummy*, that not the least Room or Entrance of it appeared, though the *Bee* was begining to make its Way out. Some of the *Galls* had a *Stem* to them, and may give some Light to the Reason of *Life*, that the *Atmospherical-Air* is not Necessary to the Essence, before the *Organs* of the Body are Employed; but that that is maintain'd by a *Subtiler Air*, that Pervades more Minute Pores, as it is Conveyed to *Fish* through the *Water*.

I have also found in the *Grayer* sort of *Galls*, not so rich in *Gum*, a small *Ichneumon* of a *Bright-green*.

XIV. I. As I remember, Mr. *Lister's* Opinion is, that the *Musca Ichneumones* lay their *Eggs* in the Bodies of *Caterpillars*; which I look upon as very Ingenious and True. These *Ichneumones* have all 4. *Wings*, *Autennæ* like *Bees*; their Body hanging to their Breast by a slender Ligament, as in *Wasps*; most, if not All, have *Stings*, and are made of a *Maggot*, that Spins her self a *Theca* before she Turns into a *Nympha*. There is great Variety of them; some Breed as *Bees* do, laying an *Egg* which produceth a *Maggot*, which they Feed till it comes to its full Growth; others, as we guess, Thrust their *Eggs* into *Plants*, the Bodies of *Living Caterpillars*, *Maggots*, &c. For, it is very surprizing to observe, that a great *Caterpillar*, instead of being *Changed* into a *Butter-Fly*, (according to the usual Courte of Nature) should produce sometimes one, sometimes two or three and sometimes a whole *Swarm* of *Ichneumones*. I have observ'd this *Anomalous Production* in a great many Sorts of *Caterpillars*, both *Hairy*, and *Smooth* in several

Ichneumon Wasps and the manner of laying their Eggs in the Bodies of Caterpillars; by Mr. Fr. Willoughby, n. 76. p. 2279.

veral sorts of *Maggots*, and, which is most Strange, in one *Water-Insect*. When there come many of these *Ichneumon Maggots* out of the Body of the same *Caterpillar*, they Weave all their *Theca's* together into one Bunch; which is sometimes Round, with a *Web* about it just like a Bag of *Spiders Eggs*. But none of them *Feed* upon *Spiders Eggs*; but it is the Similitude of those *Theca's*, Conglobated together: to the *Eggs* of *Spiders*, that hath occasioned that Conjecture.

One of the *green Caterpillars*, common in the Heaths in the *North*, went so far on to her *Natural Change*, that she made herself up into a great *Brown Theca* almost of the Shape of a *Bottle*, which was Filled with a *Swarm* of *Ichneumones*, And I have Observed in one or two other sorts, that from the very *Aurelia* itself hath come an *Ichneumon*; which is very odd, that the *Caterpillar*, *Stung* and *Impregnated* by the *Ichneumons*, should be yet so far *Unhurt*, and *Unconcerned*, as to make her self a *Theca*, and to be *Turned* into an *Aurelia*.

I have often seen a Great *Ichneumon* Dragging a *Caterpillar* in the highway. This Year 1671. Mr. *VVray*, in company with another ingenious Neighbour, observed one *Haling* a Large *green Caterpillar*, much Bigger than herself, which after she had Drawn the length of a *Pearch*, she laid down, and then takes out a little Pellet of Earth, with which she had stopped the Mouth of a small *Hole* like a *Worm hole*; then she goes down into it, and staying a very little comes up again, and draws the *Eruca* down with her into the *Hole*, and there Leaves her, and afterwards not only stops but fills up the *Hole*, sometimes carrying in little Clods, and sometimes Scraping Dust with her Feet, and Throwing it backwards into the *Hole*, Going down after it her self, to Ram it close. Once or twice she Flew up into a *Pine-Tree*, which grew just over her *Hole*, perhaps to fetch *Cement*. When the *Hole* was Full and Even with the superficies of the Ground about it, she Draws 2. *Pine-Tree Leaves*, and lays them near the Mouth of the *Hole*, and Flyes away. Not taking Notice that she came any more in 3. or 4. Days, we Digg'd for the *Caterpillar*, and found it pretty Deep. I put it into a *Box*, expecting it would have Produced an *Ichneumon*: but it dried away and nothing came of it.

We lately observed a sort of *Ichneumons*, or rather *Vespa*, which Prey upon several sorts of *Flyes*; when they fly with them, they hold them by the Heads, and carry them under their Bellies. These make *Holes* a great depth in the Ground, in which they lay their *Young*, and *Feed* them with the *Flyes* they Catch, Creeping Backwards into the Ground, and Drawing the *Flyes* after them. I suspect they may at first lay their *Eggs* in the very Body of a *Fly*: but one being not enough to bring the *Young one* to its Full Growth, they *Feed* it with more. The *Theca's* are at last all Covered over with the *Wings*, *Legs*, and other *Fragments* of *Flies*.

By Dr. Lister ib:
p. 2281. p. 2284.

2. This kind of *Insect* is one of the greatest Puzzles in Nature; there being Few *Excrescencies* of *Plants*, and very many *Births* of *Insects*, wherein these *Slender Wasps* after divers Strange ways are concerned.

'Tis true the *Swarms* of these *Ichneumons*, coming out of the Sides of *Caterpillars*, do immediately make themselves up into Bunches, and each particular *Theca*, from the *Cabbage Caterpillar* (for Example,) is wrought about with *Yellow Silk*, as those from the *Black* and *Yellow Jacobaea Caterpillar*

Caterpillar with White: but as for *Web* to Cover those *Bunches of Theca's* I never observed it but in the *Green-Caterpillars*, so Common in our *Lincolnshire Heaths*, which are Fixed to *Bents* or other *Plants*. These in truth never but deceived my Expectation, for I verily thought I had found, when I first Observed them, a *Caterpillar Equivalent* to the *Indian Silk Worm*; but having Cut them in two, and Expected to have found a *Caterpillar's Chrysalis* in the middle, there presented themselves a *Swarm* of *Ichneumons*. These are as Large, many of them, as my Thumb; that is, at least four times Bigger than the *Folliculus* or *Egg-Bag* of any *English Spider* I ever Saw yet. I have had them in several Boxes, some 8. some 10. some 12. Days in *Vermiculo*, Feeding upon the very *Cakes* of *Spiders-Eggs*, before they wrought themselves *Theca's* for further Change; and they Seldome exceeded the Number of Five to One *Cake* of *Eggs*, &c. So that you may assure Mr. *Willoughby*, this is no Conjecture, but a Real Observation.

Concerning the Name *ιχνεύων* I refer you to Mr. *Ray*, who is another *Hesychius*: and we have Observations enough to make us believe, that those very *Insects*, we have here Treated of, are, for Kind, the *Ichneumones* of the *Antients*.

n. 77. p. 3005.

XV. It hath been credibly reported, that *Horse-Hairs* thrown into Water will be *Animated*; and yet I shall shew you by an unquestionable Observation, that such things as are vulgarly thought *Animated Hairs* are very *Insects*, Nourished within the Bodies of their *Insects*, even as *Ichneumones* are within the Bodies of *Caterpillars*. I find many Particulars collected by the industry of *Aldrovandus* concerning this *Insect*: But our own Observation is this.

Hair-Worms; by Dr. Mart. Lister, n. 83. p. 4064.

Apr. 2. 1672. There was thrown up out of the Ground of my Garden a certain *Coal black Beetle* of a Middle size, and Flat shape, and which I have observed elsewhere Common enough. I Dissected some of them, and was surprized to find in their *Swollen Bellies* of these *Hair Worms*; in some 3. in others but only one. These Particulars we carefully Noted.

1. That upon the Incision they *Crawl'd* forth of themselves.
2. That putting them into Water, they *Lived* in it many Days, and did seem to Endeavour to Escape by Lifting up their Heads out of the Water, and Fastening them to the sides of the Vessels; very plainly Drawing the rest of their Body forward.
3. That they cannot be said to be *Amphisbena*, but do *Move forward* only by the *Head*, which is fairly Distinguishable from the *Tail* by a Notable Blackness.
4. That the 3. I took out of the Body of one *Beetle*, were all of a *Dark Hair Colour* with *whitish Bellies*, somewhat Thicker than *Hog's-Bristles*: but I took out of the Body of Another *Beetle* one that was much Thicker than the Rest, much Lighter Coloured, and by measure just $5\frac{1}{2}$ Inches long; whereas all the rest did not Exceed $3\frac{3}{4}$ Inches.

Some Observations about Bees; by Dr. Geo. Gard. n. 175. p. 1157.

XVI. M. *Leeuwenboeck* in 1673. took notice of five little *Instruments*, which are on the *Head* of the *Bee* before; four whereof are two Pairs, the one being called by him *Scrapers*, the other *Arms*, the fifth he calls the *Wiper*, supposing that by it they wipe off the *Honey* from the *Flowers*. This last is truly the *Sucker* or *Proboscis*, being Hollow and made up of all Circular Fibres, wherewith the *Bees* suck the *Honey* from the *Flowers*.

The Globulets which break forth from the *Attire* of *Flowers*, Described by Dr. *Grew* and *Malpighius*, which are for the most part of an Oval Figure, and of different Colours (some *White*, some *Yellow*, some *Red*) seem to be Bags of *Liquors*, and are the Materials which the *Bees* carry in for their *Wax*, as is evident not only from the different Colours of the *Wax* upon their *Legs*, according to the different Colours of the *Globulets* of the *Respective Flowers* we see them light upon; but for that also if you take them gathering *Wax* from any particular *Flower*, and view a small parcel of that *Wax* with a *Microscope*, you will find it to consist of the *Globulets* of the same *Flower*; tho' it is not so easie to Discover what *Liquor* they make use of, to causethem to stick together.

On the Inner side of the *Hinder Legs* of *B E E S*, on the Joint towards the *Toe*, next to that on which they curry the *Wax*, there are a great many Rows of *Yellow Sharp Pointed Stiff Bristles*, set all in order like the *Teeth* of *Combs* for *Lint*; which I look upon as the *Instruments* wherewith they Break these *Globulets*, and Prepare their *Wax*.

The Generation of a sort of Bees in Old Willows; by Sir Edm. King. n. 65. p. 2098.

XVII. 1. About the Beginning of *May*. 1670. Sir *J. Bernhard* sent me a piece of *Old Willow Wood* out of *Northamptonshire*, in which were lodged many *Insects* curiously wrapt up in *Green Leaves*, in several *Channels* or *Burrows*, each with 12, 14 or 16 *Leaves* Round the *Body*, and several of them with as many little round bits of *Leaves* at each End, to stop them up close. These, thus made up, are near an *Inch* long, or the best part of an *Inch*, put in one after another into a Bore made in the *Wood* fit for their Reception. They are in the manner of *Cartrages* of *Powder*, wherewith *Pistols* are wont to be Charged. In some part of those *Burrows*, they are placed so near one another as to Touch; in others, at some considerable Distance. These *Insects* observe this Method in placing themselves, that sometimes they make a direct way into the Length of the *Wood*, sometimes they Bore out into the side, and run another way; those *Channels* being not unlike the *Burrows* of *Rabbits*, all which they fill up with these Round appearances of *Wrapt Leaves*, all regularly wrought. In which I find either something *Alive*, or Appearances of something that hath *Dyed* there, and is *Putrify'd*: In some a great Number of *Mites*, of a *Dark Ash Colour*, shaped not unlike *Common Mites*; in others I find seeming *Excrements* of some small *Insect*, with the *Decayed Parts* of the *Dead Insect*; in others, *White Maggots*. Some of these *Maggots* I took out of their *Theca*,

or Bagg, and put them in warm Places in the Sun, and they thereupon grew something Bigger, but changed not Shape nor Colour, but Dyed. The rest I kept close in a Box till the 8 of July. Then I took one of them out of the *Wood*, and opened the *Leaves*, and felt something stir, Hearing also an Humming Noise like that of a *Bee*; and as soon as I had opened the *Theca*, a Perfect *Bee* did fly out against my Window, as strongly as a *Common Bee* out of an *Hive*, having much of the Colour and Bigness of those when they are New Flyers. The rest, being disturbed, Eat themselves out. They have all *Stings* like *Bees*; and I am of the Opinion, that they are *Common Bees*.

2. I have had the good Luck to find a great many of these *Cartrages* in a *Rotten Willow*; and, by the Shape of the *Maggot*, was confident, they would produce *Insects* of the *Bee-Tribe*. Mr. *Snell*, an Ingenious Gentleman, brought of them to the *Wells* at *Astrop*, and directing me to the Place where he got them, I there found great Plenty in the Trunk of a dead *Willow*: Beginning to unfold some of them, Mr. *Wray* immediately judged them to be made up of pieces of *Rose-Leaves*; and called to Mind, that this very Spring Mr. *Fr. Gessop* brought him a *Rose leaf*, out of which himself saw a *Bee* bite such a piece, and fly away with it in her Mouth. Whereupon, searching the *Rose-Trees* thereabout, we found a great many *Leaves*, with such pieces bitten out of them, as these *Cartrages* are made up of. The *Cuniculi*, or *Holes*, never cross the Grain of the Wood, excepting where the *Bee* comes in, and where they open one into another. From the Place of Entrance, they are wrought both upwards and downwards; so that sometimes the *Bee-Maggot* lies under her Food, and sometimes above it. One End of the *Cartrage*, viz. That which is next the Entrance, is always a little *Concave*; the Other End, which is farthest from the Entrance, a little *Convex*, and is received into the *Concave* of the next beyond it. The sides of the *Cartrage* are made up of Oblong pieces of *Leaves*, and pasted together; the Ends of Round ones; and where ever they do not lie close one to another, the intermediate space is filled up with a Multitude of these little Round Pieces, laid one upon another.

By Mr. Fr. Wil-
louby. ib.
p. 2100.

The *Cartrages* contain a Pap, or Batter, of the Consistence of a Gelly, or something thicker; of a Middle Colour between *Syrup* of *Violets* and the *Conserve* of *Red Roses*; of an *Acid Taste*, and Unpleasant *Smell*. In each of these, at the *Concave* End there lies one *Bee-Maggot*, which feeds upon the forementioned matter, till it grows to its full Bigness, and then makes and Encloseth her self in a *Theca*, or *Husk*, of a *Dark-Red* Colour, and Oval Figure; in which she is *Changed* into a *Bee*. The Remainder of her Food you may find dried into Powder at the *Convex* End; and her *Excrements* at the *Concave* without the *Theca*.

The *Bees* were of a shorter and thicker Shape, than the *Common Honey Bee* more *Hairy*, &c. But the surest Mark to Distinguish them is, that the *Forcipes* or *Teeth* of these are Bigger, Broader, and Stronger; in Shape like those of a *Wasp*, or *Hornet*; from which she also sufficiently Differs, in having a *Tongue* like a *Bee*, which they want.

They

They made their way out along the Channel thorough all the intermediate Cartrages, and not through the Solid Wood. Of the Corruption of the Matter within the Cases, when the *Bee Maggots*, or *Nymphæ*, happen to Miscarry are Bred, *First*, little *Hexapods*, which produce *Beetles*; *Secondly*, *Maggots* which produce *Flies*; *Thirdly*, *Mites*, &c.

From what hath been observed concerning this *Bee*, and by a great many more Parallel instances, it appears that it is the *Bee Maggot*, and not the *Old Bee*, that *Covers* the Cells before the *Change*: For here the *Old Bee*, when she hath left Provision enough with an *Egg*, *Closes* up the *Cartrage*, and hath no more to do; the *Maggot* a great while after making the *Theca*, which is Analogous to the *Cover* of the Cells.

By Dr. Lister.
n. 160. p. 594.

3. I have observed that the *Bees* breeding in *Cases* of *Leaves* are not very scrupulous in the choice of those *Leaves*, but will make use of *Exotick Plants*; such as *Blew-Pipe* or *Syringe Tree*. Here is a very strange *Oeconomy* of Nature yet *Unsolved*: The furthest *Bee*, says Mr. *Willoughby*, makes her way out along the *Channel* through all the intermediate *Cartrages*: And according as these *Channels* run *Upwards* or *Downwards* in the *Body* of the *Tree*, the *Maggot-Bee* at the far or *Upper End* of each *Channel* is *First Laid*, and it should seem both *Hatched* and *Perfected First*. But I take it otherwise, that that *Bee* which is *Nearest Day*, although it be *Last* laid, is yet the *First Hatched*; and I ground my *Conjecture* upon this, that 'tis *Probable*, that the *Eggs* in the *Mother* are all fit for *Laying*, or equally *Ripe* or *Forward* (as we say) at the time that the *First* of them was *Laid*, but are not therefore all laid by the *Dam*, until she has *Provided* them of *Meat* and a *House*, each separately, as is the *Nature* of *Bees*: and yet in *Recompense*, the *Warmth* of her *Body*, or rather the *Daily Encreasing Heat* of the *Summer-season*, to which the *Mother Bee* is continually *Exposed*, (whilst the *First* laid *Eggs* are sheltered in their *Deep Channels*,) hastens their *Vitality* so much, that they are *Hatched Worms*, and begin to *Feed*, before the *First* laid, and consequently are *First Perfected* into *Bees*. But this is *Conjecture* only, and not *Observation*.

By Mr. Fr. Willoughby.
n. 74. p. 2221.

4. The *Cartrages* that I got at *Astrop* in *August*. 1670. do now in *July*. 1671. almost every *Day* afford me a *Bee*: And I can hear them *Gnawing* out their way before I see them. So that there is nothing irregular in the way of *Breeding* of these *Bees*: But the *Contrivance* of *God* and *Nature* in it is very *Admirable*. Having shut their *Young* ones in those *Cells* with sufficient *Provision*, they all, as well the *Uppermost* as *Lowermost*, before *Winter*, come to *Full Growth*, or are *Turned* into *Nymphæ's*; in which *Condition* they are *Designed* to lye all *Winter*, as the most of *Insects* do. The next *Summer*, those must necessarily be *first* *Excited* out of their *Torpor*, and *Changed* into *Flyers*, by the *External Heat* and *Air*, that lye next it. If any be *Laid* so *Late*, that they have not time enough to come to the *State* of *Nymphæ's* before *Winter*, they will most certainly *Dye*; and then it is no loss nor inconvenience, though their *Cells* be *Perforated*.

XVIII. M. Villermont has received from America a sort of Honey-Comb, (of a different Make from the European) which is Composed of small Bottles, or Bladders, of Wax, of a Brownish Colour, inclining to black; being as Big as Olives and shapt like the Spanish Olives. They Hang together in Clusters, almost like a Bunch of Grapes, and are so Contrived, that each of them has an Aperture during the Time of Work, but it is Clos'd up as soon as the Vessel of Wax is Fill'd with Honey; and then the Bees go to Work with another Vessel.

A strange sort of Bees in the West-Indies; by M. Villermont. n. 172. p. 103.

Fig. 186.

Their Lodgings are ordinarily taken up in a Hollow Tree, or the Cavity of a Rock, by the Sea side; these being the Properest places to secure them from such Animals as are Greedy of their Honey, and therefore likely to Molest them: And they have the more Need of this Caution, because they are more lyable to be Disturbed than Ordinary Bees, as having no Stings, and being Capable of doing good, but no Hurt to any thing, as the Party that Lived at Cayenne, very well knows. When the Combs are Removed, they must be carried gently, and in the same Position they lay in, till you come to the Place where you Design to take out the Honey.

The Honey it self is Clear and Liquid as Rock-Water, and hardly to be Distinguished from it by the sight. When you would take it out, you must Pierce every Bottle a little more than $\frac{1}{3}$ from the Bottom; for if you Pierce it Lower, you find a Bottom, or Sediment, whose Thickness would hinder it from Running: and as you Prick every Bottle, you must have some Vessel ready to receive what comes from it. This Gentleman says, that he thinks the Liquor is one of the most Agreeable things in the World. If you Drink Fasting the Quantity of a good Glafs, or about half a Pint, it will give you 2 or 3 Stools in about 2 Hours time; according to the Temperament of the Party: but if you Drink it at Meals, it does not Purge at all.

XIX. On Thursday Mar. 9. 167 $\frac{1}{2}$ there was at the next house to mine (in Herefordshire) a Swarm of Bees. It was a very Fair Day to Entice them: but else we never have them till the middle of May. I had it from the Owner, one Parry, now in my Work: And I enquired of him, whether they did not all Leave the Hive (as sometimes they do unseasonably,) either for Want of Food, or out of Distaste? He told me, no, but there are as many Left behind as came forth. But I (who have some time studied the Regiment of that little industrious Wise Creature) do conceive, that Poverty drew them Abroad to seek their Fortunes; the infinite Wisdom having imparted such a Providence to that little Common Wealth, as to send Part of their Company abroad to Shift, before their whole Stock of Food shall be consumed to the Destruction of them all.

An Early Swarm of Bees; by Mr. Rich. Reed. n. 70. p. 212.

XX. A. The Bee House, lying on One Side, with the Frame placed in it.
BBBBBBBB The Frame.
CCCC. The Screw Pinns that hold the Frame Fast.
D. The Square-Hole at Top Open.

A Bee-House used in Scotland; by Mr. H. Oldenburg. n. 96. p. 607.

E.

- Fig. 187. E. The *Windows*.
 F. The *Door*, for the *Bees* to go in and out.
 G. The Place by which the *Knife* Enters to *Cut* the *Honey-Combs* asunder upon Occasion.
 HH. The inward *Crease* at the *Bottoms*.
- Fig. 188. A. The *Bee-House* set *Upright*.
 B. The *Square-Hole*, through which the *Bees* work *Downward*.
 C. The *Shutter* that *Covers* the *Hole* upon Occasion.
 D. The *Door* for the *Bees*.
 E. A *Sliding Shutter* that *Covers* the *Door* in *Winter*.
 F. The *Window*.
 GG. The *Handles* for *Lifting* all.
 HH. The *Outward Crease* at the *Top*, for *Fastening* one *Bee House* over another.
- Fig. 189. A. The *Frame* for the *Bees* to *Fasten* their *Work* upon.
 BB. The *Screw Nails*.

This *Bee House*, (which was sent by Sir *Will. Thompson*,) is made of *Wainscot*, about 16. *Inches* in *Height*, and 23 in *Breadth* between the opposite sides. It hath 8 sides; each almost 9 *Inches* in breadth. It is close covered at *Top* with *Boards*, having a *Square Hole* in the *Middle*, 5 *Inches* long, and about 4 *Inches* broad; with a *Shutter* that slides to and fro in a *Grove* about half an *Inch* Longer than the *Hole*. It hath 2 *Windows*, *Opposite* to one another; and may have more of any *Figure*, with *Panes* of *Glass* and *Shutters*. The *Door* for the *Bees* is *Divided* into 3 or 4 *Holes*, about half an *Inch* *Wide*, and as *High* with a *Shutter* that *Slides* in a *Grove* to cover them in *Winter*. It hath 2 *Iron Handles* with *Joynts*, to be placed about the *Middle*, if there be *No Windows* on the sides where they are, or above them, if there be. At the *Top* it hath a *Crease* all round it, about half an *Inch* in *Depth* on the *Out* side, and 1½ *Inch* *High*; and another on the *Inside* at the *Bottom*; which serves to *Fix* them when set upon one another. It hath also a *Hole* about 2 *Inches* in *Height* and as much in *Breadth* on one side at *Bottom*, by which the *Knife* is put in to *Cut* the *Bees Work*, that passes through the *Hole* from one *Bee House* into another, as they work *Downward* into the *Empty House*; which hath a *Sliding Shutter* to cover it. Within the *Bee House* there is a *Square Frame* made of 4 *Posts* joyned at *Top*, at *Bottom*, and in the *Middle*, with 4 *Sticks*, for the *Bees* to *Fasten* their *Work* upon: Which though they will serve, yet it may be *Securer* to have 2 more added in every of their *Places*, *Crossing* the *Frame* either from the middle of the *Opposite* side *Sticks*, or from the *Angles* where the *Posts* are placed.

This manner of *Bee House* is useful for preventing the *Swarming* of *Bees*: For, when the *Bee House* wants *Room* for the *Young Bees*, 'tis known that they *Swarm* and *Fly* away to find a *House* for themselves: Which is prevented by placing an *Empty* one made thus, under the *Full* one, having the *Door* at the *Top* *Open*, that they may *Work* *Downwards* into it. And when both are *Full*, the *Bees* will all be in the *Lowest House*: and then to get the *Honey* and



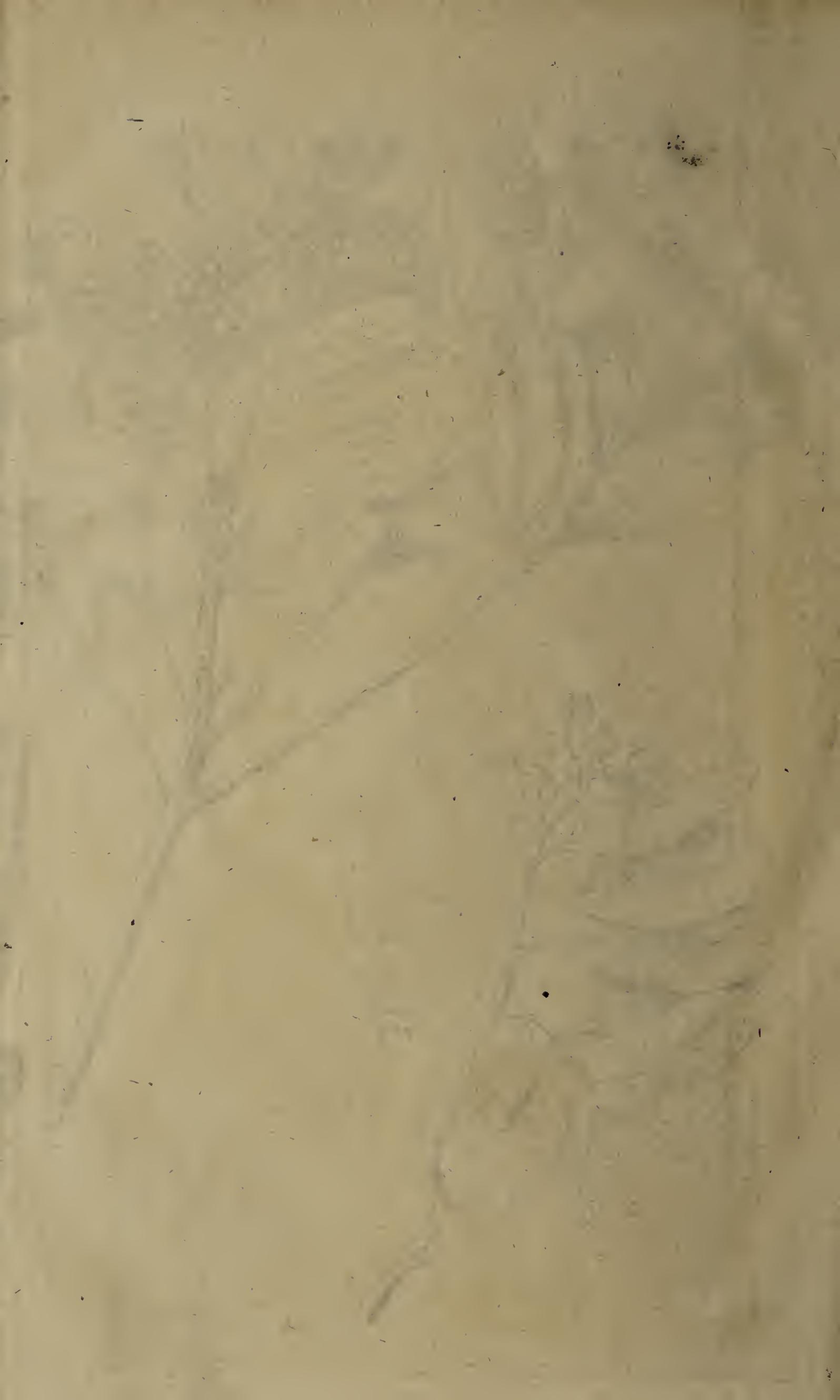




Fig. 173.



Fig. 174.



Fig. 175.



Fig. 183.

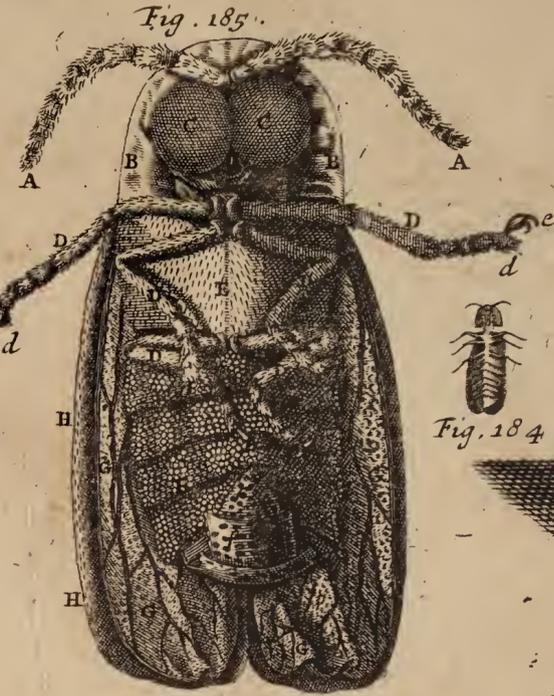


Fig. 185.



Fig. 184.

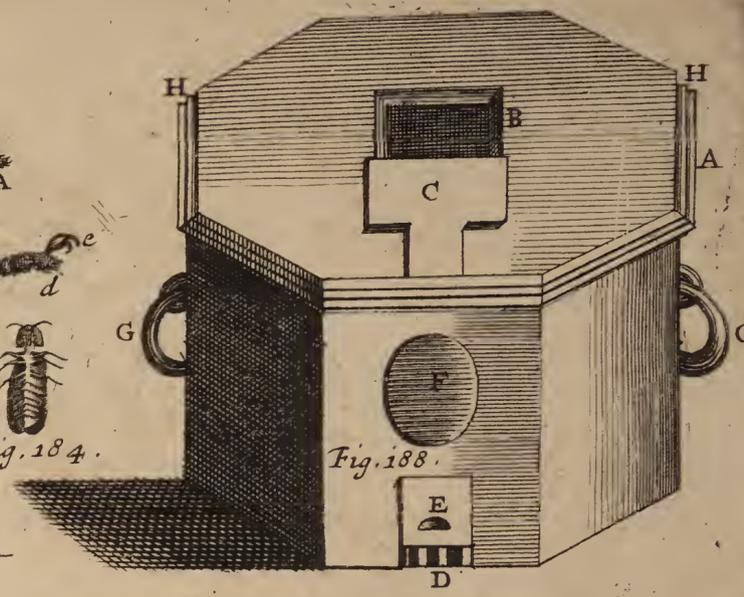


Fig. 188.

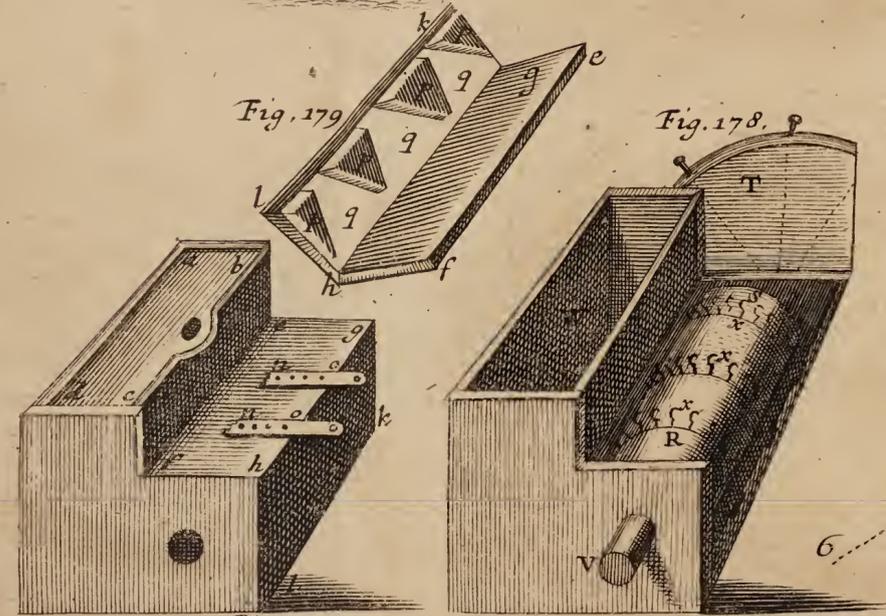


Fig. 179.

Fig. 178.

Fig. 177.

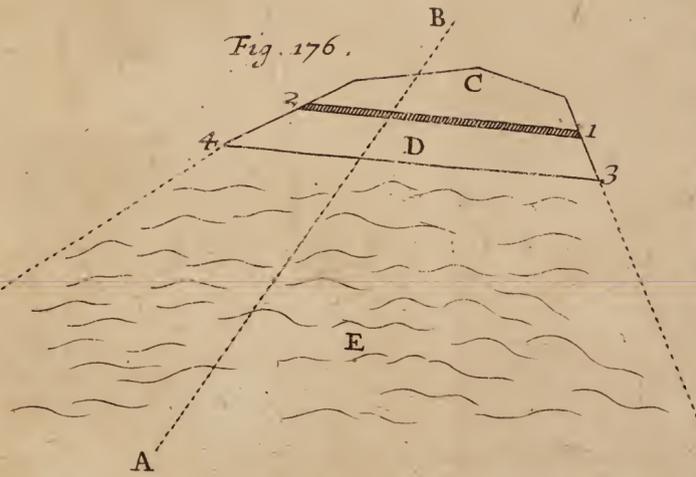


Fig. 176.

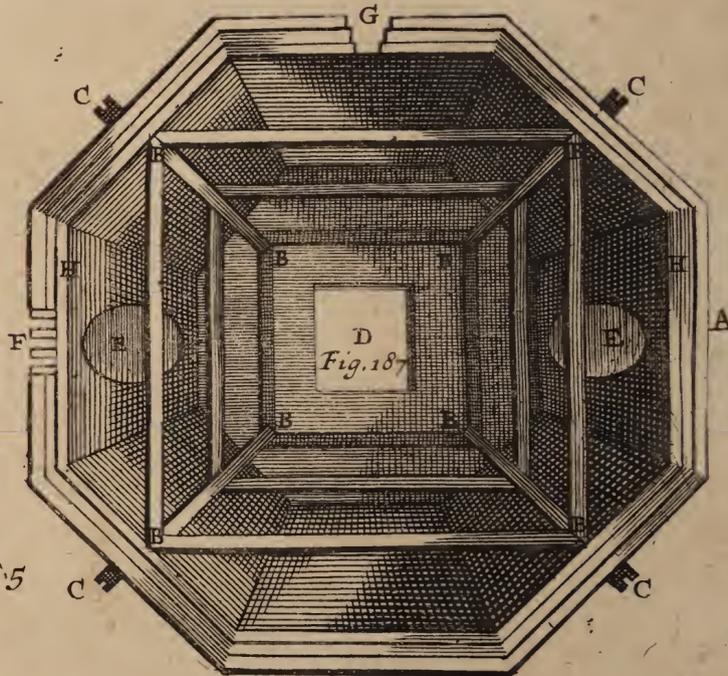


Fig. 187.

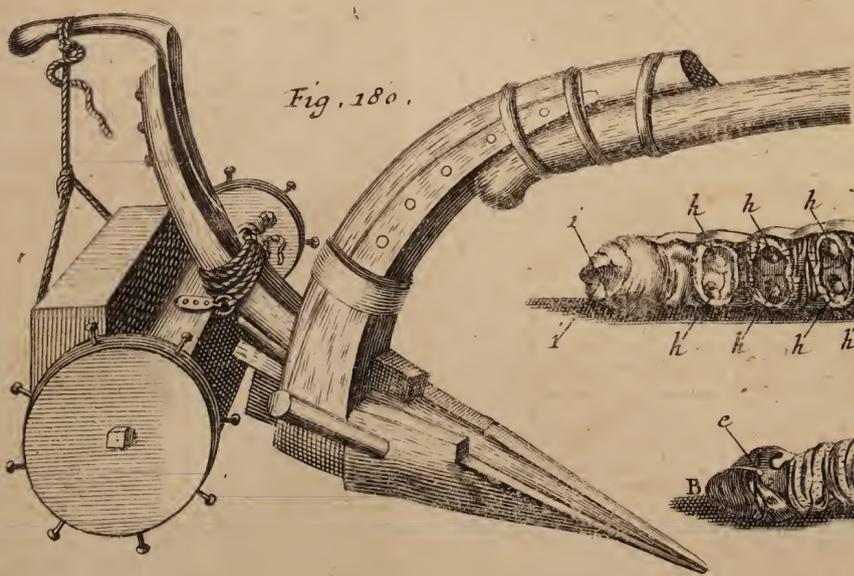


Fig. 180.

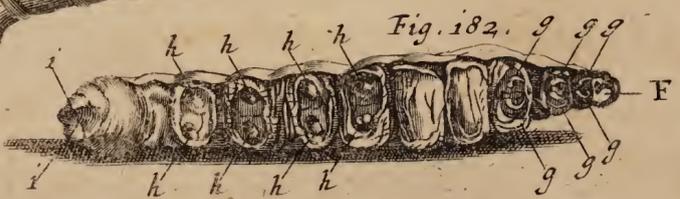


Fig. 182.

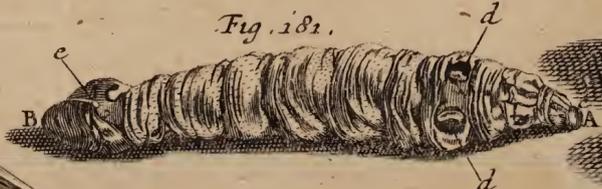


Fig. 181.

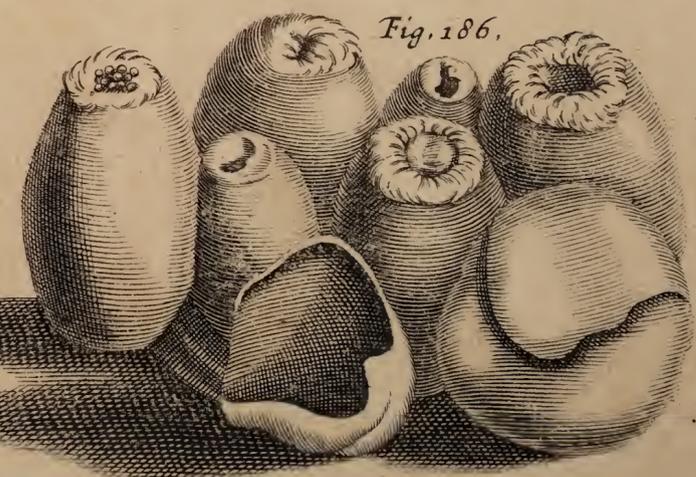


Fig. 186.

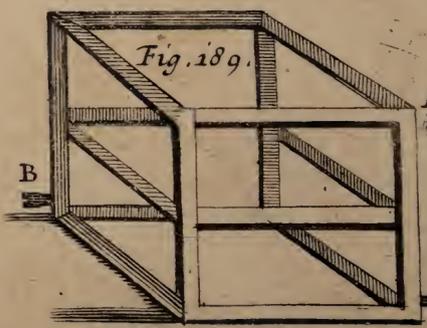


Fig. 189.

and *Wax* without Destroying or Troubling the *Bees*, with a Thin Long *Knife*, broad at the End and Sharp on both Sides, the *Bees-Work* is to be Cut as Low as can be, and the Uppermost *Bee-House* to be Lifted off by the *Handles*; and being Reversed, the *Screws* are to be taken out, and then the *Frame*, with all the *Bee's Work* upon it, will easily Slip out, and so the *Empty Bee House* may be forthwith set Under the Other, if need be, and the Uppermost having the *Square-Hole* above Covered with the *Shutter*, some other *Cover* may be set over it, to keep the *Bees* from the Injuries of the *Weather*. And if this Separation be made in the *Spring*, or *Summer*, the *Bees* will love their *New House* the better that it hath been used before.

XXI. I am inform'd that great *Swarms* of *Locusts* have Lately appeared in *Wales*. They were first seen about the 20, of *October* 1693. Scattered about the *Fields* in *Marthbery Parish* in *Pembrokeshire*: Where they were generally taken notice of at first, because of the Unseasonableness of the *Time* for *Grashoppers*; but afterwards, for that upon further Examination, they found them Distinct from our *English Grashoppers*, in *Signs*, *Colour*, &c. I could not Learn, that any of them have been seen *Flying* in that *Country*: But from *North-Wales* I am informed, that two Vast *Swarms* of them had been seen in the *Air* not far from *Dol-gelheu*, a *Market Town* of *Merioneth-shire*, and I guess by the *Date* of my *Friend's Letter*, that it was near the same time that those others of *Pembrokeshire* had been taken Notice of in the *Fields*.

Swarms of Locusts in Wales;
by Mr. Edw.
Floy'd. n. 208.
p. 45.

They are of the same *Species* with some *African Locusts* in my *Custody* in the *Museum Ashmol.* for which we are obliged to *Mr. J. Aubrey*, who received them some years since from *Tangier*. This *Pilgrim-Locust* I call *Locusta Erratica*, *Alis Ichthyocollæ adinstar Pellucidis, Reticulatis Maculis conspersis*. It is in length (from the *Head* to the tips of the *Wings*) 3. *Inches* and $\frac{1}{4}$ of a *Reddish Colour* all over, except the *Wings*. As to the *Head* and *Caputium*, it resembles the *fourth Fig.* of *Moufett*. The *Eyes* are *Prominent* and very *Large*, somewhat of the *Form* and *Bigness* of *Gromwel-Seeds*, of a *Reddish Colour*, *Elegantly Streaked*.

The *Antennæ* are about the *Bigness* of a *Hog's Bristle*, and *Curiously Geniculated*. The *first pair* of *Legs* are not quite an *Inch* long; the *Second* somewhat above that length; but the *3d.* 2. *Inches* and $\frac{1}{4}$. These *Hind-Legs* are very *Beautiful*; for the *Thighs* are *Hexangular*, and *Elegantly Sealed* on the *Outside*, with a *black List* extended *Length ways* through the *midst* of them. The *Shanks* are of a *Lively Red Colour*, adorned on the *Hinder part* with 2 orders of small *Sharp Prickles*, placed not *Opposite* to each other, but *Alternately*. The *Wings* are about 3 *Inches* long, resembling very much those of the *Larger Libellæ*, or *Dragon-flies*, but all over *Garnished* (the *Outer Wings* at least) with *Reticulated Black Spots*.

I see not much *Reason* to doubt but that these are the very same *Species* of *Locusts*, so *Famous* in *History* for their *Wandering over*, and *Depopulating* whole *Regions*.

Plin. Lib. xi. c.
29. *Jul. Obsc.*
quens in Lib.
Prodigiorum,
Moufett.

Green-Worms
in Wales; by
Mr. Edw. Floyd.
n. 208. p. 45.

XXII. I find in a *M.S. History of Pembroke-shire* (written about the Year, 1603. by one Mr. Geo. Owen, a Gentleman of that Country, who seems to have been a Person of considerable Accuracy and Veracity) that about the Beginning of *June* 1601. a piece of Ground to the Quantity of 200 *English Acres*, was Covered suddenly (as if the same had Fallen in a Shower out of the Air) with a kind of *Caterpillars* or *Green Worms*, having many *Legs*, and Bare without *Hair*. They were found in such Abundance, that a Man treading on the Ground should tread upon 20 or 30. of them: And in this sort they continued for the space of 3. *Weeks* or more, no Man knowing how they came, nor any of the like sort were ever seen in the Country before nor since, and being Opened there was nothing found within them but *Grass*. The Place was on a Hill in the Parish of *Maen-Clochog* above *Hynnon-Dhewi*, or *Phynnon Dhewi*. They were found as it were with one accord to go one way, *viz.* up the Hill, and went Over the Hill a *Quarter* of a *Mile*; and more: And as they went they Devoured and Consumed the *Grass*, that the Ground appeared *Bare* and *Red* like *Tallow*. And after they had Continued there 3 *Weeks*, there resorted thither an Infinite Number of *Sea Maws* and *Crows*, as if all of many Countries had been Summoned thither, who in Few Days Consumed them all. Also *Swine* fed upon these *Worms* eagerly, and Waxed very fat.

Swarms of
Beetles in Ire-
land; by Dr.
Tho. Molyneux.
n. 234. p. 741.

XXIII. According to the best account I can get of the vast *Swarms* of *Insects* which of late Years have much Infested this Kingdom of *Ireland*, I find that this *Flying Army* was First taken Notice of in the Year 1688. They appeared on the *South West Coast* of the County of *Gallway*, brought thither by a *South-West-Wind*, one of the Common, I might almost say *Trade winds*, of this Country. From hence they made their way into the more Inland Parts, towards *Heddford*, a place belonging to Sir *George St. George, Baronet*, about 12 *Miles* North from the *Town* of *Gallway*. Here and in the adjacent Country, Multitudes of them shewed themselves among the *Trees* and *Hedges* in the Day time, hanging by the *Boughs* Thousands together in *Clusters*, sticking to the Back one of another, as in the manner of *Bees* when they *Swarm*. In this Posture, or Lying still and Covert under the *Leaves* of the *Trees*, or Clinging to the *Branches*, they continued Quiet with little or no Motion during the Heat of the Sun: But towards Evening or Sun set, they would all Arise, Disperse, and Fly about, with a strange *Humming Noise*, much like the *Beating* of *Drums* at some Distance, and in such Vast Incredible Numbers, that they darkened the Air for the space of 2 or 3 *Miles* square.

Those that were Travelling on the *Roads*, or abroad in the *Fields*, found it very Uneasy to make their way through them, they would so Beat and Knock themselves against their *Faces* in their Flight, and with such a Force, as to Smart the place where they Hit, and leave a Slight Mark behind them.

A short While after their Coming, they had so entirely Eat up and Destroy'd all the *Leaves* of the *Trees* for some *Miles* round about, that the whole Country though it was in the Middle of Summer, was left as Bare and Naked as if it had been in the Depth of Winter: And the Grinding of the Leaves in the Mouths of this Vast Multitude altogether, made a *Sound* very much resembling the *Sawing* of *Timber*.

They came also into the *Gardens*, and Destroy'd the *Buds*, *Blossoms*, and *Leaves* of all the *Fruit-Trees*, that they were left perfectly Naked: nay, many of them that were more Delicate and Tenderer than the rest, Lost their *Sap* as well as *Leaves*, and quite *Withered* away, so as they never Recovered it again, particularly several *Trees* in the Curious Plantation of one Mr. *Martin*.

Nay their Multitudes spread so Exceedingly, that they got into the *Houses*; where Numbers of them Crawling about, were very Irksom: and they would often Drop on the Meat as it was Dressing in the Kitchen, and frequently fall from the Ceiling of the Rooms into the Dishes as they stood on the Table while they Eat; so extremely Offensive and Loathsom were they.

Their Numerous *Creeping Spawn*, which they had lodged *Under Ground* next the Upper Sod of the Earth, did yet more Harm in that Close Retirement, than all the *Flying Swarms* of their Parents had done abroad: for this young Destructive Brood lying Under-ground fell a Devouring the *Roots* of the *Corn* and *Grass*, and Eating them up Ruined both the support of *Man* and *Beast*. This *Spawn*, when first it gave sign of *Life*, appeared like a Large *Maggot*, and by taking Food and increasing every Day, became a Bigger *Worm*, till at length it grew as big as a great *White Caterpillar*; from whence according to the usual *Transformation* Natural to these smaller Animals, came forth this our *Flying Insect*.

The Rage of this *Plague* of *Vermin* was fortunately Checkt several Ways; *High Winds*, *Wet* and *Misting Weather* Destroyed many Millions of them in one Days time: Whence I gather, that though we have them in these *Northern Moist Climates*, they are more Natural, and more peculiarly belonging to *Warm* and *Dry* Countries. Whenever these ill Constitutions of the Air prevailed, their Bodies were so Enfeebled, they would let go their Holds, and Drop to the Ground from the Branches where they stuck, and so little a fall as this, at that time, was of sufficient force quite to Disable, and sometimes perfectly Kill them. Nay, it was Observable, that even when they were most Agile and Vigorous, a slight Blow or Offence would for some time hinder their Motion, if not Deprive them of Life.

During these Unfavourable Seasons of Weather, the *Swine* and *Poultry* of the Countrey Watched under the *Trees* for their *Falling* and Eat them up in abundance being much Pleased with the Food, and Thriving well upon the Diet. Nay I have been assured, that the Poorer sort of the *Native Irish* (the Country then labouring under a Scarcity of Provilion) had a way of *Dressing* them, and Lived upon them as *Food*.

In a little time it was found that *Smoak* was very Offensive to these *Flies*: and by *Burning Heath*, *Fern*, and such like *Weeds*, in this or that Corner of their *Gar-*

dens or *Orchards*, which lay most convenient for the *Wind* to Disperse it among the *Trees*, they would secure their *Gardens* and Prevent their *Incurfions*; or if they had Entered, Drive them out again.

But towards the *Latter End* of the *Summer*, they constantly *Retired* of themselves; and fo wholly *Disappeared*, that in a few *Days* you should not fee one of them *Left*. Some think that they take their *Flight* like *Swallows*, and other *Birds* of *Paſſage*, as they are called, to a more *Distant Country* and *Warmer Climate*. But the *True Reason* of their *Disappearing* I take to be, that after their *Coition* is over, (for 'tis about this time they are ſeen to *Couple* by faſtening to one another by their *Tails*.) they *Retire Under-Ground*, in order to lay their *Spawn* there, for a *Succeeding Generation*; and likewise to *Compose* and *Settle* themſelves to *Sleep* for the *Reſt* of the *Enſuing Year*, as ſeveral other *Animals* are known to do: for inſtance, *Snails* among *Inſects*; the *Hedg-Hog* among the *Beaſts*; and as I have good *Reason* to think, the *Ortygometra*, or *Rail*, among the *Birds*. And what further *Confirms* in this *Opinion*, concerning theſe *Inſects*, is, that I am certainly informed by ſeveral good *Hands*, that in the *Spring* time, by accidental *Digging* and *Ploughing* up the *Ground*, great *Hollows* or *Nests* of them are frequently *discovered* and *broken up*, where they find whole *Buſhels* together in one *Heap*, but in ſuch a *Quiet Condition* they ſeem to have but little *Life* and *Motion*: for they do not *Stir* unleſs you *Touch* or *Diſturb* them, and then *Move* but little and *Feebly*, as if they had been *Aſleep* and were *wakened* out of it. Theſe *Large Caverns* to which they *Retire* are often met with under a *Firm ſolid Surface* of *Earth*, that has not been *Stirred* or *Ploughed* in many *Years* before: and no *maniſt Paſſage* can be *Diſcovered* How they got there.

In the *Summer* (1695 or 96.) all along the *South-Weſt* *Coaſt* of the *County* of *Gallway*, for ſome *Miles* together, there were found *Dead* on the ſhoar ſuch *Infinite Multitudes* of this *Vermine*, and in ſuch *Vaſt Heaps*, that by a *Moderate Eſtimate*, one *Computed* there could not be leſs than 40. or 50. *Horſe-Loads* in all. Theſe (as I take it) were a *New Colony*, or a *Supernumerary Swarm* from the ſame place whence the *Fiſt* ſtock came to us in 1688. Driven by the *Wind* to *Sea* from their *Native Land*: which I conclude to be *Normandy* or *Brittany* in *France*, it being a *Country* much *Infeste*d with this *Inſect*, and that lies very *Open* and *Expoſed* to all theſe *Parts* of *Ireland*; and from whence *England* heretofore has been *Peſter'd* in the ſame manner with *Swarms* of this *Vermine*. But theſe meeting, by good *Fortune*, with a *Contrary Wind* before they could *Reach Land*, their *Progreſs* was ſtopt, and *Tired* with their *Voyage*, they were all *Driven* into the *Sea*, which by the *Motion* of its *Waves* and *Tides* Caſt their *Floating Bodies* in *Heaps* upon the ſhore. And this was a moſt *Lucky Accident*: for had this *Second ſupply* *Arrived*, they would have *exceedingly* *Encreaſed* the *Numbers* of thoſe which are already very *trou- bleſome* to us.

It is *Obſerved* that they ſeldom keep above a *Year* together in a *Place*: and they *Compute* their uſual *Stages*, or *March*, to be about 6 *Miles* in a *Year*. Hitherto they have directed their *Progreſs* *Westerly*; following the *Course* of that *Wind* which *Blows* moſt *Commonly* in this *Country*.

And this last Year, 1697. they reached as far as the *Shannon*, and some of the scatter'd loose Parties Cross the *River*, and got into the Province of *Leinster*; but they were met there by a stronger Army of *Jackdaws*, which devour'd great Numbers of them. They begin to be Apprehensive of them in the *Queen's County*: but they hope to divert their Passage thither by *Firing* the *Heath* upon the Mountains between them and the *King's County*.

Wherever the Country has been Infested with this *Vermin*, by one Consent, though Erroneously, they have given them the Name of *Locusts*. But the true *Locust*, much resembling in Shape a common *Grashopper*, though Larger, is quite a Different sort of *Insect* from this, which belongs to that *Tribe* call'd by the Naturalists *Κολεόπτερος*, or *Vagini pennis*, the *Scarabeus* or *Beetle-Kind*, that has strong Thick *Cases* to Defend and Cover their Tender Thin *Wings*, that lie out of Sight and next the *Body*. And this *Species* is certainly that Particular *Beetle*, called by *Aristotle* in his *Hist. of Animals* *Μελολανθός*, from its Devouring the *Blossoms* of *Apple-Trees*; and is the *Scarabeus Arboreus* of *Moufett* and *Charleton*; call'd, by the *English*, *Dorrs*, or *Hedge Chaffers*. They are much of the Bigness of the *Common Black Beetle*, but of a *Brownish Colour*, something near that of *Cinnamon*; they are Thickly besperr'd with a Fine short Downy *Hair*, that shews as if they were Powdered all over with a Fine sort of *Dust*; The *Cases* of their *Wings* do not entirely Cover All the *Back*, for their long Picked *Tails*, (where lie the *Organs* for *Generation*) reach a good way beyond them; And the *Indentures* or *Joynts* of each side their *Belly*, appear much *Whiter* than the rest. They are exactly *Figured* by *Dr. Lister* *Scarab. Tab. Mut.*

Hist. Animal.
Adrovand. de In-
sect. l. 4.

I am fully Convinced that this *Insect* is that self same to which the *Septuagint*, and the *Vulgar Latin Translation* retaining the *Greek* word, give the Name *Βεβχός*, or *Bruchus*, Derived from *Βεβχάω* *Frendo* vel *Strideo*, Intimating the Remarkable *Noise* it makes both in its *Eating* and *Flying*. It is often mentioned in *Holy Scripture*; *Lev. 11. 22. Joel 1. 4. and 2. 25. Nab. 3. 16, 17.* But I find our *English Version* almost constantly Translates this word *Βεβχός*, though Improperly, as I think, *Cancer* *Worm*; since this Denotes only a *Reptile*, or *Creeping Vermin*, whereas that Word imports certainly a *Flying-Insect*; For the *Βεβχός* *Nab. 3. 16, 17.* is expressly said to *Fly*, and have *Wings*: and its Nature and Properties are most truly and particularly Described in these Words, *It spoileth and flieth away, they Camp in Hedges in the Day, and when the Sun ariset they flee away, and their Place is not known where they are;* That is, they then *Retire* again to the *Hedges* and *Trees* where they lie Quiet and Concealed till the Sun sets again.

I find indeed the Word *Βεβχός*, better Translated, *Locust* or *Beetle*, in that Odd Clause of the *Jewish Law*, *Lev. 11. 22.* Where *Moses* permits the *Israelites* to *Eat* the *Locust* after his Kind, and the *Bald-Locust* after his kind, and the *Beetle* after his kind, and the *Grashopper* after his kind. I must confess, it long Seemed to me very Unaccountable that here among the *Pure, wholesome Creatures*, Proper for *Humane Nourishment*, *Beetles* and thole other *Nasty, Dry, and Unpromising Vermin*, should be thought Fit to be reckoned up as *Clean* and *Proper* for the *Food* of a *Man*: But since I have had some little Experience of what has hap-
pened.

pened among our selves, I cannot but Admire the Sagacious Prudence of that *Divine-Law-Giver*. 'Tis certain *Palestine, Arabia, Egypt,* and the other Neighbouring Countries about them, were all extreamly Subject to be Infested with these sorts of Pernicious *Vermin*: And therefore *Moses*, foreseeing the great *Dearth* and *Scarcity* that they might one Day bring upon his People, gives them here a *Permissive Precept*, or a sort of *Hint* what they should do, when the *Corn, Grass, Olive-Trees, Fruit-Trees, Vines,* and other *Provisions* were destroyed by the *Locust* and *Βεῦχοι*, or *Beetles*, swarming in the Land; why then, for want of other *Nourishment*, and rather than *Starve*, he tells them, they might Eat and Live upon the Filthy Destroyers themselves, and yet be *Clean*. And thus we see the *Native Irish* were Authors of a *Practical Commentary* on this Part of the *Levitical Law*, and by Matter of *Fact* have Explained what was the *True* sense and meaning of this otherwise so *Dark* and *Abstruse* a Text. It is also more than probable that this same *Destructive Beetle* we are speaking of, was that very Kind of *Scarabeus*, the *Idolatrous Egyptians* of old had in such *High veneration*, as to pay *Divine Worship* to it, and so frequently Grave its *Image* upon their *Agulios* and *Obelisks*, as we see at this Day. For nothing can be Supposed more *Natural*, than to imagine a Nation addicted to *Polytheism*, as the *Egyptians* were, in a Country frequently suffering great *Mischief* and *Scarcity* from *Swarms* of *Devouring Insects*, should from a *Strong Sense* and *Fear* of *Evil to come*, (the *Common Principle* of *Superstition* and *Idolatry*) give *Sacred Worship* to the *Visible Authors* of these their *Sufferings*, in hopes to render them more *Propitious* for the *Future*: Thus 'tis Allowed of all *Hands*, that the same People *Adored* as *Gods*, the *Ravenous Crocodiles* of their *River Nile*; and thus the *Romans*, though more *Polite* and *Civilized* in their *Idolatry*, *Febrem ad minus Nocendum venerabantur, eamque variis Templis Extructis colebant*; says *Valerius Maximus*. L. 2. c. 5.

The Vasa Testicularia of a Beetle; by Dr. Swammerdam, n. 94. p. 604, 1, 6042.

XXIV. *Scarabæi Nasi-cornis Genitalia*, quoad *Vasa Testicularia*, admissim cum *Humanis* convenire *Testiculis*, atque ex *Unico tantum Funiculo*, Longo, Cavo, innumerabiliter Flexo, atque (quod nondum in *Homine* mihi visum,) *Principio seu Apice Cæco*, constare, non sine aliquo *Stupore Lustravi*.

Non alienum itaq; fore duxi eorum *Delineationem* Cl. *Tuæ* transmittere; in qua imprimis exhibentur non modo *Testiculi* ex *Unico Funiculo Duos pedes & sex pollices* Longo; sed & *Vasa Deferentia*, semen *Copiosum* ac *Album*, quando *Læduntur*, stillantia; nec non *Vesiculæ* seu potius *Glandulæ Seminales* sex, admodum *Elegantes*; *Glandularumq; Seminalium Ductus* protensi, materiam *seminalem* *Sub-flavam* (ut in *Homnibus* ac *Brutis* quoque observantur) continentis.

XXV. I here send you the *Figure* of a *Large Flying-Beetle*, of a *Dark shining Brown*, with a *Huge pair of Horns*, (in proportion to the *Body*,) shaped and Branched exactly like a *Stagg's* or *Hart's*, from which last it hath its *Denomination*; our *People* in *Virginia* and *New England* calling it a *Flying Hart*. It flies *High* and *Swift*, and rests most commonly upon *Branches*

A Flying Hart; by n. 127. p. 652.

or Trunks of standing Trees, where, as soon as it has taken up its Station; it begins with a shrill Chirping Voice, which it raises by little and little till it makes the whole Woods Ring again, and then lessens gradually till it ceaseth with a kind of silent Murmur, as if the little Creature had Rung it self asleep; then it flies to some other place, and begins the same Tune again.

The *Horns* are of a shining Hard Substance, and the Tips of them touch the same Plane with the *Belly*.

XXVI There is a *Cimex* of the largest Size, of a Red Colour, spotted Black, and which is to be found very frequently, and Plentifully, at least in its Season, upon *Henbain*: I therefore in my private Notes, intitle it *Cimex Ruber, Maculis Nigris Distinctus, super Folia Hyoscyami frequens*. This Insect in all Probability doth Feed upon this Plant (on which only we have yet Observed it) if not upon the *Leaves*, by Striking its *Trunk* (the Note of Distinction of this Kind of Insect from the rest of the *Beetle* kinds) into them, and Sucking thence much of its Substance, like as other sorts of *Cimices*, will upon the Body of *Man*, &c; yet upon the *Unctuous* and *Greasy Matter*, with which the *Leaves* seem, to the Touch, to Abound. It is farther Observable, that that *Horrid* and *Strong Smell*, with which the *Leaves* of this Plant do affect our *Nostrils*, is very much Qualified in this Insect, and in some measure *Aromatick* and *Agreeable*, and therefore we may Expect, that that *Dreadful Narcosis*, so Eminent in this Plant, may likewise be Usefully Tempered in this Insect.

A Musk-Scented Insect, feeding upon Henbain; by Dr. M. Lister. n. 72. p. 2176.

About the Latter End of *May*, and sooner, you may find Adhering to the Upper side of the *Leaves* of this Plant, certain Oblong Orange Coloured Eggs, which are the Eggs of this Insect. These Eggs yet in the *Belly* of the *Females* are *White*, and are so sometime after they are laid: But as the *Young Ones* grow near the Time of their being *Hatched*, they acquire a *Deeper Colour*, and are *Hatched Cimices*, and not in the Disguise of *Worms*. If the *Riper Eggs* be Crushed upon *White Pepper*, they *Stain* it of Themselves (without any Addition of *Salt*) with as *Lively* a *Vermilion*, or *Coleur de Feu*, as any thing I know in Nature; *Cochineel* scarce excepted, when assisted with *Oyl of Vitriol*.

Other Musk-Scented Insects, by Mr. J. Ray. n. 74. p. 2229.

XXVII. 1. I have seen Two sorts of Insects which Smell of *Musk*. The One is like the common *Capricornus*, or *Goat-Chafer*, which is mentioned by all Naturalists that write of *Insects*, and which Smells so strong of that *Perfume*, that you may Scent it at a good Distance, as it flies by, or sits near you. The Other is a small sort of *Bee*, which in the *South* and *East* parts of *England* is frequently to be Met withal in *Gardens* among *Flowers* in the *Spring-time*.

Other Musk-Scented Insects, by Mr. J. Ray. n. 74. p. 2229.

2. The two Insects mentioned by Mr. Ray Smell of *Musk* to an High Degree. The small *Bees* are very frequent in the *Wooles* in *Lincolnshire*, and about the latter End of *April*, are to be found in *Pastures* and *Meadows*, upon the Early Blown *Flowers* of a sort of *Ranunculus*; but it is something Impro-

per By Dr. M. Lister. n. 76. p. 2281.

per to say *Bees* feed on *Flowers*: And likewise the same *Bees* are no less Frequent on the *Flowers* of *Dens Leonis*, &c.

The *Sweet Beetle*, is a very large *Insect*, and well known about *Cambridge*. All the *Trials* I have made to preserve them with their *Smell*, have proved ineffectual: For both sorts of these *Insects*, will of themselves, in a very few *Weeks* become almost *Quite Sentless*.

To these I shall add Another *Sweet smelling Insect*, which is a *Hexapode Worm* feeding on *Gallium Luteum*.

Mr. *Willoughby* informs me, that he hath found the *Goat-Chaffer*, or *Sweet Beetle*, out of Season as to that *Smell*. Perhaps it might be at the time of the *Coit*: for as much as at that Time, when I took them *Highly Perfumed*, I had observed the *Female* full of *Eggs*.

XXVIII. 1. It is generally Believed, that the *Cochineel* Comes out of a *Fruit* called the *Prickle Pear*, Bearing a *Leaf* of a *Slimy Nature*, and a *Fruit Blood Red*, and full of *Seeds*, which give a *Dye* almost like to *Brasiletto-Wood*, that will *Perish* in a few *Days* by the *Fire*: But the *Insect* Ingendred of this *Fruit* or *Leaves*, gives a *Permanent Tincture*, as is generally known.

There grows a *Berry* (by report) both in *Bermudas* and *New England*, Call'd the *Summer Island-Reedweed*, which *Berry* is as *Red* as the *Prickle Pear*, giving much the like *Tincture*; out of which *Berry* come out first *Worms*, which afterward turn into *Flies*, somewhat bigger than the *Cochineel-Flye*, feeding on the same *Berry*: In which we Read there hath been found a *Colour*, No whit Inferior to that of the *Cochineel Flye*; and as to *Medicinal Vertue*, much Exceeding it.

'Tis also probable that *Insects* may be engendred, out of Other *Vegetables*, either *Herbs*, *Berries*, and other *Fruit*, and *Woods*, giving the *Tincture* of its *Original*, which will hold in *Grain*.

To Breed *Insects* out of *Herbs*; Dry them, (for they yield the Best *Tincture*; Otherwise stamp them, and let them Dry, till they will suffer no more *Juice* to Run from them, (this in the *Sun* or in a *Proportionable Heat*;) or if *Dryed*, infuse them with *Water*, in a *Heat* for 24 *Hours*; then *Vapour* away the *Water*, till the *Dissolution* be as *Thick* as a *Syrup* (but for this use Strain them not from their *Fæces*;) take this *Masse* and put it into an *Earthen* or *Wooden Vessel* Covered with some *Straw*, or something else of that *Nature*, that it Lye not too Close, and so Proportion the *Quantity* to the *Vessel* that the *Air* may come about and into the *Masse* (yet not too Much.) Then set this *Vessel* in a *Ditch* or *Pit* made in the *Earth*, in a *Shady Place*, and put about it some *wet Leaves*, or some such *Putrifying Rubbish*, and over it a *Board*, and on that some *Straw*, or the Like; and it will produce first a *Shelly Husky Worm*, and then a *Fly* of the *Tincture* of the *Concrete*, but *Durable* and somewhat more *Advanced*.

And as for *Berries*, Stamp and Boil them, Evaporating them to the *Consistence* of a *Rob*, and then use them as the Former.

n. 77. p. 3003.

The Cochineel
Fly by
n. 40. p. 796.

To Generate O-
ther Flies for
Like uses.

Lastly, for *Woods*, Infuse them in *Water* being first *Pulveriz'd*, and *Boil* out their *Tincture*, and then *Evaporate* also the *Water* to such a *Thickness*, as the other, and *Handle* them in the *Like Way*.

The *Flies* will play about the side of the *Vessel*, and the *Surface* of the *Matter*; which taken, are to be *Killed* in a *Warm Pan* or *Stove*, and so *Dryed* and *Kept*.

2. An Old *Spaniard* at *Jamaica*, who lived many *Years* in that *Part* of the *West-Indies*, where great *Quantities* of *Cochineel* is made, affirms that the *Insect* whereof it is made is the very same which we call the *Lady-Bird*, or *Cow-Lady*. It *Appears*, he says, at first, like a small *Blister*, or little *Knob* upon the *Leaves* of the *Shrub* on which they *Breed*, which afterwards by the *Heat* of the *Sun*, become a *Live Insect*, or small *Grub*. These *Grubs* in *Process* of time become *Flies*, and being come to full *Maturity*, (which must be found out by *Experience*, in *Collecting* them at several *Seasons*) they *Kill*, by making a great *Smother* of some *Combustible Matter*, to *Windward* of the *Shrubs* whereon the *Insects* are *feeding*, (having before spread some *Cloaths* under the *Plants*) whereby all the *Insects* being *Smother'd* and *Kill'd*, by *shaking* the *Plants*, will tumble down upon the *Cloaths*; thus they are *Gathered* in great *Quantities*, with little *Trouble*. Then they spread them on the *same Cloaths*, in some bare *sandy Place*, or *Stone Pavement*, and *Expose* them to the *Heat* of the *Sun*, until they are *Dry*, and their *Bodies shrivel'd* up, which being rubb'd gently betwixt ones *Hands*, will *Crumble* into *Grains*, and the *Wings* separate from them, which must be *Garbled* out. Others, 'tis said, do *Expose* them to the *Sun* in *Broad* and *Shallow Copper Basons*, where-in the *Reflection* of the *Sun* will dry them sooner.

By -- n. 193.
p. 502.

201 77

The *Tree* or *Shrub*, on which they *Breed*, Call'd the *Prickle-Pear*, or *Indian-Fig*, is easily and quickly *Propagated*, by putting a single *Leaf* above *Half* its depth into the *Ground*, which seldom fails to take *Root*, and throw out *Other New Leaves* at the *Top* thereof. Others say, they may be *Raised* from the *Seed*, or *Small-Grains*, which are to be found in the proper *Season* in the *Fruit*, which is something like a *Fig*, arising out of certain *Yellow Flowers*, or *Blossoms*, that grow out at the *Tops* of the *Uppermost Leaves*; which *Fruit* is full of a *Red Pulp*, that when full *Ripe*, *stains* the *Hands* of them that *Touch* it, like *Mulberries*, with a *Purple* or *Sanguine Colour*, Whereon, or on the *Blossoms*, some say the *Insects* do *Feed*; which haply may be the *Occasion* of that *Rich Tincture* within their *Bowels*.

3. The *Figures* 191, 192, 193. Represent the *Cochineel Fly*, as seen on its *Belly* by the help of the *Microscope*; and by the *Naked Eye*; and as seen on its *Back* through a *Microscope*.

Figures of the
Cochineel-Fly;
by Dr. Tyson.
n. 176. p. 1202.

XXIX. In *August* 1695. I traced a *Death Watch* by the *Noise*, and found it in a *Copper-Body*; it resembled *Dry Dirt* in *Colour*. I found another, some *Years* before on a *Rotten Post*. This small *Beetle* had another *Answered* it, in the same *Room*; and after a *Minutes* distinct *Beating*, would forbear for the other to *Answer*.

The Death:
Watch; by Mr:
Benj. Allen.
n. 245. p. 376.

The part it *Beats* with is the Extream Edge of the Face; which I may call the *upper-Lip*, the *Mouth* being protected by this *Bony Part*, and lying underneath out of View.

Fig. 194.

It was $\frac{1}{2}$ of an *Inch* long; the Colour a *Dark Brown*, with *Spots*, something lighter, irregularly Placed, which would not rub off readily. They seemed to lie rather athwart the *Back*, and Direct on the *Head*; as in the small *Figure 194*, which is much of the same size with it, and the *Maculæ* are designed for the *Grayish Spotts*. Under the *Vaginae*, are *Pellucid Wings*, and the *Body* is of a *Pullous Colour*. The *Head* appeared Large, by reason of a large *Cap* or *Helmet*, which Cover'd it round, only at the *Ear* turned up a little; from under this appeared the *Head*, which was Flat and Thin; the *Eyes*, forwards: the *Lip* Hard and Shining; the *Ears* of the *Helmet* Greyish. Two *Antennæ* proceeded from under the *Eyes*, which, by their Meeting on the *Breast*, I conjectured to assist their *Feeding*, and to be rather *Probosces*; and the *Helmet* to be *Turned up* for *Hearing* sake; and the *Belly* Plicated as other *Beetles*.

The other *Beetle* that *Answered* it was *Less*, and the *Marks* on the *Back* not so distinct.

Fig. 195.

By the *Microscope* I discovered the *Marks* to be thick set *Spots* of *Hair*, of a *Castor Colour*; the *Head* all *Hairy*, and the *Face* Thick of *Curled Hair*. On the *Belly* was a little but thin set *Hair*. The *Eyes* appeared Large, as in the *Figure*, the superficies consisting of many small *Squares* furrowed deep between, and these lay in *Lines* Transversly descending towards the *Nose*. These *Eyes* were not *Moveable* but *Contiguous* to the *Face*, without any *Cavity* to *Receive* them; and they were very *Opake*. The *Antennæ* proceeded from under the *Eyes*; the *First* large *Joint* having a *Cavity*, out of which it proceeds at the sides of the *Lip*. Between the *Eyes* the *Face* Rises in a little *Ridge*, which is the *Nose*, and is signified by the *Light* part of the *Face*. And just below it, the *Nostrils* are Covered by *strait Pendulous Hair*, proceeding from the lower *Ridge* of the *Nose*. Under this *Hair* the *Cavity* is *Dark*. Below the *Nose* the *Lip-shades* shew the more deprest Places. Under this *Lip* are *Visible* 4 *Forcipes*, 2 of each side, to lay hold on its *Food*.

The *Musca Lupus* in *Virginia*; by *Mr. J. Banister*. n. 198. p. 670.

XXX. 1. I have observed, that that sort of *Flies* which *Mouffett* calls *Musca Lupus*, and some others, (as the *Tabani*, *Aseli*, &c.) that have but *Two Wings*, have growing out of their *Body*, under each *Wing*, a small flexible *Apex* or *Pointel*, with which they *Poise* their *Body*, and keep it in *Equilibrio*, as the *Dancer on the Rope* does with his *Pole*; for pull these off, and their *Flight* is short, and *Unstedy*, nor can they, tho' they have the use of their *Wings*, *Guide* themselves so, as to keep themselves from the *Ground*, or to *Avoid* striking against whatever is in their way.

A Note; by ---
ib. p. 691.

2. *Dr. Hook* has Observed these *Pendulums*, and Described them in his *Micrographia Obs* 38. p. 273.

XXXI. I here send you a *Viviparous Fly*: which is one, if not the very Biggest, of the *Harmless Tribe* that I have met with in *England*. I call them *Harmless*, because that they are without that *Hard Tongue*, or *Sting*, in the *Mouth*, with which the *Æstrum* kind, or *Gad-Flies*, trouble and Offend both *Man* and *Beasts*. This *Fly* is striped upon the *Shoulders* *Grey* and *Black*, and as it were *Checkered* on the *Tail* with the same two *Colours*. The *Female* may be known by a *Redness* on the very *Point* of the *Tail*. The very latter *End* of *May* 1666 I opened several of them, and found two *Bags* of *Live* *White Worms*, of a *Long* and *Round* Shape, with *Black* *Heads*; they moved both in my *Hand*, and in the *Unopened* *Vesicles*, backwards and forwards; as being all disposed in the *Cells* *Length-ways* the *Body* of the *Female*, like a *Sheaf*. Some such thing is *Hinted* by *Aldrovandus*: And I suspect all of this *Tribe* to be in some *Measure* *Viviparous*.

A Viviparous Fly; by Dr. M. Lister. n. 72. p. 2170. n. 160. p. 595.

Lib. 1. de Insect.

XXXII. 1. In a *Great* and very *Ancient* *Wall* of *Free-stone* in the *Benedictins* *Abbey* at *Caen* in *Normandy*, facing *Southward*, there are to be found *Many* *Stones* so *Eaten* by *Worms*, that *One* may run his *Hand* into most of the *Cavities* which are variously *Fashioned*, like the *Stones* which I have seen *Wrought* with so much *Art* in the *Louvre*: In these *Cavities* there is *Abundance* of *Live-Worms*, their *Excrement*, and of that *Stone-Dust* they *Eat*. I have taken some of these *Living* *Worms*, which I found in the *Eaten-stone*, and *Put* them into a *Box* with several *Bits* of the *Stone*; leaving them there together for the space of *Eight* *Days*; and then *Opening* the *Box*, the *Stone* seemed to me *Eaten* so sensibly, that I could no *Longer* *Doubt* of it.

A kind of Worms Eating out Stones; by M. de la Voye. n. 18. p. 321.

These *Worms* are *Enclosed* in a *Shell*, which is *Grayish* and of the *Bigness* of a *Barly-Corn*, *Sharper* at one *End* than the *Other*. By the means of an *Excellent* *Microscope*, I have *Observed*, that 'tis all *Overspread* with *Little* *Stones*, and *Little* *Greenish* *Eggs*; and that there is, at the *Sharpest* *End* a *little* *Hole*, by which these *Creatures* *Cast* out their *Excrement*, and at the *Other* *End*, a somewhat *Bigger* *Hole* through which they put out their *Heads*, and fasten themselves to the *Stones* they *Gnaw*. They are not so *shut* *Up*, but that sometimes they come out, and walk *Abroad*. They are all *Black*, about two *Lines* of an *Inch* *Long*, and *3* *quarters* of a *Line* *Large*. Their *Body* is *Distinguisht* into several *Plyes*, and near their *Head* they have *3* *Feet* on each *Side*, which have but two *Joints*, resembling Those of a *Lowse*. When they *Move*, their *Body* is *Commonly* *Upwards*, with their *Mouth* against the *Stone*. They have a *Big* *Head*, somewhat *Flat*, and even of the *Colour* of a *Tortoise-shell*, *Brownish*, with some small *White-Hair*; Their *Mouth* is also *Big*, where may be seen *4* kinds of *Jaw* *Bones*, lying *Crosswise*, which they *Move* continually, *Opening* and *Shutting* them like a *Pair* of *Compasses* with *4*. *Branches*. The *Jaws* on both sides of the *Mouth* are all *Black*; the *Nether-Jaw* hath a *Point* like the *Sting* of a *Bee*, but *Uniform*. They draw *Threads* out of their *Mouth* with their *Fore-feet*, Using that *Point* to *Range* them, and to *Form* their *Shells* of them. They have *10* *Eyes*, very *Black* and *Round*, which appear to be *Bigger* than a *Pin's* *Head*. There are *5* of them on each side of the *Head*, standing as in the *Figure*

Fig. 196.

H h h h h 2 2 I

Another sort
Eating Mortar.
ib. p. 322.

2. I have also found that *Mortar* is *Eaten* by an infinite Number of *Small Creatures*, of the Bigness of *Cheese-Mites*. These have but 2 *Eyes*, and are *Blackish*. They have 4 *Feet* on each side pretty Long. The *Point* of their *Muzzle* is very Sharp, as that of a *Spider*. In *Old-Mortar* betwixt *Stones*, that is found in *Walls* made with *Rubbish*, there is a great store of them, together with great Plenty of their little *Eggs*. You may observe more of them in *Walls* exposed to the *South*, than in *Others*; and that the *Worms* that *Eat* the *Stone*, Live longer than those that *Eat* the *Mortar*; which keep not above 8 *Days* Alive. Without a very good *Microscope* and a Great Deal of *Attention*, 'tis Difficult to see them Well.

I have seen Other very *Old Walls* altogether *Eaten*, as those of the *Temple* at *Paris*, where I could find *No Worms*: But the Cavities were full of *Shells* of Various kinds, Diversly Figured, and Turn'd; all which I believe to be *little Animals Petrify'd*.

A Scolopendra;
by Mr. J. Ray.
n. 74. P. 2221.

XXXIII. The *Scolopendra* which is by *Bruerus* ascribed to *Muffett*, in the later part of his Chapter *de Fulis*, p. 202. I saw in the *Cloysters* of *Trinity-Colledge* in *Cambridge*, 12 or 13 *Years* ago.

A Swarm of Fly-
ing Grasshoppers
in Languedoc;
by Com-
municated by M.
Justel. n. 182.
p. 147.

XXXIV. These *Insects* appear to Sight, in Nothing Different from the *Common* sort of *Grasshoppers*: But they take their *Flight* like *Birds*, which is particular to them. They are much about an *Inch* in Length, of a *Grey Colour*. In the *Year* 1685 the *Earth* in some places about *Aramont* in *Languedoc*, near *Avignon*, was Covered 4 *Fingers* thick with them, in the *Morning* before the *Heat* of the *Sun* was Considerable: But as soon as it began to be *Hot*, they took *Wing* and Fell upon the *Corn*, Eating up both *Leaf* and *Ear*, and that with such *Expedition*, by reason of their great Number, that in 3 *Hours* they Devour'd the *Corn* of a *Whole Field*; after which they again Took *Wing*, and their *Swarms* were so *Thick* that they Covered the *Sun* like a *Cloud*, and were *Whole Hours* in *Passing*. They Flew Against the *Wind*, and Went over the *Castle* which is very *High*, and Seized upon another *Field* of *Corn*, which they Destroyed like the *Former*. After having *Eaten* up the *Corn*, they fell upon the *Vines*, the *Pulse*, the *Willows*, and Even the *Hemp*, notwithstanding its Great *Bitterness*. Afterwards, about the *End* of *August*, they Ceased *Flying*, and Copulated, and the *Female* Stuck her *Tail* into the *Hard Earth*, where she Cast a *Foam*, and made therewith, in the *Ground*, a *Hole* as Big as that of a *Goose-Quill*, and about an *Inch* Long, wherein she Laid her *Eggs*; which are Much of the Size of *Millet-Seed*. There would be sometimes 50 of these *Eggs* in a *Hole*, which are so Covered Over with the same *Earth*, that the *Water* does not Get in. After this, all these *Insects* Died, and Stunk very Much. They Began to *Hatch* in *April*, 1686. In *March*, we thought upon *Destroying* their *Eggs*, which lye not above a *Fingers Breadth* in the *Earth*: and we took of them 180 *Quintals*, being 9 *Tuns*. Since their *Hatching*, they have taken above 15 *Tuns* of the *Young Grasshoppers*; which are not yet Bigger than *Flyes*: And there are yet a Mul-
titude

Vid. Sup.
§. XXI. XXII.
§. XXIII.

titude that have Escaped us. If this Care had not been taken, there would have been enough of them to have *Eaten up* the *Corn* of the *Whole Province*.

XXXV. *Fleas* bring forth *Eggs*, (or a sort of *Nitts*;) from these *Eggs* are hatched *Worms*; these *Worms* make to themselves *Bags* like *Silk Worms*; and from out of these *Bags*, come *Fleas*. The *Eggs* they Deposite on *Dogs*, *Cats*, *Men*, or other *Animals*, infested with them; or in the *Places* where they Sleep, which, for being *Round* and *smooth*, Slip Ordinarily straight to the *Ground*, or fix themselves in the *Plyes*, or other *Inequalities*, of the *Coverlets* and *Cloaths*. From these are brought forth *White Worms*, of a *Shining Pearl Colour*, which feed themselves on the *Bran like Substance* which sticks in the *Combs* when *Puppies* are *Combed* to take out the *Fleas*; or with a certain *Downy Substance*, that is found in the *Plyes* of *Linnen Drawers*; or other such like *Excrement*. They come in a *Fortnight*, to the *Bigness* of *Fig. 197* and are very *Lively* and *Active* and if they have any *Fear*, or if they be *Touched*, they suddenly *Roul* themselves up, and make as it were a *Ball*. A little after, they come to *Creep*, after the manner of the *Silk Worms* that have no *Legs*, with a *Brisk* and very *swift Motion*. When they are come to their usual *Bigness*, they *Hide* themselves, the most they can, and *Bringing* out of their *Mouths* the *Silk*, they make round themselves a *small Bag*; *white* within as *Paper*, but without always *Dirty*, and *Foul'd* with *Dust*. The *Bags* are to the *Naked Eye* of the *Bigness* of *Fig. 198*. without *Magnifying*. In other two *Weeks*, in the *Summer time*, the *Flea* is perfectly formed: without that the *Worm* *Quits* its *Exuvia* in its *Bag*; as do the *Silk Worms*, and as do all *Caterpillars*, which *Leave* in the same their *Exuvia*. The *Flea*, so long as it is inclosed in the *Bag*, is *Milk-White*, although it has its *Legs*, but two *Days* before it comes out, it becomes *Coloured*, grows *Hard*, and *Gets Strength* so that coming speedily out, it straight *Leaps* away.

Fig. 199. Represents the *Eggs*; *Fig. 200*. The *Worm*; *Fig. 201*. The *Bag*; *Fig. 202*. The *Flea*: But all *Magnify'd* by the *Microscope*.

XXXVI. There have Occurred to my Observation but 3 sorts of *Ants*, Commonly without *Wings*; viz. *Very Black*, *Dark-Brown* and *Philemora*. Each Kind inhabit by themselves in their several *Banks*, two sorts seldom or never being found together; and if Either of the Other two sorts be put into the *Black Ants-Bank*, 'tis Worth observing what *Enmity* there is betwixt these little *Creatures*, and with what *Violence* the *Black Ones* will *Seize* on the *Red*, Never *Leaving* to *Pinch* them on the *Head* with their *Forceps*, or *Claws*, till they have *Killed* them upon the *Place*: which done, they will carry them *Dead* out of the *Field*, from their *Bank*. But if you put *Black Ants* into a *Bank* of the *Red*, the *Black* seem to be so *Sensible* of the *Strangeness* of the *Place* they are in; that there they will not *Meddle* with the *Red*: But as if they were *Frighted*, and *Concerned* for nothing but *self-Preservation*, *Run* away.

Upon *Opening* of these *Banks*, I *Observe* first, a *White Substance*, which to the *Bare Eye* looks like the *Scattering* of fine *White Sugar* or *Salt*, but very *Soft* and *Tender*. And if you take a *Bit* of it, as *Big* perhaps, as a *Mustard-Seed*, and

The Generation of Fleas; by S. D'iacinto Ce. stone. n. 249. p. 42.

Fig. 197.

Fig. 198.

The Emmet or Ant; by Sir Edmund King. n. 27. p. 425.

and lay it on the *Object Plate* of a Good *Microscope*, you may by Opening it with the Point of a *Needle* Discern many Pure, White, and Clear Appearances in Distinct *Membranes* all Figured like the Lesser sort of *Birds-Eggs*, and as Clear as a *Fish's Bladder*. This *Substance*, as it hath been just now Described, I find in the *Ants* themselves; which I take to be the True *Ants-Eggs*; It being Obvious to the Observation, that Wherever this is Uncovered, they make it their Business to Carry it away in their *Mouths* to secure it, and will, after you have Scattered it, Lay it on a Heap Again, with what Speed they can. I Observe they lye in Multitudes upon this (if I may so call it) *Spawn* of Theirs: And after a Little Time, every one of these small Adherances is Turned into a little *Vermicle*, as small as a *Mite*, hardly Discerned to *Stir*. But after a Few Days More, you may Perceive a *Feeble Motion* of *Flexion* and *Extension*, and they begin to look *Yellowish* and *Hairy*, Shaped very like a *Small Maggot*: And so, Keeping that Shape, grow almost as Big as an *Ant*, and have Every One a *Black-Spot* on them. Then, they get a *Film* over them, *Whitish* and of an *Oval-Shape*: for which Reason, I suppose, they are Commonly called *Ants-Eggs*; which yet (to speak Properly) they are Not.

I have Opened many of these, Vulgarly call'd *Ants-Eggs*, I mean the *lesser Sort*, (for there are some as Big as a *Wheat-Corn*, others less than a *Rye-Corn*) and in some I find only a *Maggot*, to appearance just as was Described Before. In others, I find a *Maggot*, beginning to put on the Shape of an *Ant* about the *Head*, with two little *Yellowish Specks*, where the *Eyes* are Designed; in others a further Progress, and Furnisht with every thing to Compleat the Shape of an *Ant*: But wholly *Transparent*, the *Eyes* only excepted, which are then, as *Black* as *Black Bugles*. But when they Newly put On this Shape, I could never Discern the Least *Motion*, in any one part of the little Creature; whereof the Reason may perhaps be, the *Weakness* of their *Fibres*: for after a little more time, when they begin to be *Brownish*, they have Strength to Stir all their Parts. At last, I met with some of these Reputed *Eggs*, which being carefully Opened by me, I took out of several of them every way Perfect and Compleat *Ants*: Which did immediately Creep about, among the Rest, no way Differing from many Other *Ants*, but by a more *Feeble Motion* of their *Limbs*. And this I took for a Clear Demonstration of what I Designed, which was to know, that the *Film* does Only Cover the *Maggot*, while she is *Transforming* into an *Ant*, and fit to Shift for Herself. The *Black-Speck*, that is at One End of Every such Reputed *Ants-Egg*, I suppose to be Cast out of the *Maggot*, in her *Transformation*: Since after it puts on the Shape of an *Ant*, the *Speck* is quite Gone, and the Whole Body of the *Ant* pure *Clear*; since also this *Speck* at the End of the said *Egg*, lies always Close to the *Anus* of the *Included Ant*.

It is Observable how upon a Breaking up of their *Banks*, they make it their Business immediately to Carry their *Young* out of Sight again; laying the *Several Sorts* of them in *Several Places* and *Heaps*: the which if you *Mingle* again, or *Scatter*, you shall, laying but some Bits of *Slate*, or the like, in any place they may Come to and Get Under, after a Few Hours see all the *Vermicles*, and

Vulgarly

Vulgarly call'd Eggs, Laid in their several and distinct Parcels under such Pieces of Slate, &c. Provided the place be not so Cold as to Chill their Limbs; which if it be, by being brought to the Fire, they will soon Recover their Strength, and fall to their Business again, of Securing their Little Ones. They know all the sorts of their Young so Well, that you cannot Deceive them though you may with Fine Sugar, Salt, or the Crums of very White Stale Bread, scattered in the Mould, where their First True Eggs are (as I call them) be Mistaken your self, yet the Ants will Not, nor touch a Bit, of what is not their Own Offspring.

I have Observed in Summer, that in the Morning they bring up those of their Young (that are Vulgarly call'd Ants-Eggs) towards the Top of the Bank: so that you may, from 10 in the Morning until 5 or 6 Afternoon, find them Near the Top; especially about One, Two, or Three of the Clock, and Later, if the Weather be Hot; when for the most part they are found on the South Side of the Bank. But towards Seven or Eight at Night, if it be Cool or likely to Rain, you may Dig a Foot Deep before you can find them.

XXXVII. Dr. Hulse in Aug. 1670. sent me these Observations; Bare an Ant-Hill with a Stick, and then cast Cichory Flowers upon it, and you shall see the Ants Creep very thick Over them: Now as they Creep, they let fall a Drop of Liquor from them, and where That Chanceth to Light, there you shall have in a Moment a Large Red Stain. Sometimes they will be a pretty While before they Discolour them, and at other times, they will do it suddenly. At the first I guessed that being Vext, by stirring their Hill, they might thrust their Stings into the Flowers, and thorow them Convey that Sharp Liquor: But by Bruising them, and Rubbing the Expressed Juice against the Flowers, I find they will be equally Stain'd. 'Tis a thing well Known, that Ants, if they Get into Peoples Cloaths, and so to their Skin, will cause a Smart and Tingling, as if they were Nettled; which I Conceive is done by Letting fall the Forementioned Corrosive Liquor, rather than by Stinging.

To what sort of Liquor to refer this Juice, I know not. I Dropt Spirit of Salt, and Oyl of Sulphur upon the Flowers: but they did not Cause them to Change Colour. I likewise put Salt of Tartar Upon them, and Dropt thereon a little Spirit of Salt, which Caused a sufficient Fermentation: but Prevailed not, to Change the colour of the Flowers in the Least.

This Observation holds True not Only in Cichory Flowers, but also Lark-Spur, Borage, and, I suppose, All Others of a Blew Colour.

Some years since Mr. Sam. Fisher of Sheffield, made me acquainted with these Experiments, viz. If with a staff, or other Instrument you stir an Heap of Ants, (especially Horse-Ants,) so as to Anger them, they will let Fall thereon, a Liquor, which if you presently Smell to, will Twinge the Nose like Newly Distilled Spirit of Vitriol.

The Acid-Juice
of Pismires; by
Mr. J. Wray, n.
68. p. 2063.

A Weak Spirit of *Pismires*, will turn *Borage Flowers Red* in an Instant; Vinegar a little Heated, will do the Like. *Pismires Distill'd* by themselves, or with Water, yield a Spirit; like Spirit of Vinegar, or Rather like the Spirit of *Viride Aëris*, Lead put into this Spirit, or Fair-Water with the Animals themselves being Alive, maketh a Good *Saccharum Saturni*. Iron put into the Spirit, Affords an *Astringent Tincture*, and by Repetition a *Crocus Martis*. Take *Saccharum Saturni* Thus Made, and Distill it, and it will afford the same *Acid-Spirit* again, which the *Saccharum Saturni* made with Vinegar will not Do; but Returns an *Inflammable Oil* with Water, and Nothing that is *Acid*. *Saccharum Saturni* made with *Viridi Aëris*, doth the same (in This Respect) with that made with Spirit of *Pismires*. When you put the Animals into Water, you must Stir them to make them Angry, and then they will spirt Out their *Acid Juice*. No Animal that Ever We Distilled (he speaks of his Brother and Himself) except this, Yields an *Acid Spirit*, but Constantly an *Urinous*; and yet we have Distilled Many, both *Flesh, Fish,* and *Insects*.

In Dr. Hulse's Account, where he saith that spirit of Salt, and Oil of Sulphur, Dropped upon *Cichory Flowers*, did not Cause them to change Colour, it is to be Understood of the Flowers Entire, and Unbruised: For any Blew Flowers, being a little Bruised, and then a Drop of Spirit of Salt, or any Other *Acid Spirit*, let fall thereon, will turn instantly Red. The Reason is Obvious; for that the Leaves of the Flowers (as all the Other parts of the Plant) being Invested with a skin or Membrane, the Liquor Dropp'd thereon cannot Easily penetrate it, and so Commix. it self with the Interiour Juice or Pulp. Hence it is, that if these Flowers be put into Cold Vinegar, especially if the Weather be Cool, they will not Change Colour for a Considerable Time; but if you Heat the Vinegar, they will Change Immediately.

Another Insect yielding an Acid Juice; By Dr. M. Lister, ib. p. 2067.

2. Having Observed that a *Pismire* bruised and smelt to, Emits a strange Fiery and Piercing savour, like the Leaf of the Herb, by Botanists call'd *Flammula*, Broken at one's Nostrils, I have by this means found an Insect, which, I suspect, may yield an *Acid Liquor*, as well as the *Pismire*; and that is the Long and Round Bodied Red Colour'd *Julus*; Distinguished from all Other *Multipeds*, in that their Innumerable Legs are as small as a Hair, and White, and in Going they are Moved like Waves, not Rare amongst Dry Rubbish; No *Scolopendra*, Ours being an Harmless Insect, and that armed wit Dangerous *Forcipes*. The Body of this *Julus* being Bruised, strikes the Nostrills Exceeding Fiercely.

Musk-Scented Ants; by Dr. Lister, n. 77. p. 3002.

Vid. Sup. §. XXVI. & XXVII.

XXXVIII. Sep. 2. 1671. I found in a Sandy Ditch-Bank about a Mile and an half from York, in the High Road to London, a sort of exceeding small *Pismires* (by which Note alone I think they may be sufficiently Distinguisht from all, at least, that I have seen.) Those without Wings, were of a Light Yellow, or Flaxen, and being Broken at ones Nostrils they Emitted, like Others, an Acid or Jowre scent; but those of the same Bank with Wings, were Cole Black, and these Bruised and smelt to, Emitted a Fragrant smell-like Musk; And an Apothecary in York, Famous for his Diligence in Chymical Operations, did

Compare

Compare them (Unseen and not yet made Known to him) to an Excellent Balsom, he is wont prepare.

vel *Fila mittunt*; ut sunt qui
aut *Prædandi causa Texunt*

vel *Reticula Orbiculata*, Numero IX.

1. *Araneus Subflavus*, Alvo paululum Acuminata inflexaque.
2. *Araneus Rufus*, *Cruciger*, cui utrinque ad Superiorem Alvi partem velut Singula Tubercula eminent.
3. *Araneus Cinereus*, *Pictura Clunium* in 5. fere partes divulsa, iisque plenis admodum.
4. *Araneus Flavus*, 4. Albis præter *Picturam Foliaceam*, in Clune *Maculis insignitus*.
5. *Araneus Nigricans*, Clunibus ad *Similitudinem Querni Foliæ pictis*.
6. *Araneus ex Viridi Inauratus*, Alvo prætenui proceraque.
7. *Araneus Cinereus*, Sylvarum incola, alvo in *Mucronem fastigiata*, seu *Triquetra*.
8. *Araneus Viridis*, *Cauda Nigris Punctis* superne notata, ipso Ano *Croceo*.

9. *Araneus Pullus*, *Cruciger* in alvo plena.

vel *Plagas Globatas*, N. IV.

10. *Araneus Variiegatus*, alvo *Orbiculata*.

11. *Araneus Rufus*, Clunium *Orbicularum fastigio in modum Stellæ Radiato*.

12. *Araneus Pullus*, *Domesticus*.

13. *Araneus Cinereus* *Macula Nigra* in summis Clunibus insignitus, *Minimus*.

vel *Telas sive Linteamina*. N. VIII.

14. *Araneus Subflavus*, *Pilosus*, prælongis pedibus, *Domesticus*.

15. *Araneus Nigricans*, *Prægrandi Macula* in summis Clunibus, cæterum iisdem oblique virgatis, *Domesticus*.

16. *Araneus Fuliginus* è *Craven*, insigni *Candore* distinctus, *Cauda Bifurca*.

17. *Araneus Subflavus*, *Nigrantium Macularum Quadratarum Catena* in Clunibus insignitus; item cui utrinque ad Clunium *Latera singulæ obliquæ Virgulæ Flavescentes*.

18. *Araneus Cinereus*, *Maximus*, *Cauda Bifurca*.

19. *Araneus Niger* aut *Castaneus*, *Glaber*, Clunibus summo *Candore* interstinctis.

20. *Araneus Cinereus*, *Mollis*, cui in alvo, oblique virgata, *Macula latiuscula* è *Nigro Rubens*.

21. *Araneus* plerumque *Lividus*, sine ulla *Pictura* alva *Acuminata*.
aut ideo *Nihil Texunt* (nisi *filorum Ejaculatio* ac *Volatus* illorum spectet:) cum tamen *alias* possint; nimirum *Telas* ad *Tutandum Fætum* aut ad *Hyberna*; sed *Aperto Marte Muscas* Venantur, atque
ii sunt

A Table of Spiders found in England; by Dr. M. Lister, n. 72. p. 2175.

- vel *Lupi dicti*, N. V. Hi vero, cum Superioribus singulis 8 habent Oculos.
22. *Araneus Subrufus*, Parvus, Citissimo Pede.
23. *Araneus Cancriformis*, oculis è *viola Purpurascens*, Tardipes.
24. *Araneus Cinereus*, Alvo undulatim Picta, insigniter Procera, Acuminata:
25. *Araneus Fuscus*, alvo Oblique virgata.
26. *Araneus Niger*, Sylvicola.
- vel *Phalangia*, sive Assultim ingredienti, N. III. Hi vero 6. tantum, Oculos habent.
27. *Araneus Cinereus*, sive ex *Argento Nigroque Varius*.
28. *Araneus Subflavus*, Oculis *Smaragdinis*; item cui secundum *Clunes* 3. virgulæ *Croceæ*.
29. *Araneus Subrufus* è *Craven*, sive *Ericetorum* sive *Rupium*. vel omnino *Nulla Fila mittunt*; ut sunt qui plerique Longissimis Tenuissimisque *Pedibus* donantur: atque Hi duos tantum Oculos habent, *Telaque* sive *Brachia Digitata*. N. IV.
30. *Araneus Rufus*, non *Cristatus*, Gregatim Vivens.
31. *Araneus Cinereus*, *Cristatus*.
32. *Araneus* è *Candido Nigroque Varius*, *Minima Bestiola*, *Sylvicola*.
33. *Araneus*, ut puto, *Coccineus*, vulgo dictus, *a Tant*, *Anglicè*.

Spiders darting their Threads into the Air and Swimming in it; by Dr. Lister, n. 50. p. 1014.

XL. 1. I have discover'd that all Spiders that Spin in a Thread, (those which we call *Shepherds*, or *Long legg'd Spiders*, never do,) are the Makers of those *Long Threads*, in the Air in Summer and especially towards September, so much wondered at, and in such Infinite Quantities every where. I exactly Marked all the ways of Weaving, used by any sort of them, and in those Admirable works, I ever Noted, that they still let down the Thread they made Use of, and drew it after them.

At length in nearly attending on One, that wrought a Net. I saw him suddenly in the mid work to Desist, and turning his Tail into the Wind to Dart out a Thread, with the Violence and Stream we see Water spout out of a Spring. This Thread, taken up by the Wind, was in a Moment Emitted some Fathoms Long, still issuing out of the Belly of the Animal: by and by the Spider leapt into the Air, and the Thread Mounted her up swiftly. After this first Discovery, I made the like Observation in almost all the sorts of Spiders, I had before Distinguished: and I found the Air filled with Young and Old, Sailing on their Threads, and Undoubtedly seizing Gnats and other Insects in their Passage; there being often as manifest signs of slaughter, as Legs, Wings of Flies, &c. on these Threads, as in their Webs Below.

One thing yet was a Wonder to me, viz. that many of these Threads, that Came Down out of the Air, were not Single but Snarled, and with Complicable Woolly Locks, now More now Less; and that on these I did not always find Spiders, though Many Times I had Found Two or Three upon One of them:

them: whereas when they First *Flew Up*, the *T'hread* was still *Single*, or but little *Tang'ed*, or it may be Thicker in one place than another. In the End by Good attention. I plainly found them, to get to the *Top* of a *Stalk* or *Bough*, or some such like thing, where they Exercise this *Darting* of *Threads* into the *Air*; and if they had not a Mind to *Sail*, they either swiftly *Drew it Up* again, winding it up, with their *Fore-Foot* over their *Head* into a *Lock*, or break it off short, and let the *Air* carry it away. This they will do many times together: and you may see of them that have *Chains* of these *Locks* or *Snarled Thread* before them, and yet not taken *Flight*.

Again, I found that after the *First Flight*, all the time of their *Sailing*, they make *Locks*, still *Darting* forth fresh supplies of *Thread*, to *Sport* and *Sail* by.

It is further to be Noted, that these *Complicated Threads*, are much more tender, than our *House Webs*.

In *Winter* and at *Christmass*, I have Observed them busy a *Darting*: but few of them *Sail* then, and therefore but *Single Threads* only are to be seen. And besides, they are but the *Young Ones*, of last *Autumns Hatch*, that are then Employed: and it is more than probable, that the *Great Ropes* of *Autumn* are made Only by the *Great Ones*, and upon Long Passages, and *Summer Weather*, when Great Numbers of *Prey*, may Invite them to stay Longer Up.

2. I have seen *Spiders* shoot their *Webs* 3. *Yards* Long before they begin to *Sail*: and then they will (as it were) *Fly* away incredibly Swift. Which *Phænomenon* doth somewhat Puzzle me: seeing sometimes the *Air* doth not *Move* a *Quarter* so *Fast* as they seem to *Fly*. Mostly they Project their *Threads Single*, without *Dividing* or *Forking* at all to be seen in them. Sometimes they will *Shoot* the *Thread Upward*, and will *Mount* with it in a *Line* almost *Perpendicular*: and at other times, they Project in a *Line Parallel* to the *Plain* of the *Horizon*; as you may Often see by their *Threads* that Run from One *Tree* to another, and likewise in *Chambers* from One *Wall* to Another.

I Confess, this Observation at First made me think, that they could *Fly*: because I could not Perceive, how a *Thread* could be Drawn so *Parallel* to the *Horizon* between two *Walls* or *Trees*, as abovesaid, unless the *Spider* flew through the *Air* in a *Straight Line*.

The way for *forking* their *Threads*, is Expressed by the *Figure*. What Reason should be given of this *Dividing*, I know not, except that their *Threads* being thus *VVinged*, become better Able to sustain them in the *Air*.

They will often *fasten* their *Threads* in several Places to the Things they Creep upon: The manner is, by beating their *Tailes* against them as they Creep along, which may be understood by the *Line a. b.* By this Frequent *Beating* in of their *Thread* among the *Asperities* of the Place where they Creep, they either secure it against the *Wind*, that it be not Easily Blown away: or else whilst they Hang by it, if one stick Breaks, another Holds Fast; so that they do not Fall to the Ground.

By Dr. Hulse, n.
65. p. 2103.

Fig. 203.

Fig. 204.

By Mr. J. Wray.
ib.

3. I had the *First* Notice of this *Darting* of Spiders from Dr. *Hulse*, which was not long after Communicated to me by Mr. *Lifter*; Nor is it any Great Wonder, that inquisitive Persons, applying themselves to Observe and Consider the *Same* Subjects, should make the *Same* Discoveries.

By ib.
p. 2104.

4. Mr. *Lifter* intimates in a Later Letter, That Mr. *Wray* knew nothing of his having Observed the *Darting* of Spiders, no more than he knew that either Mr. *Wray* or any body else had Observed it, until such time as he occasionally sent Mr. *Wray* a Catalogue of our *English* Spiders; Upon which Subject Mr. *Wray* put this among other Questions, whether he had Observed this *Darting* of Spiders.

Whence it appears that this Observation is as well Mr. *Lifter's* as Dr. *Hulse's*.

By Dr. Lifter.
n. 160. p. 592.

5. I take the *Forking* of *Some* Threads (for Dr. *Hulse* Excepts the *Most*) to be meerly *Accidental*; even as it is to our *Hair*: Neither do I think that any such thing is *Designedly* done by the *Animal*, and for as much as I have Observed, *Spiders* Threads of themselves are exceeding Slick and Smooth. There is indeed a *Dividing* in the *Projection* of the *Threads* of many Sorts of *Spiders*, and especially among those which we Distinguish by the name of *Lupi*, which Tribe is most Frequent, and particularly Delighted in *Sailing*, yet this *Dividing* is much of another Nature than *Forking*. These *Lupi* will *Dart* a whole *Stamen* or *Sheaf* at Once, Consisting of many *Filaments*: Yet all of one Length, all divided each from the Other, and Distinct until some Chance either Snap them Off, or Entangle them. But for the most part you may Observe, that the Longer they Grow, the more they Spread, and appear to a Diligent Observer like the Numerous *Rays* in the *Tail* of a *Blazing-Star*. As for that which Carries them away in the *Air*, so Swift off hand, it is as I have already Hinted partly their *Sudden Leap*; and partly the Length and Number of the *Threads* Projected, the *Stream* of the *Air* and *Wind* Beating more Forceably upon them: And thus we see a *Rope* that Unexpectedly Slips, Comes home with a Seeming Violence; and partly (and that much too) the Posture and *Management* of their *Feet*, which, at least by some sort of them, I have Observed to have been Used very like *Wings* or *Oars*, the several *Legs* (like our *Fingers*) being sometimes Close Joyned, and Other times Opened, again Bent, or Extended, &c. according to the several Necessities and Will of the *Sailer*. To *Fly* they cannot be strictly said, they being Carried into the *Air* by *External Force*; but they can, in case the *Wind* suffer them, *Steer* their *Course*, and perhaps *Mount* and *Descend* at Pleasure: and to the Purpose of *Rowing* themselves along the *Air*, 'tis Observable that they ever take their *Flight Backwards*, that is, their *Head* looking a Contrary Way, like a *Sculler* upon the *Thames*. It is Scarce Credible to what *Height* they will *Mount*: Which yet, is precisely True, and a thing Easily to be observed by one that shall Fix his *Eye*, some Time on Any Part of the *Heavens*, the *White Webbs* at a *Vast Distance* very Distinctly *Appearing* from the *Azure Sky*; but this is in *Autumn* Only, and that in very *Fair* and *Calm* *Weather*.

XLII. S. Redi having affirm'd, that Creatures reputed *Venemous* are indeed *No Poysons*, when *Swallow'd* tho' they may Prove so, when put into *Wounds*, Mr. Nath. Fairfax, for Confirmation thereof, alledges Examples of Several Persons well known to him, (Himself also having been an Eye-Witness to some such Experiments) who have Frequently *Swallow'd Spiders* even of the *Rankest Kind*, without any more More Harm than happens to *Hens, Robin-Red Breasts*, and other *Birds*, who make *Spiders* their *Daily Commons*. And having made Mention of some Men that Eat even *Toads*, he Adds, that though a *Toad* be not a *Poyson* to us in the *Whole*, yet it may *Invenome Outwardly* according to some parts so and so stirr'd: An instance whereof he alledges in a *Boy*, who Stumbling on a *Toad*, and Hurling *Stones* at it, some *Juice* from the *Bruis'd Toad* chanced to Light upon his *Lips*, whereupon they *Swell'd*, each to the *Thicknes* of about 2 *Thumbs*.; and he neglecting to Use, what might be Proper to Restore them, they have Continued in that *Mishapen Size* ever since.

The Invenomous-
ness of Spiders
and Toads; by
Dr. Nath. Fair-
fax. n. 22. p. 39.

XLII. Mr. Nath. Fairfax relates, that a *Spider* Bruis'd into a Small *Glass* of *Water*, *Ting'd* it somewhat of a *Sky-Colour*: And he is Informed, that a *Dozen* of them being put in, they would *Dye* it to almost a *Full Azure*.

Spiders Tinge,
Water of a Sky-
Colour, by Dr.
Fairfax. n. 22.
p. 391.

XLIII. Upon the *Dissection* of a *Rattle Snake* which was sent *Alive* from *Virginia* to Mr. Hen. Loades, a Merchant in *London*, I find both its *External* and *Internal Parts* so conformable in almost all *Respects* to those of a *Viper*, that I have taken the *Liberty* of placing it in that *Class*, and from the *Rattle* which sufficiently *Differences* it from other *Serpents*, of Naming it *Vipera Caudifona*.

The Anatomy of
a Rattle Snake;
by Dr. Edw. Ty-
son. n. 144. p. 25.

It was 4 foot 5 inches long; the *Girth* of the *Body* in the *Largest* place, which was the *Middle*, was 6½ *Inches*; the *Girth* about the *Neck* 3 *Inches*, near the *Rattle* 2 *Inches*; the *Head* Flat on the *Top* as is the *Viper*, and by the *Protuberance* of the *Maxillæ* somewhat representing the *Head* of a *Bearded Arrow*; at the *Extremity* of it were the *Nostrils*; between them and the *Eyes* but somewhat lower, were 2 other *Orifices*, which I took for the *Ears*, but after found they only led into a *Bone* that had a pretty large *Cavity*, but no *Perforation*.

Fig. 209. a.

Fig. 209. b.

The *Eye* was round, about ¼ of an *Inch* Diameter: There was a large *Scale* Jetting over the *Eye*, which seem'd to serve as a *Palpebra* for defending it from any thing falling on it; but I could not perceive 'twas capable of *Closing*, tho' *Inwards* it seem'd to have a *Membrana Nictitans*, which removes any *Dust* that might adhere to the *Eye*.

The *Scales* on the *Head* were the smallest of any; those on the *Back* Larger; and so proportionably Greater to the Biggest part of the *Body*; and so Diminishing thence again to the setting on of the *Rattle*; all in *Figure*, somewhat resembling *Parfnip-Seeds*. Their *Colour* was *Various*, those on the *Head* like

like the Colour of the *Feathers* on the Back of a *Green Finch*, speckled with small *Black Spots*; whereof there were 4 larger and more remarkable: Those on the *Back* were a *Dark Feuilemorte* a *Black* and a *Darkish Yellow*, and speckled, making a curious *Chequer* or *Dappling* on the Back by this intermixture of Colours; but as they grew nearer the *Tail* they became *Darker*, and at last almost *Black*. The *Scales* on the *Back* had an Edged Riling in the Middle, which was still Less Protuberant as they grew nearer the *Sides*, where they were Flat.

The *Belly* seem'd Flat, covered with Long *Scales* of a *Yellowish* Colour, Speckled *Black*. From the *Neck* to the *Anus* we Numbred 168. beyond the *Anus* were 2 half *Scales*; thence 19. *Whole Scales* of a *Black Lead-Colour* with *Yellowish Edges*; from thence to the *Rattle* 6. Orders or Rows of smaller *Scales* of the same Colour. The *Scales* of the *Belly* were Joyned to each other by *Distinct Muscles*; the Lower *Tendon* of each *Muscle* being inserted into the upper Edge of the Following *Scale*, and the other *Tendon* of the same *Muscle* inserted about the middle of the Foregoing *Scale*. These *Muscles* were more *Fleshy* towards the Middle of the *Scale*; and then its *Fibres* did run *Obliquely Ascending*. To each *Scale* was appropriated a *Rib*, whose Point did joyn with the Extream of it, which must much Advantage the Use Nature seems to Design them for, by strengthening them to perform their *Reptile Motions*; for the *Scales* are so many *Feet*, which being Free and Open Downwards, they thereby take Hold of the Ground, and so Contract their Body *Forwards*, and then *Shoot* out again; and so perform their *Motion*. Hence it is, that on *Rocks* their *Motion* is much *Quicker*, than on the *Earth*, or *Plains*, because here they have the *Firmer Footing*. But in *Soft Ground*, tho' their *Belly* be *Flat*, yet they can Contract it to an *Ellipsis*, or an *Acute Angle*, that so they may take the *Deeper Hold*; as I have observed in a *Viper*. This *Coat of Armour* (for their Defence,) is so *Curiously* contrived that though it Covers the *Whole Body* yet by its frequent *Joyntings* it admits of all *Motions*.

Fig. 205. sss.

Having placed this *Rattle-Snake* on its *Back*, we *Opened* it: and observed that the *Tendons* of the *Abdominal Muscles* made a *Linea Alba* in the midst of the *Scales* of the *Belly*; where likewise did run a large *Blood Vessel*, arising from the *Vena Cava*, towards the lower part of the *Liver*.

Fig. 205. rrr.

Fig. 205. aaa.

The *Wind Pipe* (which is Common to it with the *Viper-Kind*) as soon as it enters the *Breast*, presently meeting with the *Lungs*, consists only of *Semi-Annular Cartilages*; which being Joyned at both ends to the *Membrane* of the *Lungs* inwardly is quite Open, and immediately Transmits the Air to the *Vesiculae* of the *Lungs*: For Dividing the *Wind Pipe* we perceived it easily extended above $1\frac{1}{2}$ Inch Wide; whereas before it Meets with the *Lungs* the *Cartilages* are *Annular*. The *Trachæa* or *Wind-Pipe* was 20 Inches Long, Terminating near the *Heart* and Beginning of the *Liver*, and Reaching to that part of the *Lungs* which made the *Great Bladder*. The *Cartilages* of the *Trachæa*, near the Beginning were $\frac{3}{8}$ of an Inch, but

Fig. 208. aaaa.

but toward the *End* $\frac{1}{2}$ of an *Inch*, and lying *Flattish* from *End* to *End*. These *Cartilages* were not so *Distinct* as in other *Animals*, but often running into one another.

The *Lungs* begin from the *Throat* and run down 3 *Foot* in length: The *Upper* part of them that lay in the *Fore* part of the *Body* for the Length of a *Foot*, and did reach to the *Heart*, was made of small *Vesiculæ*, or *Cells*, like the *Lungs* of a *Frog*; but, from the frequent *Branchings* and *Chequer* of the *Blood Vessels* there, appeared of a *Florid-Red*. This Part *Tapers* proportionably to the *Body*: The lowest part of it near the *Heart*, moderately *Blown*, was in *Compass* $5\frac{1}{2}$ *Inches*; a little *Lower*, for the space of 4 *Inches*, the *Cells* gradually disappeared, so that they seemed at last to form only a *Reticular Compages* of *Valvulæ Conniventes* on the *Inside* of the *Membrane* of the *Lungs*; and the *Compass* of the *Greatest* place here, was about $6\frac{1}{2}$ *Inches*; but from thence to the *End* of the *Lungs*, was only a *Large Bladder*, without any *Cells*; composed of a *Thin*, but strong *Transparent Membrane*, the *Compass* of which, *Blown* as the former, was $8\frac{1}{2}$ *Inches*.

The *Lungs* of the *Salamandra Aquatica*, and some other *Animals*, are only 2 large *Bladders*; In the *Frog*, *Crocodile*, &c. are two large *Lobes*, fill'd with *Membranous Vesiculæ*, or *Cells*: Our *Rattle-Snake*, and all that *Family*, tho' they have but one *Lobe* of *Lungs*, yet in that they comprise the 2 former sorts; the *Fore* part being fill'd with *Numerous Vesiculæ*; the latter an *Entire* large *Bladder*.

In the *Land Tortoise* there are 2 *Lobes*, one on each side; but these are subdivided into several others, according to the *Partitions* of the *Ribs* that are fixed to the *Shell*; and they lie chiefly in the *Belly*, that is, the *Lower* part of the *Body*. But what I would *Remark* is, that where the *Bronchiæ* first *Enter* these *Subdivisions* 'tis *Reticulous*; then they form a large *Cavity*: so that in these *Animals*, where the *Nixus* of *Respiration* is not so frequent; *Nature* provides a sufficient *Store-House* for this (so necessary a *Pabulum Vitæ*) in these *Larger Bladders*, whence 'tis *Dispensed*, according to the *Exigency* of the *Oeconomia Animalis*. For the *Tortoise*, *Viper*, *Rattle Snake*, *Frogs*, *Toads*, &c. which *Sleep* a great part of the *Year*, as before they betake themselves to this *Repose*, they take in their *Store* of *Food*, so perhaps that of *Air* too; a more *Constantly* *Requisite* supply of *Life*. For when thus *stupidly Asleep*, and sometimes to all appearance *Dead*, it may be questioned whether they have any *Motion* of those *Parts*, which is required for drawing in *Fresh Air* in *Inspiration*. But since their *Life* here is so *Imperceptible* and *small*, this *Stock* may be sufficient, the *Decay* being so little. So the *Salamandra Aquatica*, that *Lives* under *Water*, for *Lungs* has 2 *Large Bladders*, not unlikely for this *Reason*, that it might not be forced so often to *Raise* it self out of the *Water* to *Breathe* in *fresh Air* when the former is spent and decayed.

In a *Viper* I lately *Dissected*, (which remained *Alive* some *Days* after the *Skin*, and most part of the *Viscera* were separated) I observed the *Lungs* all this while not *Rising* and *Falling*, as in *Inspiration* and *Expiration*, but *Constant*, *Equally* *Extended* with *Air*; and that as soon as it *Dyed*, it *Expired* and they

Fig. 205. b.

Fig. 205. ccccc

they *Fell*. But the *Stomach* was *Empty*, and I doubt not was so some considerable time before; as was the *Rattle-Snake's*, which for 4 *Months* at least had *Eaten* nothing; so that although they can live so long without *Food*, yet Nature is mighty *Provident* in supplying them with *Air*, in *Bestowing* on them so large *Receptacles* for receiving it. So the *Ephemeron*, the *Silk-worm* and other *Butterflies*, which all their *Life-time*, when in that *State*, do not *Eat*, or take in any *Food*, yet have their *Bronchiæ*, or *Lungs*, Remarkably large, and *Numerous*; as if they were sufficient alone for *Maintaining* their *Life*; for if they be *Occluded* with *Oyl*, or otherwise, they are *strait suffocated*, and *Dye Convulsed*.

The *Oesophagus*, or *Gula*, which serves only in most other *Animals* for *Transmitting* the *Food* into the *Stomach*, seems here to be intended by Nature for something more; for upon blowing up this Part, I observed two large *Swellings*; nor was the *True Stomach* capable of that *Extension* as these were. The whole length of the *Oesophagus*, was 2 *Foot* $3\frac{1}{2}$ *Inches*; the length of the *Proper Stomach* 5 *Inches*, lying in a *strait Line* with the *Oesophagus*, but *Thicker* than it, having a remarkable *Coat* more on the *Inside*, easily *Distinguishable* by its *Colour*, *Substance* and *Plicæ*, and jetting over the *inside* of the *Gullet*; and in all respects as in the *Viper*. From the *Pylorus* the *Ductus*, streightned again for $1\frac{1}{2}$ *Inch*, and then formed a large *Intestine*, which afforded a *Pleasant Sight*, by the *Weaved Rugæ* of its *Inward Coat*; which *Gut*, after some small *Windings*, Ended at last in the *Rectum*, whose *Capacity* was much less than the former. In the *Stomach* and *Guts*, I observed abundance of *Lumbrici Teretes*; which is a *Disease* *Vipers* likewise are subject to. I take the *Swellings* in the *Gullet* to perform the same *Use* in these *Animals* as the *Crop* in *Birds*, and the *Paunch* in *Quadrupeds*: they being convenient *Receptacles* for retaining what *Food* the *Stomach* cannot yet well receive; and here it seems the more *Requisite*, since they *Feed* but at *One* time of the *Year*. And since in that *Promiscuous Food* they take in, which they swallow always *Whole*, there are often some parts unfit to be *digested*, and therefore to be returned again, the *Gullet* here being very long, and upon that *Account*, *Incommodious* for this *Action*; Nature has provided these *Swellings* in it, where they may be respited till *Recruiting* its *Force*, it gives them another *Lift*, and upon a third *Effort* at last wholly *Ejects* them. And if what is confidently *Reported* by many be true, That on *Occasion* of *Danger*, they *Receive* their *Young* into their *Mouths*, these are fit places for *Receiving* them.

The *Food* before it can prove *Aliment*, must be *Comminuted*, and broken into the smallest *Particles*, which in these *Membranous Stomachs*, I cannot see how it can be performed, but by *Corrosion*. A *Principal Menstruum* in doing this, I take to be that *Liquor*, which is discharged by the *Glands* that are seated, in some at the *Beginning* of the *Throat*, and are called *Salival*; or just above the *Stomach* or *Gizzard* of *Birds*, and called the *Echinus*; or in others in the *Stomach* it self, and called the *Glandulous Coat*, and such I take the *Inward Coat* of the *Stomach* of our

Rattle Snake to be. When *Comminuted* 'tis Discharged into the *Guts*: Which, that the *Chyle* might not pass off with the *Fæces*, are often *Convolutèd*, or *Winding* as here; that so by impeding a too quick *Descent* of it this Way, or by *Valves*, a separation may the better be made; and then the *Fæces*, as usefess, cannot quicker be discharged than by the *Rectum*; which where the *Fæces* are *Hard*, is furnished with a *Stronger Muscle* the better to help its *Action*; and such seem'd the *Rectum* here, and the *Fæces Harder* than Usual in *Vipers*.

Fig. 205. ecc.

The *Heart* was Placed near the bottom of the *Trachea*, on the *Right* side of it. The *Length* of it was $1\frac{1}{2}$ *Inch*, its *Figure* rather *Flat* than *Round*; encompassed with a *Pericardium*, and the *Auricle* Larger than the *Heart* it self. It hath but one *Ventricle*, the *Valves* small, and *Fleshy*, and the *Inside* of the *Ventricle* distinguish'd by 4 or 5 *Cross Furrows*. Why *Charas* should make the *Heart* of the *Viper* to have two *Ventricles*, I see no *Reason*; I should much more easily allow a *Double Auricle*, one at the *Entrance* of the *Vena Cava*, of which there are *two Branches Descending*, and one *Ascending*; the other for the *Arteria Aorta*, which has *Two Ascending* and *One Descending*.

Fig. 205. k.

Fig. 205. l.

Fig. 205. nnn.

Fig. 205. mmm.

A little below the *Heart* lies the *Liver*, which was about an *Inch* wide, in the largest place, and seem'd divided on one side by the *Vena Cava* into 2 *Lobes* of an *Unequal Length*; for that on the *Left* side was about *Ten Inches*, and that on the *Right* side about a *Foot Long*. Its *Colour* was a *Brown red*, and it's *Use* no doubt for the *Separating* the *Gall* that was contained in a *Bladder* seated at some distance below it. This *Gall-Bladder* was 2 *Inches* long; the *Colour* of the *Gall* contained in it a *Grass-Green*, which sweating through its *Coats* had deeply *Tinged* all the adjacent *Parts*; the *Tast* of it, in a *Viper*, which seems the same, for I did not taste it here, was first *Salt*, then a *Sweet-Bitter*. The *Ductus* which brings it from the *Liver*, is *Obscure*, and hard to be found: But the *Ductus Cysticus* by which it empties its self into the *Intestine* is evident enough. It arises from the *Top* of the *Bladder*; so gently *Descending*, passes through that part which *Charas* takes for the *Pancreas*, but which the *Ancients* call'd the *Spleen*; and so *Enters* the beginning of the *Large Intestine*. In *Vipers* indeed, the *Colour* of this *Part*, and *Situation* so near the *Intestine*, seems an *Argument* for *Charas* his *Conjecture*: but here it's *Colour*, which was *Deep-Red*, and such hitherto I have observed the *Pancreas* to be in no other *Animal*, as likewise its *Figure*, not spreading but more *Compact*, seem to favour the *Opinion* of the *Antients*. I have only this to say of it, that it was about the *Bigness* of a *Large Bean*; that it adhered to the side of the *Intestine* at the *Beginning* of it; and that through the *Middle* of it, as is already observed, the *Ductus Biliaris* did pass.

Fig. 205. oo.

Fig. 205. p.

Fig. 205. q.

The *Fat* which was very *Plentiful*, is said to be used by the *Physitians* of *Mexico* with good *Success*, in the *Sciatica*, and all *Pains* of the *Limbs*, and for *Discutting Preternatural Tumors*. The *Membrane* it adhered to, I take for

the *Omentum*; which encompassed all Parts contained in this *Lower-Belly*; and was joined to Both sides of the *Ribs*, so running to the *Rectum*, and forming a *Bag* that Inveloped the Parts here, but was Free and not Conjoined towards the *Belly*. The *Lower Belly* I call it, to Distinguish it from the rest of the *Trunk*, for the Whole was but one continued *Cavity*; there being no Partition of it by any *Diaphragme*.

Fig. 206.

The *Two Kidneys* which lay to the *Back* on each side of the *Spine*, but not very firmly conjoined, were about 7 *Inches* long; that on the *Right* side something Longer than the *Left*, and about $\frac{1}{2}$ *Inch* Broad each: And tho' the *Substance* of it seems One Continued Body, yet it is plainly distinguishable into several *Lesser Kidneys*; for they ought to be reckoned as many as there are distinct Systems and Orders of *Vessels*; which, according to the Advantage of the Body of this *Animal*, are placed *at length*, not *Piled* on one another. As I remember in one of the *Kidneys* I numbred 15, all very curiously Contrived, and with an inexpressible Beauty. When they were first taken out of the Body, the Whole seemed a delicate *Compages* of *Vessels*, and the Intermixture of those of the *Blood* with those other *White* ones, that are the *Secretory*, composed most Regularly-formed Bodies. In the *Figure*, that on the *Left* side represents the *Upper Superficies* of the *Kidney*, which appears first in the *Dissection*; the other, the *Lower* side which lies to the *Back*; in both there are two large *Blood Vessels* running down each side; one marked *mm*, the other, where the *Vas deferens* runs, but is not here Represented; and from these arise several *Lesser Branches*, *ooo* at set distances, which curiously spreading themselves do Form, as it were *Ramifications* of *Trees*. As many as there were of these *Emulgent Vessels* (for so I take them to be) so many *Kidneys* were in each; the Interstices, *ppp* of these *Blood-Vessels*, were filled up with other *White* ones; which I doubt not are for the *Secretion* of the *Urine*, and on this side did appear more numerous, than on the other. But 'tis Impossible to Represent the Curious interweavings of both; but here in the *Under-side* of the *Right Kidney*, in some places, they appeared more distinct; for *QQ* shews the Large *Blood Vessel*, whence arises the *Emulgents*, *rrr* which spreading themselves very thick into the Bodies, *sss* make them appear all *Bloody*; between which for a little space, there appears a small Body of the *white Secretory Vessels*, *ttt*. The Use of this Part, in all *Animals*, is for carrying off the *Lixivial* and superfluous *Serum* of the *Blood*: which is of so great Consequence, that even those *Animals* that *Drink not* at all, or but very little, yet by Nature are furnished with them; as the *Rattle-Snake* may be thought. When the *Separation* of this *Humour* is made in the *Kidneys*, 'tis Conveyed thence by the *Ureters* into a *Bladder*, if the too frequent Exclusion of it might be Inconvenient to the *Animal*; or, if it be made in Lesser Quantity, into a *Cloaca*, just at the *Anus*, and so to be Ejected.

Fig. 206. uu.

The *Ureters* did run almost the Length of the *Kidneys*: being a common *Trunk* that received the *Lesser Branches* that went to each single *Gland*, and did Terminate near each other in the *Cloaca*, making a *kissing* there

there; for our *Rattle-Snake*, like *Birds*, had a *Cloaca*, which in the *Female Viper*, receives the Orifices of the *Ureters*, and the *Two Uteri*; and in part may be said that of the *Rectum* too, which had a *Connivent Valve* that Covered it.

Near the Verge of the *Cloaca*, we observed two other *Orifices*, which seemed Covered by the Folding of the Skin; and these led into those *two Bags* which I have taken the Liberty to call the *Scent-Bags*: One of them was about an *Inch* Long, and as big as a *Goose-Quill*, but Taper towards the End, and from the Colour of the *Liquor* it contained, appeared *Darkish*: The other *Bag* was something less, and its Colour as in the *Viper*; this Difference, I suppose, may be *Accidental*. The *Liquor* included in them was something *Crafs*, and of a strong and very *Unpleasant Smell*; such, but in a more Intense Degree, as the *Animal* did Emit before *Dissection*.

I shall here add, that our *Common Snakes* have a far greater *Fætor* (which lies in the same *Bags*) than our *Adders* or *Vipers*: And I have been told by *Travellers*, that some *Crocodiles* will leave a strong, but *Grateful Smell* behind them; which, if so, I doubt not but it may be upon the same Cause.

But usually, tho' this *Liquor* when new, and in great *Quantity*, be *Offensive*, and of an *Ill Smell*, (and such is *Civet* likewise, which is nothing else) yet when *Dry*, and in *Lesser Proportions*, it may prove more *grateful*.

Thus the *Liquor* in the *Scent-Bags* of a *Weasel* being *Dryed* on a *Paper*, and kept some time, did not seem *Unpleasant* to me; but rather the contrary: And I see no Reason why *Pole-Cats* may not be *Civet-Cats*, though they may not turn to that Account. But in a *Lyon* I *Dissected*, the *Liquor* contained in the *Scent-Bags* was, in the Opinion of all that *Smelt* it, much like that of *Oyl* of *Anise*, or *Fennel-Seed*; which was almost the Only Difference I could find between the *Lyon* and a *Cat*; for in a *Cat* this *Liquor* is *Ill scented*.

The *Testes* are very *Unproportionate* in Length, the Right being $2\frac{1}{4}$ *Inches* Long, the Left $1\frac{1}{4}$ *Inch* long, scarce so big in *Compass* as a *Goose Quil*. The *Unequal Length* of this Part *Charas* takes notice of in *Vipers*; and I shall add, that the *Ovarium* of the *Female Viper* is the same; for that of one side was as big again as the other. The Colour of the *Testes* was *White*, as is usual, and so was their *Substance*. The *Vasa Præparantia* had nothing *Uncommon*: But the *Deferentia* were *Remarkable*; for though they did run in a straight *Line* almost from the *Testes* to the *Penis*, and did form no large *Body*, yet this *Ductus* was so often *Involuted*, that were it *Unravelled* and *Extended* its whole length, 'twould be twice as long; which made me think that it was only the *Extension* of the *Epididymis*; for the whole *Testis* is but a *Congeries* of curiously *Convolutèd Vessels* which terminate in the *Epididymis*, whose *Continuation* makes the *Deferens*. And where its *Convolution*s are many upon the *Body* of the *Testis* it self, there the *Deferens* is an even *Ductus*: But as in our *Subject* it making

Fig. 206. mm.

Fig. 206. kb.

Fig. 206. ii.

Fig. 207. a.

making no such Body there or but a very small one, in its Passage downwards it was every where Crimped, and about the middle of the *Kidneys* often *Convolut*ed. Upon the *Dissection* of a *Viper*, I have since found that they were Continued along the *Penis*, *Single* where the *Penis* was so, and afterwards *Divided*, and did run to the End of Each: Nor, were there any *Vesiculæ Seminales* or *Prostrates* here to Receive them.

Fig. 206. kk.

There were 4. *Penes*, two on each side, which lay *Sheathed* in the Body: so that upon first Opening it they were not perceived, but only the large *Orifices* where they were drawn in as a Finger of a Glove may be by a Thread fastened to the end. But having Protruded them by a *Probe*, they appeared as is represented in the *Figure*. And I did observe that towards the *Basis*, or Root, they were *single* of each side, and that here they were thick beset with Prickles, whose Points looked Backwards, and were very sharp, and seem'd, especially when Dry, like the Substance of the Bristles of a *Hedge-Hog*: but hence they were Divided, and did Form two Round Bodies of the bigness of a small Goose Quill, about $\frac{3}{4}$. of an *Inch* Long, of a *Red* Colour, but the whole, as Protruded, was above an *Inch* Long. When protruded I found they could easily be Retracted, and Drawn in by the help of Large *Muscles*, that were fastened to them and did run along under, and were at last Inserted at the End of the *Tail* at the setting on of the *first Rattle*; which upon the Trial was so plain that we needed not doubt of the Use of them, and I shall therefore call them *Retractores Penum*. There are several *Animals* that have no *Penis* at all, but *Vasa Deferentia*; as most *fishes*. All *Quadrupeds* that I know of have but a *Single* one. Some *Birds* have but *One*. Most others, if they may be said to have any, have *two*, but very short. In *Crabs*, *Lobsters*, &c. there are *two* long ones, one on each side: but *Earth-worms*, *Leeches*, *Shell-snails*, &c. are *Hermaphrodites*, and have the perfect *Organs* of *Both sexes*. But where the *Sex* is *single*, the *Rattle-snake* and that *family* have these *Organs* of *Generation* the most Numerous of any I have hitherto met with. But why the *Male Rattle Snake*, or the *Male-Viper*, should have 4. *Penes*, when the *Female* has but 2. *Uteri* for receiving them, seems a Difficulty to me. Amongst many Conjectures I have had about it, what seems the most to satisfy me, is this; That they have the *Penis* here on each side *double*, or *Forked*, that so being entered the *Uteri*, by spreading themselves like the *Pythagorean Y*. they may the better and more firmly be Retained there till they have performed their Duty. And this too seems one Use of the *Aculei*, or *Bristles*, towards the *Root* of them: for having their points looking Backwards when once they have entered the *Pudendum*, they must needs Lock them in, and retain them there, till such time as the parts being tired, and Subsiding, have leave to Retreat. For in *Animals* that have no *Vesiculæ Seminales* 'tis requisite that the *Coitus* be *Long*, that so the *seed* which cannot Quickly, may Leisurely, be Transmitted from the *Testes*: but where 'tis before hand Stored up in the *Vesiculæ*, there the *Coitus* is soon over; but when they must Expect the *Generation*, or at least a Sluggish Descent of it, Nature makes Provision for the more convenient performing it. So in *dogs*, which have no

Vesiculæ

Vesiculæ Seminales, near the *Root* of the *Bony Penis* there is a Large Body made up of an abundance of Cells and Vessels: which upon the Rushing in of the *Blood* and *Spirits*, is so mightily Extended and Swelled, that it forceably keeps him in, till such time as the *Impetus* be over, and the part Subsides. So the *Lump fish* on it's *Breast* has a Large Round Body Curiously contrived, like the *Tail* of a *Leech*, or the *Acetabulum* of the *Polypus* by which it can firmly adhere to the *Females*, and so by this Means, tho' its *Penis* be very short, yet be able to perform a *Coitus*. *Cats*, *Lyons*, &c. which have likewise very short *Penes*, that they may the better Cling, are forced to make Use of their *Teeth* and *Claws*, and from the Pain of these, not from the Scalding of the *Seed*, come those fierce *Scrieks*, and Hideous *Yowlings*. Therefore in our *Rattle Snake*, (where, as we have observed, there are no *Vesiculæ*, and where the *Vas Deferens* is all along Crimped and Winding: and so upon both Accounts must be thought to be long in *Coition*) the Contrivance and Structure of these Parts seem very Requisite. For altho' in this Action they Twist their Body, which may be some Advantage too, yet not Sufficient alone: for otherwise upon a little Occasion the Parts would be apt to Slip out, which now they cannot, being *Forked*, and *Hooked in* too by the *Aculei*, or *Bristles*. But the *Deferentia* being Continued to the End of the *Penis* do likewise shew this must be the Use of them. But that the *Female* may receive no Injury by these *Spines*, Nature has made that Part of the *Uteri* which they Enter, Strong and Gristly; as we observed in a *Viper*: and that the *Male* too might not be Harmed by an over Extention of these Parts, those strong *Muscles*, which serve for *Retracting* and Drawing them in, do likewise secure them in this respect too. It may be likewise considered, since they are Naturally so Cold and *Frigid*, whether these *Aculei* may not serve to Incite them, and stir them up.

The *Head* was but small, yet the *Rictus* was very Large. The *Tongue* in all respects like that of a *Viper*, was composed of 2. Long Round Bodies, Contiguous and joyned together from the *Root* $\frac{2}{3}$ of its Length, with great Agility they could Dart them out, and Retract them again; and that part which appeared out was of a *Black* Colour, whereas that which lay *Sheathed* within was *Red*; for 'twas fastened below the *Throat*, and thence was Covered with a *Vagina*, or Sheath to the place where it Issues out, which was near to the End of the *Larynx*; and for the better *Ejaculation* of it, the under *Jaw* too was here Divided, leaving a considerable Space.

For if it were conjoyned as in other *Animals* and beset with *Teeth*, they would be apt to injure the *Tongue*; or at least it might prove incommodious to the Use 'tis designed for, which in part I suspect with *Charas* to be for Catching *Flies*, and such small Creatures, they have a mind to Devour.

Over the *Tongue* did lye the *Larynx*; not formed with that Variety of *Cartilages* as is Usual in other *Animals*, but so as to make a *Rime*, or *Slit*,

Fig. 209. e.

Fig. 209. d.

Fig. 209. f.

for

for Receiving or Conveying out the *Air*. Nor was there any *Epiglottis* for preventing other Bodies from Slipping in; this being sufficiently provided for, by the Strict Closure of them: And the *Air* passing only through such a *Slit*, without the Contrivance of other Parts for Modulating it, can only make such a *Sound* as we observe in their *Hissing*.

Fig. 209. cc. b.

Fig. 209. dd.

Fig. 210. b.

Fig. 211.

Fig. 210. g.

Fig. 210. f.

The *Teeth* are of Two sorts. 1. The Lesser which are seated in each *Jaw*, and serve for the Catching and Retaining the *Food*. 2. The *Poysonous Fangs* which Kill it, and are Placed without the *Upper-Jaw*. They are all *Canini*, or *Apprehensores*: for since they do not *Chew* or Bruise their *Food*, but Swallow all Whole as they meet with it, there is no need of *Molars*. Of the first sort of *Teeth*, in the *Lower Jaw* there are 2. Rows on each side; 5 in a Row, the Inward Lesser than the Outward: so that there are here 20 in all. In the *Upper Jaw* there are but 16. 5 on each side Placed Backwards, and 6. before: These do no Harm. The *Fangs* are placed without the *Upper Jaws*, towards the Fore part of the *Mouth*, not fastened to the *Maxilla*, as the other *Teeth*: but the two Outmost and Largest *Fangs* were Fixt to that *Bone*, which, if any, may be thought to be the *Ear-Bone*. The other *Fangs* I could not perceive were fastened to any *Bone*, but to *Muscles* or *Tendons* there. These *Fangs*, or Larger *Teeth*, were not to be perceived upon First Opening the *Mouth*, they lying Couched under a strong *Membrane* or sheath; but so as did make a large Rising there on the Outside of the *Lesser Teeth* of the *Maxilla*: but at pleasure when *Alive* they could Raise them to do Execution with; not unlike as a *Lyon* or a *Cat* does it's *Claws*. These *Teeth* were Hooked and Bent like the *Teeth* of a *Barbarossa*: but some of the *Smaller* of them were Bent at *Right-Angles*. On each side we met with about 6. or 7. but not placed altogether so exactly as in the *Scheme*. In all these *Teeth*, especially the *Larger*, we took notice of a pretty large *Foramen*, or Hole, towards the *Root* of it; and towards the *Point* there was a plain Visible and Large *Slit*, like the Cut of a Pen Sloping; and that part from the *Slit* to the *Root* was perfectly *Hollow*: which first of all was Discovered to us, by pressing gently with our Finger the side of the *Gumme*; for then we did perceive that the *Poyson* did readily Arise through the *Hollow* of the *Teeth*, and Issued out of the *Slit*.

This *Poysonous Liquor* I observed to be of a *Water Colour*, lightly Tinged *Yellow*. What the *Poyson* of *Serpents* is, and how it produces its Dire Effects, has been of Late Contested between S. *Redi* & M. *Charas*. 'Tis *Redi's* Opinion, that the *Yellow Liquor* contained in the *Vesicles* of the *Gummes* of *Vipers*, is the Only and True Seat of the *Poyson*; That this Juice is not *Venemous*, when taken in at the *Mouth*; but that it is so when let into *Wounds*, whether it be used when *Liquid*, or after it is *Dryed*. But M. *Charas* wholly Opposes this, and Asserts, that the *Poyson* is no where but in her *Inraged Spirits*; and that this *Yellow Juice* is nothing but a meer *Innocent Saliva*.

But the Fabrick of the *Teeth*, (they being thus *Hollow*, and having that Large *Slit* towards the End, and this *Juice* so readily and naturally issuing through them) seems to me to Argue, that Nature Designs it for other Uses than *Nourishment*; so if so, by giving them so Large a Vent she would be frustrated of her end. But they being so Sharp and strong at the Ends, and the *Slit* too placed towards the Back, not inside of the *Tooth*; what can be more conveniently Contrived both for making the *Wound* and infusing the *Poyson*? For if the *Slit* was inwards, by the struggling and Withdrawing of the *Animal* Assaulted, the *Slit* would be apt to be stopt, and Occluded; and the Descent of the *Poyson* prevented: But being thus formed, it gives a greater Advantage for its *Infusion*. Thus the *Scorpion*, the *Bee*, the *Emmet*, nay the *Sting* of a *Nettle*, at the same time they make a *Wound*, they leave behind them a Drop of *Liquor*, which excites those Dreadful *Symptoms*: Whereas the *Wound* without it, would be inconsiderable. And what has some Weight with me, (contrary to the Sentiments of M. *Charas* of the *Innocence* of this *Liquor*) is a Relation I had from an intelligent and Knowing Person; who informed me that being in the *Indies*, there came to him and his Company an *Indian* with several sorts of *Serpents*, and offered to shew them some Experiments about the Force of their *Poyson*, and the Difference of them; and that his Practice is Common with them. Having therefore pull'd out a Large One, the *Indian* told him that this would do no Harm; therefore making a *Ligature* on his Arm, as they do in *Letting Blood*, he Exposed it Naked to the *Serpent*, having first Whipt and Irritated him to make him Bite it. The Blood that came out of the *Wounds*, made by his *Teeth*, he gathered with his Finger, and laid it on his Naked Thigh till he had got near a *Spoonful*. After this he takes out another call'd *Cobras de Cabelo*, which was Lesser, and enlarges much upon the Greatness of its *Poyson*; and to shew them in part an instance of it, Grasping it about the Neck, he Expresses out some of the *Liquor* in the *Baggs* of the *Gummes* about the Quantity, as he thought, of $\frac{1}{2}$ a *Grain*, and this he puts to the *Coagulated Blood* on his Thigh, which as soon as mixt with it straight put it into a great *Fermentation*, and Working like *Barme* Changed it into a *Yellowish Liquor*. The same has been likewise observed by others, and does seem to give us some Light, how 'tis that this *Poyson* Acts, and confirms the known Observation, that the *Biting* of a *Viper* will Cause the *Yellow Jaundise*. A present Antidote for this *Poyson* is said to be the *Snake-Stone*; *Pierre de Cobras de Cabelo* 'tis call'd by the *Portugueses*, and is Famous all over the *Indies*: 'tis Described by *Gracias ab Horto*, by *Kircher* and others; particularly by Senior *Redi* who renders very much suspected the Relations that are commonly had of its great Force and Virtue: But that it does not always Fail some Accounts I have had of Persons Relieved by it here in *England*, have Convinc'd me. One instance is Remarkable that was told me by an Eminent Physitian in *London*, of a Person near the Town that was Bit by a *Viper*; his Hand and Arm soon Swelled with great Extremity of *Pain*: But upon the Application of this *Stone* for one Night both were Asswaged, and he thought himself well, and took off the *Stone*, which did still firmly Adhere. But not long after his former

former *Symptomes* violently returning, he had recourse to his *Antidote*, and then suffered it to continue there till it Fell off it self, and so was Cured. One Tryal I formerly made my self, in a Patient troubled with the *Gout* in her *Stomach*; having removed it thence, it seiz'd her *Toe*: but she being impatient of the *Pain*, that I might seem to do something, and to hinder her using abundance of Medicines, which every Body was like to advise her to, and might be apt to strike it to her *Stomach* again, I thought of this; holding the *Stone* therefore in my Hand, and without acquainting her, I put it near the *Foynt* where her *Pain* was most; and being very near it, I perceived it move out of my Hand, and readily Adhere to the Part. Soon after she acquainted me, that she very sensibly perceived a great Drawing and Trickling all down her *Leg* and *Thigh*, and afterwards owned an *Abatement* of her *Pain*. In *Pestilential Swellings* very Probably it may be of *Use*.

Amongst the *Bones* of the *Head*, I observed that the *Cranium* here was Entire, and without *Sutures*: only where some other *Bones* were joyned to them; as forwards over the *Nostrils* were 2 *Small Bones*, to which were fastened the *Cartilages*, or rather *Bones* which Divide the *Nose*. The other *Bones* seemed admirably Contrived for the great Extension, and Widening of the *Maxillæ*: Which seems a great Provision of Nature; for since it must Swallow all things *Whole*, and its *Head* is but small, without this most *Mechanical* Contrivance it were impossible to do it. The *Upper Jaw* Forward was joyned to the *Bone* that receives the *Poysonous Fangs*; and which had a Large *Cavity* in it, which Opened *Outward*, and was thought to be the *Foramen* of the *Ear*: but *Inwards* we observed No *Perforation* for a *Nerve*, unless there might be one that comes to it under that *Bone* which conjoyns it to the *Cranium*. This *Articulation* seems Advantagious, both for the *Motion* of the *Fangs*; which Lye sometimes *Couched*, sometimes *Erected*; as of the *Jaw* too: but its Principal and most Remarkable Advantage for *Swallowing* Large Bodies, is the Curious *Articulation* of the *Maxillæ* Backwards to the *Cranium*. by 2 *Bones*, which from their Use (since we know no Name to Distinguish them by) we shall call *Maxillarum Dilatores*. Their Shape, Bigness, and Aptness for this *Motion* will readily enough be conceived by the *Eye* in observing the *Figure*. For the *Lower Jaw* being not Conjoyned at the *Mentum*, as is usual in other *Animals*, but *Parted* at a good Distance; upon the receiving a Large Body, as the *Membrane* here to which they are Fastened easily Extends, so by Lifting up, as also by Bringing these 2 *Bones* more to a straight Line, it must needs considerably widen the *Rictus* of the *Mouth*: and for this Cause too they are made *two*, not *one*, for performing this *Motion* more easily. This *Articulation* of the *Dilatores* (which is very Curious) with the *Upper* and *Lower Jaw*, makes those *Protuberances* of the *Head*, which we likened to that of a *Bearded Arrow*. The *Lower Jaw* of each side was Composed of *two Bones*, as appears in the *Figure*, but firmly conjoyned. The *Fore Bone* was for receiving the *Small Teeth*, the *Hinder* towards the *Articulation* grew Broad; as likewise did the *Bone* of the *Upper Jaw* answerable to this place in the *Lower*. But this *Upper Jaw*, towards the *Poysonous Fang* Divided into *two Bones*; one was fastened to the *Bone* of the

Poisonous Fang Outwards; the other, which received the Small Teeth, was inserted into the same Bone more inwards.

The *Vertebræ*, according to the whole Figure of the Body, were smallest towards both Extrems, and Largest in the Middle. From the Neck to the *Anus* there were as many observed as Scales on the Belly. viz. 168. but from the *Anus* to the setting on of the Rattle, 29 more in Number than the Scales.

The former *Vertebræ* had a Flat Upright Spine towards the Back; and a Slender Round oblique Descending one inwards to the Belly. To each *Vertebra*, besides those Spines just mentioned, there were other *Processus's* for the Advantage of Setting on of the *Ribs*, and the *Articulation* with one another: But what was most remarkable the Round Ball in the Lower part of the Upper *Vertebra*, which enters a Socket of the Upper part of the Lower *Vertebra*, like as the Head of the *Os Femoris* does the *Acetabulum* of the *Os Ischij*; by which Contrivance, as also the *Articulation* with one another, they have that Free Motion of Winding their Bodies Any Ways. The *Ribbs* in the Neck were small, but Larger towards the Middle of the Body, where they were about 2 Inches long: but towards the Tail they grew Lesser and Shorter again; and did all Terminate at the Beginning of the Scales of the Belly. In the *Vertebræ* of the Tail inwards there were 2 Spines: Whereas in the other *Vertebræ* there was but one; as likewise there were here Transverse slender *Processus's* something Analogous to *Ribs*.

To the Last *Vertebra* of the Tail was fastened the Rattle; in our Subject there was but 5. but some others seemed to be Broken off. That next the Tail was of a Lead-Colour; the others, of a Cinnicous. 'Tis well Described by Dr. Grew, in his *Museum Reg. Soc.* This Rattle, (according to *Gulielm. Piso* (and I know no other use of it) - was given by Nature to this Pernicious Animal, *ut illius Sonitus admonitus quilibet Homo non solum, sed & quaecunque Pecus, vel Jumentum, tempestivo sibi Caveat à vicino Hoste.* Some Authors assert, that every Year there is an Addition of a New Rattle; which Dr. Grew suspects, for then he must Live 16 Years; for so many Joints there are observed in some in our Repository; I have been told, in some there have been above 20. These Rattles are placed with their Broadest part Perpendicular to the Body, not Horizontal. And the First is fastened to the Last *Vertebra* of the Tail by means of a thick Muscle under it; and by the Membranes that Conjoyn it to the Skin.

Fig. 205. Represents the Upper part of the Body Opened, *aaa*. The *Aspera Arteria*. *B*. The Upper part of the Lungs, which is Vesiculous. *cccc*. The Lower part of the Lungs, which makes a Large Bladder. *d*. The First Swelling of the Oesophagus, or False Stomach. *eee*. The Oesophagus, or Gullet, and that part of it where 'tis Streighter. *f*. The Second Swelling of the Oesophagus, or Second False Stomach. *g*. The True Stomach. *h*. A short Streightning of the Gut, a little below the Pylorus. *i*. The Intestines. *k*. The Heart. *l*. The Auricle. *mmm*. Three Arteries, whereof there are 2. Ascending, and one Descending. *nnn*. Three Large Veins, whereof 2 are Descending, and

Fig. 212. a. b.

Fig. 212. c. d.

Fig. 212. e.

Fig. 213. bb.

Fig. 11, 12.

Mus. R. S.
pag. 51.Explication of
the Figures,
Designed by Mr.
Rich. Waller.
ib. p. 55.

the 3d. *Ascending*; which last does seem to Divide the *Liver* into two *Lobes*.
 oo. The *Liver*. p. The *Gall-Bladder*. q. The *Spleen*, as 'tis call'd by the *Antients*; but by *Charas*, the *Pancreas*. rrr. A large *Blood-Vessel* that runs in the midst of the *Scales* of the *Belly*. ss. The *Muscles* belonging to the *Scales* of the *Belly*.

Fig. 206. The *Parts* Contained in the *Lower* part of the *Body*. aaa. The *Intestines*. b. The *Gall-Bladder*. c. the *Ductus Bilarius*, that passes through the Middle of the *Spleen*, or as call'd by *Charas*, the *Pancreas*, and Enters the large *Gut*. d. The *Spleen*, or *Pancreas*. ee. The *Intestines*, which was very large and *Winding*, but *Short*. ff. The *Rectum*. g. The *Anus*. hb. The *Testes*. ii, ii. the *Vasa Deferentia*. kk. the *Penes* on each side, which First at the *Root* are *Conjoyned*, and are thick beset with *Bristles*. l, l. The *Muscles* that serve for the drawing in the *Penes*. m m. The *Scent Baggs* n n. A Large *Blood Vessel* that runs on one side of the *Left Kidney*. oo. The *Emulgents* that arise from the same, p p p. The *Secretory Vessels*. Q Q. The Large *Blood Vessels* of the *Right Kidney*. rrr. The *Emulgents* arising from it. sss. A Round *Body* of *Blood Vessels* ttt. *Secretory-Vessels*. uu. The *Ureters*.

Fig. 207. The *Penes* of one side of a *Viper*, a. The *Vas Differens*, which afterwards *Divides*, and runs to the End of the *Penes*. b. The *Penes* c. The *Muscle* which *Retracts* the *Penes* in.

Fig. 208. The *Lungs* Open'd by the *Trachea*. aaaa. The *Arteria Aspera*, Divided in the middle. bbb. some Larger Branches of *Blood-Vessels*. ccc. The *Vesiculæ*, or *Cells*, of the *Lungs*.

Fig. 209. The *Head*, with its *Mouth* Open'd. a. the *Hole* of the *Nostril*. b. the *Foramen* which Leads to a large *Cavity*, which has no *Perforation* for any *Nerve* inwards: but yet 'tis thought to be for *Hearing* cc. the *Small Teeth* in the *Upper-Jaw*. dd. the *Large Fangs*, or *Poysonous Teeth*. eee. the *Place* where the *Bladders* of *Poyson* lye, f. the *Larynx*. g. the *Forked Tongue* h. the *Teeth* in the *Lower-Jaw*. i. the *place* where the *Lower Jaw* is *Divided* at the *Mentum*.

Fig. 210. The *Scul*. a. the *Cranium*, without any *Sutures*. bb. the *Orbits* of the *Eyes*. cc. two small *Bones* over the *Nose*. d. the *Gristly*, or rather *Bony Sepimentum* of the *Nose*. ee. A small *Bone*, that lyes between the *Cranium* and that *Bone* in which is fixed the *Poysonous Fangs*. ff. A *Cavity* in that *Bone*, to which is fastened the *Poysonous Fang*, whose *Outward Orifice* is represented in Fig. 209. by the Letter. b. and is thought to be the *Ear*. g. the *Large Poysonous Fang*, which is fastened to the *Ear Bone*. h. the other *Poysonous Teeth*, which are not *Fixt* in the *Bone* but to *Muscles*. ii. the *Upper Maxilla*, which contains the *Small Teeth*. kk. One side of the *Lower Maxilla*, with its *Double Row* of *Teeth*, which in the Middle seems to be joyned by a *Suture*. l. the *Distance* at the *Mentum*, between the two sides of the *Lower Maxilla*, or *Jaw*. mm. Where the two *Maxillæ* are joyned together *Backwards*, and by a *Tendon* are fastened to another *Bone*, which from its Use, and for *Distinctions* sake, we call *Dilatores Maxillarum*

illarum. mm. the Dilatores of the Jaws. *oo.* A short Bone which Joyns the Dilator's to the Skull, or Cranium. *p.* the Vertebrae of the Neck.

Fig. 211. The Poysonous Teeth.

Fig. 212. One of the Vertebrae of the Back. *a.* the Outward Spine, of the Vertebrae, which is Flat Longways. *b.* the Inward Spine of the Vertebrae, which is Round. *c.* A large Flat Processus, for the Articulation of the Vertebrae. *d.* Small Transverse Processus's for the setting on the Ribbs. *e.* A Round Ball, like the Head of the Os Femoris, which enters a Socket of the Lower Vertebra, as that does the Acetabulum of the Os Ischii.

Fig. 213. One of the Vertebrae of the Tail, *a.* the Spine towards the Back. *bb.* the two Inward Spines. *cc.* the Transverse Spines, Analogous to Ribbs.

Fig. 214. The Vertebrae of the Tail, and the Musculous Flesh which fastens the First Rattle. *a.* the Vertebrae. *b.* the Muscle on which is fastened the Rattle.

Fig. 215. A Single Rattle, which has 3 Joints: the First and Largest appears when Conjoyned with others; the two other serve for the Fastening on the Succeeding Rattles, and are Covered by them.

Fig. 216. The Five Rattles as joyned together.

XLIV. The Wild-Penny-Royal or Dittany of Virginia, groweth straight up about one Foot high, with the Leaves like Penny-Royal, with little Blew Tufts at the joyning of the Branches to the Plant, the Colour of the Leaves being a Reddish-Green; but the Water Distill'd, of the Colour of Brandy, of a Fair Yellow: The Leaves of it Bruised are very Hot and Biting upon the Tongue. Of these Leaves so Bruised we took some and having tyed them in the Cleft of a long Stick, we held them to the Nose of the Rattle-Snake, who by Turning and Wriggling laboured as much as she could to Avoid it: But she was Kill'd with it, in less than half an Hour's time; and, as was supposed, by the Scent thereof. This was done A. 1657 in July, at which Season those Creatures are reputed to be in the greatest Vigour for their Poison. It is also remarkable that in those Places where the Wild Penny-Royal or Dittany grows, no Rattle-Snakes are Observed to come.

A Way of Killing Rattle Snakes; by Capt. Silas Taylor. n. 3. p. 43.

n. 4. p. 76.

XLV. There is this Difference between the Brooding of Snakes and Vipers; the Snakes lay their Eggs in Dung-hills, by whose Warmth they are Hatched: but the Vipers Brood their Eggs within their Bellies, and Bring forth Live Vipers. To which may be added, that some Affirm to have seen Snakes lye upon their Eggs, as Hens sit upon theirs.

The Brooding of Snakes and Vipers; by n. 8. p. 138.

XLVI. In order to examine the Opinions, of M. de la Chambre, S. Redi, and others, concerning the Poison of Vipers, Dr. Francini came to the House of S. Magalotti 2 Jun. 1672. and sent for a Box in which were a great many Heads, cut off that Morning, of Vipers lately come from Naples; S. Magalotti also sent to the Publique Market for a couple of Pigeons, to be sure of having some that

Experiments made with Vipers; by Mr. Tho. Platt. n. 87. p. 5060.

were not Prevented by any *Antidote*. The *Pigeons* being come, the *first* was wounded with the *Teeth* of a *Viper's Head* that had been cut off about 7 or 8 a Clock the same Morning. The way of making the *Wound*, was by thrusting twice the *Master-Teeth* into the fleshy part of the *Pigeon's Breast*, till such time as pressing the Upper part of the *Jaw*, the two little *Bladders*, that serves as *Gums* to the *Teeth*, did empty out upon the *Wound* some of that *Yellow Liquor* which here is supposed to be the True and Only *Poison* of the *Viper*. This *Pigeon* being thus *Bit*, and set upon the Ground, began to stagger immediately, and Dyed in less than 3 or 4 *Minutes*. The *second Pigeon* was Wounded in the same Manner; but at the first *Wound* there only Entered one of the *Teeth*, which brought forth a great deal of *Blood*; the second time they both Entered, and this had the same Fate, with this difference only, that he Languisht *half a quarter* of an *Hour*.

The next Morning 6 *Pigeons* and a *Cock* having been brought, Dr. *Francini* at first, thrust several *Thorns* of *Rose Shrubs* into the *Breast* of one of those *Pigeons*, to manifest, that such *Accidents* as might befall those that should be *Wounded* by the *Teeth* of the *Dead Vipers*, were not meerly caused by the *Wound*; and afterwards for the further satisfaction of the Company, he took a *Pin*, which was none of the least, and gave another *Pigeon* a very *Deep Wound* in the *Breast*, which was no sooner got Free, but began to leap and frisk about the Room, as if it had not been concerned in the least. Then a *third Pigeon* was bit in the *Breast* by both the *Master Teeth* of a *Viper's Head*, that had been cut off the Morning before; the Effect was, that the *Pigeon* had the same *shaking Fits*; after which, falling upon his *Belly*, in 5 or 6 *Minutes* after the *Wound*, he *Died*; giving Signs a little before of a *Painful Agony*, by his often *Gaping*. Another having been served after the same manner with another *Head*, had the like *Accidents*, and *Died* within a *Quarter* of an *Hour*. It was also observed that the *Wound* of this *last Pigeon* let out a great deal of *Blood*; whereas not so much as one *Drop* was seen to come out of any of the others.

After the Experiments the Dr. took 3 *Stalks* out of a *Broom*, and having smooth'd them, and sharpened them at the ends after the manner of a *Lancet*, he drew from the *Gums* of several *Heads* enough of that *Jellow Juice* to dawb two of those *Stalks*; which being thus moistened with that *Liquor*, were both put into the *Breasts* of 2 *Pigeons*, and there left; the like having been done to another with the *third Stalk* not covered with that *Juice*, which was at least one third part Bigger, and longer than the other Two. In a word, the *Two first* Dyed within 4 or 5 *Minutes*, and the *Last* was in *August* following in *S. Magalotti's Pigeon-House*, as *Brisk* and fat as ever, tho' the *Stalk* was not drawn out till after some *Days*.

Upon a Relation, that some had Asserted at *Paris*, that to *Swallow* a *Viper's Head*, was a most certain Preservative and Remedy against the *Biting* of a *Viper*, Dr. *Francini* made these two Experiments; he made the *Cock* swallow a *Viper's Head*, and then caused him to be well Bitten in both *Thighs* by a *Live* one. The other Experiment was by Trusting the *Teeth* of a *Dead Viper's Head* into another *Pigeon*, that had before got down one of these *Heads* into

Fig. 208.

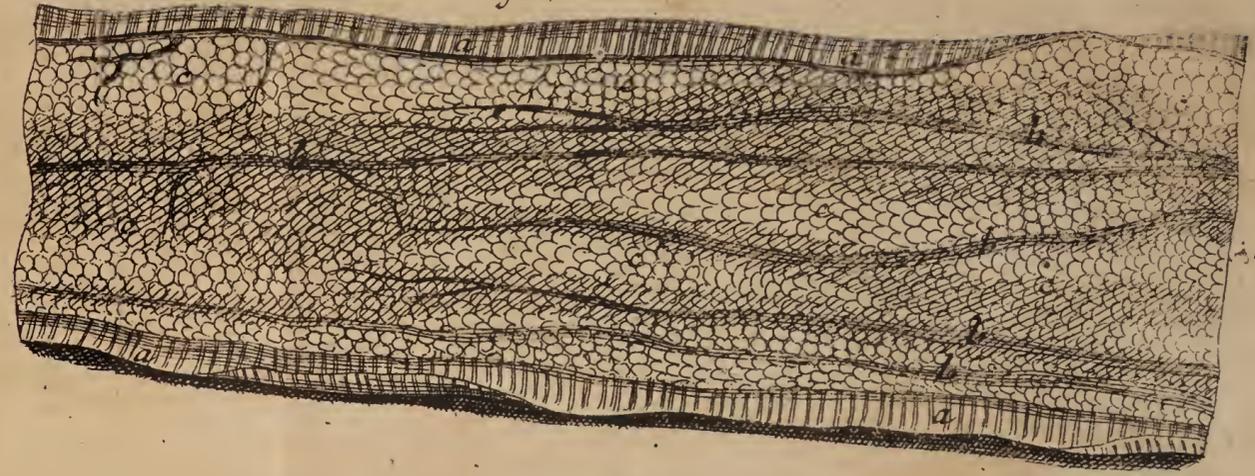


Fig. 205.

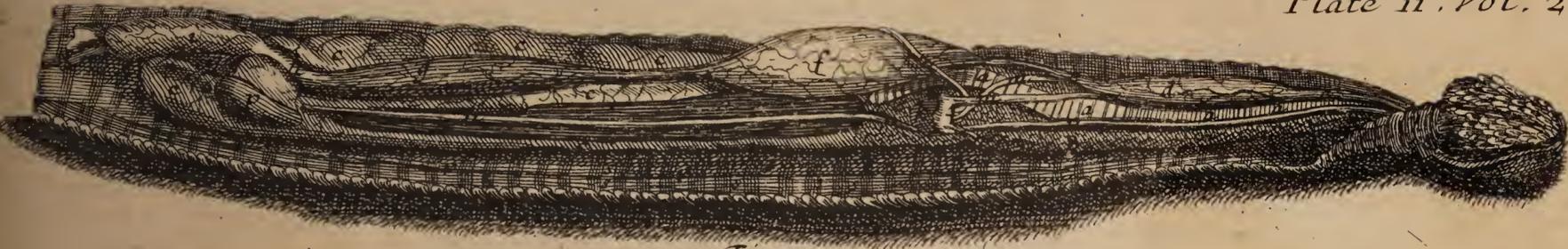


Fig. 206.

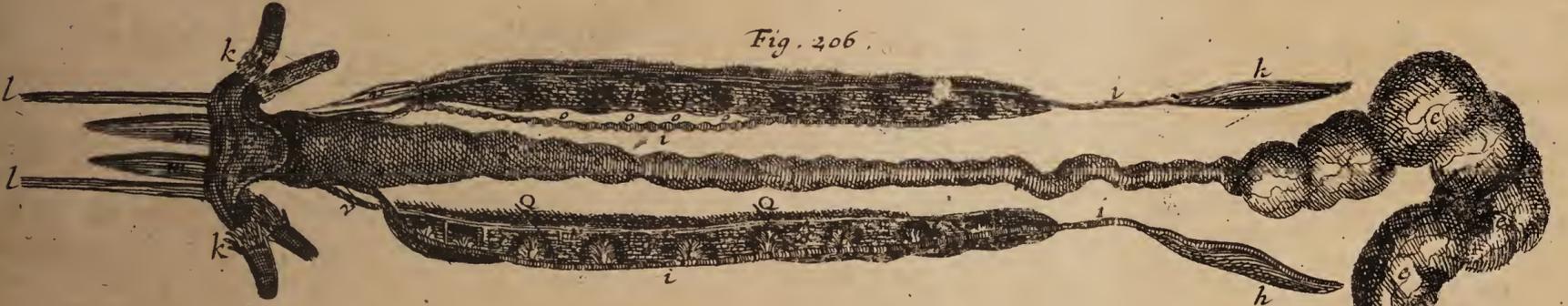


Fig. 207.



Fig. 210.

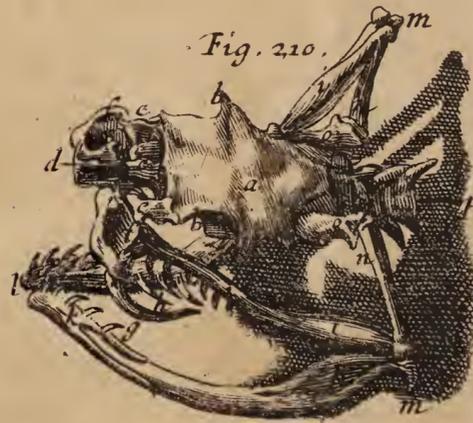


Fig. 209.



Fig. 196.

Fig. 198.



Fig. 202.



Fig. 195.



Fig. 191.

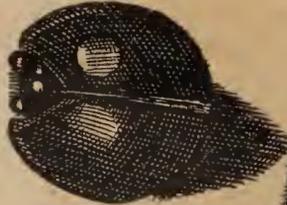


Fig. 212.



Fig. 211.

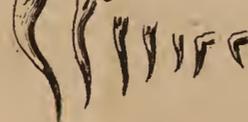


Fig. 192.



Fig. 216.



Fig. 215.



Fig. 199.



Fig. 197.

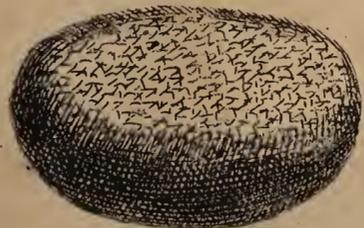


Fig. 193.



Fig. 194.



Fig. 204.

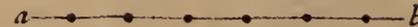


Fig. 214.



Fig. 213.



Fig. 203.



Fig. 190.

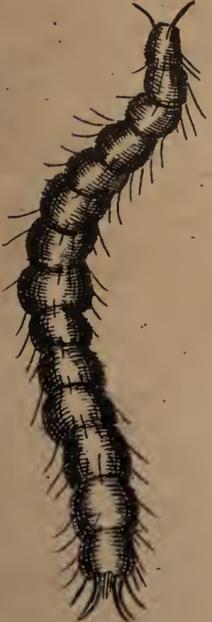


Fig. 200.



into his *Belly*. The Conclusion was, that both Died; the *Cock* within a *Quarter* of an *Hour*; and the *Pigeon* in less than 4 *Minutes*.

Some few *Days* after, *Dr. Francini* repeated the same *Experiments*, by causing 2 *Pigeons* to be *Bit* by a *Viper's Head* that had been *Dead* above 10 *Hours*, they both *Died*, one in 6 *Minutes*, and the other in 8. And with another *Viper's Head* he *Poisoned* a *Chicken*, which *Died* in 10 *Minutes*. There appeared afterwards another *Pigeon*, that had been *Wounded*, many *Hours* before, by a *Dead Viper's Head*, but it had been *Dead* so long, that the *Liquor* quite dried up in the *Gums*, was become so *Hard*, that for all the squeezing of it nothing would come to the *Teeth*, whence this *Pigeon* was very well: And *Dr. Francini* having caused the same *Bird* to be *Bit* again by the same *Dried Head*, it had, after a little fluttering with his *Wings*, whilst the *Pain* of the *Biting* lasted, no other harm.

A *Live Viper* then being taken, 4 *Chickens* were bit by it one after another: The *Two first*, either because the *Liquor* did not *Penetrate* into the *Wound*, or the *Blood* Expelled it, appeared not to have any *Distemper*; the 4th looked as if it would *Die* presently, but a little after coming to himself, he got clear off for that time; but the 3^d, who seemed at first to be very lively, *Died* within an *Hour* and an *half*.

There being afterwards a young *Bitch* brought in, of a pretty size, she was *Bit* twice by a *Live Viper* in the *Middle* of the *Hanging* part of the *Ear*. Whereupon she very soon began to give *Mortal Signs*, by *Staggering*, *Vomiting* and being *Convulsed*: after which, having a little *Recovered* herself, the same *Accidents* Returned upon her, by which she was *Reduced* to such a grievous *Condition*, that 4 *hours* after her being *Bit*, she could not stir any more, and seemed just as if she had been *Dead*, holding out her *Tongue*, and looking very *Gastly*, without any other sign of *Life* than that of a *Painful Breathing*; to which she added sometimes a *Faint Barking*, and a *Languishing Howling*. In this *Condition* she was still found next *Morning*; only her *Respiration* was yet weaker, and she appear'd just a drawing to her *End*. It was observed that no *Part* of her *Body* was *Swelled*, nor had any *Spot* upon it. She had voided backward some *Matter* of a very *Black Colour*, of which her *Hind Parts* being very foul, a swarm of *Gnats* and *Wasps* were devouring her alive: Which Moved one of the *Servants* of the *House*, to knock her on the *Head*.

After this, there were *Bit* two *Capons* and a *Pullet* by a *Fresh Viper*, vexed on purpose; and because they gave not then any *Signs* of being *Ill*, they were sent back to their *Coops*, and there having continued well till *Evening*, they were surprized at *Night* by a *Distemper*, which in all likelyhood proceeded from the *Poyson*; for next *Morning* one of the *Capons* and *Pullet* were found *dead*.

XLVII. *Mr. Rob. Burdet*, an *English Merchant* at *Aleppo*, on the 4 *Oct.* 1678 was *Bit* by a *Serpent* on the *Left Wrist*, near the *Pulse* towards his *Hand*. It seem'd at first like two *Pricks* of a *Pin*; he immediately vomited, and his *Wrist* and *Hand* began to *swell* presently; he had some few *Days* before a *Looseness*, which perhaps this increased. He rode easily, after he was *Bit*, about 2 *Miles* Home, and

The Symptoms attending the Bite of a Serpent; by Mr. Aar. Goodyear. n. 245. p. 351.

as soon as he got to his Chamber, he said he was *Bit* by a *Rat*, (and would not own it was a *Serpent*) though a *Turk* accidentally passing by, said he saw the *Serpent* Hang at his *Wrist*, as he pull'd his Hand out of the Refuge, hoping to have taken a *Hare* that he had Cours'd in there. He said he felt no *Pain*, but a great *Desire* to *Sleep*; his *Arm* continued *Swelling* Upwards, and grew *Black*. Some little Remedies were used till the rest of the *Factory* Return'd, and then they begun to *Cup* and *Scarify* his *Arm*; he having still no *Pain*, but a great *Drowsiness*: but was kept *Waking*, to use that little Time he had left, to Prepare himself for *Death*; which he Performed exceedingly well. At last the *Swelling* came up to his *Shoulder*, and then he Complained much; and within a *Quarter* of an *Hour* Died. He was *Bit* about 10 in the *Forenoon*, and *Died* about 3. in the *Afternoon*. His *Body* *Swell'd* much after *death*, and *Purged*. The *Snake* was like a *Common Snake*, for *Length*; his *Colour* *dark Sandy*, with *Black spots*; his 2. *Teeth*, or *Fangs*, are like those of a *Rattle Snake* on the *Upper Jaw*; the *Poyson* lyes in the *Gums*; and vvhenever they Fetch *Blood* of any *Creature* they certainly *Kill*, though in some parts sooner than in others. The people of the *Country* say, that if as soon as one is *Bit* by a *Serpent* they shall *Suck* immediately the *Wound*, they may be saved: but they must rub first their *Gums* and *Teeth* with *Oyl*, that none of the *Poyson* may Touch any place where the *Skin* is broken, and Spit out immediately what they suck; every time *Washing* the *Mouth*, and taking more *Oyl*. This *Serpent* Kill'd a *Dog*, in about 8. *Minutes* time, biting him at the *End* of his *Ear*; and 2. *Young Turkeys* afterwards in 3. or 4. *Minutes* each, *Biting* them at the *End* of a *Claw*; and then we *Poysoned* him with the *Oyl* of *Tobacco* out of a *Reed Pipe* (that had been much *Used*, and not *Cleansed* for a *Week* or two) and he died in about 2. or 3. *Minutes*, trembling as soon as the *Oyl* was Dropt into his *Mouth*.

A Stone Healing
the Biting of a
Serpent; by Sr.
Phi. Vernatti,
n. 6; p. 102.

XLVIII. Sr. *Philiberto Vernatti* some time ago sent from *Java Major* (where he Resided) a certain *Stone* affirmed by him to be found in the *Head* of a *Snake*, which laid upon any *Wound* made by any *Venomous Creature* is said to *Stick* to it, and to *Draw* away all *Poyson*: and then, being put in *Milk*, to *Void* it's *Poyson* therein, to make the *Milk* turn *Blew*; in which manner it must be *Used*, till the *Wound* be *Cleansed*. The like Account of such a *Stone* is given by *M Thevenot* in the *Relations* of his *Voyages* and *Travails*.

Observations on
several Poysons;
by Sr. Theodore
de Mayerne,
n. 211. p. 162.

XLIX. The *Venome* of a *Viper* in it self is not *Mortal* to a *Robust* and sound *Body*: and tho' very *Unhappy* and *Mischievous* Accidents attend it; as a great *Tumour*, *Tension* and *Weight* of the *Part*, *Humidity* and *Variety* of *Colour*, *Phrensies*, *Convulsions* and *Vomitings*; yet in 8. or 10. *Days* at most these Accidents are over: and although the *Patient* may be very *Ill*, yet he recovers again; whilst the *Poyson*, having run through *Divers Parts* of the *Body*, at last always throws it self into the *Scrotum*, and *Swelling* it extremely causes a great *Heat* and *Quantity* of *Urine*, very *Hot* and *Sharp*, by which it is *Discharged*; this *Evacuation* being the *Ordinary* and most certain *Crisis* of the *Disease*.

It is Observable that the *Perspiration* being Obstructed by the *Poyson*, a Man Bit by a *Viper*, and Swelled up, in 3. or 4. Days shall Weigh almost as much more than he did before. A Sickly Person, under an ill habit of Body, or Fearful, Dies Infallibly, and in short time by this *Venom* without speedy Help. In the Extream *Nervous Parts*, near the *Pulse* and *Tongue*, the *Bites* are dangerous, and Accidents very Painful. Fresh *Vipers* that have not Bit, but have the *Bladders* of the *Gums* full of *Venom*, are the most Mischievous: Wherefore *Mountebanks*, to impose upon the People, either make their *Vipers* Bite before they bring them out; or with a *Needle* Scratch the *Gums*, and Pre's out the *Poyson*.

The Remedy for these Great and Painful *Swellings* is, to Drink the *Decoction* of *Marrubium*, or the Powder taken inwardly, and a *Fomentation* with the *Decoction*, applying a *Cataplasm*, made with *Marrubium Tapsus Barbatus* and *Agrimony*, on the place. *Aristolochia* is also a strong and powerful *Antidote* against the *Viper*: so that if one be Bit on the *Tongue*, he need only take a slice of this *Root*, Heat it and Apply it, and it goes away.

Pontæus, a Chymical *Mountebank* (from whom I had the above mentioned Observations) composed his *Antidote* of *Extract* of *Juniper Berries* drawn with a *Decoction* of *Roots* of Round *Aristolochia*, of *Succisa*, *Marrubium Album*, *Flower* of *Brimstone* and of *White Vitriol*. For *Poyson* not *Corrosive*, such as those of *Animals* and *Vegetables*, and even for the *Plague* it self, (which he believes he can Cure by the same Remedy) he makes use of no *Vitriol*: But if the *Poyson* be *Sublimate*, which of it self excites *Vomiting*, he Adds *Vitriol*; not in a proportion to *Vomit*, as a *Drachm*, but only a *Scruple* or half a *Drachm*, the *Vomiting* being assisted by the *Corrosive Poyson* it self.

To Encrease the Value of this *Antidote* with the people, when the Experiment is made on *Dogs*, to that *Dog* which they would have Dye of the Bite of the *Viper*, he gives with the *Antidote* a Quarter of a *Nux Vomica* not powdered but only cut in Bits, and the next Day the *Dog* Dies. If it were powdered the *Dog* would Dy in half an Hour. He says *Nux Vomica* never Vomits but shuts up the *Stomach*, and Contracts the *Nerves* by its *Poyson*. To preserve the *Dogs* Alive, you must give them with the *Antidote* or any thing else, 3. or 4. Grains of *Sublimate*, which immediately sets them a *Vomiting*, and so saves them Alive.

He offers to take all sorts of *Poysons*, even *Corrosives*, after an ordinary *Meal*, and for a Tryal of Skill he refuses them not on an *Empty Stomach*. He much Esteems *Morsus Diaboli*, *Succisa* or *Devil's Bit*, against all sorts of *Poysons*. He Laughs at the *Poyson* of a *Toad*, which he says has none at all, no more than a *Frog*.

The manner of the Acting of the *Vipers Poyson* is thus; In about $\frac{3}{4}$ of an hour, a *Syncope*, or *Swooning*, seizes them with *Trembling*, and *Convulsions*, *Tingling* of the *Ears*, and frequently *deafness* for a Moment: next as it were a *White Sail* comes before their *Eyes*, which soon Vanishes: On the place of the *Bite* a *Swelling* Rises, at first of the Bigness of a *Pea* which grows as big

as a *Bean* or a *Nut*, and Increasing enlarges it self over the Neighbouring Parts, to a very considerable *Tumour* and stretching of the *Flesh*, which grows *oedematous*, and by little and little falls into the *Scrotum*, and Leaves the Part *Black*, *Blew* and *Yellow*. It makes as it were *Bags* in the *Skin*, which feel *Heavie* when you walk, as if fill'd with *Quick. Silver*. Do what you will the *Poyson* will have its *Course*: and it is usually 3. *Days* before it comes to the *Heighth*, and as long *Abating*.

He says the *Gall* of the *Viper* is no ways *Venomous*: all the *Poyson* is in a *Liquor* in the *Gums*, which is *Yellow* like *Oyl*; of which you may easily *Disarm* the *Viper*. The *Viper* is the Most *Venomous* of *Serpents*; the *Asp* is but a *Species* of the *Viper*. The *Napellus* is a very *Dangerous Poyson*, Acting by its *Acrimony*: but you must take a great *Quantity* of it. It burns the *Throat* extremely as does *Alum*: but it is *Cured* by the *Antidote*. *Crude-Antimony* does *Nothing* if attacked by the *Antidote*.

The most mischievous of all *Poysons* is *Opium*: of which having given an *Excessive Quantity* to a *Servant*, at first he he had *Convulsions*; then strange *Vomitings*, not able to let any thing go *Down* into his *Stomach*; a *Stecpiness* followed; all which time they kept him *Awake* as much as possible *At last* all of a *Sudden*, he *Grew well*, and called for *Victuals*.

A Salamander;
by S. Steno, n. 21.
p. 377.

L. M. Steno writes from *Rome*, that a *Knight* called *Corvini* had assured Him, that having cast a *Salamander*, brought him out of the *Indies*, into the *Fire*, the *Animal* thereupon *Swell'd* presently, and then *Vomited* store of *Thick Slimy Matter*, which did *Put Out* the neighbouring *Coals*, to which the *Salamander* retired *Immediately*, *Putting them out* again in the same *Manner*, as soon as they *Rekindled*; and by this means saving himself from the *Force* of the *Fire* for the space of *two Hours*; That afterwards it *Lived 9. Months*; that he had kept it *11 Months*, without any other *Food*, but what it took by *Licking* the *Earth*, on which it *Moved*, and on which it had been *Brought* out of the *Indies*, which at *First* was *Covered* with a *Thick Moisture*, but being *dryed* Afterwards, the *Urine* of the *Animal* served to *Moisten* the same; but being put upon *Italian Earth* it *Dyed 3 Days* after.

Observations on
a Cameleon; by
Dr. Jonath. God-
dard, n. 137. p.
930.

LI. This *Cameleon* was a *Female*; The *Skin* appeared mixt of *Several Colours* like a *Medley Cloth*; *Lighter* towards the *Belly*; otherwise near upon it, *Equally Mixed*. The *Colours* discernable are *Green*, a *Sandy-Yellow*, a *Deeper Yellow* towards a *Liver Colour*; and indeed one may easily fancy some *Mixture* of all or most *Colours* in the *Skin*; whereof some are more *Predominant* at sometimes. There are some *Permanent black Spots* on the *Ridge* of the *Back*, and on the *Head*. Upon *Excitation*, or *Warming*, she becomes suddenly *Full* of *Black Spots* of the bigness of a *Great pins Head* *Equally* dispersed on the *Sides*, with *small Black Streaks* on the *Eye-Lids*; all which after-ward do *Vanish*. The *Skin* is *Grained* with *Globular Inequalities*, like the *Leather* called *Shagreen*. The *Grossest Grain* is about the *Head*, next on the *Ridge* of the *Back*, next on the *Legs*; on the *Sides* and *Belly* *Finest*; Which perhaps in several *Postures*, may shew several *Colours*, and when the Creature

is in Full Vigour, may also have in some sort *Rationem Speculi*, and *Reflect* the Colours of Bodies adjacent: Which, together with the *Mixture of Colours* in the *Skin*, may have given Occasion to the Old Tradition of *Changing* into *All Colours*.

The *Eyes* resemble a *Lens*, or *Convex-Glass*, set in a *Versatile Globular Socket*; which she turned *Backward*, or any way, without moving her *Head*. And ordinarily the one a *Contrary* or *Quite Different* way from the other. The *Tongue*, (which she was never seen to put forth of late, though she often opened her *Mouth Wide*) was easily drawn out, when she was *Dead*, to half the *Length* of her *Body*, being *Round* and *Full* toward the *End*, like a *Pestil*, with some *Cavity* at the *Extremity*: Having a *Bone*, about half the *Length* of it, toward the *Root*; over which also the *Fore-part* would *Slip Backward*. The *Bone*, where connected to the *Body*, is *Bifurcated*. She hath *Teeth* plainly to be *Felt* and *seen* above and *Below*, on the whole *Circumference* of the *Jaw*.

The *Trunk* of the *Body*, for the *Structure* of it, is all *Thorax*, or *Breast*, having *Ribbs* from the *Neck* to the setting on of the *Tail*. The *Ribbs* are of *two* sorts; the *Larger* above tending *Backward* from the *Spine*, or *Back-Bone*; the *other*, from the *Extremities* of the *former*, tending *Forward*, as in the *Breasts* of *Fowls*. There is a kind of *Diaphragm*, a *Thin Transparent Membrane*, as in *Birds*, separating a small *Portion*, about the *4th* part of the *Cavity* next the *Belly*, from the rest: Wherein is *Contained* a small *Ventricle* connexed to the *Gula*; to which is *Continued* an *Intestine*, having some little *Convolution* in the *Conveyance* of it; which *Extended* might be about the *length* of the whole *Body*, with *Head* and *Tail*. The *Excrements* therein *Black* or of a *Sad French Green*. She had a small *Thin Liver* *Contiguous* to the *Upper part* of the *Diaphragm*: In part *Divided* into *2 Lobes*, of a *Blackish*, or very *Sad-Colour*. The *Lungs* seemed to be made of *Membranous-Cells*, or *Divisions*, very *thin* and *Transparent*, resembling a little *Light Froth*. The *Heart* was *Firm* and *Fleshy*, but very *small*; and at the very *Fore End* of all the *Breast*, or *Body*. At the *Hinder End* of the *Body* was a *Double Ovary*, consisting of *5* or *6 Eggs* (of the *bigness* of the *Greatest Pins Heads*, and sticking to the *Back*) on each *Side*: of the *same Colour* and *Consistence* with those of the *Yolk* of an *Egg*.

LII. Miratus sum valde, D. Thrustono in Testudinum, Lacertarum & Ranarum Sectionibus non occurriffe Commercium inter Bronchia & Pulmones, quos Vesiculas, à laxitate Exterioris Pulmonum Membranæ obortas, vocat; cum sane immissa in Trachæam Fistula, & simul insufflato Aere, Pulmones eidem Trachææ appensi hinc inde circa Cor turgeant; quod & ad Libitum Animalis frequenter accidit: Hi etiam, dum Aere turgent, si filo innodentur ut Siccescant, secti patenter oculis Cellulas & Vesiculas, evidenter Membraneas, exhibent. Et licet in Ranis brevis sit Bronchiorum processus, à Larynge tamen Bini Ductus, Semicircularibus aliquot Annulis conflati, in Membraneas Vesiculas hiant; atque ita succedit Inspiratio & Expiratio. At in Testudine, Lacertis

Observations about the Lungs of Frogs; by S. Malpighi. n. 71. p. 2149.

Diatriba de Respir. Usu Primario.

& similibus, oblonga *Trachea* in binos subdivisa Ramos, Aerem *Pulmonaribus Vesiculis* subministrat. Scio in *Ranis*, prope *Os*, hinc inde binas interdum turgentes erumpere *Vesiculas*, (procul tamen à *Pulmonibus*) quæ *Buccæ* sunt Appendices, & Aere interdum, à *Pulmonibus* in *Oris* Cavitatem *Expiratione* propulso, foras exilire.

Circa exaratos *Pulmones* Reticularem *Musculum* locari scias, cujus *Carneos Plexus*, *Sinus*, & *Vesiculas* ambientes, alias ruditer delineavi. Hujus Mirabilis *Contextus* patet in *Ranis*, & *Lacertis* præcipue; nam Multiplices *Carnei Lacerti* per Longum producuntur, & Transversaliter elongatis *Fibris* invicem continuantur; intermediæ vero areæ Reticularibus *Carneis Plexibus* ulterius occupantur, non absimili ritu ac in *Arborum Foliis* accidit: *Retis* autem enarrata hæc Minora *Spatia* rectis postremo *Fibris*, quasi brevibus *Tendinibus*, pervaduntur. Mirabilis hic *Musculus* non *Exteriorem* tantum *Pulmonum* ambit *Regionem*, sed interiores quascunque *Vesiculas* & *Sinus* circumdat, ita ut suo *Motu* singulas *Pulmonis* partes comprimendo, *Expirationem* *Sonumque* promoveat. Hæc eadem *Structura* in *Pulmonibus* Perfectorum *Animalium* proportionaliter observatur, & in *Agnorum* extremis præcipue *Lobulis*, Aere turgidis, & adhuc *Mollibus*, patet.

The Production
of Todpoles; by
Mr. Rich. Wal-
ler. n. 193.
p. 523.

Fig. 217.

Fig. 218.

Fig. 219.

Fig. 220.

Fig. 221.

Fig. 222.

Fig. 223.

LIII. Mar. 12 1689. I took some *Frog-Spawn* out of a Ditch, which I suppose might have been Spawnd about 14 Days, and kept it in a Gally-Pot of Water; which I shifted every Day or two, and kept them in a Window where the Sun Shined some part of the Day. At the first they appear'd as Fig. 217. being a Round Black Globule Encompast with a Clear Liquor as I afterwards found, and a *Membrane* encompassing that Liquor, and that Encompast with a larger Sphere of a more Mucous Liquor. The 2d. Day they appear'd as Fig. 218. The 3d. Day as Fig. 218. The 4th. Day as Fig. 219. About the 6th Day, several of them were Loosed from their *Eggs*, and on the 7th. and 8th. more of them: When they appear'd of the Shape of Fig. 220. which in Fig. 221. is Represented bigger than the Life, that the Posture they lay in may be seen the better. On the 7th and 8th Days, upon pricking of them with the point of a Needle they would Contract themselves; some of them on the 8th Day would of themselves bend their Bodies, but not Move out of their Place. When they first got through their *Egg* (which I suppose they did by Eating their Way) they Hung fast upon the Outside of it, by that Part which I afterwards found to be their *Mouth*, and when Loosed from their Hold they Sunk to the Bottom of the Water, and could not Rise again. On the 9th Day they were not Visibly increased in Bulk, only they Moved themselves more Freely at the Bottom of the Vessel.

At about 14 Days End they appeared as Fig. 222. at which time they Swam about in the Water by Moving their *Tails*, as Fig. 223. and some Rudiments of their *Fore-Legs* were Visible, which looked Forked and like the Sprig of a *Plant*. At 3. Weeks end their *Mouths* were to be seen, which they Opened and Shut, and emitted *Fæces* from the other End. At a Months end the *Eyes* were to be Discerned, at which time they would Swim near the

Top

Top of the Water, and Opening their *Mouths* let out a small Bubble of *Air*, and I suppose take in *Fresh*.

The Liquor which was Contained in the innermost *Membrane*, was more Transparent than the other, which was a *Mucous* Liquor, and like the *White* of an *Egg*; the Whole was a little *Heavier in Specie* than *Water*, for a Single *Egg* Sunk when Loosed from the rest: But when they were Fastened a great many together, they *Swam*, every 3 *Eggs* leaving a little space, which being fill'd with *Air*, made them *Specifically Lighter* than *Common Water*.

LIV. The *Ductus Alimentalis* in *Animals* from its Uses may ordinarily be Divided into 4. parts. 1. That which conveys the *Food*, as the *Oesophagus*. 2. That which *Digests* or Corrodes it, the *Stomach*. 3. That which *Distributes* the *Chyle*, the *Intestines*. 4. That which Empties the *Fæces*, the *Rectum*: But a *Leech* is all *Stomach*, from one end to the other, and does devour at a Meal several times the Weight of its whole Body. The *Stomach* when swelled and stretcht with *Blood* is far bigger than the *Leech* it self; nay several times Exceeds it. But I mistook the Number, it was not *One*, but *Many Stomachs*; for the Cavity is Divided by several *Transverse Membranes*, into *Divers Distinct Camera's*; but these *Membranes* in the Middle have a Hole that leads from One into the Other: But by the Pouching out of each side, each of these may be Reckon'd also *Two*; in all we may number, (there being 10 or 12 of these *Camera's* besides these 2 long ones which at last run to the *Tail*) at least 22 if not 24 *Stomachs*. But the *Rectum* which lies between the Forking of the 2 Last long *Sacculi*, or *Stomachs*, is but Small, and short in respect of the Whole.

The Stomach of a Leech; by Dr. Edw. Tyson. n. 144. p. 33.

LV. The *Upper Lip* of a *Leech* is stretched out into a Point, and falls upon the *Under*, which is Round like a *Crecent*, and Shorter. Its *Throat* on the inside is covered with a great many *White Muscles*, about 5 or 6 *Lines* long, as big as a small *Thread*, and lying *Parallel* one to another, along its Body. When it applies the *Mouth* to the *Flesh* of any *Animal*, all these *Muscles* Contracting themselves, she *Sucks* it with so great *Violence* and *Greedi-ness*, that she makes it enter in Form of a little *Pap* into its *Throat*. So that all the Effect of *Suction* terminating in a very little space, of necessity the *Flesh* must Break in that place.

The Anatomy of a Leech; by Mr. Fran. Poupart. n. 233. p. 722.

There is seen at the End of its *Tail*, a little Flat thing, exactly Round, the Border of which is elevated far above the *Tail*, and all round it, which it applies so Uniformly upon the Bodies to which it Fastens it self, that it Touches them in all their Parts; and then drawing up a little the Middle of this Flat part, without taking off the Edges, she makes of it, as it were a little *Balm* which leaves a Cavity in its Middle. This excellent *Glue* fastens so strongly to the *Tail* of the *Leech*, that 'tis a hard matter to pull it away without making some Rent, especially if you draw it perpendicularly from the Surface on which the *Animal* is Fastened. It has always recourse to this little instrument for Fastening its Body, to the end it may not be suspended in the *Air*, while

it Draws its *Nourishment* by *Suction*, or else that it be not Carried away with the Current of the Water, while it carries its *Head* here and there for Seeking its *Nourishment*.

Its *Gut* goes in a straight Line from the *Mouth* to the *Anus*, as big as a Gooses Quill, all along set with a great Number of little *Valves*: Some of which make a perfect *Circle* with a Hole in the middle, and others a *Half Moon*; some are shap't *Spiral* ways, and there is a Great one of this sort near the *Tail*, fashioned like a *Heart*, which leaves only a very little Hole, near which is found much *Yellow Fat*, which fills all the Cavity of the *Intestine* to half an *Inch*. Two little *Intestines*, or *Appendixes*, each half an *Inch* long, and of the bigness of the Feather of a little Birds Wing, pierce the *Great Gut*, in which they are Open at one end and shut at the other. All this structure makes it Evident why the *Intestine*, which makes no *Convolution*s, and yet reserves ordinarily but *Liquid Aliments*, does yet retain them to a Perfect *Concoction*.

A *Nerve* the Bigness of a Horse Hair, all Black, Hard to Break, having *Knots* at a Distance one from the other, beginning at the *Mouth* of the Animal, passes over the Parts that serve for *Generation* in the *Male*: 'tis Fastened in a straight Line all along the *Gut* above, Ends at the little *Circle* in the End of the *Tail*, and in the Way sends out *Branches* to the Right and Left Side, which go from every *Knot*. 'Tis very probable that by this *Canal*, the *Animal Spirits* run abundantly, which gives so great *Briskness* to this *Reptile*, which make it Ply into so many Fashions, Swim so swiftly, so Properly, and Suck with such Greediness.

The *Leech* is *Hermaphrodite*; the Parts of the *Male* Destinated to *Generation*, are placed where the *Neck* ought to be. The *Yard* which is about 2 *Inches* long, is *White*, Round, Hollow, and Gristly: a part of the *Yard*, which is always in the Body, is a *Sheath*, about 15 *Lines* of an *Inch* long, as Big as a Little Birds Quill, covered with a fine *Membrane*, which Fastens it strongly to the *Belly*, round about a little *Hole* given the *Leech* for putting Out and In his *Yard* when he Pleases, and not for *Breathing* as the Antients said. The other part of the *Yard*, which comes out 9 or 10 *Lines* of an *Inch*, is the Bigness of a Sowing Thread, and the End of it, for the length of 2 *Lines*, is Bigger than the Rest. All the *Yard* is Hollow; and has in its Cavity a *White Muscle* as big as a Hair, Fastened only to the *Root* and *Head*, all the rest being at Liberty. 'Tis with this *Muscle* that the Animal Draws the *Yard* into its *Sheath*; which any one may Try by Cutting it at the *Root*, to Draw out this *Muscle* with his Nails. On every side of the *Root* of the *Yard*, is a little *White Webb*, Flat, Oval, about 2 or 3 *Lines* long, resembling *Small Guts* twisted about, with a *Cartilaginous* Body, as big as a Double Thred, and 2 *Lines* long, which Fastens to the *Root* of the *Yard*: in which 'tis probable it carries the *Prolifick* Matter. A little above the *Root* of the *Yard* between these 2 *Webbs*, there is a little *Gristly Globule*, 2 *Lines* long, *White*, *Hard*, *Hollow*, *Round*, *Oval*, *Sharp*, inwardly covered with a *Membrane*, *Wrinkled* and full of a *Milky Liquor*. There is at the *Head* of this *Globule* a small *Web*, like to an *Epidydymis*, whose little *Canal*, of the same piece with it, creeps

creeps over the *Globule* and is Fastned at the Point of it, and above the *Epididymis* are 2 *Glandes* exactly Round, each as big as a Grain of *Millet*. I take this little *Globule* to be a *Testicle*. All along every side of the *Intestine* is a White Canal, or *Ovarium*, of the Bigness of a small Twisted Thread, and folded in a thousand Manners, to which are fastened with a *Tail*, as it were the Grain of a *Raisin* to their *Grape*, many little *Globules* exactly Round, as big as a little Pea, full of a *Milky Juice*, and some little White *Eggs*, Gristly, perfectly Round, as big as a Grain of *Millet*, Hard, which are hardly Broken, making a Noise, and full of a *White Matter*. There is in the *Intestine*, towards the end, a great *Valve* fashioned like a *Heart*, with two little *Bags*, where begin 1000 small Channels made of fine *Yellow Fat*, which fill the Cavity of the *Intestine* for half an *Inch*. It's probable that these Passages of *Fat* receive the *Prolifick Liquor*, to Conduct it into the *Ovarium*.

LVI. There is an Extraordinary *Sanguisuga*, or *Leech*, found sometimes sticking fast in the Fish call'd *Xiphias*, or *Sword Fish*: *S. Boccone* gives it the Name of *Hirudo*, or *Acus Cauda utrinque pennata*, because of its Working it self into the Flesh, and Sucking the *Blood* of the said Fish. He describes it to be of about 4 *Inches* long; the *Belly* of it White, *Cartilaginous*, and *Transparent*; without *Eyes* or *Head*, (that he could observe) but instead of a *Head*, it had a *Hollow Snout*, encompassed with a very Hard *Membrane*, differing in *Colour* and *Substance* from the *Belly*; which *Snout* it thrusts whole into the *Body* of the *Fish*, (as strongly as an *Auger* is wound into a piece of *Wood*;) and fills it full of *Blood* unto the very *Orifice*. It hath a *Tail* shaped like a *Feather*, serving for its *Motion*, and under it two *Filaments*, or slender *Fibres*, longer than the Whole *Insect*, whereby, it seems, it clings about *Stones* or *Herbs*, and sticks the Closer in the *Body* of the *Sword-Fish*; of which it attacks those Parts only where the *Fins* of the *Fish* cannot touch or Trouble it; the *Observer* affirming, that he hath often found it Sticking in the *Back* and in the *Belly*, and sometimes Close to the *Head*, sometimes Close to the *Tail* of that *Fish*, but always far enough from the *Fins*. Within its *Belly* he noted some *Vessels*, like *Small Guts*, reaching from One End of it to the Other, which by the Pressure of his *Nail*, he made reach to the *Orifice* of the *Snout*; whence they retired back of themselves to their Natural Scituation; they seeming to be the Instruments for Sucking the *Blood*, because the *Snout* is, in it self an Empty Part, destitute of *Fibres* and *Valves* to Draw and Suck with; whereas these *Vessels* having a Motion resembling that of a *Pump*, in which the *Snout* of this Animal serves for a *Sucker*, Drawing the *Blood* from One End to the Other: And the *Belly* of this *Insect* being fram'd Ring-wise, the Structure serves to Thrust the said Inner *Vessels* unto the *Orifice* of the *Trunk*, and to draw them back again.

An Extraordinary Leech, which torments the Sword-Fish; by S. Paulo Boccone. n. 99. p. 6159.

This Creature as it Torments the *Sword-Fish*, so it is, by our *Observer's* Relation, Vexed it self by another *Insect*, which he calls a *Lowse*, of an *Ash-Colour*, fastened toward the *Tail* of this *Leech* as Firmly as a *Sea Snail* is to a *Rock*. 'Tis of the Bigness of a *Pea*, and hath an *Opening*, whence come out

many.

many small Winding and Hairy *Threads*. It hath not been Observ'd, (as far as our Author could Learn,) to Trouble, or to be upon any other Animal than this *Leech*.

The Odd Turn of
Some Shell
Snails; by Dr.
M. Lister. n. 50.
p. 1011. n. 72.
p. 2171.

LVII. I have found Two sorts of *Shell-Snails*, Easily Distinguish'd One from Another, and from all besides, because the *Turn* of the *Wreaths*, is from the *Right Hand* to the *Left*, contrary to what may be seen in *Common Snails*. They are very small, and might therefore well Escape thus long, the more *Curious Naturalists*; neither of them much Exceeding, at Least in Thickness, a *Large Oat-Corne*.

The *First* I thus Describe: The *Open* of the *Shell* is pretty Round, the *Second Turn*, or *Wreath*, is very large for the Proportion, and the Rest of the *Wreaths*, about the Number of *Six*, are still *Lessened* to a *Point*. This *Turban*, or *Conical Figure* is well near a *Quarter* of an *Inch*; the Colour of the *Shell* is *Dusky*, yet when the *Shrunk Animal* gives leave, you may see Day through it, and then it is of a *Yellowish* Colour. These *Shells* are extreme *Brittle* and *Tender*.

The *Second* sort seem to be much *Stronger* and *Thicker Shell'd*; they are well near *Half* as long again as the Other, and as *Slender*; they have the *Exact Figure* of *Oat-Corn*, being, as it were, *Pointed* at Both Ends, and the Middle a little *Swelled*. The *Open* of the *Shell* is not *Exactly Round*, there being a peculiar *Sinus* in the Lower Part thereof. I think you may number about 10 *Spires*; having their *Turn* from the *Right Hand* to the *Left*. The Colour of the *Shell* is of a *Dark* and *Reddish Brown*.

Both these sorts of *Snails*, when they *Creep*, lift up the *Point* of their *Shells* towards a *Perpendicular*, and Exert, with Part of their Body, *two Pair* of *Horns*, as most of their Kind do.

Cat. Plant:

In *March* I have seen many of them *Pair'd*, and in the very *Act* of *Venerary*: and therefore it is most *Certain* (contrary to the Opinion of *Aristotle*) that they *Engender*. But whether those that are thus found *Coupled*, be *One* of them *Male*, and the other *Female*, or rather, as Mr. *Wray* hath Observ'd, that they are *Both Male and Female*, and do, in the *Act* of *Generation*, both *Receive* into Themselves, and *Immit* a *Like Penis* (as it seems Probable to any Man that shall Part them) I shall not Determine.

These *Snails* are to be Found, frequent enough under the *Loose Bark* of *Trees*; as *Old Willows*, and in the Ragged *Clefts* of *Elms* and *Oak*, &c. and in No Other Place that I could Observe.

Some sorts of
Virginian Snails
by Mr. J. Banister.
n. 198.
p. 671.

LVIII. 1. The Outside of One Sort of *Land-Snails* in *Virginia* is of *Ash-Colour*, inclining to a *Yellow*; the Inside *White*, with a *Blush* of *Red*; and in the Middle of the *Entry*, on the *Inturn* of the *Shell*, Grows a *Small White Tooth* or *Protuberance*. But what is most Remarkable, the *Shell* it self is *Transparent*; and you may plainly perceive by the *Opacity* there, that the *Body* of the *Animal* lyes near the *Spiral String*, or *Center*, on which the *Arch* is Turned, and that the *Empty Part* of the *Shell* is spread with a *Thin spotted Film*. Near the *Tooth*, but more *Inward*, is to be seen a little *Waterish Speck*, which

which by a kind of *Systole* and *Diastole*, Contracts and Dilates it self; from this proceeds a *Limpid Trunk*, which runs into the *Film*, and there Divides into *Branches*: These grow Lesser, and Spread, as the *Animal* Recedes or Approaches the *Mouth*; and when it is out, Extend themselves to the very *Lip* of the *Shell*. I suppose the same to be in all, at least the *Land-kind*, tho' not easily to be Discerned. It is likely also, that the *Film*, the *Nautilus*, or *Carvil* (as the Sailers Call it,) Exerts, may be *analogous* to This.

2 This Description of the *Heart* of a *Snail*, agrees well with the *Anatomy* thereof, made, and long since Published, by *Harder* and *Fr. Redi* By Dr. Lister. *ib.*

3. There is a *Small Snail* of the *Land Kind*, with a *Dented Aperture*, and an *Outward Coat*, on which it is *Hirsute*, or rather finely *Echinated*. By Mr. Banister. *ib.* p. 672.
I am apt to believe, that these (nor hardly any else) are not *Dented*, till they are at their *Full Growth*: For I find several *Small Ones* amongst them, with an *Open Entrance*, that seem to belong to this *Kind*.

I have hitherto Observed very little Variety of *Naked Snails*; I know of but One Kind, which is a small *Ash Coloured* and *Spotted* One, and *Milky*, like *Dr. Lister's*, *Fig. XVI*.

LIX. In Oct. 1684. There were two Ladies at *Mynehead*, (where I then was) who told me that there was a certain Person living by the Sea-side in *Ireland*, who made considerable gain, by *Marking* with a Delicate Durable *Crimson-Colour*, fine Linnen of Ladies, Gent. &c. Sent from many Parts of that Island, with their Names, or otherwise as they pleased, which was made with some Liquid Substance taken out of a *Shell-Fish*; and one of them thought it to be taken out of the *Shells* here *Figur'd* and *Describ'd*. Hereupon I made many Experiments on all the *Shell Fishes* I had taken on that *Coast*; and at last Obtain'd that Delicate Colour they told me of. The whole Process is as followeth. The Purple-Fish, by Mr. Will. Cole. n. 178. p. 1278. Fig. 224, 225, 226, 227, 228.

The *Shells* being Harder than most of other Kinds, are to be broken with a smart stroke of a Hammer, on a Plate of Iron, or firm piece of Timber, (with their *Mouths* downwards) so as not to Crush the *Body* of the *Fish* within: The Broken pieces being pickt off, there will appear a White *Vein*, lying Transversly in a little Furrow or Cleft, next to the *Head* of the *Fish*, which must be digg'd out with the stiff Point of a *Horse-Hair Pencil*, being made short and Tapering. The *Letters*, *Figures*, or what else shall be made on the *Linnen* (and perhaps *Silk* too) will presently appear of a pleasant *Light Green* Colour; and if placed in the Sun, will Change into the following Colours; *i. e.* if in *Winter*, about *Noon*, if in the *Summer*, an *Hour* or two after *Sun Rising*, and so much before *Setting*, (for in the *Heat* of the *Day*, in *Summer*, the *Colours* will come on so fast, that the succession of each Colour, will scarce be distinguisht,) next to the first *Light Green*, it will appear of a *deep-Green*; and in few *Minutes* change into a *full Sea-Green*; after which in a few *Minutes* more, it will Alter into a *Watchet Blue*; from that, in a little time more; it will be of a *Purplish-Red*, after which, lying an *Hour* or

two, (supposing the Sun still *Shining*) it will be of a very *Deep-Purple-Red*, beyond which the Sun can do no more. But then the *Last* and most *Beautiful Colour* (after Washing in scalding Water and Sope) will (the Matter being again put out into the Sun or Wind to Dry) be a fair *Bright Crimson*, or near to the *Prince's Colour*; which afterwards, (notwithstanding there is no use of any *Stiptick* to *Bind* the Colour) will Continue the same, if well ordered; as I have found in Handkerchiefs, that have been Wash'd more than 40 times; only it will be somewhat Allay'd, from what it was, after the *first Washing*. While the Cloth so writ upon, lies in the Sun, it will yield a very strong *Fætid* smell, as if *Garlick* and *Assa-Fætida* were mix'd together.

The *Shells* are of *diverse Colours*, but most part of them *White*; some are *Red*, some *Yellow*; others of both these Colours; some a *Blackish-Brown*; many of a *Sandy Colour*; and some few *Striped* with *White* and *Brown* Parallel Lines. It seems to be a kind of *Amphibious* Animal, alternately living in both Elements every *Tide*: For being out of their Native place, and in want of such *Vicissitudes*, they take this Course to find the Air; when any of them are put into a *Vessel* of *Sea-Water*, [for in *Fresh* they soon *Expire*] after they have lain some time on the *Bottom* of the *Vessel*, they *Creeping* to the *Superficies* of the *Water*, and by Extending a kind of *Lipp*, with their *Operculums*, cling to the side of the *Vessel* or *Pan*, (which is most convenient for their *Ascent*) with about *half* that Part above the *Water*; sometimes *creeping* down under it, and *Returning* again to their *Station*, between *Wind* and *Water*.

Fig. 229.

I have found that sometimes their *Veins* are Fuller and *Whiter*, and the Juice more *Viscid*, at other times more *Flaccid* and *Watery*.

These *Shells* are in great abundance on the *Sea-Coast* of *Somersetshire*: I have found them also on the *Shores* of *South-Wales*, opposite to it; and I doubt not but they may be found on the other *Coasts* of *England*, especially the *South* and *Western* Parts, where I am almost assured I have formerly seen them, though then unknown to me. And I am of Opinion there may be found on our *Marine Coasts*, some Bigger *Shells* which may have a *Colouring* Juice, though not the same with this, for that I know few Natural things, both of *Animals* and *Vegetables*, but what have diverse sorts of the same Kind, in the same Place.

I am assured by some who have *Boyl'd*, *Drest* and *Eaten* of this *Fish*, that they are wholesome Food; as good at least, and Taste as well as *Lym-pots* or *Winkles*; only the *Flesh* is something *Harder*.

Perhaps this *Colouring Juice* may be the *Spermatick* and *Prolifick* Matter, by which they *Propagate* their Kind: Which I am inclinable to think, from its *Consistence*, *Virulent*, and *Fætid Savor*. Or else it may be a *Humour* in this Animal, which by its *Vital Energy*, as the *Spring* of *Life* and *Motion*, supplies the want of *Heart*, *Liver*, *Blood*, &c. as in other *Exsanguineous* *Animals*.

There are many sorts of this *Purple Fish*, differing in *Bigness*, *Structure*, *Colour* of the *Shell*, according to the *Nature* of the *Sea Grounds*, *Depth* or *Shallow-*

Shallowness of Water, Rocks, Gravel, Mud, as also the *Latitude*, where they are found; and so Differing also in the *Varieties* of Colours of the *Tinging Juice* in their *Veins*, as *Black*, *Livid*, *Violaceous*, *Deep Sea Green*, *Light* and *Deep Red*, *Amethystine*, &c. But the Best of all were found in the *Tyrian Seas*, near that Island on which the Renowned City of *Tyre* was built, (now an inconsiderable Town call'd *Sur*;) this was Celebrated, and Priz'd above all the rest, for that it Excell'd them all in its illustrious Colour, call'd in former Ages by Divers Names; as *Ostrum Sarranum*, *Pelagium*, *Venenum Tyrium*, *Purpurissum*, *Flores Tyriani*, &c. Almost all Authors agree, that it lies in a certain *Vein* in the *Fish*: And some of them mention it to be *White* and *Viscous*, as this of ours is. ¶ This Excellent *Dye* seems to have arrived at its Highest Perfection in the Days of *Pliny* (being in the Reigns of the *Vespa-* *sians*) when the Artists of the Imperial City of the World, in Preparations of that *Tinging Succus* for *Dying* the *Robes* and other Vestments of *Emperors*, *Senators*, &c. strove to excel each other in new fashion'd *Purples*, to Gratify the Luxuriant Excess of the Great ones of those times, by Preparing and *Mixing* the Colour found in the several Sorts of these *Shells*. These Colours sold then at Great prices; that which was the Fine *Double Dyed Purple* of *Tyre*, call'd *Diabapha*, yielded 1000. *Roman Denarii* the *Pound*, which is Computed to be more than 30 *l. Sterling*: and this of *Ours*, being so Excellent a Colour; without other Preparation, or Addition of any thing to it, may now, or at least hereafter, by farther improvement vie with the *Tyrian Purple*.

Johnston, out of *Aristotle*, mentions a *Species* of these *Fishes*, under the Name of *Littorales quæ parvæ & Flore sunt Rubro*; this agrees with *Ours*, which may be named *Purpura Littoralis (sive Teniensis) Parva Turbinata*.

LX. Oct. 7. 1651. Testudinem meam appendi, priusquam Latibulum adiret, ibidem per totam Hyemem Hybernatura, pendeatque exacte 4 lb. 3. Un. 7. Dr.

Observations on a Tortoise; by Sir Geo. Ent: n. 194. P. 533.

Oct. 8. 1652. Erutam è Terra Testudinem (nam se pridie Humaverat) appendi denuo, ponderabatque. 4 lb. 6 un. 1. dr.

Mar. 16. 165 $\frac{2}{3}$. Testudo sponte è Latibulo suo prodiit: Pendeatque 4 lb. 4. un.

Oct. 4. 1653. Testudo postquam per aliquot dies Fejunasset, subtusque Terram sese Abscondisset, inde educta atque appensa Ponderabat 4 lb. 5. un. Oculi (quos diu Clausos habuerat) tum Aperti plurimum Madescabant.

Mar. 18. 165 $\frac{3}{4}$ Testudo è Latebris prodiens, & in Lance appensa ponderabat 4 lb. 4. un. 2. dr.

Oct. 6. 1654. Testudo ad Hyberna ituriens pendeat. 4 lb. 9. un. 3. dr.

Die Feb. ultimo 165 $\frac{7}{8}$. Testudo ex Hyemali Crypta prorepens pependit 4 lb. 7. un. 6. dr. Amisit itaque Ponderis 1. un. 5. dr.

Oct. 2. 1655. Testudo, Hyematum itura, pependit 4 lb. 9. un. prius autem aliquandiu Fejunaverat.

Mar. 25. 1656. *Testudinem* è *Latebris Hybernalibus* prodeuntem appendi, eratque 4 lb. 7. un. 2 dr.

Sept. 30. 1656. *Testudo*, subtus Terram Ituriens, pendeat 4 lb. 12. un. 4. dr.

Mar. 5. 1656. *Testudo*, de subtus Terram exiens, pondo erat 4 lb. 11. un. 2. dr. fs.

Unde satis liquet quam *Fixis*. Particulis hæc Animalia, quæ sub Terra se muniunt adversus *Frigus Hybernum*, constant: cum per tot *Menses* tam Exigua pars Corporis in *Sudores* aut *Effluvia* abeat, ut an vivent necne, dum hunc in modum *Sepulta* jacent, merito ambigatur.

A Tortoise living 3 days without a Head; by M.
n. 26. p. 480.

LXI. S *Steno* writes from *Florence*, that a *Tortoise* had its *Head* Cut off, and yet it was found to *Move* its *Foot* 3 Days after.

A sort of Oysters in E. India; by M. Witzen.
n. 203. p. 871.

LXII. 1. In the River of *Goa* there is a *Shell* represented in Fig. 230 which holds a sort of *Oyster*: It is very scarce, and in the *Indies* as well as here in *Holland* the *Shell* Powdered is esteem'd a good *Medicine*.

Fig. 230.
By Dr. Lister.
ib. p. 872.

2. The like sort of *Oyster-Shells* is to be found in the *West-Indies*. And considering the Hint given us by M. *Witzen*, of its being thought *Medicinal* at *Goa* where it is found; and also how that *Calcined Shells* are the most common Entertainments all over the *Indies* Chewing them all Day long with the Leaves of a certain *Hot, Piperate, and Spicy* Plant, and a sort of *Nut* mixt therewith; we may reasonably suspect the *Goa Stone* to be made up of them, or such like ingredients.

Shining Worms in Oysters; by M. Auzaut.
n. 12. p. 203.

LXIII. 1. M. *Auzout*, at the Intimation of M. *de la Voye*, Observed a *Shining* Clammy Moisture in *Oysters*, which stuck to the *Shell*, and being drawn out, Shone in the Air its whole Length (which was about 4 or 5 *Lines*,) and being put upon the Observers Hand, continued to *Shine* there for some Time. And afterwards causing more than 20 *Dozen* of *Oysters* to be opened, in the Dark, he found this *Shining Substance* to be really *Worms* (as M. *de la Voye* had thought them before,) and those of 3 sorts; One sort was *Whitish*, having 24 or 25 *Feet* on each side, forked, a Black speck on one side of the *Head* (taken by him for a *Chrystalline*) and the *Back* like an *Eele* stript off her *Skin*; the *Second* was *Red*, and resembling the common *Glow Worms*, found at Land, with Folds upon their *Backs*; and *Feet* like the former, and with a *Nose* like that of a *Dog*, and one *Eye* in the *Head*; The 3d. sort was *Speckled*, having a *Head* like that of a *Sole*, with many Tufts of *Whitish Hair* on the sides of it.

2. The Observer also saw some much Bigger, that were *Grayish*, with a Big *Head*, and 2. *Horns* on it, like those of a *Snail*, and with 7 or 8 *Whitish Feet*: But these though kept by him in the Night, *Shined* not.

3. The 2 first sorts are made of, a matter easily Resoluble, the least Shaking or Touch turning them into a *Viscous* and *Aqueous* Matter; which falling from the *Shell*, stuck to the Observers Fingers; and *Shone* there for the space of 20 *Seconds*: And if any little part of this matter, by strongly shaking the *Shell*, did fall to the Ground, it appeared like a little piece of *Flaming Brimstone*; and when shaken off nimbly, it became like a small *Shining Line*, which was *Dissipated* before it came to the Ground.

4. This *Shining* Matter was of *Different Colours*; some *Whitish*, some *Reddish*; but yet they both afforded a *Light*, which appeared a *Violet* to this Observer's Eye.

5. He Observed among them 2 more Firm than the rest, which *Shone* all over; and when they fell from the *Oyster*, *Twinkled* like a great *Star*, *shining* strongly, and emitting Rays of a *Violet Light* by Turns, for the space of 20 *Seconds*. Which *Scintillation* the Observer imputes to this, that those *Worms* being *Alive*, and sometimes Raising their *Head*, sometimes their *Tail*, like a *Carpe*, the *Light* Increased and Lessened accordingly; seeing that when they *shone* not, he did, viewing them by a *Candle*, find them *Dead*.

6. Forcibly shaking these *Oyster-Shells* in the *Dark*, he sometimes saw the whole *Shell* full of *Lights*, now and then as big as a *Fingers End*; and abundance of this *Clammy* Matter, both *Red* and *White*, which he judges to have been *Worms* Burst in their *Holes*. And in the shaking he saw all the *Communications* of these little *Verminulous Holes* like to the *Holes* of *Worms* in *Wood*.

7. In more than 20 *Dozen* of *Oysters*, he took no *Shell* (10 or 12 excepted) but it emitted *Light*: And he found some of this *Light* in 16 of the *Oysters* themselves.

8. This *Light* occurs more frequently in *Big*, than *small Oysters*; in those that are *Pierced* by the *Worm*, oftner than in those that are not; and rather upon the *Convex* side, than the other; and more in *Fresh* ones than in the *Stale*.

9. Having somewhat Scaled the *Convex*-side of the *Shell*, and discovered the *Communication* of the *Holes*, wherein the often mentioned *viscous Moisture* that has any form of *Insects* is found, he smelt a *Scent* that was like the *Water* of a *Squeezed Oyster*.

10. The *Worms* give no *Light* when *Irritated*, but if they do, the *Light* lasts but a very little *Time*: Whereas that which appears in those that were not *Angred* before, continues a great while; the Observer affirming to have kept of it above 2 *Hours*.

LXIV. The *Pearl-Shells* in *Norway* and elsewhere do breed in *Sweet-Waters*. Their *Shells* are like to those, which commonly are call'd *Muscles*, but they are *Larger*. The *Fish* in them looks like an *Oyster*; and it produceth a great *Cluster* of *Eggs*, like those of *Craw-Fishes*, some *White* some *Black*,

The Origine of
Pearl; by M.
Christophorus
Sandius. n. 101.
p. 11.

(which latter will yet become *White*, the Outer *Black-Coat* being taken off;) these *Eggs*, when Ripe, are Cast out, and being cast out they Grow, and become like those that Cast them. But sometimes it happens, that one or two of those *Eggs* Stick fast to the side of the *Matrix*, and are not Voided with the rest. These are Fed by the *Oyster* against her Will, and they do Grow, according to the Length of Time, into *Pearls* of Different Bignesses, and imprint a Mark both in the *Fish* and the *Shell*, by the Situation, conform to its Figure.

This Account I received from a *Dane*, call'd *Henricus Arnoldi*, an Ingenious and Veracious Person, having by his own Experience found it so at *Christiana* in *Norway*, and with great Seriousness assured me of the Truth thereof.

Pearl Fishing
in Ireland; by
Sir Rob. Red-
ding. n. 198.
p. 659.

LXV. There are 4 *Rivers* in the County of *Tyrone* abounding with that sort of *Muscles* wherein *Pearls* are found, all Emptying themselves into *Lough Foyle*, whereon stands the Town of *Derry*, and so into the Sea. There are also other *Rivers* in the County of *Donegall*, a River near *Dundalk*, the *Shure* running by *Waterford*, the *Lough* call'd *Lough-Lean* in *Kerry*, which afford the like *Fish*; and no doubt there be many more that I do not know.

In the Warm Months before Harvest is Ripe, whilst the *Rivers* are Low and Clear, the Poor People go into the Water, and some with their Toes, some with Wooden Tongs, and some by putting a sharpened Stick into the opening of the *Shell* take them up: And although by common Estimate not above one *Shell* in a *Hundred*, may have a *Pearl*, and of these *Pearls* not above one in a *Hundred* be tolerably Clear, yet a vast Number of Fair Merchantable *Pearls*, and too good for the *Apothecary*, are offered to Sale by those People every Summer Assize. I my self saw a *Pearl* bought for 50 *Skill*. that weighed 36 *Carrats*, and was Valued at 40 *l*. and had it been as Clear as some others produced therewith, it would certainly have been very Valuable. And a Miller took a *Pearl* which he sold for 4. *l*. 10. *Skill*. to a Man that sold it for 10 *l*. to another who sold it to the late Lady *Glenanly* for 30 *l*. with whom I saw it in a Necklace; she Refused 80. *l*. for it from the late *Dutchess* of *Ormond*. The *Young Muscles* never have any *Pearl* in them.

The Natives, though very foul Feeders, will not Eat the *Fish*: Which seems to me to Cut like the *Oyster*, *Blackish Green*. The *Shell* is fastened with 2 *Tendons*, one at Each End, whereas the *Oyster* and *Scallop* are with one only in the Middle. They ly in part opened, putting forth their *White Fins*, like a Tongue out of the Mouth, which directs the Eye to them in the Water; being otherwise *Black* as the Stones in the River. The *Backs* of the *Shells*, just about the Hinges on which the *Valves* do Open, are all Broken and Bruised both *Young* and *Old*, and shew the several *Crusts* and *Scales* that make the *Shell*: and is caused (I think till I know better) by the many great Stones that are Driven over them by the Flouds from the Neighbouring Mountains, which are most Impetuous after

after any little Rain. The *Insidies* of the *Shells* are of an *Oriental* and *Pearly* Colour and Substance, like a flat *Pearle*, especially when first Opened; and I was told by an Ingenious Person, living upon the Place; that he had Observed in some *Shells* under the First Coat a *Liquor* that was very *Orient* and *Clear*, that would move upon the Pressure of the Finger; but that such a *Muscle* never had *Pearl*: which *Liquor* I should think was the true *Mother* of *Pearl*.

The Part where the *Pearl* lieth is in the *Toe*, or Lesser End, at the Extremity of the *Gut*, and Out of the Body of the *Fish* between the two *Films*, or *Skins*, that Line the *Shell*. I believe that this *Pearl* Answereth to the *Stone* in other *Animals*; and Certainly like that Encreaseth by several *Crusts* growing over one another, which appeareth by Pinching the *Pearl* in a *Vice*, the Upper Coat will Crack and leap away; and this *Stone* is Cast off by the *Muscle*, and voided as it is able; and many *Shells* that have had *Pearls* in them, are found now to have none; which will appear by these Instances; the *Shells* that have the best *Pearls* are Wrinkled, Twisted, or Bunched, and not Smooth and Equal, as those that have none. And the Crafty Fellows will guess so well by the *Shell*, that though you watch them never so carefully, they will open such *Shells* under the Water, and put the *Pearls* in their Mouths, or otherwise conceal them. Yet sometimes when they have been taking up *Shells*, and believed by such Signs as I have mentioned, that they were sure of good Purchase, and refused good Sums for their Shares, they found no *Pearl* at all in them. Upon Discourse with an Old Man that had been long at this Trade, he advised me to seek not only when the Waters were low, but in a Dusky Gloomy Day also, Lest, said he, the *Fish* see you, for then he will shed his *Pearl* in the Sand; of which, I believed no more, than that some *Muscles* had voided their *Pearls*, and such are often found in the *Sands*.

I conceive that these *Pearls*, if once *Dark*, will never be *Clear* upon any Alteration in the *Health* or *Age* of the *Muscle*, or of the *Moon*; and that if the first Seed be *Black*, all the Coats superinduced will be still *Clouded*.

The Bottoms of these Rivers I observed to be part *Sandy*, part *Stony*, and part *Oazy*. Many of these *Muscles* ly in *Brackish* Water; being driven down the Rivers 4 or 5 Miles within the *Flowing* of the *Sea*. I have sometimes Observed the same *Pearl Clear* at one End, and *Dark* at the other.

LXVI.. *Pectinem* nactus, ineunte *Januario*, ejus Dissectionem, qua potui accuratione, certe ex Uno Exemplari, institui. Imprimis vidi *Cardinem* ex *Concava valva* leviter incurvari, & super injici alteri ac *Planæ Valvæ*, totoque illo Latere inter se *Cartilaginæ* quadam firmiter connecti: Item in ipso medio spatio *Cardinis* alteram Aterrimam Robustamque admodum *Cartilaginem* disponi. Hinc adeo mira illa Constrictionis vis, & fortasse *Planam Valvæ*, Remi alicujus more, movendi, adque Pernicitatem & volatus quandam imaginem moliendam: de quo quidem non semel loquuti sunt veteres tanquam huic *Conchilio* peculiari.

The Anatomy of
a Scallop; by
Dr. M. Lister.
n. 229, p. 567.

Apertis autem *Valvis* hæc conspicienda sese exhibent. Ad Dextram & sub *Cardine* Os Cucullatum, instar *Ostreæ*. Velamina autem *Oris* conficiuntur ex Concurfu *Branchiarum* Exteriorum, quæ *Musculosæ* sunt, totumque *Animala* Capite ad *Ani* exitum, scilicet sinistram versus è regione *Oris*, ubi inter se rursus connectuntur, circumambiunt.

Ex isto autem Pari *Branchiarum* Exteriorum ea quæ *Planæ Valvæ* incumbit, *Centro* suo adhæret superiori Limbo ingentis cujusdam *Musculi* Rotundi, qui ex *Rectis* Angulis in *Mediis Valvis* inseritur: Altera verò Exterior *Branchia* similiter conjungitur, alteri *Capiti* ejusdem *Musculi* *Centralis*.

A *Musculo* vero *Centrali* Ambæ istæ Exteriores sive *Spuriæ Branchiæ* & *Tenui Membrana* & *Pellucida* admodum constant; Et ad *Medias Valvas* expansæ, leviter iis adhærent, ut moveri inde non possint, tuenturque *Animalis Dorsum* ab *Aquæ* Injuria, intra *Valvas* receptæ; à loco vero, istius *Adhesionis*, *Crassus* quidem *Musculus* *Mirificus*, tanquam *Limbus*, incipit. Is autem à me *Depingitur* tantum eo quo contrahitur modo; sed in *Vivis* mirè *Extensibilis* est, etiam longè ultra *Margines Vulvarum*. Item *Laciniis* donatur, & ex *Rufa* variatur *Lineolis* *Elegantissimis*. Multis autem *Diebus* à *Piscatione* nostri *Pectinis* is *Limbus* haud obscurè movebatur. *Usum* autem ejus sic intelligo, nempe ex *Contractione* *Incurvata* *Introrsum*, more *Retis* cujusdam, cum ambo isti *Branchiati Musculi* extra *Conchas* emissi sint, quicquid intra se complexi fuerint, sibi mutuo *adpliciti*, ad se rapiunt in *victum Animalis*: *Laciniis* autem, extremis suis *Marginibus* tenuitur *incisis*, *Aqua Marina* separari videtur, retento *Cibo*. Si qui vero sint alii ejusdem *Partis* *Usus*, me latent. Illud tamen addere lubet, hunc *Limbum* posse inservire etiam *Mecationi* cujuslibet *Animalis* *Minuti* aut *Pisciculi*, ex forti *Compressione*; itemque ex *Motu Undulatorio*, qui in eo valde *Notabilis* est, posse circumferri *victum*; eumque tandem, quacunque *Parte Circuli Retiarii* sit, ipsi *Oris* exporigi, ita *Manus Locum* quodammodo supplet.

Ad *Veras* autem, certe quæ ita appellari solent, *Branchias* venio, hæc vero quatuor sunt leviter *Flavicantes*, atque *Pectinatim* striantur *Eleganti* quodam opere. Illæ autem *Branchiæ Musculum* magnum *Centralem* circumambiunt, interque se comprehendunt sive incumbunt *Utero*, ejusque *Ovario*, certe *Partibus Generationi* dicatis. Harum autem *Partium Figuræ* rectè à me ante *Delineatæ* fuerunt, & jam *Vivo* quoque *Animali* video ejus partem inferiorem ex *Croco* resplendere; Superiorem vero *Albicare*; juxta *Os* vero *Processus* quidam, *Duplici Foramine* apertus, conspiciendus est. Horum autem *Foraminum Unum*, *Vulvæ* *Exitus* Existimandus est; & si *Androgyni* sint *Pectines* (quod suspicor ex perpetua similitudine istius *Partis* in omnibus à me visis, & vivo & *Conditis*) *Alterum*, ad *Maris* *Genitale* *Membrum* exerendum instituitur.

Ad *Caput* procedo; Huic *Os Labis* circumscriptum est *Rufescentibus*, more *Branchiarum* *Internarum*; & *Brevibus* admodum, & in nostro *Exemplari* *Crispis*, forte *vitiosis* & *mutilatis*. Sub ipsum vero *Cardinem* medium duo prægrandes veluti *Circuli* sive *Cavitates* instar *Oculorum* (ut *Oculi* non sunt) alicujus *Rhombi* *Piscis*, oblique positorum.

Os vero *Caputque* excipit *Majusculum Meconium Subnigrum*, ad sinistram vergens. Pone id *Cor* latitat, perque ipsum *Pericardium Pellucidum* conspici potest; ex carneo leviter *Rufescit*. *Cordis Aorta* in *Branchias* dispertitur. An vero id solum *Pericardium* sit, quod scilicet proxime adjacet. *Nigro Meconio*, sive totum etiam illud *Figura Rhomboide* comprehensum, hæreo. An pars ejus *Inferior Vesica Urinaria* sit, quæro: Certe ex *Meconio* oritur *Intestinum Rectum*, superque *Pericardium* equitans, ad *Internas Branchias* protenditur, & *Musculo Centrali* adnectitur.

Musculus autem *Centralis Orbicularis* est, *Albus & Lævis*. magna superficiæ suæ parte, quâ *Conchæ* adhæret; ex sinistra vero parte, alio *Candidiori Musculo* lacerato distinguitur, & *Conchæ* magis formatur.

aaa. Os, *Caputque* bb. *Meconium Aterrimum* c *Cor*, prout subter *Membranam* latitat. dd. *Pericardium*, an *Vesica Urinaria Rhomboides* eeeee. *Intestinum Rectum* *Pericardio* super equitans. fffff. magnus *Musculus Centralis*. gg. alius *Musculus* laceratus *Testis* fortiter adhærens. hhhh *Branchiæ Internæ*. ii. *Uteri prælongati Exitus*, duobus *Foraminibus* distinctus tanquam in *Androgynis*. kk. *Uteri* pars superior *Albida*. ll. *Uteri* pars *Inferior Crocea*. mmmmm. *Limbus Variiegatus*, sive *Musculus Retiarius Secundus*.

Explication of the Figure.

Fig. 231.

LXVII. There are found on the Coasts of *Malabar* and *Ceylon*, certain *Cockles*. or *Shells*, in *Dutch* call'd *Kouk-borens*. These *Shells* contain a *Fish* that lives in the *Bottom* of the *Sea*, fixt in the *Body* of the *Shell*, and at a certain *Season* of the *Year*, they cast their *Seed*, which produces a sort of *Matrix* of the size of the *Figure*. This long *Body* which is *Wrinkled* like an *Andouille*, or *Sausage*, is fill'd with a great *Number* of *Round Cells*, which are so many *Matrices*, each producing its little *Shell-Fish*; which quit not their *Cells* till they are grown to such a *bigness* and *Maturity*, as their *Weight* Breaks them off, and loosens them from their *Cells*, and so from their common *Matrix*, which remains fastened to the *Bottom* of the *Sea* by the great *End*, the other *End* moving about freely in the *Water*, which is flexible every way like an *Andouille*. It is observable that this *Matrix* has a kind of *Back-part* and *Belly*; the *Back* is somewhat like that of a *Skelvis*, and of a *Grayish* Colour, the *Belly* is *Whiter*, and is that part which is fill'd with the *Cells* from one *End* to the other: The *Skin* which covers it is very like that of *Stock-Fish* or other *Dryed Fish*.

A sort of Cockles in East India, by M. Witzem. n. 203. p. 87c.

Fig. 232.

LXVIII. The *Stones* in the *Heads* of *Craw fish* are always on the *Outside* of the *Stomach*, while the *Old Coat* sticks on the *Back* of the *Fish*, and pass into the *Stomach* as soon as they *Cast* their *Coats*; I never saw them on the *Outside*, when they have *Changed*, nor *within* before.

Stones in the Heads of Crawfish; by Mr. Ch. King. n. 266. p. 672.

I have Observed that the *Males* of *Crawfish* change their *Coats* a considerable time before the *Females*; for they always keep theirs till they have parted with their *Young* from their *Tails*.

LXIX. Those

Cancelli, or
Soldiers; by Mr.
Will. Cole.
n. 178. p. 1284.

Vid. Sup.
§. LIX.

LXIX Those who shall seek after the *Purple-fish* will find, as I have done, some of those *Shells* in which are the *Cancelli*, or rather *Astaci*, unto which they are more like, and so may Mistake: For those little *Crabbs*, or *Craw-Fishes*, I have found in most of our *English shells*, excepting the *Bivalved*, and *Patella's*. Of these *Fishes* in many parts, (especially in the *West Indies*,) there are many sorts, and some very Large, which our Country-men there call the *Soldiers*; for that they say, they Enter by force, Kill and take Possession of those Houses they have not built; and when they grow too big, forsake them, and enter into Larger. Whether that be True, I know not, but this I have found, when I have broken some of the *Shells* in which those *Vagrants* are, so as not to Bruise their Bodies, and then put them *Naked* into the Water, I have beheld them with nimble springing Motion, to Run to and fro till they find a Stone to hide themselves under; which not finding, they bury themselves in the loose Sand. This Observation gave me full satisfaction, that they were not (at least all the Kinds,) *Connate* and *Coalescent* with their *Shells*; and other *Testaceous* Animals of the Sea and Land are.

A Stellar-Fish;
by Mr. Win-
throp. n. 57.
p. 1151. n. 74.
p. 2221.

Fig. 233.

LXX. 1. I understand by the Fisher man who brought me this *Fish*, that he never saw, nor Heard of any but 6 or 7 that were taken at several times by himself, not far from the *Shoals* of *Nantucket* (which is an Island upon the Coast of *New-England*) when he was Fishing for *Cod*. This *Stellar fish*, when it was alive, and first pulled out of the Water, was like a Basket, and had gathered it self round like a *Wicker-Basket*, having taken fast hold upon that *Bait* on the *Hook* which he had sunk down to the Bottom to catch other *Fish*, and having held that within the surrounding *Brachia*, would not let it go, tho' drawn up into the Vessel; until by lying a while on the Deck, it felt the want of its Natural Element, and then Voluntarily it Extended it self into a *Flat Round* Form. The only Use that could be discerned of all that Curious Composure, wherewith Nature had Adorned it, seems to be, to make it as a *Purse-Net* to Catch some other *Fish*, or any other thing, fit for its *Food*; and as a *Basket* of Store to keep some of it for future supply; or as a *Receptacle* to prepare and Defend the *Young Ones* of the same kind from *Fish* of *Prey*; if not to feed on them also (which appears probable the one or the other;) for that sometimes there were found pieces of *Mackerel* within that *Concave*: And he told me, that once he caught one, which had within the Hollow of its Embracements a very small *Fish* of the same Kind, together with some piece or pieces of another *Fish*, which was judged to be of a *Mackerel*.

He told me that every one of the *smallest Parts* had *Motion* when it was alive, and a *Tenacious* strength; but after it was Dead and Extended to a flat Round, it was so Brittle that it could not be Handled without Breaking some Parts of it; but by carefully laying it to Dry, it was somewhat Hardened. I think (till a fitter *English* Name may be found for it) that it may be Call'd a *Basket-Fish* or a *Purse-Net-Fish*.

2. This

2. This Elaborate Piece of Nature we may Call *Piscis Echino Stellaris Visciformis*, its *Body* (as was noted by Mr. Hook) resembling an *Echinus* or *Egg-fish*, the *Main Branches*, a *Star*, and the *Dividing* of the *Branches*, the *Plant Missel-toe*. This *Fish* spreads it self from a *Pentagonal Root*, which encompasseth the *Mouth* (being in the Middle, at *a.*) into 5 *Main Limbs* or *Branches*, each of which, just at the issuing out from the *Body*, subdivides it self into *two* (as at *i.*) and each of those 10 *Branches* does again (at 2.) Divide into *two* parts, making 20 *Lesser Branches*: Each of which again (at 3.) Divide into *two* *Smaller Branches*, making in all 40. These again (at 4.) into 80; and those (at 5.) into 160; and they (at 6.) into 320 They (at 7.) into 640; at 8, into 1280; at 9. into 2560; at 10. into 5120; at 17. into 10240; at 12. into 20480; at 13 into 40960; at 14. into 81920; beyond which, the farther Expanding of the *Fish* could not be certainly Traced, though possibly each of those 81920 small Sprouts or Threds, in which the *Branches* of this *Fish* seem'd to *Terminate*, might, if it could have been Examined when living, have been found to subdivide yet farther. The *Branches* between the *Joints* were not Equally of a Length, though for the most part pretty near; but those *Branches*, which were on that side of the *Joint*, on which the *Preceding Joint* was placed, were always about a 4th or 5th part Longer than those on the other side. Every of these *Branchings* seem'd to have, from the very *Mouth* to the smallest *Twigs* or *Threds*, in which it ended, a *Double Chain* or *Rank* of *Pores*, as appears by the *Figure*. The *Body* of the *Fish* was on the other side, and seem'd to have been *Protuberant*, much like an *Echinus*, or *Egg-fish*, or *Button-Fish*, and, like that, Divided into 5 *Ribbs* or *Ridges*, and each of these seem'd to be kept out by two small *Bony Ribbs*. NS. In the *Figure* is represented Fully and at Length, but One of the *Main Branches*, whence 'tis easie to Imagine the Rest, cut off at the 4th *Subdividing Branch*; which was done to avoid *Confusion*.

By ---- n. 37.
P. 1153.
Fig. 233.

3. This *Star-Fish* is the *Stella Arborescens Rondeletii*; First Described by Him, and since by other Naturalists.

By Mr. Frah.
Willoughby.
n. 58. p. 1200.

LXXI. 1. In Dec. 1696. Two Remarkable *Marine Animals* were found in the *Stomach* of a Common *Cod-Fish* sold in the *Fish-Market* in *Dublin*. One of them by lying long in the *Stomach* was much Mangled and in part Digested: But the other was Compleat in all its Parts, and had received no manner of Alteration, save 'twas Dead. It was Bigger at one End, and went Taper or Gradually Lessening towards the other. It was 4 $\frac{1}{2}$ Inches Long; and where Largest, as it was 1 $\frac{1}{2}$ Broad, so it was about 3 $\frac{1}{2}$ Inches in Circumference: At the Smaller End, not above 1 $\frac{1}{2}$ of an Inch Broad. It had neither *Shell*, *Crust*, *Scales*, or *Bone*, for its Covering, but was soft: Yet not Flabby, or Fleshy, as the *μαλάκια*, or *Mollia*, but rather *Membranous*.

A Scolopendra
Marina; by Dr.
Tho. Molineux:
n. 225. p. 405.

Fig. 234, 235.

The *Back* or *Upperside*, was shaped Roundish, especially towards the sides; in the Middle it was something Flattened; the *Belly* was perfectly Plain. Along the middle of the *Back* ran a large *Stripe* from one extrem to the other,

Fig. 234.

about $\frac{2}{5}$ of an *Inch* broad, towards the Upper-End, but still narrower as it came towards the *Tail*. This *Stripe* was all covered with a short soft sort of *Down*, not unlike in Texture, Colour, and Substance, to that which grows on the *Back* of the *Leaf* of *Tussilago* or *Colts-foot*. Joining to the Edge of this *Stripe*, ran from one End to t'other, a *List* about $\frac{2}{5}$ of an *Inch* broad, that covered both sides of the Animal, and part of his *Back*. This *List* or *Verge*, was thickly shagged, with a fine Soft *Hair* that grew very Thick, and about $\frac{1}{4}$ of an *Inch* long; of a most delicate *Changeable Red* and *Green* Colour, and of so sparkling a vivid *Lustre*, that nothing of this kind could shew more Beautiful. Among this soft *Hair* were thickly interspersed, without order, an abundance (some *Hundreds*, I believe) of Black sharp, Hard *Prickles*, about the same Length of the *Hair*, and the Thickness of a Hog's Bristle, but much Harder, and very sharp at the Points. The *Tail*, or smaller End, Terminated in the *Back*, with 2 Triangular Pellucid soft *Scales*, that covered the Orifice of the *Anus*, at which its Excrement was discharged; as I found when I opened it, for the Extremity of the *Intestine* was closely inserted into this Passage.

Fig. 235.

The Bigger End, tho' it had not any *Horns*, *Eyes*, *Ears*, *Nose*, or *Gills*, yet because 'twas opposite to the *Tail*, and here was the *Mouth*, we may properly enough call the *Head*. The *Mouth* was a very large Patulous Opening, for the Bulk of the Animal; not placed at the End, but somewhat Underneath, as part of the *Belly*, and could not be seen when the *Back* was turned Uppermost. The *Belly* was flat, and no ways Protuberant, Covered with a smooth Naked Skin, of a much lighter Colour than the *Back*, irregularly *Spotted*, with little dark *Brownish Spots*, some larger some smaller: 'Twas Broader towards the *Head*, and grew narrower still towards the *Tail*; where for about the space of an *Inch*, it was curiously Pinched with little *Indentures*, resembling the small *Joints* in the *Tails* of some *Insects*. These *Divisions*, or *Joints*, were still shorter and closer to one another, the nigher they were to the Extremity of the *Tail*. Beginning close at each Corner of the *Mouth*, and so along both sides of the *Belly*, was Ranged a Row of *Feet*, in a close continued Series down to the Utmost Tip of the *Tail*. The Largest were placed towards the *Mouth*, and Upper part of the Body, where they were about a *Quarter* of an *Inch* long, but downwards they grew Less and Shorter, still gradually diminishing, the nearer they approached the End of the *Tail*; where they were so Minute, that they were insensibly lost, and not easily to be Distinguished by the *Eye*. I distinctly Counted, from the *Mouth* to the *Tail*, on one side 36, and I could not be positive but there might be still more. From within the Body, through the middle of each *Foot*, pass 4, 5, or 6 of the same sort of sharp hard *Prickles*, that were interspers'd amongst the soft *Hair*. These were larger or smaller, and more or less in Number, according to the Size of the *Foot*, and gave it strength and firmness instead of *Bones*: And likewise issuing forth beyond the End of the *Foot*, served in lieu of *Toes*, or *Claws*. Joining to this Row of *Feet*, towards the *Back*, was Ranged along each side in a direct Line, a Series of small, thin, soft, flat

flat *Fins*, Face to Face in such an Order, that each *Foot* was exactly answered by its Correspondent *Fin*; so that their Number was precisely the same with that of the *Feet*, and they kept the same Rule of Proportion in their Size, still gradually diminishing, the nearer they approached towards the *Tail*. I distinctly counted of these, as of the *Feet*, 36 of a side; each *Fin* was curiously Fringed at the Edge, with the same *Beautifully Coloured Hair*, I before mentioned to have covered the Sides and part of the *Back*. By help of these *Fins* it performed *Progressive Motion* through the *Water* as a *Fish*; and by means of the *Feet* could *Creep* along the bottom of the *Sea*, as a *Reptile*.

When I Open'd it, I found a Thin *Membranous Gullet*, that led from the *Mouth* to the *Stomach*, about an *Inch* long. From this was continued straight downwards the *Stomach*, of a *Whitish* Colour, and of a *Tough Thick Texture*, consisting of an *Outward and Inward Membrane*, with a sort of *Carneous Substance* between; resembling somewhat in Make, tho' not in Figure, the *Gizzard* in some *Fowl*; 'twas as large as the upper Joint of a *Man's little Finger*. To this was annexed the *Intestine*, of a very differing Colour and Substance from the *Stomach*; for 'twas *Reddish*, Soft and Tender, and of a much smaller Cavity; 'twas continued almost directly, or with little Circumvolution, to the *Anus*. The *Brain, Heart, Gills, Liver, or Parts for Generation*, (if they have any) were hardly, if at all, to be distinguished.

The *Muscular Parts* were very Curious, Large and Distinct. One long continued *Stripe of Red Fleshy Fibres*, about the *Sixth* part of an *Inch* Broad, ran directly along the middle of the *Back*, from the *Head* down to the *Tail*. This *Fleshy stripe* sent out from each side, like so many *Rays*, 36 several *Pair* of smaller *Lateral Muscles*, which by the considerable Interstice between, I could easily distinguish from each other; making so Regular a *Figure* all together, that they might very aptly be Resembled to the *Spine, or Backbone*, of the *Passer Marinus*, or common *Plais-Fish*, when it is entire with all its *Ribs, or Transverse Processes*, issuing by *Pairs* from both sides of each *Vertebra*, from the *Head* down to the *Tail*. In this manner every particular *Foot and Fin* were supplied with their Correspondent *Muscles*, to give them *Motion*, either together or apart, as the Necessity or Design of the Animal required. And moreover, considering this sort of *Muscular Mechanism*, with the Taper shape of the *Body*, and likewise the Posture and Use of the many *Prickles* interspersed among the *Hairy Shag* that covered the sides; it seems very evident to me, that besides its *Progressive Motion*, it had also the Power, (as have most of the *Many-footed Land-Reptiles*, and some *Water Insects* I have observed) of Contracting its *Body* in such a way, that Bending its *Head Inwards*, it Roll'd the rest of the *Body* Round it as a *Center*, making a *Figure* like a *Rope Coil'd* into a *Helix*; and in this Posture, beset almost quite round with *Sharp Prickles* starting out directly forward, it Guarded it self from *Violences* that might Annoy it.

This Animal, on many Accounts, I think may properly be Ranged with the *Scolopendræ Marinæ* described by *Rondeletius*: but it may be distinguished from them by Calling it *Scolopendra Marina à Capite Latiori versus Caudam sensim gracilescens, Limbo Pulcherime Hirsuto Spinulisque crebris interstincto è Mari Hibernico.*

Explication of
the Figures. 234,
and 235.

a a a a a. The Downy List that Runs along the Back; *bb.* The two Triangular Scales that Cover the Anus; *cccccccc.* The Verge of Fine Changeable Green and Red Hair that covered the sides, and part of the Back; *ddddddd.* The Hard sharp Prickles interspersed among the Hair; *eeee.* The Skin of the Belly; *ffff.* several Incisures resembling Joints towards the Tail; *ggggg.* Darker Spots in the Skin of the Belly; *hhhh.* The Feet of Each side the Belly; *IIIIII.* The Fins with their Hairy Fringe behind the Feet; *kk.* The Large Mouth Opened Wide.

By Mr. Dale.
n. 249. p. 51.

2. I Observed at *Harwich* in 1698. divers of these *Marine Animals* brought up by the Fishermen, which they call *Sea-Mice.* They are Described by *Rondeletius*, (and by *Moufett* and *Johnson*) Figured under the Title of *Physalus*, but Badly.

By Dr. Molyneux. n. 251.
p. 127.
De Piscibus.
L. 15. p. 429.

3. I think if we'll suppose that *Rondeletius* saw what he Describes under the Title of *Physalus*, we can't imagine that he and I had the same Object before us. This will appear Evident by comparing his Words with Mine; For he says of His Animal *Ore caret*, whereas I say, the Mouth of mine was a Very Large Patulous Opening for the Bulk of the Animal; He says, *in Medio Latior est & Extrema Gracilescunt, Pudendi Muliebris speciem referens*, whereas I say, 'twas Bigger at One end, and went Taper, or gradually Lessening, towards the other; he says, *in Dorso Tumores parvi eminent, Verrucas Piscatores nostri vocant*, I am sure I could observe none such but say, the Back was covered with a Short soft sort of Down, in Colour, Texture and Substance like that which grows on the Leaf of *Tussilago*; *Venenatum experti sumus*, says He, whereas I found Two of the *Scolopendra's* I described in the Stomach of an Animal that had Devoured them, and Digested one as its Natural Food and sustenance, from whence we may conclude that they are not Poysonous; and besides *Rondeletius* his Icon agrees exactly with his own Description, whereas it neither agrees with my Description nor my Figure,

Vol. 3. p. 87.

But I have lately, in the *Acta Med. & Phil. Hafn.* of *Tho. Bartholine*, met with the Figure of a *Sea-Insect* under the Name of *Vermis Aureus vel Species Erucae Marinæ rarior*, which I am confident is the same with Mine; tho' *Bartholines* Figure is Faulty, and the Description short, False, and Imperfect.

De Insect. L. 5.
Cap. 15.

And I am apt to think that *Ulysses Aldrovandus* Design'd Our *Scolopendra* by the *Scolopendra Marina Lato Corpore Subcastaneo velut Pedibus Innumeris longiusculis Aurei Coloris*; tho' his Icon be much worse than *Bartholines*, and requires some strength of Phansy, to guess whether it be Really so or not.

LXXII. At Sir *Just. Isham's* I lately saw 4 very large Carps that a Boy took with his Hands in the *Heat of the Day*: His way was this, he Waded into the *Pond*, and then returning to the sides he would Grope them out in the Sedge or Weeds, and *Tickling* them with his Fingers under the Belly, quickly removed his Fingers to the *Gills*, and threw them out upon the Land; and this he did not in a Narrow but Large *Pond*, of about an *Acre* of Ground. He knows when he is upon the *Carps Layer* (if I may use that Term) by the *Warmth* of the Water: and then he immediately repairs to the sides to pursue his Game.

A way of Catching Carps; by Mr. J. Templer. n. 95. p. 6066.

I may here note, that *Carps* (and I suppose all other *Fish* that keep near the *Bottom*) keep always in a *Shoal* And when they move from one place to another, they Raise the *Mud* in the *Heat of the Day*: So that you may easily observe, what *Road* they travel, by *Muddy Tincture* near the bottom of the Water; and that so certainly as you cannot easily miss of Covering the Greatest part of them with a *Cast-Net*.

LXXIII. From *Lampton* towards *Bridgewater*, *Eeles* are so cheap in the *Frosts* of Winter, that they Vend them for little. Their abundance is from hence, that as the People Walk, in the *Frosty Mornings*, on the Banks of the River, they discern towards the Edges of the Banks, some parts not *Hoar*, as the rest, but *Green*: Where searching the *Holes* of the Banks, they find Heaps of *Eeles*.

Eeles Discovered plentifully in Frosts in Somersetshire; by Dr. J. Beale. n. 18. p. 323.

LXXIV. I have lately met with Relations of two very Large *Eels* caught upon the Coast of *Essex*: they both had all the *Characterizing Notes* of the *Eel*, and Wanted those *Barbles* which the *Eel* sometimes hath not, but the *Conger* is Never without. The *First* was taken somewhere about *Cricksea*: Its *Length* from the Tip of off the *Nose* to the *Tail's End*, was 5 Foot 8 Inches; and in *Circumference* it was 22 Inches. The *Other* was taken in *Maldon-Channel* about a *Mile* below the *Town*: the *Length* of which was 7 Foot; the *Circumference* 27 Inches; the *Weight* 36 Pounds; and out of its *Belly* was taken 5 Pounds of *Fat*; its *Skin* was *Black*, and being stuf, is still preserved at *Maldon*. This *Fish* was supposed to have been brought down thither by the great *Floods* at the Breaking of the Last *Frost*: because of a Hurt it had on its *Back*, which the *Fisherman* who caught it told me, he did conjecture might be from some *Mill* it must pass through.

Two very Large Eeles; by Mr. Dale. n. 238. p. 90.

LXXV. 1. The Reason of the Difficulty of Discovering the manner of the *Generation* of *Eels*, is the *Different Way* of *Generation*, and that they *Breed* in *February*, a time when Few are taken but what are Preserved in *Trunks* or *Ponds*, where they *Breed* not. This I Examined 2 Years since, in some taken at a *Mill* in which *Holes* they *Breed*, especially near *Gravelly Shallows*; and found one with *Egg*, another with 6 *Young ones* in the *Great Intestine*, which

The Generation of Eels; by Mr. Benj. Allen. n. 231. p. 664.

which I call the *Strait Bowel* that Descends immediately from the *Pylorus* until the *Winding* begins. They were fastened to very small *Placenta* each, which was Fixed to the *Intestine*; the *Meseraicks* at that time were very Turgid. The *Eggs* were on the Outside of the *Intestine*. It is certainly *Viviparous*, and *Feeds* not, at least *Gross*, in the *Winter*; during all which they lye still, till they have Discharged their *Young*. The *Parts* Distinguishing the *Sex* are Discoverable; those of the *Male* Affixt to the Extremity of the *Kidney*: the *Female* had a *Slender Gland* Transversely lying near the *Bowel*; but of this I dare not say much.

In *Salt-Water Eels*, I have not found the like, though Searcht for; because, I am of Opinion, they do not *Breed*, but are the same with the *Fresh-water* ones, since such Multitudes of *Fresh Water-Eels* go down to the *Sea*, and cannot Return, yet are never taken at *Sea*, among the many brought hither; and there are *Vestigia* of their *Beards* in the *Fresh-Water-ones*.

By Mr. Dale.
n. 238. p. 92.

2. That the *Generation* of *Any Animal* cannot be *Equivocal* or *Spontaneous*, but from animal *Parents* hath been so well by many Undeniable Arguments Asserted, and by Multiply'd Experiments Confirmed, by those Famous and Celebrated *Virtuosi*, *Malpighius*, *Redi*, *Swammerdam*, *Leewenboeck*, *Mr. Ray*, and Others, that I think there is no room to doubt but that *Eels* have the same Original: But it is much Disputed amongst Learned Naturalists, whether *Eels* have *Distinct Sex* or are *Hermaphrodites*. *Mr. Allen* Affirms the *Parts Distinguishing the Sex* to be Discoverable: But *M. Leewenboeck* could never Find any such thing; For *All* those that he hath Dissected, he Declares, were Provided with an *Uterus*: From whence he doth conjecture them to be *Hermaphrodites*, and besides the *Uterus* to be provided with *Masculine Seed*.

Another Controversy about the *Generation* of *Eeles* is, whether they are *Oviparous* or *Viviparous*.

I find many ingenious Persons who firmly Believe them to be *Oviparous*: But their Sentiments are Contrary to the Observations of *Walter Chartwynd* Esquire who in the Month of *May*, found them to be *Viviparous*, by Cutting open the *Red Fundaments* of the *Females*, from whence the *Young Eeles* would issue forth *Alive*.

And although *Mr. Allen* Affirms them to be certainly *Viviparous* yet his Observations concerning the Place of their *Conception*, I cannot conceive to be Consonant to that Care and industry of Nature, in providing convenient Receptacles for preserving the *Fætus*; neither is it Agreeable to Reason to believe, that when Nature hath provided an *Uterus* in *All Animals*, not only the *Viviparous*, and such as only Cherish the *Embryo in Utero*, but in the *Oviparous* also and *Insects*, the *Eel* and *Xiphia*, or *Sword-Fish*, should be the only Animals without it; much less that the *Guts*, appointed by Nature, for the *Secretion* of *Nourishment*, and the *Expulsion* of the *Fæces*, and are always

always in Motion, should be the Place of Generation in any Animal; though we may Allow *Eels* not to Feed *Gross* in the *Winter*. On the contrary, that the *Eele* hath an *Uterus*, is asserted by *M. Lewenboeck*, who never found them without; which perhaps is that Part which *Mr. Allen* Names a slender Gland, transversely lying near the *Bowel*.

Besides, Nature having in all Animals, *Oviparous* as well as *Viviparous*, hitherto Dissected, provided not only an *Uterus* but also *Tubes* (first observed by *Fallopious*) for the conveying the *Ovum* from the *Ovarium* to the *Uterus*, another great Difficulty and Objection lieth against *Mr. Allens* Observations; and in which indeed he seems to Contradict himself; for whereas he saith, that in one *Eel* he found *Eggs*, and those on the *Outside* of the *Intestine*, but in the other, 6. *Young Ones*, each fastened to a small *Placenta*, and those *Within* the *Great Intestine*, How, and by what Passages, could those *Eggs* come into the *Intestine*, to be formed and invigorated; unless we may suppose they do, like the *Embroy's* of some sorts of *Insects*, which for the conveniency of *Food*, Eat their own way into their *Heterogeneous*, or Assumed *Matrices*.

LXXVI. In *April* 1669. at *West-Chester*, I met with a *Young Porpess*, caught upon those *Sands*. The Length was 3. *Feet* 7. *Inches*; A string of 2. *Feet* and 2. *Inches* Girded him in the thickest place; The shape of his *Body* was not much unlike that of a *Tunny-Fish*, only his *Snout* Longer and Sharper; his *Skin* was Thin, Smooth, and without *Scales*: In an *Old* and well Grown *Fish*, it's like the *Skin* may be Thick and Tough, as *Rondeletius* represents it. His *Fins* are *Cartilaginous*; and Flexible, not sharp or prickly, as the *Antients* report them. On his *Back* he hath only *One*, which was distant from the *Tip* of his *Snout* 1 *Foot* and 9. *Inches*, and the *Basis* of it in Length 5½. *Inches*; so that measuring from the *Tip* of his *Snout*, to the *End* of the *Tail*, it was Scituate somewhat below the *Middle* of the *Fishes* Length. On the *Belly* it had only one pair of *Fins*, 9½. *Inches* distant from the *Tip* of the *Lower Mandible*, much about the Place, where the foremost pair of *Fins* in other *Fishes* usually grow. The *Tail* is Forked, of the Figure of a *Crescent*; the Breadth thereof from *Angle* to *Angle* 11 *Inches*; and the *Plain* of it lyes *Parallel* to the *Horizon*, as in all others (I suppose) of the *Cetaceous Kind*: The Reason whereof I conceive to be partly to supply the Use of the *Hindmost* Pair of *Fins* in other *Fishes*, which serve to *Ballance* the *Body*, and keep it up in the *Water*, and partly, to facilitate the *Fish's* *Ascent* to the *Top* of the *Water* (to which he can immediately raise himself by a light *Jerk* of his *Tail* thus placed) for the use of *Respiration*, which is necessary for him.

Observations on the Anatomy of a Porpess; by Mr. J. Ray, n. 74. p. 2220. n. 76. p. 2274.

For, doubtless if violently Detained *Underwater*, he would in a short time be *Suffocated* or *Drowned*. Immediately under the *Skin* lay the *Fat*, which as I remember our *Seamen* call the *Blubber*: It was firm, full of *Fibres*; and in this small *Fish*, of an *Inch* Thickness, encompassing and enclosing the *Whole* *Body* *Back*, *Belly*, and *Sides*. The Use whereof I conceive to be, 1. To keep the *Cold-water* at a *Distance* from the *Blood*, which is, I believe *Actually* and

to the Touch *Hot*; 2. To keep in the *Hot Steams* of the *Blood* from *Evaporating*, by that means also *Preserving* and *Maintaining* its *Natural Heat*; 3. Perhaps also, to *Lighten* or *Counterpoise* the *Body* of the *Fish*, which would otherwise be too *Heavy* to *Move* and *Swim* in the *Water*. Under the *Blubber* lay the *Musculous Flesh* like to that of *Quadrupeds*, but of a *Darker Colour*.

The *Body* was *Divided* into 3. *Regions*, or *Ventres*, like a *Quadruped's*, viz. *Head*, *Breast*, and *Belly*. The *Vessels* and *Viscera* in each *Venter*, for the main the same as in *Quadrupeds*; The *Abdomen* was encompassed about with a strong *Peritonæum*; The *Guts* Joyned to the *Mesentery*, and of a very great *Length*, by *Measure* 48. *Foot*, without any *Difference* or *Distinction* of *Great* and *Small*, neither was there any *Blind Gut*, or *Appendix*, that I could find; The *Stomach* was of a strange *Make*, being *Divided* into 2. *Large Bags*, beside other smaller *Ones*: I found nothing in it, but a good *Number* of those little *Long Fishes*, which our *Fishermen* dig out of the *Sands* at *Low-water*, and therefore call'd in some places *Sand-Eels*, by some they are call'd *Launces* and by *Gesner*, *Ammodytæ*. The *Liver* was of a *Moderate* size, situate in the *Right* side, and *Divided* into 2. *Lobes*, having no *Cistis Fellea*, or *Receptacle* of *Gall*, annexed. The *Pancreas* *Large*, sticking close to the 3^d. *Bag* of the *Stomach*, into which also its *Ductus* *Enters*, and *Emptys* its self. The *Spleen* was *small* and *roundish*: The *Kidneys* *Large*, sticking close to the *Back*, and lying contiguous one to the other, made up of many little *Kernels*, like to, but much *Lesser*, than those of an *Ox*; of a *Flat* *Figure*, having no *Pelvis* in the *Middle*, but the *Ureters* going out at the *Lower* *End*. The *Urine Bladder* was *Oblong*, and *Little* for the *Bulk* of the *Animal*, having on each side a *Round Ligament*, made of the *Umbilical Arteries* degenerating: The *Penis* *long*, *slender*, having a *small sharp Glans*; it appears not *Outwardly*, but lies *Hid* in its *Sheath* within the *Body*, *Doubled* up, or rather *Reflected*, in the *Form* of the *Letter S*. as is that of a *Bull*. The *Testicles* ly within the *Cavity* of the *Abdomen* on each side, as they do in an *Hedg-Hog*, and some other *Quadrupeds*, of an *Oblong* *Figure*; for their *Internal* *Substance*, *Seminal Vessels*, both *Præparantia* & *Deferentia*, *Epididymides*, *Vas Pyramidale*, *Corpus Varicosum*, and *Glandulæ Prostatæ*, exactly like to those of *Quadrupeds*. The *Seminal Vessels* *Perforate* the *Urethra* with many little *Holes*; whereof 4 are most *Conspicuous*, somewhat above the *Neck* of the *Bladder*.

It had 6. *Short Ribs* that had no *Cartilages* and 7. that had *Cartilages* (on Each side I mean.) The *Breast-bone* was very *small*. The *Diaphragm* was *Musculous*, as in *Quadrupeds*. The *Heart* *Large*, included in a *Pericardium*, had its 2. *Ventricles*, its *Valvulæ Sigmoides Semilunares*, *Tricuspides* & *Mitrales*, its *Coronary Arteries* and *Veins*: and in a word, the whole *Structure* and *Substance* of the *Heart* and *Lungs* agreed exactly with that of *Quadrupeds*. The *Wind Pipe* was very *short*, as it must needs be, the *Fish* having no *Neck*; the *Larynx* at *Top* was of a *singular* *Figure*, running out with a *Long Neck*, and a *Nob* at the *End* like an *Old-Fashioned Ewer*.

The *Pipe* in the *Head* through which this *Kind* of *Fish* draw their *Breath*, and *Spout* out *Water*, lies before the *Brain*, and ends *Outwardly* in *one* common *Hole*, but *Inwardly* it's *Divided* by a *Bony Sceptum*, as it were into 2 *Nostrils*; but below again it opens into the *Mouth* in *one* *Hole*. This lower *Orifice* is furnished with a strong *Sphincter*, whereby it may be shut and *Opened* at pleasure: and above this *Sphincter* the sides of the *Pipe* are lined with a *Glandulous* *Flesh*; which if you press, you will see start out of many little *Holes*, or *Papillæ*, into the *Cavity* of the *Pipe*, a certain *Glutinous* *Liquor*. Above the *Nostrils* is a strong *Valve* or *Membrane* like an *Epiglottis*, which serves to stop the *Pipe*, that no *Water* get in there against the *Fish's* *Will*. Within the *Fistula* are 6 *Blind* *Holes* having no *Outlet*; *four* *Tending* toward the *Snout*, *two* above the *Valve* that stops the *Nostrils*, and *two* *Beneath* it; and *two* *Tending* towards the *Brain* having a long but narrow *Cavity* for the *Use* of *Smelling*, as I conjecture, though *Opening* the *Brain* I could find neither *Olfactory* *Nerves* nor *Processus* *Mammillares*.

The *Eyes* are small considering the *Bigness* of the *Fish*, and *Scituate* at a good *Distance* from the *Basis* of the *Brain*. The *Snout* is long, and furnished with very large *Muscles*, to *Root* or *Turn* up the *Sand* at the *Bottom* of the *Sea* for to find *Fishes*; as appears in that we found nothing in his *Stomach* but *Sand-Eels*, which, as was intimated before, lye *Buried* in the *Sand*. The *Brain* and *Cerebellum* are, for the substance and *Anfractus* of them, the same with those of *Quadrupeds*, only differing in the *Figure*, as being shorter; But what they want in *Length*, they make up in *Breadth*. They have also the like *Teguments* called *Dura* and *Pia Mater*; *Six* or *7*. *Pair* of *Nerves*, besides the *Optick*; the same *Ventricles*: only in the *Medulla Oblongata* we observed not those *Protuberances* call'd *Nates* and *Testes*. The *Skull* (*Cranium*) is not so strong and thick, as in *Quadrupeds*: but *Articulated* after the same manner to the *First* *Vertebra* of the *Back-bone*. This largeness of the *Brain*, and *Correspondence* of it to that of *Man*, argue this *Creature* to be of more than ordinary *Wit*, and *Capacity*; and make to seem less *Fabulous* and *Improbable* those *Antient* *Stories* related by *Herodotus*, *Pliny* the *Elder*, and *Pliny* the *Younger*.

In each *Jaw* it had 48. *Teeth*, standing in a *Row* like to little *Blunt* *Pegs*. The *Tongue* was *Flat* above of an *Equal* *Breadth* to the very *Tip*, which was *Toothed* or *Pectinated* about the edges, *Tyed* firmly down to the *Bottom* of the *Mouth* all along the *Middle*, as *Aristotle* truly saith.

Whence I cannot but wonder, that *Rondeletius* should herein *Contradict* *Aristotle*, and *Affirm* (contrary to *Truth*, as I believe) *quod* *Dolphinis* *Lingua* *est* *Mobilis*, *quæ* *modo* *Exeri* *modo* *Condi* *potest*; unless perchance in this particular the *Dolphin* differs from the *Porpeff*. For the *Porpeff* is, as I take it, the *Phocæna* of the *Antients*, which is a lesser sort of *Dolphin*, and not the *Dolphinus*: at least if the *Fish*, we are *Describing*, were a *Porpeff*; for the *Teeth* of this *Fish* were lesser than, and of a *Different* *Figure* from, those in the *Jaw* of the *Dolphin* we got beyond *Seas*; yet is the *Difference* not *Great* between the *Dolphin* and *Phocæna*. As for that *Fish*, which our *Seamen* now a days call

the *Dolphin*, and which, as it is Described by Mr. *Terry* and *Ligon*, hath *Teeth* on it's *Tongue*, small *Scales*, is *Finn'd* like a *Rock*, of a Pleasant *Smell* and *Taste*, what it is I know not: but I am sure it is *Toto Genere* Different from the *Dolphin* of the *Antients*.

We Observed not in this *Fish* any *Nostrils* beside those in the *Fistula*, nor any *Ear-holes* or *Meatus Auditorii* at all; wherein also *Aristotle* Agreeeth with us: which yet *Rondeletius* found out near the *Eyes*. But we observed in the *Skull* a *Bone* answering to the *Os Petrosum*: which most certainly was the *Use* of *Hearing*.

As for the Name *Porpeps*, I agree with *Gesner*, that it was so Call'd, quasi *Porcus Piscis*, most Nations calling this *Fish* *Porcus Marinus*, or the *Sea-Swine*: Indeed it Resembles a *Swine* in many Particulars: as the *Fat*, the *Strength* of the *Snout*, &c.

A Venemous
Scratch with the
Tooth of a Por-
peps; by Dr. M.
Lifter. n. 233.
p. 726.

LXXVII. Forte ex dissectione *Delphini*, ante Dies Tres minimum mortui, admodum leviter *Digitum Vulneravi* ab interna Parte; at citra *Sanguinem*, scilicet simplici *Dentis Rasura*. Nihil autem Mali inde sensi ad *Quartum* usque *Diem*: quo tempore cum quodam *Livore* *Digitus* paululum Intumuit ad *Articulolum*. Malum indies serpebat, adeo ut intra *Alios Quatuor dies* *Digitos Duos* Infecisset; Tertiusque tandem *Digitus* male se habuit. *Plurima* ex *Consilio Chirur- gorum* adhibui, at parum profuerunt; jam *Manus* Correpta est, *Dolorque Car- pum* invasit; ex hoc autem *Fomento* primum stetit. (℞ *sq Spermatis Ranarum* ℥vi. *Boli Armen.* ℥is. f. *Vitrioli Albi* ℥iiii. m.) Calide bis quotidie admotum est. Item interdum alio modo (℞ *Vitrioli Albi Combusti, Boli Armeniac. an.* ℥iiii. *Camph.* ℥i. *Aq. communis* ℔viii. m. f. *Collyrium*.) Deinde *Nutrito* imposito, & superinjecto *Emplastro* ex *dolo & diapalma*, convalui ex hoc *Inusitato* ac *Improviso* *Malo*, Præter *Livorem* autem, qui satis *Venenum* indicabat, *Molestus* ac *Odius* quidam *Pruritus*, an *Igniculus* dicam, me *Dies* *Noctesque* vehementer Angebat, *Cuticulam* *Partium* *Correptarum* ex toto perdidit: *digitum* autem ad *Vires* suas non nisi post aliquot *Menses* restituti sunt.

Poisonous Fish
about the Baha-
ma Islands; by
M. J. L. n. 114.
p. 312.

LXXVIII. The *Fish* that are here (at *New-Providence* one of the *Baba- ma-Islands*) are Many of them *Poisonous*, bringing a great *Pain* on their *Joints* who *Eat* them, which continues so for some short time, and at last with two or three days *Itching* the *Pain* is *Rubb'd* off. Those of the same *Species*, *Size*, *Shapes*, *Colour* and *Taste*, are one of them *Poyson*, the other not in the least *Hurtful*; And those that are, are so only to *Some* of the *Company*. The *Distemper* to *Men* never, that we hear of, proves *Mortal*: *Dogs* and *Cats* sometimes *Eat* their *Last*. In *Men* that have once had that *Disease*, upon the first *Eating* of *Fish*, though it be those that are *Wholesome*, the *Poisonous* *Ferment* in their *Body* is *Revived* thereby, and their *Pain* *In- creased*.

Whales and
Whale-Fishing
about Bermudas;
by n. 1.
p. 11.

LXXIX. 1. An understanding and hardy Seamen gives this Account of the *Whale Fishing* about the *Bermudas*; that though many attempts of *Mastering* the

the *Whales* of those Seas had been Unsuccessful, by Reason of the Extraordinary *Fierceness* and *Swiftiness* of these Monstrous Animals, yet the Enterprize was lately Renewed: and Fit Persons having been out at Sea 17. Times and Fastened their Weapons a *Dozen* of times, they Kill'd in these Expeditions 2. *Old Female Whales*, and 3. *Cubs*; whereof one of the *Old* ones, from the *Head* to the Extremity of the *Tail*, was 88. *Foot* in Length, by Measure, its *Tail* being 23. *Foot* Broad, the *Swimming Fin* 26 *Foot* Long, and the *Gills* 3. *foot* Long, having great Bends underneath from the *Nose* to the *Navil*; upon her After Part, a *Fin* on the *Back*; being within Paved (this was the plain Seaman's Phrase) with *Fat* like the *Cawl* of a *Hog*. The *other old* one, he said, was some 60. *foot* long: Of the *Cubs*, one was 33. the other Two much about 25. or 26 *foot* long. The shape of the *Fish*, he said, was very sharp Behind, like the Ridge of a House; the *Head* pretty Bluff, and full of Bumps on both sides; the *Back* perfectly *Black*, and the *Belly White*.

Their *Celerity* and *Force* he Affirmed to be wonderful; in so much that one of these Creatures, which he *Struck* himself, towed the Boat wherein he was, after him, for the space of 6. or 7. *Leagues*, in $\frac{3}{4}$ of an *Hour's* time. Being wounded, he saith, they make a Hideous *Roaring*, at which all of that Kind that are within Hearing, come towards that place, where the Animal is, yet without striking or doing any Harm to the Wary. He is of Opinion, that this *Fish* comes nearest to that sort of *Whales*, which they call the *Fubartes*; they are without *Teeth*, and longer than the *Greenland-Whales*, but not so Thick. That they Fed upon much *Grass*, growing at the Bottom of the Sea, was seen by Cutting up the *Great Bag* or *Maw*, wherein he had found in one of them about 2. or 3. *Hogsheads* of a *Greenish Grassy Matter*.

The Largest sort of these *Whales* might afford 7. or 8. *Tuns* of *Oyl* if well Husbanded: the *Cubbs* yield but little, and that is but a kind of *Jelly*. That which the *Old* ones Render, doth Candy like *Pork's Grease*, yet Burneth very well. He observed that the *Oyl* of the *Blubber* is as Clear and Fair as any *Whey*: but that which is Boyl'd out of the *Lean*, Interlarded, becomes as Hard as *Tallow*, spattering in the Burning; and that which is made of the *Cawl* resembleth *Hog's Grease*. He affirms that though this *Grease* be *Boyling*, yet one may run ones Hand into it without *Scalding*. To which he adds, that it hath a very *Healing Vertue* for *Cuttings*, *Lameness*, &c. the part Affected being Anointed therewith.

The time of *Catching* these *Fishes* is from the Beginning of *March* to the End of *May*, after which time they appear no more in that Part of the Sea, but Retire (as it is Thought) into the *Weed-beds* of the *Gulf* of *Florida*; it having been Observed, that upon their *Fins* and *Tails* they have store of *Clams* or *Barnacles*, (upon which he said, *Rock weed* or *Sea-Tangle* did grow a Hand long;) many of them have been taken off them, of the Bigness of Great *Oyster Shells*.

The same Person saith, that since his former account there hath been Taken, n. 8. p. 132. by order of the *Bermudas Company*, 16. of those *Whales*: the *Oyl* whereof, to the quantity of 50. or 60. *Tuns* arrived in *Ireland* some Few Months ago.

He adds, That about 2 Years since, there Stranded upon the Coast of *New-England* a dead *Whale*, of that sort, which they call *Trumpo*, having *Teeth* resembling those of a *Mill*, and its *Mouth* at a good Distance from, and under the *Nose* or *Trunk*, and several Boxes or *Partitions* in the *Nose*, like those of the *Tails* in *Lobsters*; and that being opened, there run out of it a Thin Oily Substance, which would Candy in time, after which the Remainder being a Thick Fatty Substance, was taken out of the same Part with a Scoop. And this Substance he Affirmed to be the *Sperma Ceti*; adding further, that the *Blubber*, as they call it, it self, of the same sort of *Whales*, when Stewed, yields on the Top a Creamy Substance, which taken off, and thrown upon *White Wine*, lets fall a Dirty Heterogeneous Sediment, but what remains aloft affords a *Sperma-Ceti-like* Matter.

He concludes his Relation with observing, that these *Whales* were to be met with, between the Coast of *New England* and *New Netherland*, where they might be Caught 8 or 9 Months in the Year; whereas those about the *Bermudas*, are to be found there only in the Months of *February*, *March* and *April*.

By --- ib. p. 133.

2. Concerning the *Death* of the *Whale*, which hath been related to have stranded upon *New-England*, it is not very Improbable but that it may have been Killed by a certain *Horny Fish* which is said by Mr. *Terry* (in his *East Indian Voyage*) to run his Horn into the *Whale's Belly*; and which is Known, sometimes to Run his Horn into *Ships* (perhaps taking them for *Whales*) and there snapping it asunder; as happened not long since to an *English Vessel* in the *West Indian Seas*.

By Mr. Rich.
Norwood. n. 30.
p. 566.

3. Within these 2 or 3 Years, in the Spring time and Fair Weather, they take sometimes one 2 or 3 *Whales* in a Day. They are less, I hear, than those in *Greenland*, but more Quick and Lively; so that if they be Struck in Deep Water, they presently make into the Deep with such violence, that the *Boat* is in Danger to be Haled down after them, if they cut not the *Rope* in time; therefore they usually Strike them in *Shoal-Water*. They have here very good *Boats* for that Purpose, Mann'd with 6 *Oars*; such as they can Row Forwards or Backwards, as occasion requireth. They Row up gently to the *Whale*, and so he will scarcely shun them; and when the *Harpineer*, standing ready fitted, sees his Opportunity, he strikes his *Harping Iron* into the *Whale* about or before the *Fins*, rather than toward the *Tail*. Now the *Harping Irons* are like those which are usual in *England* in striking *Porpoises*; but of singular good Metal, that will not break, but winde, as they say, about a Man's Hand. To the *Harping Iron* is made fast a strong Lythe *Rope*, and into the *Socket* of that *Iron* is put a *Staff*, which when the *Whale* is struck, comes out of the *Socket*; and so when the *Whale* is something Quiet, they Hale up to him by the *Rope*, and it may be, Strike into him another *Harping Iron*, or Lance him with *Lances* in *Staves* till they have Kill'd him. I do not hear that they have found any *Sperma Ceti* in any of these *Whales*; but I have Heard from Credible Persons, that there is a Kind of such as have the *Sperma* at *Elutheria*, and others of the *Ba-*
hama

Bahama Islands (where also they find often Quantities of *Amber Greece*;) and that those have great *Teeth* (which *Ours* have not,) and are very *Sinewy*. One of this Island of *Bermudas* (*John Perinchief*) found one there *Dead*, driven upon an *Island*; and, though I think Ignorant in the Business, yet got a great Quantity of *Sperma Ceti* out of it. It seems they have not much *Oyl* as *Ours*; but the *Oyl*, I hear, is at first, like *Sperma Ceti*; but they *Clarifie* it, I think, by the *Fire*.

4. We have in these Seas about *Bermudas* great store of *Whales*, which in *March*, *April* and *May*, use our Coast. I have my self *Killed* many of them. Their *Females* have abundance of *Milk*, which their *Young* ones suck out of the *Teats*, that grow by their *Navel*. They have *No Teeth*, but *Feed* on *Moss*, growing on the *Rocks* at the bottom during these 3 *Months*, and at no other Season of the Year. When that is Consumed and gone, the *Whales* go away also. These we *Kill* for their *Oyl*: But there have been *Sperma-Ceti-Whales* driven upon the *Shore*, which *Sperma* (as they call it) lies all over the *Body* of those *Whales*. These have diverse *Teeth*, which may be about as big as a *Man's Wrist*.

By Mr. Rich-
Stafford. n. 40.
p. 793.

I have been at the *Bahama Islands*, and there have been found of the same sort of *Whales Dead* on the *Shore*, with a *Sperma* all over their *Bodies*, but I could never hear of any of that sort that were *Killed* by any *Man*; such is their *Fierceness* and *Swiftiness*. One such *Whale* would be worth many *Hundred Pounds*. They are very strong, and Inlaid with *Sinews* all over their *Body*, which may be drawn out *Thirty Fathom* long.

LXXX. 1. I conjecture that *Fishes*, by Reason of the *Bladder* of *Air* that is within them, can sustain or keep themselves in any *Depth* of *Water*; for the *Air* in that *Bladder* being more or less *Compressed*, according to the *Depth* the *Fish* swims at, takes up more or less space; and consequently the *Body* of the *Fish*, part of whose *Bulk* this *Bladder* is, is *Greater* or *Less* according to the several *Depths*, and yet retains the same *Weight*. Now the *Rule de Insidentibus Humido*, is, that a *Body* that is *Heavier* than so much *Water* as is equal in *Quantity* to the *Bulk* of it, will *Sink*; a *Body* that is *Lighter*, will *Swim*; a *Body* of *equal Weight*, will rest in any part of the *Water*. By this *Rule* if the *Fish* in the *Middle-Region* of the *Water*, be of *Equal Weight* to the *Water* that is *Commensurate* to the *Bulk* of it, the *Fish* will Rest there without any *Tendency* *Upwards* or *Downwards*: And if the *Fish* be *Deeper* in the *Water*, the *Bulk* of the *Fish* becoming *Less* by the *Compression* of the *Bladder*, and yet *Retaining* the same *Weight*, it will *Sink*, and Rest at the bottom: And on the other side, if the *Fish* be *Higher* than the *middle Region*, the *Air* dilating it self, and the *Bulk* of the *Fish* consequently *increasing*, but not the *Weight*, the *Fish* will rise *Upwards*, and Rest at the *Top* of the *Water*.

The Use of Air
Bladders in Fi-
shes; by---
n. 114. p. 320.

Perhaps the *Fish* by some *Action* can *Emit* *Air* out of his *Bladder*, and afterwards out of its *Body*, and also, when there is not enough, *Take in Air* and *Convey* it to this *Bladder*; and then it will not be *Wondred*, that there should

should be always a fit Proportion of *Air* in the Bodies of all *fishes*, to serve their Use, according to the *Depth* of Water they are Bred and Live in. Perhaps by some *Muscle* the *Fish* can *Contract* this *Bladder* beyond the *Pressure* of the Weight of Water. Perhaps the *Fish* can by its sides, or some other Defence, keep off the *Pressure* of the Water, and give the *Air* leave to dilate it self. In these Cases the *Fish* will be Helped in all intermediate Distances, and may *Rise* or *Sink* from any Region of the Water without moving one *Fin*.

By Mr. Boyle.
ib. p. 311.

2. To determine whether a *Fish* doth *Rise* or *Sink* in Water by *Constricting* or *Expanding* himself, Take a *Bolt-Head* with a *Wide Neck*, and having filled it almost full with Water, put into it some *Live Fish* of a convenient size; that is, the biggest that can be got in, as a *Roche*, *Perch*, or the like, and then draw out the *Neck* of the *Bolt-Head* as slender as you can, and fill that also with Water. Then Observe the Motion of the *Fish*, and if upon his *Sinking*, you perceive the Water at the Slender Top does *Subside*, you may Infer, he *Contracts* himself, and if upon his *Rising*, the Water be also *Raised*, you may Conclude, he *Dilates* himself.

By Mr. Ray.
n. 15. p. 349.

3. I think that ——— hath Hit upon the True Use of the *Swimming Bladders* of *Fishes*. For 1. It hath been observed, that if the *Swimming Bladder* of any *Fish* be Pricked or Broken, such a *Fish* *sinks* presently to the Bottom, and can neither support nor Raise up it self in the Water. 2. *Flat-fishes*, as *Soles*, *Plaise*, &c. which lie always Groveling at the Bottom, have No *Swimming Bladders* that I could ever find. 3. In most *Fishes* there is a manifest *Channel* leading from the *Gullet*, or Upper Orifice of the *Stomach*, to the said *Bladder*, which without doubt, serves for Conveying Air thereunto: But there is a *Valve* or some other Contrivance to hinder the *Egress* of it, so that you shall sooner Break the *Bladder* than force any *Air* out by this *Channel*. Yet in *Sturgeons*, Mr. *Willoughby* hath observed, that Pressing the *Bladder*, the *Stomach* presently swell'd: So that it seems in that *Fish* the *Air* passes freely Both ways.

I verily think there is in the *Coat* of this *Bladder* a *Musculous Power* to Contract it when the *Fish* Lifts: For, in many *Fishes* it is very Thick and Opake, like the *Coat* of an *Artery* (which hath as Dr. *Willis* observes, such a *Muscular Faculty*) as for Example in all the *Cod-kind*; in some, v. g. the *Hake*, call'd in Latin *Merlucius*, it is inwardly covered with a *Red Carneous* substance, which I take to be *Musculous Flesh*; in others it is Forked at the Top, and to each Horn hath a *Muscle* affixed. Now the *Musculous Force* need not be great, being still assisted by the Water, as the *Fish* Descends; the *Pressure* of the Water being much Greater at the Bottom than at the Top.

The Power also of *Dilating* the *Abdomen* by the *Muscles* assists those *Fishes* to *Rise*, whose Natural Place is towards the Bottom: And the *Air* Compressed in the *Bladder* *Dilating* it self as the *Fish* Ascends, Facilitates that Action of the *Muscles*. But those *Fishes* that descend by *Contracting* the *Bladder*, letting the *Contracting Muscle* cease to Act, will *Rise* again of their Own Accord, the *Air* within *Dilating* it self; as we see in *Glass Bubbles* by *Compression* of the *Air* in them Descending, which as soon as the Force is removed, Ascend without more ado.

Besides the *Flat Fishes*, I before mentioned, all the *Cartilagineous Kind*, as well *Flat* as *Long*, want *Swimming Bladders*: What Courſe they uſe to *Ascend* and *Descend* in the *Water*, I know not. Many of the *Eel-kind* (not All) have *Swimming Bladders*, yet can they hardly *Raiſe* themſelves in the *Water*, by reaſon of the *Length* and *Weight* of their *Tails*: I ſuppoſe, the *Air Bladder* being near their *Heads* Helps them to lift up their *Head* and *Fore-part*.

LXXXI. I have obſerved in the *Eyes* of *Fish* that the *Proceſſus Ciliaris* is not Faſten'd to the joyning of the *Cornea* and *Sclerotis*, as in all Other Animals that I Diſſected, ſo as to Hinder the *Watery Humor* to go any further *Backward*. For I conſtantly obſerved that the *Humor Aqueous* may move a good way *Backward* in ſome, and in others almoſt as far as the *Optick Nerve*. And in as many *Fish* as I could conveniently examine carefully, I have found a *Membrane* which Covered the *Tunica Cornea*, ſo as not to let any *Water* come to it. This answers the *Membrana Nicitans* in *Fowl*, and reaches on all ſides to the *Cutis* of the *Fish* to which it is faſtened. This is *Transparent*, and pretty *Thin*; and ſo is all the *Cornea*, if compared to that of *Quadrupeds*.

The Eyes of
Fish; by Dr.
Allen Moulen.
n. 199. p. 716.

I have alſo Obſerved that the *Eyes* of *Fish*, as well as thoſe of *Fowl*, are more or leſs *Cartilaginous*: For the *Sclerotis* is a *Cartilago ſui Generis*, eſpecially near the *Cornea*; and in the Larger ſorts of them, I have found the whole *Sclerotis* ſuch a kind of a *Cartilage*.

LXXXII. *Fish* are Remarkably Different from all other Animals in many particulars. The moſt conſiderable Difference is their want of *Lungs*, and their not *Breathing*: And yet it is Neceſſary that ſomething ſhould ſupply this in *Fishes*, which may have the ſame Effect upon their *Blood*, as the *Air* has upon Ours, by entering into our *Lungs*, that is to ſay, to *Divide* and *Diſſolve* it, and render it Fit for *Circulation*. Now we find no part in *Fish* more Proper to produce this Effect than the *Bronchiæ* that lye like ſo many *Leaves* upon each other under their *Gills*: For they receive the *Water* in by the *Mouth*, and Return it by the *Gills*, or Receiving it in by the *Gills* they Throw it out by the *Mouth*. Hence it is agreed upon by all that the *Water* contains ſomething that Produces this Effect, and this ſeems moſt probably to be *Air*.

The Structure of
the Internal
Parts of Fiſh,
by Dr. Char.
Preſton. n. 225.
P. 419.

That there is *Air* in all *Water* cannot be Doubted after this Experiment of *M. Marolle*. He ſet a *Veſſel* of *Water* over the *Fire*, ſo to Drive out the *Air* from it. This *Water* he put into the *Air Pump*, to Draw out the *Air* from it; and after that Fill'd a *Viol* with it, within 2 or 3 *Fingers* of the *Top*, which ſpace he left only Full of *Air*, and ſtopt the *Viol* well; and by ſhaking it the *Water* Imbibed the *Air*, ſo as to Riſe up and quite Fill the *Viol*.

But we need not wonder that *Fish* cannot alſo Live in the *Open Air*. Their *Blood* is Naturally leſs *Hot* than ours, ſo that the natural *Heat* of ours would be a *Fever* in them, and *Mortal*: For the *Nitre* of the Pure *Air* is in too great

a Quantity, and too subtil, so that it Dissolves their *Blood* too much, and makes it too *Fluid*, whereas the *Nitre* in the *Water* is more Gross and in Lesser Proportion; whence it gives their *Blood* only a *Fluidity* requisite to keep it in its Natural State. To prove that it is in the *Bronchiæ* that this Division is performed, we need but Observe their Extraordinary *Redness* above any other part of the Body; a Proof that the *Blood* is there more Divided. *Fish* are also found to *Dye* in *Water* frozen over, which happens plainly from their Communication with the *Outward Air* being Hindred by the *Ice*.

The *Heart* of *Fish* is Different from that of Other *Animals* in its having but *One Ventricle*: For it has only the *Vena Cava* and the *Aorta* that open into it, having *No Lungs*. So that by the *Aorta* the *Blood* comes out of the *Heart*, which is Branched into a Thousand *Capillaries* over the *Bronchiæ*, and is after Reunited; which Reunion is made under the *Basis* of the *Cranium*; and because the *Blood*, when once there, has no need of being forced Higher Upwards, they have no occasion for a *Second Ventricle* for that purpose, as *Terrestrial Animals* have. The Reunion of these *Capillaries* of the *Bronchiæ* being made, they Form two large *Trunks*, of which one proceeds towards the *Head*, and the other towards the *Lower Parts*.

Fish have a *Diaphragm*; but not for the same Purpose as in Other *Animals* that *Breath*. It is always strait and Tense, and Perpendicular on the *Vertebræ*; it Hinders the *Terminating Salts* that Exhale from the *Intestines* from coming to the *Heart*, which might cause some Alteration there.

Their *Stomach* is *Membranous*; for *Fish* Swallow down other Smaller *Fish* Whole, and sometimes *Earth*. Wherefore 'tis needful to have a Power of Contracting and Straitning it self, forceably to Break to pieces the Hard Matters contained therein. Their *Intestines* make several great *Windings* about; a Sign the *Fermentation* is but Slow therein; which is made up by the Length of the *Intestines*. The *Liver* has much the same Situation as in Other *Animals*; as also the *Spleen* has. They are provided of a *Gall-Bladder*, a *Ductus Choledochus* and *Pancreas*, or rather Two little Baggs fastened to the *Ventricle* for the same use. *Fish* have usually many *Pancreas's*, so that in some there have been told 44 They have *Kidneys*, *Bladder*, &c.

They have the *Ovary* near the *Vertebres* of the *Loins*. The *Eggs* come forth at a Passage below the *Anus*: And the *Male* has a like *Ductus*, or *Hole*, by which they Eject their *Seed* upon that of the *Female* to impregnate the *Eggs*; which the *Male* sometimes Changes the Colour of, as he passes over them, when he Casts his *Seed* upon them after they are *Laid*.

Fish have on the *Vertebræ* of the *Loins* a *Bladder*, very large in Proportion to their Bulk; which serves, by *Compressing* or *Dilating* it self, to render the *Fish* more or less *Heavy*, as Occasion requires. The *Fins* and *Tail* assist them in their Passage through the *Water* whither they will: But 'tis this *Dilatation* that makes them capable of *Swimming* in it; and if this *Bladder* be by any means

means Burst, so that it cannot be *Extended*, the *Fish* can no more *Raise* it self in the *Water*, but keeps continually at the *Bottom*. *Flat-fish*, such as *Soles*, have none of this *Bladder*: For they are able, by Reason of their *Breadth*, to keep themselves up in the *Water*. *Cray fish*, and other *Shell fish* want it likewise, for the most part: for they *Creep* only at the *Bottom* of the *Water*. There are many *Fish* that have them *Double*.

LXXXIII. *Anserum Ferorum Quinque Genera* vulgo numerantur in *Agro Eboracensi* satis frequentium; viz. 1. *The little Spanish Goose*; Sc. æque *Parvus ac Brenta*; sed *Figura & Colore* quodammodo ad *Anserem Domesticum* accedens; ab *Hispania* denominatur. 2. *The Barnicle* satis cognitus. 3. *The Scotch Goose*, Sc. *Vulgatissimus Ferus*, à *Scotia* ad nos, exeunte *Augusto* adveniens, è quibus fere constant innumeri illi *Greges* qui in *Planis Campis* (*the Woclds* dictis) & alibi passim inveniuntur. 4. *The Whilk*, *Anser Maximus Niger*, ineunte *Bruma* primum adveniens; raro alibi quam in *Pratis*, *Pascuisque Herba* pascitur. 5. *Anser Palustris* *Noster*, *Grey Lagg* dictus; huic *Magnitudo Anseri Domestico* subpar.

The Wild-Goose; by Dr. M. Lister. n. 175. p. 1160.

Caput ex Fusco Nigricat, & ad *Medium Collum Infuscatur*; *Dorsum ex Cinereo Livescit*; ipsæ autem *Alæ*, & earum *Remiges Nigricant*; *Uropygium Albescit*, ejusque *Pennæ Externæ Albidæ* sunt; *Venter Cinereus*, is vero *Imus* sensim fit *Niveus*; *Rostrum* a *Capite* ad *Mediam* fere *partem Nigrum*; deinde *Subpurpureum*, ipso ejus *Apice Nigro*; in *Superiore Mandibula* non nisi unus *Denticulorum* *Ordo*, atque idem *Simplex Ordo* in *inferiore*; item huic *Lingua* utrinque *Uno Denticulorum* ordine *Armatur*. *Pedes Subpurpurei*, sive *Carnei Coloris*; *Ungues* fere *Albidi*, excepto *medii Digiti*, qui ex *majori parte Nigricat*. *Pendet Libris 7.* & fere *Dimidium*. In *Paludibus Agri Eboracensis* *Nidificant*; ipsi & eorum *Pulli* *Mense Maio* pinguescunt, & in *Deliciis* habentur.

But I will not Affirm the *Grey Lagg* to be Different from the *Common Wild Goose*; Mr. *Ray's* Description and mine so well agree, save in the *Colour* of the *Bill* and *Leggs*.

ib. p. 1161.

LXXXIV. In the *Western Islands* of *Scotland*, the *West Ocean* throws upon their *Shores* great *Quantities* of very *Large* *Weather-beaten Timber*; The most *Ordinary Trees* are *Firr* and *Ash*. Being in the *Island of East*, I saw lying upon the *Shore* a *Cut* of a large *Firr-Tree* of about $2\frac{1}{2}$ *Foot Diameter*, and *9 or 10 Foot long*; which had lain so long out of the *Water*, that it was very *Dry*; and most of the *Shells* that had formerly covered it, were *Worn* or *Rubbed off*. Only on the *Parts* that lay next the *Ground*, there still Hung *Multitudes* of little *Shells*: They were of the *Colour* and *Consistence* of *Muscle Shells*. This *Barnacle-Shell* is *Thin* about the *Edges*, and about half as *Thick* as *Broad*. Every one of the *Shells* hath some *Cross Seams*, or *Sutures*, which as I remember divide it into *5 parts*, near about the manner as in the *Figure*.

The Barnacle; by Sir Rob. Murray. n. 137. p. 925

Fig. 236.

These Parts are fastened one to another, with such a Film as *Muscle Shells* are.

These *Shells* hung at the Tree by a *Neck* longer than the *Shell*, of a kind of a *Filmy* Substance, Round and Hollow, and Creased, not unlike the *Wind-Pipe* of a *Chicken*, spreading out Broadest where it is fastened to the Tree; from which it seems to draw and convey the matter which serves for the *Growth* and *Vegetation* of the *Shell* and the *Little Bird* within it.

In every *Shell* that I open'd I found a Perfect *Sea-Fowl*: The *Little Bill* like that of a *Goose*; the *Eyes* marked; the *Head*, *Neck*, *Breast*, *Wings*, *Tail*, and *Feet*, Formed; the *Feathers* every where perfectly Shaped, and *Blackish* Coloured; and the *Feet* like those of other *Water-Fowl*, to my best Remembrance. The Biggest I found upon the Tree, was but about the Size of the *Figure*; Nor did I ever see any of the little *Birds* Alive, nor met with any Body that did; only some Credible Persons have assured me that they have seen some as Big as their *Fist*.

The Scotch Barnacle and French Macreufe; by Dr. Tancred Robinson. n. 172. p. 1036.

LXXXV. 1. The Bird which at *Paris* is called *Macreufe*, and in other parts of *France*, *Macroul*, the *French* Eat upon *Fish-Days*, and all *Lent*, thinking it to be a sort of *Fish*, or a *Marine* Animal with *Cold Blood*; or else a *Barnacle* Generated either out of *Rotten* or *Corrupted Wood* floating upon the *Sea*; or out of certain *Fruits* falling into the *Water*, and there Metamorphosed into a *Bird*; or else from a kind of *Sea Shells*, adhering to *Old Planks* and *Ship Bottoms*, called *Conchre Anatisferæ*. But in Truth these *Shells* contain a *Testaceous* Animal of their own *Species*; as the *Oyster*, *Cockle*, and *Muscle* doth. Whereas the *Barnacle* is of the *Goose*, and the *Macreufe* of the *Duck* kind, and both *Oviparous*; The Truth of which is Evident by the *Anatomy* of their *Parts* serving for *Generation*, and by their *Laying Eggs* and sometimes *Breeding* among us.

The *Macreufe* is the *Scoter*, or *Anas Niger Minor* described by *Mrs. Ray*. It is Frequently taken in *Nets* placed under *Water* upon the *Coasts* of *Normandy*; (most plentifully at the *Mouth* of the *Seine*), *Languedock*, and *Provence*; and I am confident, I have seen it upon the *Laguna* of *Venice*, at the *Mouths* of the *Brenta*, *Addeis*, and the *Po*. A *Duck* very like unto this (if not the same,) I also saw upon the *Mare Mortuum*, and the *Lake Avernus*.

The Macreufe; by Mr. Ray. ib. p. 1041.

2. I had no sooner seen the *Cases* of the *Male* and *Female Macreufe* which *Dr. Robinson* sent me; but instantly I found it was no *Stranger* to me. There is a particular *Description* of the *Cock* in *Mr. Willoughby's Ornithology* among the *Sea Ducks*, to which this *Bird* belongs, and not to the *Divers* or *Duckers*. *M. Graindorge's Description* I find upon attent reading to be very *Faithful*: But notwithstanding what he saith of the *Debility* of its *Feet*, unfit for *Walking* on *Land*, I see not but that it may *March* as well as the rest of its *Kind*, all which have but *Short* and *Weak Legs* in *Propotion* to the *Bulk* of their *Bodies*, and those also situate very *backwards*.

What

What the faith of the *Smallness* and *Weakness* of the *Wings*, and *Shoriness* of their *Feathers*, is common to many *Sea-fowl*, viz. the *Triadactylæ* and *Mergi* which yet by the *Nimble* Agitation of them, Fly very *Swiftly* and *strongly*.

Why they of the *Church* of *Rome* should allow this *Bird* to be *Eaten* in *Lent*, and upon other *Fasting Days*, more than others of this *Kind*, but especially the *Tridactylæ*, I see no *Reason*; the *Flesh* of these last, which Live only or chiefly by *Preying* upon *Fish* properly so called, tasting stronger of *Fish* than the *Duck-Kind*; which all Feed, partly at least, upon *Shell fish* (as *M. Graindorge* found the *Macreuse* also to do) and have a *Delicate* and well tasted *Flesh*.

I Observed in this *Bird*, and in some others of the *Sea-Ducks* that are much *Under water*, that they Want that *Vessel*, or *Ampulla*, situate in the very *Angle* of the *Divarication* of the *Wind-Pipe*, which for want of a better and *Fitter Name* we are wont to call the *Labyrinth* of the *Trachea*. We may very probably from hence *Conclude*, that the *Labyrinth* doth not serve them for a *Reservatory* of *Air*, to enable them to continue the longer under *Water*; as I sometimes conjectured; but for the *intending* and *Modulating* of the *Voice*, seeing in the *Plash-Duck* the *Females* want it: But I dam somewhat to seek about the *Use* of this *Vessel*. I Observed it in the *Mergus Cirratus longiroster major* or the *Dun-Diver*, and that very large, and extended by very strong *Bones*, and yet I thought my self to have sufficient reason to *Judge* that *Bird* to be the *Female* of the *Merganser*: But I dare not be confident that it is the *Female* because of this *Labyrinth*.

LXXXVI. In the Houses built for this *Use* there is a *Long Entrance* a b. The manner of Hatching Chicken at Cairo, by Mr. Jo. Graves. n. 137. p. 923.

on each side of which are 14 *Ovens* (some places have more, some less.) The *Bottoms* and *sides* of these *Ovens* which are on the *Ground*, are all made of *Sun-Dried Bricks*; upon which they put *Matts*, and on the *Matts*, *Eggs*.

The *Top* of these *Ovens* are *Flat*, and *Covered* with *Sticks*, (except 2 long spaces which are made of *Sun-Dried Bricks*; and are the *Hearths*, in which the *Fires* are made, to *Heat* the *Eggs* lying Under them in the *Lower Ovens*.)

Above these *Lower Ovens* are so many other, made of *Sun-Dried Bricks*, and *Arched* at the *Top*: Where also there are some *Holes*, which are stop'd with *Tow*, &c, or left *Open*, as they please, to govern the *Heat* in the *Ovens* Below. These *Upper Ovens* are made after this manner.

a. The *Mouth* of the *Oven*, opening upon the *Long Entrance* above mentioned. b. and c. *Entrances* into the *Ovens* Adjoyning. d e. two *Hearths* 3 or 4 *Inches* Deep, in which they make the *Fire*, to *Heat* this and the *Oven* Below. The *Depth* of the *Lower-Oven* is about 2½ *Foot English*: the *Second*, above 4.

They begin in the *Midst* of *January* to *Heat* the *Ovens*: Spending every *Morning* an 100. *Kintars* (or an 100. *pound Weight*) of *Camels*, or of *Buffulo's Dung*, and the like *Proportion* at *Night*, till the *midst* of *Febr.* about

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which

Fig. 257

Fig. 238

which time the *Ovens* are so Hot, that one cannot well endure to lay his Hand upon the Walls.

After this, they put the *Eggs* into the *Ovens* to *Hatch* the *Chicken*; which they continue Successively till the End of *May*.

The *Eggs* are first put upon *Mats* in the *Lower Ovens*, which are upon the Ground; 7. or 8000. *Eggs* in Number; and laid only Double one upon another.

In the *Ovens* Above these *Lower*, the *fire* is made in the Long or Little Channels, from whence the Heat is conveyed into the *Lower Ovens* before mentioned. The *Eggs* which are directly Under these *Hearths*, lie Treble one upon another; the rest, as was said, only Double.

At night, when they new make the *Fires* in the *Hearths* above mentioned, they then remove the *Eggs* that were directly Undermost (lying three one upon another) in the place of those which lay on the Sides only Double: and these being now removed, they lye Treble under the *Hearth*, because the *Heat* is Greater there than on the sides.

These *Eggs* continue in the *Lower Ovens* 14. Days and Nights: Afterwards they Remove them into the *Upper Ovens*; which are just over the *Lower*. In these (there being now no more *fire* Used) they turn all the *Eggs* four times every 24. *Hours*.

The 21. or 22. Day the *Chicken* are *Hatched*; which the *first* Day Eat not; the *Second*, they are fetched away by Women, who give them *Corn*, &c.

The Master of the *Ovens* hath a 3d. part of the *Eggs* for his Cost and Pains; out of which, he is to make such good unto the Owners (who have two *Thirds* in *Chicken* for their *Eggs*) if any happen to be Spoiled or Miscarry.

The *fire* in the *Upper Ovens*, when the *Eggs* are Placed in the *Lower*, is thus proportioned.

The first Day the greatest Fire; The *Second*, Less than the *first*; The *fourth* more than the *third*; The *fifth* Less; the *sixth* more than the *fifth*; The *seventh*, Less; the *Eighth*, more; The *Ninth* without Fire; The *Tenth* a Little Fire in the Morning; The *Eleventh*, they shut all the *Holes* with *flax*, &c. making no more Fire; for if they should the *Eggs* would Break.

They take care, that the *Eggs* be no *Hotter* than the *Eye* of a *Man*, when they are laid upon it, can well Endure.

When the *Chicken* are *Hatched*, they put them into the *Lower Ovens*, which are Covered with *Mats*. Under the *Mats* is Bran to Dry the *Chicken*: and upon the *Mats*, Straw, for the *Chicken* to stand upon.

LXXXVII. *Ants* are the Principal Food of very young *Partridges* and *Pheasants*, both Wild and Tamed, for several *Weeks*: And a chief Reason, why many find it so Nice a thing to *Breed* up the said *Birds* is, that either they give them too sparingly of this Food, or let them fast too long; not knowing, that as soon as 'tis Day-Light, they will Seek it for their Breakfast, and if they

Want

Want it, will in a few hours be Faint and Weak, and some grow so Chill for want of that supply of *Nourishment*, that it is no easy matter to Recover them. But afterwards, when they are grown bigger, if by *Ill Ordering* of those who should keep them Sweet and Often Shift their Water, or by *Ill Dyet*, as *Musty Corn*, &c. they become *Sick*, then *Ants* will not always Recover them, tho you give them never so many; and I have been forced to make use of Other *Insects* to Cure them, as *Millepedes* and *Earwiggs*; either of which will do Good, but both together Better, given in a good Quantity, and at least 2 or 3 times a Day. But then those other things must be Observed too, of Keeping their house *Clean*, and giving them *Sweet Corn* and shifting their Water twice a Day, Keeping them within till the *Dew* be from the Ground, Letting them Bask in the *Sand*, partly in the *Sun*, the Place being a little shaded, and putting them up in a Warm house before *Sunset*.

LXXXVIII. 1. It is most certain that *Swallows Sink* themselves towards Autumn into *Lakes*, no otherwise than *Frogs*; and many have assured me of it, who have seen them drawn out with a Net, together with *Fishes*, and put to the Fire, and thereby Revived. *Swallows found in Lakes in Winter; by M. J. Schefferus. n. 19. p. 350.*

2. I have frequently heard *Fishermen* Affirm, that they have here, about *Dantzick*, often *Fished* them out of the *Lakes*, in the Winter: but I never have seen it my self. *By M. J. Hevelius. ib. p. 347.*

LXXXIX. The *Ortygometra*, or *Rail*, is a sort of Fowl very Numerous in all Parts of *Ireland* in its Season; but that's but short, and lasts not above 3 or 4 Months in the *Summer*: During all the remaining parts of the Year, it lies Buried and asleep Under Ground. *The Rail, by Dr. Tho. Molineux, n. 234. p. 747.*

XC. That sort of *Bird*, mentioned by Dr. Plot to be often heard in *Wood stock-Park* (from the *Noise* it makes commonly call'd the *Wood-Cracker*.) is perhaps the Lesser sort of *Picus Martius Varius*: For since the Publishing of Mr. *Willoughby's Ornithology*, I have Observed that Bird sitting on the Top of an *Oaken Tree*, making with her *Bill* such a *Cracking* or *Snap-ping Noise*, as we Heard a long way off; the several *Snaps* or *Cracks* Succeeding one another with that Extraordinary Swiftneſs, that we could not but wonder at it. But how she made the *Noise*, whether by the Nimble Agitation of her *Bill* to and fro in a Rift of the Bough, or by the Swift striking of the *Mandibles* one against another, as the *Stork* doth, I could not clearly discern: but an intelligent Gentleman, who was very Diligent in observing the same *Bird*, said it was the Former way. *The Wood-Cracker; by Mr. Ray. n. 172. p. 1043.*

XCI. Aviculam, quam à *Germanis Silk Tail* vulgo appellari audio, unam aut alteram Sclopeti glande transfixam, *Eboraci*, exeunte *Januario* 1680. vidi. Sane perquam Elegans Avicula est; Magnitudine *Turdum* fere æquabat; huic in extremis alarum Pennis 4 aut 5 Apices Parvi Coccinei Nudi, Cornei, minime *The Silk-Tail; by Dr. M. Lister. n. 175. p. 1161.*

minime Plumis Vestiti; item in Extrema Cauda Limbus Latus, Luteus, instar Corticis Citri; cætera maximam partem *Lanius* Colore refert.

But I have since view'd the *Bill* of this Kind of *Bird* at Mr. *Charlton's*, and find it to want the *Notches* in the Upper part of the *Bill* Proper to the *Lanius-kind*; it must therefore be put amongst the *Fays*.

The Humming-Bird by Mr. Jo. Winthrop. n. 74. p. 2223.

XCH. 1. I have sent you the Curiously contrived *Nest* of a *Humming-Bird*; so Called from the *Humming* Noise it maketh whilst it Flies 'Tis an Exceeding *Little* Bird, and only seen in Summer, and mostly in Gardens, flying from Flower to Flower, sucking *Honey* out of the Flowers as a *Bee* doth; as it flyeth, not Lighting on the Flower, but Hovering over it, sucking with its long *Bill* a sweet Substance. There are in the *Nest* 2 of that Bird's *Eggs*, whether they use to have More at once I know not.

By Mr. Oldenburg. *ibid.*

2. These *Eggs* were so small that being weighed by me, the one *Weighed* but about 5 *Grains*, the other $3\frac{1}{2}$: And the whole *Nest* weighed no more than 24 *Grains*.

By Mr. Hamerly. n. 260. p. 760. n. 202. p. 815.

3. There is in most parts of *America* a Bird call'd by the *English* the *Hum-Bird*, by the *Spaniard*, *Tominicus*. He is of a most Excellent Shining *Green* Colour, and very Resplendent; the Colour doth something resemble some of our *English* *Drakes* *Heads*. It doth Inhabit in some of the Colder Parts of *America*, as well as in the Hotter. It is the *Least* of all *Birds* that I have seen there or in *England*; her *Leg* and *Foot* together is but *half* an *Inch*, the other Parts answerable; the *Trunk* of her *Body* not an *Inch*. I did weigh one (in those parts) as soon as ever it was killed, whose *Weight* was the *Tenth* part of an *Ounce* *Avoirdupois*; which I take to be about the *weight* of a *Coin*-ed *six pence*: And I have weighed here in *England* a *Tit mouse* (which I take to be the *least* *Birds* here) and it weighed above *Two* *Shillings*, and some *half* a *Crown*. I saw one of their *Nests* made of *Cotton-Wool*, in form and bigness of the *Thumb* of a *Man's* *Glove*, with the *Taper* end set downwards, wherein were 2 *Eggs* of the bigness of a *Pea*, of *Oval* form. They feed by thrusting their *Bill* and *Tongue* into the *Blossoms* of *Trees*, and so suck the sweet *Juice* of *Honey* from them; and when he sucks he sits not, but Bears up his *Body* with a *Hovering* Motion of his *Wings*. But for the Relation that he is a *Curious* *Singing* *Bird*, I think it untrue. An *Indian* *Soggamore* is not in his full *Pomp* and *Bravery* without one of these *Birds* in his *Ear* for a *Pendant*. He is call'd the *Hum-bird* or *Humming-Bird*, because some say he makes a noise like a *Spinning-wheel*, when he flies: But I have been many times very near them, both when they *Hovered*, and when they did *fly*, and I never heard any *Noise*; besides, their *Body* and *Wings* are too small to strike *Air* enough to make any *Noise*. But of this I shall not be positive, because some *Authors* are opposite to me. It is a *solitary* *Bird*: I never saw but *two* at a time together, *viz.* the *Male* and *Female*; they being easily known when together, the *Male* being somewhat bigger than the *Female*.

If one take a *Small-Birds-wing*, and stand 4 or 5 *Yards* from a *Candle* (when *Dark*) and Open the *Wing*, and look through it at the *Candle*, he may see a most *Elegant* Colour of *Red* and *Green*, which *Green* doth something Resemble the Colour of this *Bird*.

4: Perhaps the *Tomincius* does not feed on any Juice he sucks off, or out of Flowers, but rather (like many other Birds) on small Insects, some whereof lie in the bottom of most Flowers; and for which this Bird hath a Bill, where-as a Bee that sucks hath a Siphon or Hollow Probe.

By Dr. Neh.
Grew. n. 202.
p. 815.

XCIII. There is a very great variety of Species in the Parrot-kind, whether we consider the Country, Size, or Colour; *Johnston* says, the Curious have observed above an Hundred sorts of them. The sixth Species of Paroquets, by *Margravinus*, comes very near our Subject.

Observations on
the Dissection of
a Paroquet; by
Mr. Rich. Wal-
ler. n. 211.
p. 153.
Hist of Brazil.

It's size is between a Sparrow and a Black-bird, with a short Neck, Black Eyes, a Crooked Scarlet Bill, Greyish Legs and Feet, with Toes two Before, and two behind, like the Parrot; yet he never stands on One Foot to Eat with the other, as Parrots do. When he stands still on the Perch, his Breast and Belly shew of a Curious Light Green, his Back, and the Feathers of his Wings are somewhat Darker; on his Pinions are some short Blew Feathers, as likewise a pretty many on his Rump. His Bill is Encompassed up to the Eyes with a broad beautiful Scarlet Circle; reaching also down to his Throat. This Place in the Hen is of a Paler Orange Colour; wherein is the only observable Difference. The Feathers of the Tail (which in all small Paroquets is no Longer than the Wings) are not to be seen but when he flutters or spreads it. They are about two Inches long; near the Quill of a Lemmon Colour, enclining to a Green; next that a Scarlet for a pretty breadth; then a Narrow Thread of Green on some of them; after that a Black; and last of all ending in a Light Green.

Having opened the Thorax, and Abdomen (if I may so call them,) by blowing into the *Aspera Arteria*, a large Cavity or Bladder was Raised up all along the Abdomen to the Edges of the Os Ischion, and fastened to the Gizzard, containing in it all the Guts and Gizzard; but excluding the Heart and Liver. A Conformation like this is observed in all Birds, and peculiar to them, and mentioned by *M. Perault*; the Air received by the Lungs, Refreshing and carrying off the Noxious Steams from the Entrails, is not Confined, as in Men, and Quadrupedes to the Thorax only, by a *Mediastinum*.

Mech. des Ani-
m.

The *Aspera Arteria* differs from that of most other Animals; having not only a Larynx at the Top thereof, as is usual, but another also at its Entrance into the Breast, where it is divided, and Branches it self into Two. From this Structure, as I have been told; common to all Parrots, possibly it may be, that they can so readily imitate Humane Voices; but this Creature we Dissected, never attempts an Imitation of Words, making only a shrill Chirping Noise, doubling the Tone, or making it 8 Notes Lower, as a Stopt Organ-Pipe is an Eighth to the same Open. This Lower Larynx may assist the Weak Fabrick of so small a Creature as a Parrot to Counterfeit so Bass a Voice as a Man's; it being observed by some Ingenious Persons, that Parrots are Ventriloqui; and that it may be Queried whether all Ventriloquous Cheats may not by Nature be framed for such an Imposture.

The

The *Heart*, in Proportion to the Animal, was Large, and the *Liver* small.

The *Tongue* was Broad and thick, at the End somewhat like a *Man's*; whence a *Parrot* has its Name *ἀνδρωπόγλωττος*: the Extremity of it was Armed with a Black *Horny* Cover.

It has, besides the *Gizzard*, 2 *Craws*; the Uppermost *Craw* being only a Receptacle, or Sack, for the *Food* (which is *Canary-Seed*) to be again committed to the Mouth of this *Bird*, where it is again *Chewed*, having before been only *Husked*; this animal *Ruminating* as some *Quadrupedes* do; and I have observed this *Bird*, when upon the *Perch*, not only bring its *Food* again up into its Mouth, and there *Chew* it, but when the *Cock* and *Hen* sit together on the *Perch*, he will put out of his into the *Hens* Mouth. Their manner of *Chewing* is thus; The *Under Bill* being much Shorter, shuts within the *Upper*, or against the *Roof* of the *Mouth*, which is fitted with several Rows of very small and scarce to be seen *Cross-Bars*, as the Mouths of *Horses*, *Dogs*, and some other Animals are; these *Bars* are not soft, but *Horny*, as being part of the *Upper Bill*, so that the *Bird* by Carrying the Edge of the *Under Bill* and End of the *Tongue* against the *Ridges* in the *Upper*, Breaks and reduces to a *Pap* the *Seeds* that have been first Moistned in the *Craw*; to Expedite which Action the *Upper Bill* is *Foyned* just below the *Eyes*. The *Food* being thus *Macerated*, is by the *Gula* again committed to the *Second Craw*; but before its Entrance into it, it passes by an abundance of small *Glands* placed in that Part of the *Gula*, that the *Food* may Squeeze out of them in its Passage a *Juice*; of what *Necessity* in *Digestion* may be Enquired. From hence the *Food* passes into the *Gizzard*, or *Proper Ventricle*, small in Comparison of the *Ingluvies* or *Crop*; where, by several small *Stones* pickt out of the *Sand* given it, by the Motion of the *Gizzard*, it is *Comminuted*, and thence Transmitted to the *Intestines*, on the Sides of which within a small Distance, is placed the *Pancreas*.

Explication of
the Figures.

Fig. 240.

a. The *Aspera Arteria*. b. That part which forms as it were another *Larynx*. c. Part of the *Gula*. d. The *Upper Craw*. e. The *Heart*. ff. The *Venæ Axiliares*. g. g. The *Juglars*. h. A small *Gland* on one of them. i, i. The 2 *Auricles* of the *Heart*. k. k. The *Liver*. l. The *Gizzard*,

Fig. 241.

a. The *Trachea*. b. b. The *Larynx*; by which *Parrots* are rendered *Ventriloqui*. c. c. The 2 Branches of the *Trachea*.

Fig. 242.

a. a. The *Cornua* of the *Os Hyoides*. b. b. Two *Muscles* of the *Larynx*. c. The *Fissure*, or *Glottis*. d. the *Trachea*. e. the *Tongue*. f. the *Horny End* thereof.

Fig. 243.

a. a. The *Testes*. b. b. the *Deferentia*. c. c. the *Kidneys*. d. d. the *Ureters*.

Fig. 244.

a. The Upper part of the *Gula*. b. The *First* or *Upper Craw*. c. That part of the *Gula*, whose inside is *Glandulous*. d. The *Lower Craw*. e. The *Gizzard*, or *Ventricle*. f. The *First Intestine*. g. g. The *Pancreas*.

Fig. 245.

a. The *Upper Bill*. b. The *Inside* of it. d. d. The *Upper Jaw*. c. the place where the *Upper Bill* is *Moveable*. e. A *Passage* to the *Nostrils*. f. the *Lower*

Lower Bill. g. The *Upper Bill* in another Posture, to shew the small *Ridges* therein.

XCIV. The *Oestridge* is esteem'd the Largest and Tallest of Winged or Feathered Fowl, as being some times 8 Foot High: Which Bulk if we compare with the *Tominejo*, or *Humbird*, weighing about 12. Grains, we may readily discern within what Compass and Latitude the Creation of *Birds* was Ordained.

Observations on the Dissection of an Oestridge; by Dr. Edw. Brown. Ph. Coll. n. 5. p. 147.

The whole *Foot* of this Bird, à *Calcaneo ad extremum Digitum*, is $\frac{3}{4}$ of a *Yard*; upon which he sits when he Rests himself: But the *Foot* properly so Called, or *Longest Claw* is only $\frac{1}{4}$; the *Lesser Claw* $\frac{1}{8}$. and half a *Nail*. The *Nail* upon the *Longer Claw* is a *Nail* long; above which stand one above another 63 Large *Scales*, reaching up along his *Foot* Before, or before those *Bones* which answer to the *Metatarsus*: The *Lesser Claw* hath No *Nail*, and only 8 or 9 *Scales* one above another, which reach no Higher than the *Claw* it self. The *Grain* of the *Foot* is like the *Grain* of the *Skin* of an *Elephant*, but not so very Hard, and is Moveable, and gives way upon Pressure like the *Foot* of a *Camel*; there being Fat Under it, whereby he Treads Soft and without Noise: But Higher than the Two *Claws*, the *Skin* looks *Scaly*. Every small *Scale* constituting an irregular *Pentangle*, *Quadrangle*, and sometimes *Hexangle*.

From the *Heel* to the *Knee*, or that Part of the *Leg* which answers to the *Tibia* in *Man*, it is $\frac{5}{8}$ of a *Yard*. The *Thigh* above $\frac{1}{4}$. and very Thick.

Upon the *Breast* there is a Hard *Callous* Dark Substance of an Oval Figure, a *Nail* and a *half* in Length, like to that of a *Camel*, upon which he Rests himself when he Sits, with his Head Upright; and in that Posture I think he Sleeps, for we could never see him in any Other. His *Wing* is too little to Cover all his Neck. There is also a *Callous* Part upon the *Os Pubis*, Longer than the Former mentioned, but Narrow; upon which together with the *Callous* Part upon his *Breast* he Rests himself. The Length of his *Body* from the Lower part of the *Neck* to the End of the *Rump* is one *Yard*. The Longest Bone in his *Wing* is $\frac{3}{8}$ of a *Yard*, and his *Neck* a *Yard* not Measuring the *Head* with it.

The Top of the *Head* is Flat, in Length $\frac{3}{8}$ of a *Yard*, measuring from Behind the *Head* to the End of the *Bill*. It seems to be *Hairy* rather than Covered with *Feathers*: But the *Neck* hath Beautiful *White Feathers*, contrary to what some Affirm. On the Top of his *Head* there is a Flat Oval Place a *Nail* in Length, which is all *Callous*, and without any *Hair*, or *Feathers*, like the *Callous* Part of his *Breast*, but not so Thick, to Preserve the *Brain* from the *Serenes* that fall in *Hot-Countries*, and other Injuries of the *Air*, especially in the Night; and the more considerably if he Sleeps with his *Head* Upright, and not Under his *Wing*.

The *Gula* is very Large, as well as Long: But Largest at the Top near the *Head*; where it is a *Nail* and a *Half* Broad. The *Os Hyoides* stretcheth

it self down on each side of the Neck, the Length of $\frac{1}{2}$ of a Yard and half a Nail.

Besides the many *Muscles* in the Neck, for the Motion of the Numerous *Vertebræ* and the Head, there are Two most Elegant *Muscles*, which come from within the *Thorax*, arising within the *Chest* about the 2^d Rib, which insert themselves on each side of the *Aspera Arteria*; these I may name *Directores Asperæ Arteriæ*. At the First Dividing of the *Aspera Arteria*, or its Divarication on each side of the *Lungs*, there is a Ring Bigger and Stronger than any other Ring of the *Wind-Pipe*. There are Divers *Glandules* in the Neck near the *Gula*; these are of a Pale Colour like Ashes; But there are two most Beautiful *Glandules* sticking to the *Carotidal Arteries*, as they come out of the *Breast*, one on each side; these are *Blewish*.

The *Peritonæum* Doubles and Encompasses the *Stomach* loosely. He hath 7. *Ribs*, and the *Intercostal Muscles* are Broad, Plain, and Beautiful. He hath no Prominent *Breast-Bone*, like other *Fowls*, nor a Narrow *Chest* like many *Quadrupeds*, but a Broad *Breast*, and a Large Firm *Sternon*, of the Shape of a Shield, Broader than the *Sternon* of a *Man*; and indeed when he puts Down his *Head*, and Bends his *Neck* Round to come in at a Door, his *Breast* is so Broad, and his *Tread* so Different, that it is not at all like the Entrance of a *Fowl*, but wonderfully like that of a *Camel*; but with this Advantage, that the *Oestridge* bearing his Weight upon Two Legs only, his Entrance is more Bold and Graceful.

The *Penis* was about an *Inch* long, with a small *Cartilaginous* substance in it. The *Testes* lye very High near the *Kidneys* and *Back Bone*; and were very small and Slender, of a *Yellow* Colour.

The *Ear* is Round, and the Orifice will receive ones Finger. The *Eye* is Large and *Blewish*, and almost as big as a *Man's*.

The Natural Colours of the *Feathers* of this *Fowl* were *White*, *Grey*, and *Dun*; the *Feathers* of the inside of the *Wings*, upon the *Breast* and *Belly* and *Neck*, were *White*, and the *Feathers* in the *Tail* also *White*; but the rest are *Greyish*, or of a *Dun* Colour; yet it is a most Beautiful Creature surely in *Barbary*, where the Heat of the Country *Crisps* and *Curles* all its *Feathers*.

The *Rimula* of the *Larynx* is Long, and the *Cartilages* about it strong, but No *Epiglottis*, or Likeness to a *Humane Larynx*; although they that heard its Voice, compare it to the Crying or Shrieking of a Hoarse Child, but more Mournful and Dismal. The *Lungs* are of Fine Florid Colours; but Little in Proportion to the Vast *Aspera Arteria*; they stick Close to the *Back*, and are *Perforated* like other *Birds*; and upon Blowing into the *Wind-Pipe* with a Pair of *Bellows*, we could not make them Rise or Fill. The *Heart* hath 2 *Ventricles* about the bigness of a *Man's Heart*; but the Right *Ventricle* is much Thinner, and the *Valves* are more *Fleshy*.

There are Two *Stomachs* as in *Granivorous Fowls*, a *Crop* and a *Gizzard*; but the *Crop*, or first *Stomach*, Differs much from that of other *Fowls*, in that

that it is not placed without the Breast but within the *Sternum*; in that it is not Round but longer like a Bag, and of a Vast Bigness, lying Lengthwise in the Body. We found many *Glandules* in the *Coats* of this *Stomach*; a Row of them on the *Back* part of it, Reaching almost from one End to the other, about a *Thousand* of them, about *Ten* in Breadth, and an *Hundred* in Length. These lye Between the *Coats* of the *Stomach*, and every Particular *Glandule* discharges it self by a Peculiar Orifice, through the inward Coat of the *Stomach* into the *Cavity* thereof. We found some of these *Glandules* Round and Globular, some Oval, and some more Flat, and of an Irregular Figure: those which lye Highest are Roundest and Thickest, those which lye more towards the Bottom of the *Stomach*, or where it Unites with the *Gizzard*, are more Broad and Flat. These bring in a *Juice* which helps to *Digest* that Various Nourishment which this Fowl makes use of. The *Gizzard* was very large; the *Inner Coat* did not Adhere so Firmly as in other Fowls, and was very Thick and like *Flannel*, and upon our first looking into the *Gizzard* from the *First Stomach* it appeared as a piece of *Flannel*, or *Napkin*, which the *Oestridge* had Swallowed, and so stuck there. The Passage out of the *Gizzard* into the *Small Guts* is very Streight.

The *Guts* are about 20 *Yards* in Length; the *Smaller Guts*, beginning from the *Stomach*, are *Ten Yards* Long; and the *Larger Guts* down from thence to the *Anus* are near as much. At the Beginning of the *Great Guts* there are *Two Intestina Cæca*; each of them a *Yard* Long: And they have a *Skrue* or *Spiral Valve* within them after the manner of the *Cæcum* of a *Rabbit*; this *Skrue* in both the *Intestina* Winds about 20 *Turns*. The Extremity of the *Cæcum* is little, not much Differing from the *Cæcum* of a *Man*. The *Excrement*, which is thrown out by the *Guts* is of *Two Kinds*; a *White Thin Sticking Excrement*, which it Mutes like a *Hawk*; and after that another sort of *Excrement* comes, which is very like to that of a *Sheep*, but Bigger.

The *Mesentery* although it holds together such a Number of *Guts*, *Great* and *Small*, yet it is not Thick, but is only a *Transparent Membrane*; as generally in *Pennates*: but it is very large, and in some places above $\frac{3}{8}$ of a *Yard* Deep or Broad; Measuring from the Center to the *Guts*.

The *Liver* hath 4 *Lobes*, and is of a Colour not much Different from that of a *Man's*; We could find no *Bladder of Gall*. There was a *Glandule* Under the *Stomach* which might seem to be a *Spleen*: but *Pennata* and *Insecta* are said to have no *Spleens*. The *Pancreas* was Slender, and above a *Foot* long. The *Kidneys* are large, and of the Length of my Hand, as they lye both together; they are of the Shape of a *Guitar*. The *Ureters* are Firm, Strong, White and Long. Behind the *Kidneys* lye two *Glandules* somewhat Oval, of about an *Inch* and a *half* in Length, close to the *Back-Bone*.

The *Head* Resembles that of a *Goose*: and is little in Proportion to the Whole Body.

In *Africa* where some make *Meat* of *Elephants*, it is no wonder if some also *Feed* upon *Oestridges*: but *Galen*, and *Physitians*, Condemn it as Hard of *Digestion*.

The Cuntur of
Peru; by Dr.
Hans Sloan.
n. 208. p. 61.

XCV. The Magnitude ascribed to the *Cuntur* or *Condor* of *Peru*, as well as its great Force and Strength, have been the Cause that many have Doubted its Being. Capt. *John Strong*, Commander of a Ship which went into the *South-Seas*, through the *Streights* of *Magellan*, and Returned after 23 Months Voyage in the Year 1691. gave me this Account, together with a *Wing* or *Quill-Feather* of the Bird, viz. That on the Coast of *Chili* they had met with this Bird in about 33° . S. Lat. not far from *Mocha*, an Island in the *South-Seas*, and before they came at a place called *Herradura*; That his Men were very much Amaz'd at the bigness of it; and that after they had Killed it, it was 16 Foot from *Wing* to *Wing* Extended. The *Spanish* inhabitants there told them, it was the *Cuntur*, and that they were Affraid of these Birds, lest they should Prey on, or injure their Children. The *Feather* he gave me is 2 Foot 4 Inches Long; the *Quill* part is 5 Inches $\frac{3}{4}$ long, and an Inch and $\frac{1}{2}$ about in the Largest part; it Weighed 3 Drams 17 Grains and $\frac{1}{2}$, and was of a *Dark Brown* Colour, very Hollow or Concave on one side, and Convex on the other. The Seamen shot it sitting on a Cliff by the Sea-side, and Eat it, taking it for a sort of *Turkey*: in which Mistake likewise the First Comers to *Jamaica* were with a Bird in that place, called a *Carrion-Crow*, which is a sort of *Vultur*, of which kind I believe this also is.

Observations on
the Heads of
Fowl; by Dr.
All. Moulén.
n. 199. p. 711.

XCVI. 1. In the *Heads* of all *Fowl* that I have had an Opportunity to Examine, I constantly found only One *Aquæductus*, or Passage from the *Ears* into the *Pallat*; whereas in *Men*, *Quadrupedes*, and some *Amphibious Fish*, there are always Two. This Passage in *Fowl* is exactly in the Middle of the *Pallat*, below the entrance of the *Nostrils* into it. It is a Membranous Tube, Capable of Admitting a *Raven's*, if not a *Goose Quill* in Larger *Fowl*, such as *Turkeys*, *Geese*, &c. and Reaches Backward as far as the Communication from *Ear* to *Ear*; and hence it comes to serve Both; whereas there is a necessity of Two in those Animals, whose *Ears* do not Communicate.

2. I Constantly found a Hollow Space between the two Tables between the Os *Cuneiforme* reaching from *Ear* to *Ear* and as far Forward as the aforesaid Common *Aquæductus*, or rather *Ductus Aereus*, the Contrivance of it seeming more to Favour this than the Former Use. This Cavity in all *Fowl* (as far as I have Observ'd) reaches above the *Labyrinthus* on each side; so that whatever Impulse is made on the *Tympanum* on the One side, may not only be very readily Communicated by means of the *Internal Air* to the *Labyrinthus* of the same, but also to that of the Opposite side. Hence probably proceeds the Quickness of *Hearing* and *Vigilancy* of *Fowl*, notwithstanding their wanting a *Cochlea*; the Defect of which seems to be by this Structure more than Supplied; no other Creatures that we know of having any thing of it. There are several *Laminulae* and *Pillars* of Hard Bone between the Two Tables in these Cavities, Designed, as may be supposed, partly

partly for their Maintenance at a convenient Distance, and partly for *Breaking* of the *Air*, so as to Hinder *Ecchoes* and Confused Representations of Objects; as it hath been ingeniously observed by Sir *J. Hoskins*, That *Pillars* in *Churches* very much Prevent *Ecchoes*.

3. In the *Heads* of *Woodcocks*, besides the *Passages* now described, I found one on each side the *Bone*, making the Orbit of the *Eye*, proceeding from the *Ear*; and reaching forwards towards the setting on of the *Beak*; near which, they Joined in one, and Turned under the *Skull* in a small Passage leading to the *Cavity*, by which the *Ears* Communicate, and which is above described, into which it Enters. These *Passages* are also in the *Heads* of *Snites*; and moreover, One over the *sinus Longitudinalis*, and another over the *sinus Lateralis* of the *Brain*. Note, That in the killing of *Snites* and smaller Birds, if Care be not taken that the *Head* be not *Bruised*, these *Passages* cannot be Discovered, for *Blood* Extravasated in them. Note also, That the *Laminulae* and *Bony Pillars* are every where to be observed where there is a *Passage*, excepting under the *Skull*, in the *Passage* from the setting on of the *Bill* to the first *Passage* Described.

4. In the *Heads* of *Parrots* and *Paroquets*, besides the first describ'd *Passage*, I observed, between the *Two Tables*, every where *Cells* opening into others, and those into others; so that there was not any Part scarcely of the *Skull* that was not taken up with them. And this did not only appear by pouring into one *Ear*, freed from its *Drum*, the other also being Removed, a *Tincture* of *Cochineel*, and then blowing of it into all these *Cells*, so that no Part was free from *Tincture*, but it appeared also to the *Naked Eye*, notwithstanding that sometimes it was difficult to Trace the Communications of them by Reason of the Numerousness of the *Laminulae* and *Pillars* aforesaid.

5. In *Singing Birds* the Structure of these *Passages* is like that of the *Parrot* and *Paroquet*, only that the *Pillars* and *Laminulae* are Less than they should seem to be in proportion to the *Heads*. From whence it is probable, that these *Birds* are by this Structure enabled to distinguish *Sounds* and *Notes*, and also imitate them better, having a more *Musical Ear*.

6. In the *Heads* of *Pullets*, *Geese* and *Ducks*, I found only the *First* described *Passage* distinctly: But in *Pluvers*, *Bustards*, and some other, I found another that went over the *Sinus Lateralis* of the *Brain* from *Ear* to *Ear*. This seems to be designed to make them more *Watchful* than *Domestick Fowls*, or than those that live much on the *Water*, because they are liable to a great many *Dangers* that the others are exempt from.

7. In the *Ears* of all the *Fowl* that I could Examine, I never found any more than *One Bone* and a *Cartilage*, making a Joint with it, that was easily moveable.

The *Cartilage* had generally an *Epiphyse*, or two, one on each side, which were very flexible, as it self was. The *Bone* was small and very Hard, having at the End of it a *Broad Plate*, of the same Substance very Thin, upon which it Rested as on its *Basis*.

8. I Observed 3 *Pair* of *Nerves* in all the *Broad-Bill'd-Birds* that I could meet with, and in all such as Feel for their *Food* out of their Sight; as *Snites*,
Wood-

Wood-Cocks, Curlews, Geese, Ducks, Teale, Widgeon, &c. These Nerves are very large, equalling almost the *Optick Nerve* in Thickness: They begin a little more forward than the *Auditory Nerve* from a little Protuberance, which seems to be made for them. One of them goes over the *Optick Nerve* in the *Orbit* of the *Eye*; the other Two go under the *Eye*. Two are Distributed nigh the End of the *Upper-Bill*, and are there very much Expanded, passing through the *Bone* into the *Membrane*, lining the *Roof* of the *Mouth*: The *Third Pair* is distributed near the End of the *Lower-Bill*, and subdivided like the former. Note, that *Birds* that *Pick* their Food where they can see it, have not these Nerves; and that the *Pair* of Nerves belonging to the *Upper-Bill* is considerably smaller in proportion to the *Fowls*, than those observed above; whence it is Probable that these Nerves are Designed for some Great Use, both on the Account of their Number and their Largeness; and that the Use to be Assigned to them, must be to Enable them to *Distinguish* (whether by *Tasting* or *Feeling* I will not now determine) their Food, there being a necessity of a more Exquisite Sense in these *Fowl*, than in any other. The 246 Figure Represents these in a *Duck's Head*; where *aa.* Expresses the Edge of the *Cranium*, which is in part Removed for the more clear View of these Nerves; *bb.* Are the *Cells* about the *Ear*, Between the *Two Tables* above described; *cc.* The *Brain* laid bare, with its *Blood Vessels*, *ddd.* The *Three Nerves* on One side; *e.* The *Optick Nerve*; *fff.* The *Skin* and part of the *Bone* Removed, to bring the Nerves in view; *gg.* The *Two Nerves* Expanded near the End of the *Upper-Bill*; *hh.* That in the *Lower*.

Fig. 246.

9. All the *Eyes* of a *Fowl* and of *Fish*, that I have Examined, were more or less *Cartilaginous*; for the *Sclerotis* is a *Cartilago sui Generis*, especially near the *Cornea*, in all these Animals. And in the Larger sorts of both I remember to have found the Whole *Sclerotis* such a kind of a *Cartilage*.

10. I have frequently Observed in *Smaller Fowl* that the *Membrane* of the *Drum* was *Double*: For by gently pulling away the *Membrane* Lining the *Tube* of the *Ear*, I have observed at the Bottom of it a *Transparent Membrane*; which at first I took to be the *Membrane* of the *Drum*, but upon Examination, I found that the *Membrane* of the *Drum* was still Entire and in its proper Place. I have also sometimes Observed this in *Larger Fowl*, in a *Seal*, and in some Other Animals; and perhaps it may be so in all.

2. Dr. *Moulen* and my self, when we made our *Anatomies* together at *London*, shew'd to the *R. Society*, that all *Flat-Bill'd-Birds*, that *Groped* for their Meat, had *Three pair* of Nerves, that came down into their *Bills*; whereby as we Conceived they had that *Acuracy* to distinguish what was proper for Food, and what to be Rejected, by their *Taste*, when they did not see it: This was most Evident in a *Duck's Bill* and *Head*; a *Duck* having *Larger Nerves* that come into their *Bills* than *Geese*, or any other Bird that I have seen, and therefore *Quaffer* and *Grope* out their Meat the Most: But I then discovered none of these Nerves in *Round-Bill'd Birds*:

By Mr. J. Clay-
ton. n. 206.
p. 990.

Birds. But since, in my *Anatomies* in the Country, in a *Rook* I first observed two *Nerves* that came down betwixt the *Eyes* into the *Upper Bill*; but considerably smaller than any of the three *Pair* of *Nerves* in the *Bills* of *Ducks*, but larger than the *Nerves* in any other *Round Bill'd Birds*. And 'tis remarkable, these *Birds* more than any other *Round-Bill'd Birds* seem to *Grope* for their *Meat* in *Cow-Dung* and the like. Since, I have found in several *Round-Bill'd Birds* the like *Nerves* coming down betwixt the *Eyes*, but so very small, that had not I seen them first in a *Rook*, I should scarce have made the *Discovery*. In the *Lower-Bill* also there are *Nerves* that have much the same *Situation* with the *Flat-Bill'd Birds*; but very small, and scarce discernable, unless to the *Cautious* and *Curious*.

The *Ears* of *Birds* differ much from those of *Men* or *Beasts*; there's almost a direct *Passage* from one *Ear* to the other of *Birds*, so that prick but the small *Membrane* call'd the *Drum* on either *Ear*, and *Water* poured in at one *Ear* will run out at the other. But what is much more *Remarkable*, they have no *Coclea*, but instead thereof, there's a small *Cocleous* or *Twisting Passage* that *Opens* into a large *Cavity*, that runs betwixt *Two Skulls*, and passes all round the *Head*. The *Upper Skull* is supported by many *Hundreds* of small *Thred-like Pillars*, or *Fibres*; which, as we supposed, had another *Use* also, *viz.* to *Break* the *Sound* from making any *Confused Echo*, and to make it *One*, and *Distinct*. This *Passage* we observed was much *Larger* in *Singing Birds* than in others that do not *Sing*, so very *Remarkably*, that any *Person* that has been but show'd this, may easily *Judge* by the *Head* what *Bird* is a *Singing Bird*, or has *Aptitude* thereto, tho' he never saw the *Bird* before, nor knew what *Bird* it were. This has often made me *Reflect* how much the *Modification* of *Voices* depends upon the *Accuracy* of the *Ear*, and how *Deaf Persons* become *Dumb*: And since, I have observed that many *Children* that have an *Acute Wit* enough, that are *Slow* of *Speech*, that is long before they *Speak*, are much *Longer* before they can *Pronounce* those *Letters* that are sharp, as *g. b. r.* and never have an *Aptitude* to *Learn* to *Sing*.

Ib. p. 993.

I have also *Anatomized* most sorts of *Creatures*, and never found any *Four footed Creature* with an *Ear* like a *Bird*, unless a *Mole*; and a *Mole* has an *Ear* much like them, with a very *Thin Double Skull*, and a great *Cavity* like a *Bird*, and is very *Acute* of *Hearing*. The *Skull* by reason of this *Large Cavity*, being very slender is easily *Crushed*; so that a *Mole* is quickly *Kill'd* with a *Bruise* on the *Skull* like a *Lark*, and upon the *Bruise* the *Membranes* of the *Skull* turn *Black*; but when I have taken care not to *Bruise* the *Skull*, the *Membranes* were not *Black* at all.

XCVII. I have *Observed*, by *Inflation* into the *Aspera Arteria* of *Fowls*, that there is a *Continuation* of many *Vesicles* extended from the *Bronchia* through the *Abdomen* to the *Anus*. This, I conceive to be the *Cause* of the *Constant Motion* of the *Anus* in *Fowls*; the *Air* having *Ingress* and *Egress* there: and also that to be the *Reason* why the *Anus's* of *Fowls* are in *Malignant Distempers* Ap-

The Anus of Fowls applied in Malignant Distempers; by Mr. J. Templer. n. 26. p. 5031.

lied

to Draw the *Infection* out of the Body. For those *Anus's* being like *Cups* or *Ventouses*, the Fowl has often *Stuck* by it's *Anus* till it *died*; in which Case I have known 7. *Chickens* Applied to the Groin of one *Visited* by the *Plague*, that *Stuck* till they *Dyed*, and the *Eighth* went *Quickly* off and *Lived* above 1½. *Year* after.

A Blemish peculiar to the Eyes of Horses; by Dr. Rich. Lower. n. 32. p. 613.

XCVIII. 1. The *Eyes* of *Horses* are peculiarly Affected with one Defect which no Animal besides is Troubled withal (as far as I have Observed;) and that is, a *Spungy Excrecence* (commonly of a Dark *Musk Colour*) which grows out of the Edge of that *Coat* of the *Eye* call'd the *Uvea*. If this *Spungy Substance* be so great, or the Number of them such, as that they grow in several Places about the *Pupil* of the *Eye*, where it *Contracts* it self, the *Pupil* or *Sight* is very much (if not totally) Obstructed; and consequently the *Horse* sees very little or nothing at all: As I have many times taken Notice in some *Horses*, which being brought into the Sun shine, could not see at all, but suffered me to touch the *Sight* of their *Eye* with my Finger without the least *Winking*, which *Horses* being led back into the *Stable*, the *Uvea* in that *Obscure* place *dilating* itself, they could see very well again, and would not suffer me to shew my Finger near to the *Eye* without *Frequent* Closing their *Eye-Lids* and *Tossing* their Heads. The same *Horses* I understood by the Owners were very Apt to *Stumble* in the *day-time*, if it were *Bright* and *Sun shine*, but *Travelled* very well and *Securely* in the *Evening* and in *dark Cloudy Weather*.

I cannot think that these *Excrecences* come from *Straining* in great *Draughts* and *Races*, or from *Hard Travel*: because I have seen very large *Sponges* (as I may call them) in *Young Horses* Eyes of 2. and 4. *Years* Old, before they were *Backed*; which, after they have been taken up from the *Grass*, and kept with *Dry-Meat*, have very much *Abated*, and afterwards being turned to *Grass* in the *Spring* to *Cleanse* and *Cool* their Bodies, have *Increased* again to the wonted *Bigness*.

It is Remarkable, that the More and greater those *Excrecences* are, the more the *Pupil* of the *Eye* or the *Sight* is in *Danger* of being quite *Obstructed*; which you may farther *Examine* by *Turning* the *Horses Eye* to the *Light*, and observing how much of the *Pupil* they do *Obstruct*. That those on the *Upper* Edge of the *Uvea* are apt to grow the *Largest*, and *Hinder* the *Sight* most. And that that which grows on the *Middle* of the *Uvea*, does more hinder the *Sight*, by *Distracting* the *Object*, than that, which grows in either *Corner* or *Angle* of it.

I suppose no *Cure* can be expected but from a *Drying* Kind of *Diet*: Yet perhaps *Outwardly* something may be *Devised* to *Shadow* the *Eyes*, and keep them from being *Nakedly* exposed to the *Sun*, whereby the *Pupil* will not be so *Closely Contracted*, and consequently the *Sight* not so much *Obstructed*.

Two *Horses* of an *Iron-Gray* or *Dapple Gray* are frequently enclining to loose one or both *Eyes*, if *Backed* or *Hard Ridden* too soon.

By n. 37. p. 730.

In *Man* and *Beast*, (in *Horses* at least) the *Right Eye* is the *Weakest*, and most frequently failing.

The *Pupil*, or Black of the *Eye*, is Wider and Larger in those that are *Short-sighted*, than in those that see at greater Distance.

I have often noted some that are *Short-sighted*, I say not *Pore-blind*, to discern all things that are done about them, almost quite Behind them, more perfectly than the *Best-sighted*, if the Room was not too Large for the Reach of their *sight*.

Also some of Dr. *Lower's* Observations, I could Confirm by my own Experience. In my youngest Days I had a very narrow Escape from an excellent *Horse*, which had that only Defect, which they call *Moon-blind* (and they told me of it after the mischief :) I purposed to Leap a Ditch, but the Horse saw no Ditch, so we fell in together.

As Coach and Cart-Horses have Flaps on the Ear sides of their *Eyes*, so these Flaps may be fitted (and in some shew of Ornament) to shadow the Over-part of the *Eyes*, and yet to afford them Light enough to see their way. I know not whether it be Usual amongst you, but I have seen a Young Child wear a kind of Black Riband, like a Narrow *Mask* before her *Eyes*, the Riband or *Mask* having *Holes* made in fit places to Guide the *Eye*: And this was said to be an Effectual Remedy to cure the Child of *Squinting*, which she had Hereditarily from her Mother.

XCIX. Duodecimus jam excurrit Annus, quo mactandum Bovem illustravi cum præclarissimis Viris D. *Carolo Fracarsato*, & D. *Silvestro Bonfiliolo*, a cuius Collo in Dextris, ubi jugum apponitur, insigne pendebat Cornu. Hujus Longitudo 16 *Digitorum* crassitiem æquabat: Non longe à basi, ubi Latius erat, 8. *Digitorum* Latitudinem explebat. Ejus forma Conica erat, & in obtusum deducta Apicem, non parum versas finem Curvabatur. In basi tamen, ubi Collo necebat, Arctius erat. Color circa extremitatem subniger Lucidusque erat; & persimilis ei, qui in *Ungula Bubula* passim observatur. Exterior superficies Aspera erat, præcipue à Basi usque ad Medium; etenim *Cuticula* & Subjectum *Reticulare Corpus* cum contentis *Papillis* (quæ in aliis Partibus Perpendiculariter attolli solent, ac *Tactus Organum* constituunt) sensim produci inclinarique incipiebant, non dispari specie, ac in nostrorum *Digitorum* Extremitate, qui libet prope *Unguium* Radicem observare potest. *Papillæ* igitur, Laciniata *Cuticula*, & *Reticulari Corpore* circumdatæ, majorem Longitudinem sortitæ ita Inclinantur, & invicem hærebant, & ferruminabantur Extremis Finibus, ut squamosum *Piscium* Tegumentum æmularentur. Circa Basim Squamosa hæc Corpora Brevia erant, sensim vero producebantur & prope Conum Longissima reddebantur. Varius quoque erat Substantiæ modus; nam in Basi *Papillaria* hæc Corpora non ita sibi mutuo connexa conglutinabantur, sed solutis ipsorum Finibus Laciniatum & Asperum excitabatur Corpus. Ultra tamen Medietatem densiori donabantur Compage, unde & Lucida & Lævia videbantur. Interius Expositum Cornu Concavum erat, ita ut Crassities ipsius in Basi nativam *Corii* altitudinem parum excederet; gracilescente tamen & attenuato *Corio*, ad Naturam quasi Membrane

A Horn Hanging at the Neck of an Ox; by S. Malpighi. n. 166. p. 601

branae, intus ambiabatur, quod *sanguinea vasa* irrigabant; hocque detracto Solidum & Læve corpus occurrebat. Tota Concavitas referta erat *Subflavo*, Turbidoque *sero*, quod igni appositum totum fere in Naturam *Albuminis Ovi* concrefcebat. Sub Basi *Glandulae Conglobatae*, depressæ tamen, insigniter luxuriabant.

Ex hujus igitur diligenti, Inspectione patet, *Papillas* (quas non incongrue Externi *Tactus Organa* credidi) *Cuticula* & *Reticulari Corpore* custoditas, ubicunque plus justo producantur, & invicem intime unitæ ferruminantur, in solidum desinere Corpus: quod commune est *Ungulis* & *Cornibus*, quæ sola Exteriori Configuratione, & majori minorive Partium densitate donata, ad invicem discriminantur; unde veluti *Sensorii* Additamentum censenda veniunt, & *Tactui* quoque non parum Conducentia. *Cornuum* & *Cranio* erumpentium observata Productio his multum lucis confert: Hanc itaque *Vegetationem* in *Bove* deprehensum in *Physicæ* additamentum audire ne graveris.

In *Fætu* igitur, adhuc in *Utero* contento, *Cranii Os* in situ *Cornuum* fere *Cartilagineum* est, & postremo *Osseam* Naturam acquirit. *Pili* ibidem primo erumpunt. *Glabro* existente *Corio* præter *Labia*, quæ quibusdam *Pilis* ornantur. Hi taliter locantur, ut ipsorum Ordines à circumferentia versus Centrum situati & inclinati minimum quasi *Conum* efforment. Postremis quoque *Mensibus*, in *Fætu* adhuc *Concluso*, *Osseæ* Lamellæ (quibus *Cranium* compaginantur) obliquari incipiunt, & fracta *Directione* extra eminent, excitatis intro subrotundis spaciolis, unde supra *Cranium* *Osseus* Tumor primo emergit *Lenticulare* corpus præ se ferens. Hoc extenso *Corio* cooperitur, quod præ reliquis Crassum est, & Turgentes exhibet *Glandulas*. Inter *Osseum* Corpus, & *Corium*, *Periostion*, seu *Osseæ* substantiæ inchoamenta locantur, quæ paulatim manifestantur. Extra *Uterum* sensim *Osseus* Tumor *Lenticularis* parum affurgit, Turgentibus *Osseis* Lamellis. Supra *Os* crassum luxuriat *Periostion*, seu futuri *Osseis* Inchoamentum. *Corium* quoque obducitur, à quo *Tactus Papillæ* affurgentes *Reticulari* & *Cinereo Corpore* ambiuntur: Hoc copiosis *Pilis*, diversam *Inclinationem* sortitis, cooperitur. Altero elabente *Mense*, *Osseæ* substantia *Laminulis* & *Spatiulis* contexta extuberat, ita ut *Cornu* Rudimentum emergat, dimidiam *Digiti* crassitiem æquans, & *Conoidem Parabolicum* repræsentans. Hujus exterior superficies *Lævis* & *Glabra* sensim redditur, *Nigroque* inficitur *Colore*. *Corium* Crassum de more extenditur, à quo *Tactus Papillæ* erumpentes, superato *Reticulari* *Involucro*, quod *Cinereum* est, elongantur & *Nigro* ambiente *Succo* conglutinantur. Hæ circa *Cornuum* Basim inclinatæ versus *Apicem* diriguntur. Reliquæ vero ab *Apicæ* exortæ *Perpendiculares* quasi affurgunt, & *Reticulari* *Corpore* custodiuntur; earum Longitudo vix *Serici Villofi* Lanuginem æquat. Interea inclusa *Osseæ* Appendix Augmentum capit & Interias varie Configuratur: Etenim ut plurimum *Radix* *Fistulosa* excitatur substantia, quæ *Osseis* *Fibris* *Reticulariter* *implicitis* componitur; reliquum vero usque ad *Apicem* *Spongioso* constat *Corpore*. *Sanguinea* intercurrunt *Vasa*, & A-

Apex perpetuo *Submollis* firma Partium compage non gaudet. *Corium* quoque extensum *Osseam* Substantiam investit, & in Basi Crassius est. Ab hoc itaque emergentes *Tactus Papillæ* ita Proceræ redduntur, ut inclinatae versus Apicem, simulque *Reticulari Corpore* unitæ, tot *Conica* Corpora Concava efficiunt, & ex horum Unione (quasi tot Lamellis, Cæparum instar intra se positis) solidum *Cornu* Corpus efficiatur. *Papillarum* Ordines in Basi erumpentes, licet non omnes Apicem attingant, ut plurimum tamen Recta deducuntur, & fere *Cornu* ambiunt; aliæ quoque sub diversis Planis à producto *Corio* propagantur, quæ Longiores redditæ, Breviores Cooperiunt & Includunt; Unde secto per Longum *Cornu* non solum *Ossea* substantia occurrit, sed etiam *Corium* à quo Molles *Papillæ* emanant, quæ in *Cornuum* substantiam immutatae solidescunt, & Nigrescunt, avulsoque *Osse* cum ambiente *Corio*, *Fistulæ* in *Cornu* à *Reticulari* Opere excitatae patent. Occurrunt quoque *Papillarum Tactus* varii Exortus & Plana; ipsarumque Productio usque ad Apicem; unde cum diversa Plana extremum *Cornu* constituent, hinc est, quod Apicis substantia crassitiem fere *Digitum* æquat. Exaratae *Papillæ* Basim *Cornuum* excitantes Molles adhuc sunt, & de facili Lacerantur, vel in Furfures abeunt: circa Finem vero & Apicem ita adensantur, & *Reticulari Corpore* ferruminantur, ut solidæ Factæ *Nigro Lucidoque* inficiantur Colore. Harum Progressus evidens est; nam tot quasi Filamentis, per longum ductis, coagmentari videntur.

Procerioribus redditis *Cornubus*, ita ut 12. *Digitorum* crassitiem æquent, inclusa Appendix *Ossea* Longior redditur: & ubi continuo & pleno *Osse* non coagmentatur, Variis *Cellulis* concameratur & excavatur. Secto autem *Cornu* per Longum, Singula dilucidius patent; Primo enim frequenter exarata Appendix *Ossea* Laminâ componitur, ita ut Tubus efficiatur: Portiones tamen *Osseæ* oblique per transversum ductæ inferuntur, unde relictae Areae Concavitate oblongas, in equalis tamen Longitudinis & Figuræ, efficiunt, in quibus aliæ quoque ab assurgentibus parum *Osseis* Parietibus designantur. Omnes hæ Concamerationes *Membrana* tenui obducuntur, sub qua *Sanguinea Vasa* in miras propagines diramata custodiuntur. Versus Apicem *Ossea* Substantia Spongiosa est nullis *Cellulis* excavata, unde impense Rubet ex innumeris Vasculis, quibus irrigatur.

Expositam Appendixem *Osseam* extenuatum *Corium* ambit; à quo Molles de more *Tactus Papillæ* emanant, quæ *Reticulari Corpore* custoditæ, simulque ferruminatae, versus Apicem deductæ *Cornu* componunt, ita ut *Cornuum* Parietes in Basi Graciles sensim ex *Papillarum* additione reddantur, & tandem in Apice ex omnium Unione, Duorum *Digitorum* crassitiem æquent.

Horum Interior Superficies *Nigra* est, & *Fistulosis* Foraminulis versus Apicem directis exasperatur, quibus *Papillæ* admittuntur. Exterius Apex Acuminatus Solidus, Lucidus & *Ater* est; versus Medium tamen *Subalbescit* *Cornu*, & circa Basim parum *Nigrescit*, & de facili in Squammas solvitur.

Ulterius tandem Augmentum sortiuntur *Cornua*, ita ut urgente interiori *Ossea* Appendice Primi *Papillarum* Ordines à Basi erumpentes, avulsi à *Corio* Separentur, & ita diversi Fines & *Papillarum* Limbi apparent; non dispari ritu ac in *Conchis Marinis* conspiciamus, quarum compositio diversis *Testulis* Superpositis, in æqualibus tamen, coagmentatur, ita ut Extremi Fines quarumcumque *Testularum* minimum elegansque exhibeant Planum. Hæc eadem Structura evidenter quoque in *Dorcadis Cornubus* elucescit, unde à Radicibus usque ad Medium Asperitates, quasi Nodi, observantur, quæ à diversis *Papillarum* Lamellis vario tempore à *Corio* avulsis, & sursum Retractis Excoriuntur, quæ omnia diligenti *Microscopii* lustratione patent.

Postremo tandem *Cornua* Ultimum sortita Incrementum non parum immutantur; nam Exterius ipsorum Color Varius efficitur, substantia quoque solidior reddita, Diaphana fere evadit, & continuo usu Lævigatur. Interius *Ossea* appendix Obtuso terminatur Fine, totaque ipsius Longitudo gracilente *Corio* adhuc Tegitur. Ab hac emergentes olim *Tactus Papillæ* oblitterantur, præterquam in Apice: Interior enim *Cornuum* Superficies evanescentibus *Vaginulis*, seu *Reticularis Corporis* Finibus, ex Ferruminantis Succo exundante copia, tota fere circa Basim Lævis & Perpolita redditur, ita ut *Papillarum* productiones quasi obscurantur.

Analogam quoque Generationem in *Gallorum Calcaribus* observamus, quæ ex Cuticula & Subjectis *Papillis Reticulari Corpore* conditis conflantur, ita ut turgente intus *Ossea* Appendice Exterius quoque *Corium* multiplicibus *Cuticulæ* involucris obductum rapiatur, & Novum quasi *Cornu*, licet minimum, erumpat.

Ex his igitur conjectari licet, *Monstruosum Cornu* in *Bove* ortum traxisse non tam ex Ulteriori *Papillarum*, *Corii*, & *Reticularis Corporis* production, sed ex conatu Interioris Tumoris, & ex Compressione facta in Cervice à proximo Jugo: in Naturali namque *Cornuum* Eruptione emergens *Ossea* Appendix extensam sibi *Corii* portionem sensim Urget, secumque rapit, ita ut *Papillæ* versus Apicem inclinatæ elongentur. Proceriores autem redditæ sunt, in *Monstruoso Cornu*, *Tactus Papillæ* ex Copioso fortasse Succo per Filamentorum Reticularem contexturam, qua *Corium* componitur, excurrente vel elabente in continuatas *Papillas*, & in Muscosum *Reticulareque Corpus*, ut in *Ungularum* Vegetatione contingit, quæ cum Extremis *Papillarum* Finibus excitentur, in Deformem producerentur Longitudinem, nisi vel Arte, vel Attritu mutilarentur. Probabile quoque est ex Urgente assidue Jugo proximam *Cervicis* partem Compressam & inde *Callosam* redditam fuisse: *Sanguinis* namque Motus non ita feliciter celebratus est; *Ichoris* quoque & *Lenti Humoris* per exaratum *Corii* contexturam ulterior Fluxus impeditus est; & *Sudoris*, *Halitusque* Effluvia per propria *Sudoris Vascula* suppressa sunt, unde *Corii Papillæ* ultra Augmentum in Novum Solum & Compagem adaptæ sunt,

sunt & Reticulare Corpus, quod alias Mucosum est, pene Osseam nactura est Consistentiam. Hæc autem Ferruminatio probabiliter contigit ex Vitriolato Humore per Excretoria Sudoris vasa effluente, vel saltem ab Acidis Effluvis Coercitis & Fixatis, dum interim Evaporantibus Alcalibus & Aquosis Particulis Sanguinei instar Seri Solidum, Lucidumque fere Corpus excitatum est.

C. Sir Will. Lowther (in Yorkshire) had a Lamb 1694 which, being Left by the Ewe, Suckt a Weather (*Aries Cistratus*) and brought him to Milk, and was maintained by him all Summer till the latter End of August, that he was Weaned. I saw his Udder the latter End of Sept. each side whereof was about the bigness of a Hen's Egg; and he had 2 considerable Teats. I saw Milk spurted out of them; to a Yard or two's Distance, notwithstanding the Lamb had been taken from him so long. In Nov. I saw him again; but his Udder was then much fallen, each side being now about the bigness of a Walnut; there is Milk still in it, enough to Stream out above half a Yard.

A Lamb Suckled by a Weather; by Mr. Tho. Kirke. n. 214. p. 263.

There is no Tokens at all, of an Hermaphrodite in him. I compared him with another Weather, who had Teats or Paps like him, and Differed in nothing but the Udder. The Ewe Dyed upon Shearing, when the Lamb was about 5 Weeks Old: so 'tis likely it might Feed partly upon Grass, as I suppose other Lambs of the like Age do notwithstanding what they Suck from their Dams.

CI. Dr. Clark and Dr. Lower have given me an Account of a pretty Odd kind of Observation: One of them assuring me, that he had several Times, in the Lungs of Sheep found a considerable Quantity of Grass, in the very Branches of the *Aspera Arteria*; And the other relating to me, that a few Weeks since, He, and a Couple of Physitians, were invited to look upon an Ox, that had 2 or 3 Days almost continually Held his Neck Straight up, and was Dead of a Disease the Owner could not conjecture at; whereupon the Parts belonging to the Neck and Throat being Opened, they found the *Aspera Arteria*, in its very Trunk, all Stuffed with Grass, as if it had been thrust there by Main Force: Which gives us just cause to wonder both how such a Quantity of Grass should get in There; and how, being there, an Animal could Live with it so Long.

Grass found in the Wind-Pipes and Lungs of some Animals; by Mr. Rob. Boyle. n. 6. p. 100.

CII. 1. On the Borders of Italy a Murren infected the Cattle, which spread farther into Switzerland, the Territories of Wirtemberg, and over other Provinces, and made great Destruction amongst the Cattle. The Contagion seemed to Propagate it self in the form of a Blew-Mist, that fell upon those Pastures where the Cattle Grazed, in so much that whole Herds have returned home Sick; being very Dull, Forbearing their Food, most of them would Dye away in 24. Hours. Upon Dissections were Discovered Large and Corrupted Spleens, Sphacelous and Corroded Tongues, some had

A Murren in Switzerland and its Cure; by Dr. Wincler. n. 145. p. 93.

had *Angina Maligna's*. Those Persons that carelessly managed their Cattle without a due respect to their own Health, were themselves *Infected*, and Dyed away like their *Beasts*. This *Contagion* may probably proceed from some *Noxious Exhalations* thrown out of the Earth, by 3. Distinct *Earthquakes* perceived here and in our Neighbourhood in the space of *one Year*.

The Method of Cure was thus; As soon as ever there was any Suspicion of the *Contagion* upon any one of the Herd, the *Tongue* of that Beast was carefully Examined: in case they found any *Aptha* or *Blisters*, whether *White*, *Yellow*, or *Black*, then they were obliged to Rub, Scratch and Tear the *Tongue* till it *Bled*; then they wiped away the *Blood* and *Corruption* with New Unwashen Linnen: This done a *Lotion* for the *Tongue* was used, made of *Salt* and good *Vinegar*. The *Antidote* for the Diseased Cattle, and the *Medicine* for the Sick was the same. *viz.* Take of *Soot*, *Gun-Powder*, *Brimstone*, *Salt*, Equal parts, and as much *Water* as is necessary to wash it down; give a Large Spoonful for a *Dose*.

By Dr. Fred.
Slare. *ib.* p. 94.

2. I am assured, by 2 ingenious Travellers, that this *Contagion* reached the Borders of *Poland*, having passed quite through *Germany*; That it was observed to make its Progress daily, spreading near Two *German Miles* in 24. *Hours*; That it Continually without Intermision made *Progressive Voyages*, and Suffered no Neighbouring Parish to Escape, so that it did not at the same time *Infect* Places at great Distances; that Cattle secured at *Rack* and *Manger* were equally *Infected* with those in the *Field*. It were worth considering whether this *Infection* is not carried on by some *Volatile Insect*, that is able to make only such short *Flights* as may amount to such Computations.

The Diseases of
Dogs; by Sir
Theodore Ma-
yern. n. 191.
p. 408.

CIII. Dogs are subject to these Diseases. 1. The *Hot-Madness*, which is Incurable; they Fly upon every thing, and can hold out but 4 *Days*. 2. The *Running-Madness*, which is likewise incurable; They Fly Only upon Dogs, and that by Fits, and may sometimes hold out 9. *Months*. 3. *La Rage Mue*, which is a Disease that lies in the *Blood*. 4. The *Falling Madness*, which Seises on the *Head*, and is a sort of *Epilepsie*. 5. The *Blasting* or *Withering*; this lies in the *Bowels*, which Shrink up Exceedingly. 6. The *Sleepy Disease*, which comes from Little *Worms* in the *Mouth* of the *Stomach*; These Dogs Dye *Sleeping*. 7. The *Rheumatick Disease*; this Swells the *Head* very much, and makes the *Eye* *Yellow*. In these 5. Latter Diseases the Dogs will not *Eat*, (nor at any time when they are sick,) but they Live 8 or 9 *Days* without Hurting any Body, and then Dye of *Hunger*.

The Two First are Caught by the *Breath* of Dogs being together, as in the *Plague* among *Men*: the Latter are likewise *Contagious*, but *Curable*.

CIV. The *Fore feet* of a *Rat* resembleth those of the *Castor*; The *Hair* is also some *Fine*, some *Course*, as in that *Animal*; The *Tail* *Scaly*, with *Hairs* between every *Scale*, like the *Castor's*, which shews these two *Animals* to be something a-kin: and indeed the *Water-Rat* comes very near to the *Beaver*, and makes its *Holes* in the bank sides of *Ponds* after the same manner.

Observations on
the Dissection of
a Rat; by Mr.
Rich. Waller. u.
166. p. 594.

The *Penis* in the *Rat* has a particular *Passage* near the *Navel*, as in *Squirrels*; and not at the *Anus*, as in the *Castor*.

Fig. 247.

The *Liver* is full of little *Specks*, as big as *Pins' heads*; which are the little *Glands* thereof.

There was no *Gall-Bladder*, but a *Ductus Felleus*; possibly the *Bladder* was inclosed in the *Parenchyma* of the *Liver*, as it is in some *Animals*.

The *Cæcum* was much *Larger* than the *Stomach*, and in shape like that of the *Castor*.

The *Testicles* lay not *Behind*, but in the *Groins* on the *Os Pubis*. These were like a *Bottom* or *Skein* of *Thred* *Rumpled* up together, which was *Visible* through the *Coats* of the *Testicle*. This *Thred* continued of near the same *Size* in the *Epididymides*, only towards the *Deferentia* it grew *Larger*.

It was *Tender*, and not easie to be *Unravel'd*; so that I could not *Draw out* above *three Quarters* of a *Yard*.

The *Prostatæ* lay under the *Spermatick Arteries*.

The *Kidneys* were *Whitish*, with their *Succenturiati*.

At the *Neck* of the *Bladder* were inserted the *Vesiculæ Seminales*; *Transparent* and filled with the *Semen*.

Toward the *End* of the *Penis*, which had a *Bony Gristle*, were two *Large Glands*; emptying themselves near the *End* of the *Penis*, and contained a *Substance* like *Cream*, as in the *Dormouse*; observed by *Swammerdam*.

AA. The *Kidneys*; *aa.* The *Renes Succenturiati*; *bb.* The *Ureters*; *cc.* The *Crural Veins* and *Arteries*; *D.* The *Arteria Magna*; *e.* The *Vena Cava*; *F.* The *Bladder*; *gg.* The *Spermatick Vessels, Veins* and *Arteries*; *hh.* The *Testes*, with the *Branches* of the *Veins* and *Arteries*; *ii.* The *Epididymides*; *kk.* The *Deferentia*; *l.* The *Penis*; *mm.* The *Vesiculæ seminales*; *nn.* Two *Glands*, from whence a *Thick Juice* might be *Pressed out*; *o.* The *Balanus*.

Explication of
the Figure.

CV. 1. The *Sable-Mice* (which were first *Observed* in *Lapland* about *Thorne* 1697.) are near as big as a little *Squirrel*: their *Skin* *Streaked*, and *Spotted* *Black* and *Light-Brown*; they have 2 *Teeth* above, and as many under, very *sharp* and *pointed*; their *Feet* like those of *Squirrels*; they are so *Fierce* and *Angry*, that if a *stick* be held out at them, they will bite it, and hold it so fast that they may be *swing'd* about in the *Air*; they are *Fat* and *Thick*, and without any *Tail*.

Sable-Mice; by
Sr. P. Rycant,
n. 251. p. 110.

In their *March* they keep a *Direct line*, generally from *North East* to *South West*, and are innumerable Thousands in each Troop, which for the most part is a *Square*: they *March* by *Night*, and in *Twilight*, and ly *Still* by *day*. The distance of the *Lines* they go in, is of some *Ells*, and Parallel to each other. If they meet any thing that might stop them, they avoid it not, tho' it were a *Fire*, a *Deep Well*, a *Torrent*, *Lakes*, or *Morafs*, but without any *Hesitation* Venture through, and by that means, many *Thousands* of them are *Destroyed*. If they be met *Swimming* over *Lakes* and be forced out of their *Course* they presently *Return* into it again; when they are met in *Woods* or *Fields* and stopt, they set themselves upon their *Hinder Feet* like a *dog*, and make a kind of *Barking* or *Squeeking Noise*, leaping up as *High* as a *Man's Knee*, *Defending* their *Line* as long as they can: and if at last they be *Forced* out of it, they *Creep* into *Holes*, and set up a *Cry* sounding like *Biabb, Biabb*. They never come into any *House*, nor meddle with any thing that is *Man's Meat*; if a *House* happen to be in their *Way*, there they *Stop* till they *Die*, but through a *Stack* of *Hay* or *Corn* they will *Eat* their *Way*; when they *March* through a *Meadow*, they endamage it much, by *Eating* the *Roots* of *Grass*; but if they *Encamp* there by *day* they quite *Spoil* it, and make it look as if it were *burnt*, or strewed with *Ashes*. The *Roots* of *Grass* with *Rotten Wood*, and the *Insects* in it, are their *Chief*, if not only *Food*.

These *Creatures* are very *Fruitful*, yet their *Breeding* does not hinder their *March*; for some of them have been observed to *Carry* one *Young One* in their *Mouth*, and another on their *Back*.

It is reported that some *Poor Laplanders* have *Eat* several of them, and found their *Flesh* to *Taste* like *Squirrels*: *Dogs* and *Cats* *Eat* only the *Heads*, and *Birds* of *Prey* only their *Heart*. During the *Winter* they lie *Under the Snow*, and have their *Breathing Holes* upon the *Top* of it, as *Hares* and other *Creatures* use to have. The *Country People* are very *Glad* of these *Guests*, foretelling there will follow great *Plenty* of *Game*, as of *Fowl*, *Squirrels*, *Lo-Cats*, *Foxes*, &c. where of late *Years* there has been great *Scarcity*: being told by some old *People* that these sort of *Creatures* were seen in *Lapland*, about 20. or 30. *Years* before, and that thereupon they had *Abundance* of such *Game*.

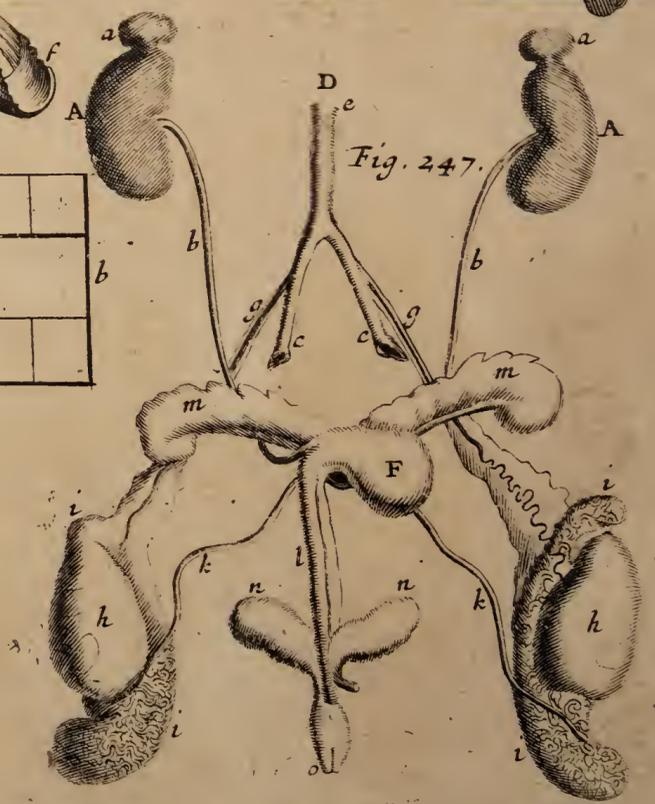
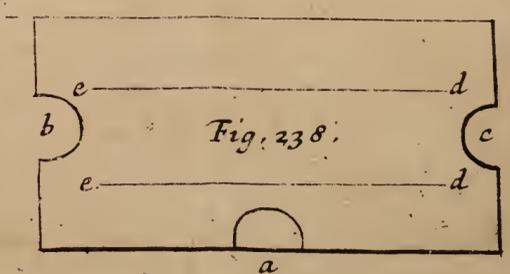
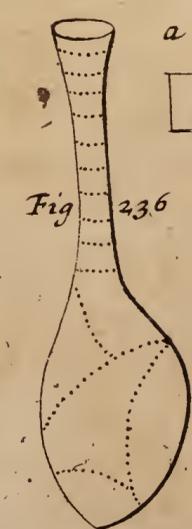
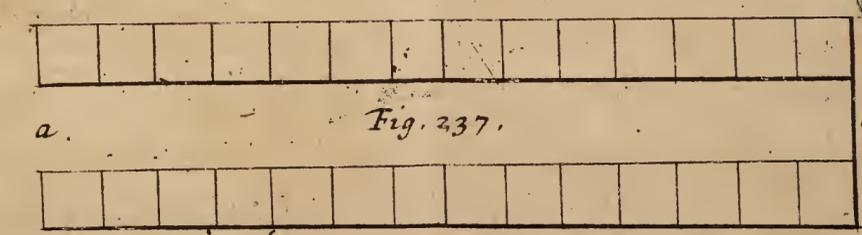
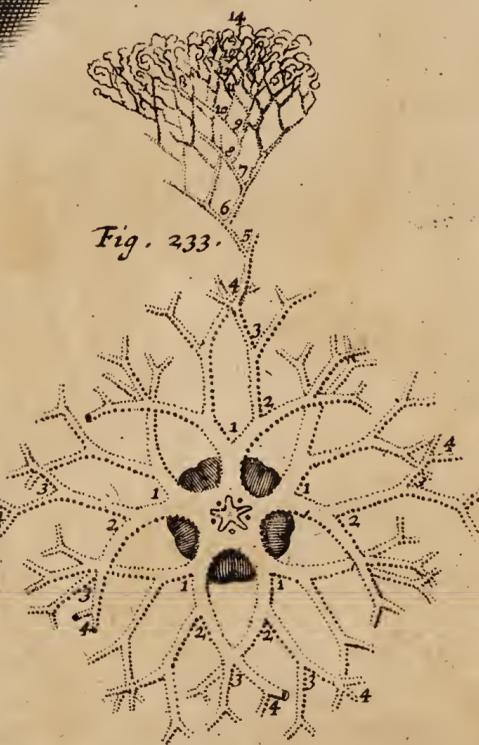
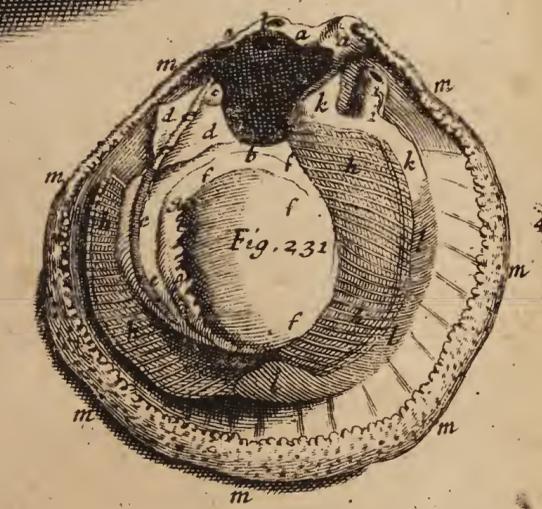
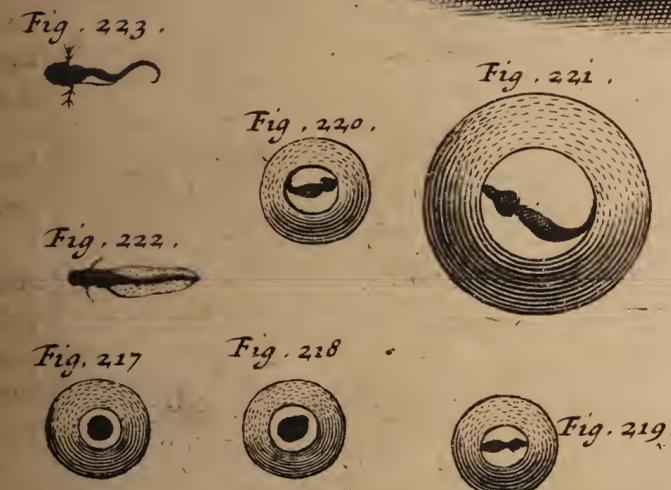
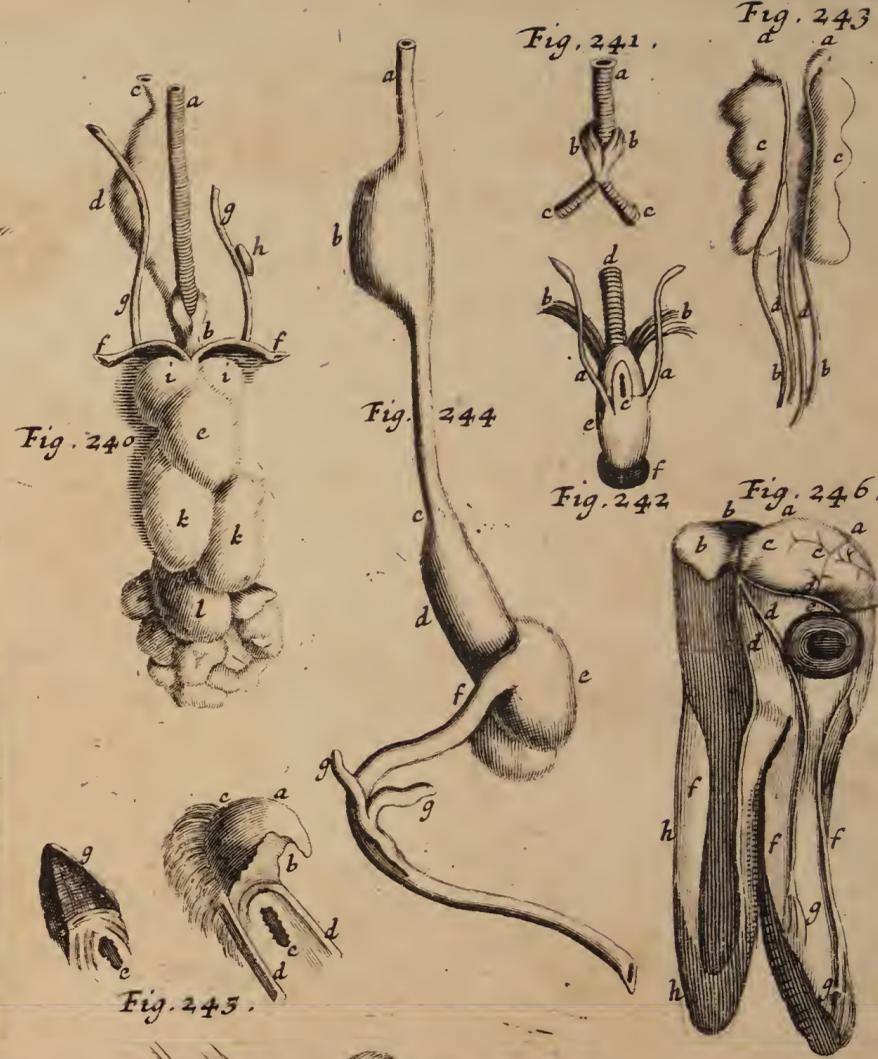
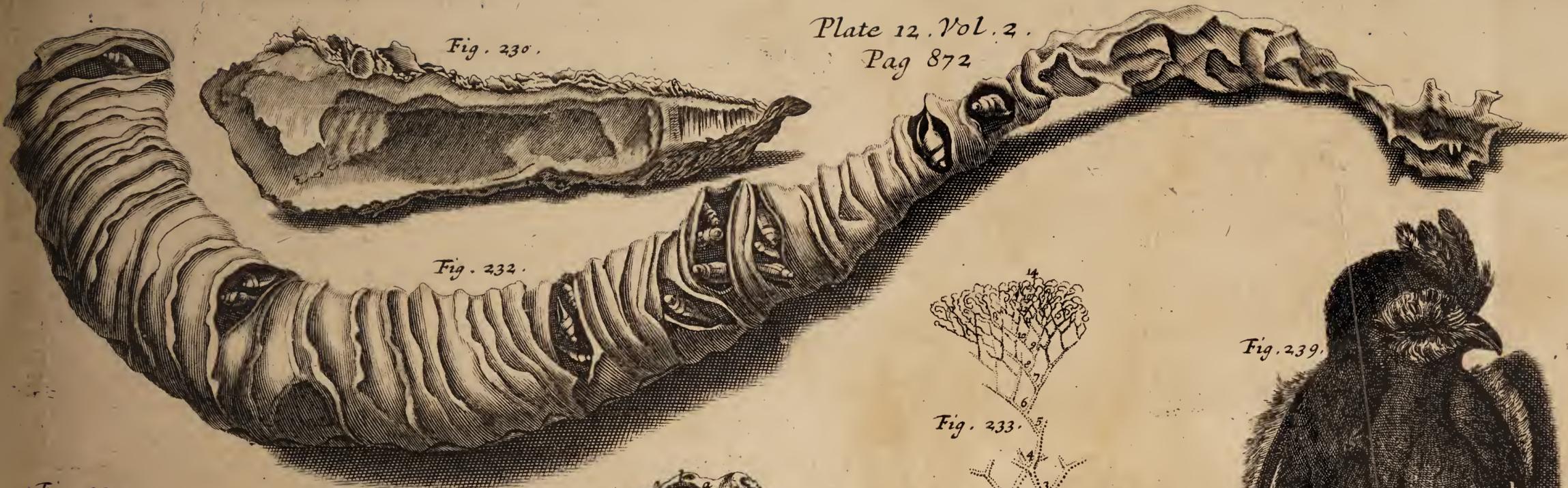
By..... ib.
p. 112.

2. These *Mice* are the same with those called *Mures Norwegici*, described by *Olaus Wormius* in his *Museum*.

The Russian Way
of curing Casto-
rium; by.....
n. 163. p. 501.

CVI. Take *Beaver Stones*, and get the *Milk* out of them as clean as you can; then set upon the *Fire* a *Skillet* or *Kettle* with *Water*, big enough to contain the *Quantity* of *Stones* you have to *Cure*; let the *Water* *Boil*, and put into it half a *Shovel-full* of *Clean Wood-Ashes*; then tie the *Stones* together in *Couples* and put them into the *Water*, and let them *Boil* therein for *half a quarter* of an *Hour*; then take some *Birch Bark* and lay it on the *Fire*, and let the *Stones* be well *Smoaked* over it for the *Space* of an *Hour*, until they are well *Dried* in the *Smoak*; then *Hang* them up in a *Kitchen*, or in the *Air*, for a *Week* or more, until they are perfectly *Dry* and *Hard*; after which they may be *Packed* up in a *Cask*, or otherwise, for *Transportation*.

CVII. Take



CVII. That the *Testicles* of the Animal in *New-England* call'd *Musk-quash*, do smell strong of *Musk*, as Mr. *Fosselin* saith, is most certain: For, I have known some of them kept a Long Time in ones Pocket, till they were become Hard and Black, and yet *Smelt* as strongly as at first, which in my Opinion, was nothing inferiour to the *Scent* of that which is commonly sold for *Musk* in the Shops. I remember, that one of our Seamen, being laid to sleep too near the Fire-place, with one of these Dried *Testicles* in his Pocket, it happened that a Coal burned through his Breeches to it, and made so great a *Scent* of *Musk*, that he might easily have been smelt a good way off.

The Musk-quash
by n. 127.
p. 653.

New-England's
Rarities.

This Animal deserves to be further enquired into, especially if what Mr. *Thevenot* relates be true; *viz.* That *Musk* is nothing else but the *Testicles* of a *Beast* like a *Deer*, found in *China*, in the Province of *Honan*.

CVIII. The whole *Shape* of this Animal (which by some Authors is called *Tajacu*) was such, that we may easily reduce it to the *Swine-kind*, as plainly appears by the *Figure*: but it was much Less than our usual *Hogs*; for from the End of the Body, where the *Tail* should be, to the Top of the *Head* between the *Ears*, was 2 foot and 2 inches, from thence to the End of the *Nose* 11 Inches. The Girth of the Body, 2 Foot; The Girth of the *Neck* 16 Inches; of the *Head*, in the Largest place, 18 Inches; and of the *Snout* 12 Inches: For the *Lower Jaw* in this *Mexico-Hog*, was more Protuberant, and the *Head* less Tapering than in our *Swine*, and in the *Skeleton* appears much like that of the *Baby Roussa*, only it had not those *Teeth*, and the *Neck* appeared so very short and thick, not from those large *Glands*, which in some of the *Swine-kind* do so stuff out their *Necks*, but from the short turning upwards of the *Vertebrae* of the *Neck*, which were kept so close to the Body, by the Insertion of that strong *Ligament* into the *Pol* from the *Back*, which in Animals that are *Prono Capite*, is of extraordinary Use, and much adds to the *Strength* of This Animal. The Colour of the Body was *Grisly*; being beset with *Bristles*, which were Thicker than those of a *Hog*, and Lesser than those of a *Hedge-Hog*: but like those of a *Hedge-Hog* or the *Quills* of a *Porcupine*, they were Variegated with *White* and *Black* Rings. The *Belly* was almost Bare. The *Bristles* on the Sides were shorter, and gradually increased in Length, as they approach the *Ridge* of the *Back*; where some were 5. Inches Long. Between the *Ears*, on the *Head*, was a Large Tuft of these *Bristles*; which were for the most part *Black*. The *Ears* were about 2½. Inches Long and Pricking up; The *Eyes* (as they are usually in *Piggs*) but Small; from the *Lower Canthus* to the End of the *Nose*, 6. Inches; The *Nose* like that of a *Hogs*; The *Mouth* not Large; The side of the *Lower Lip* made Smooth, as it were by the Rubbing of a *Tusk* in the *Upper-Jaw*; The *Feet* and *Claws* perfectly as in Common *Hogs*, only the *Upper Claws* on the same Foot proportionably Longer, being one Inch and a Quarter Long, whereas the *True-Claws* were scarce one Inch and an half. It had no *Taile*. But what is most particular, and Differences it from any other Animal I know

The Anatomy of
a Mexican Musk
Hog; by Dr. Ed.
Tylon. n. 153.
p. 359.

Fig. 248.

Fig. 249.

Fig. 250.

of in the World, is the *Feet*, or *Navel*, or *Foramen* rather, on the Hinder part of the *Back*.

Hist. Anim. Me-
xican.

These Animals are Bred in *New Spain*, *Nicaragua*, *Terra Firma*, and *Bra-
sile*: They are usually met with in the Mountains, and Woods, and go in *Herd*s
together. They Feed on *Roots*, *Acorns*, and *Fruits*: but, as the greatest Deli-
cacy, they Hunt for all manner of *Poysonous Serpents*, and *Toads*; and hav-
ing caught them, holding them with their *Fore-Feet*, with a great deal of
Dexterity, with their *Teeth*, they strip off their Skin from the *Head* to the *Tail*;
then greedily Devour them. *Postea* (saith *Jo. Faber*, who had the Account
from *F. Gregorius*, who often has seen them, and Lived in those Parts 24
Years) *Radicem seu certæ Arboris Corticem sibi notum quærit, quem comedit, ne
Veneno inficiatur: & hac ratione optime Nutritur, Crescit & Augescit.* When
they are made Tame, they will Feed on any thing: But naturally they are very
Fierce.

Ovidens Remarks that the *Swine*, which the *Spaniards* left on the Islands of
St. Domingo, *St. Joannes*, and *Jamaica*, Multiplied and Encreased; But those
in *Terra Firma* durst never go in the *Woods*, but were destroyed by the *Lions*,
Tygers, and *Lupi Cervarii*: Yet in these *Woods* there are great Herds of these
Tajacu's, that can make their party good with the Fiercest of them. If any be
Wounded, presently he gets to his Assistance a great Number of his Kind, and
never leaves till he has Revenged the Injury or is Slain. They are always at
Enmity with the *Tygers*: and there is often found the Body of a *Tyger*, and a
abundance of these *Tajacu's* slain together. If they spy a *Man* they will Fiercely
set on him, and his best Escape is to get up a *Tree*, which they will most furi-
ously assault with their *Teeth*: nor will easily leave him, till forced by *Hunger*,
or Slain by him, by *Club*, *Darts*, or a *Gun*. If they Hunt them, their *Dogs* are
often Torn in pieces by them. Their *Flesh* is Esteemed very Good, and much
Desired by the Inhabitants. They have but a very Little *Fat*. Our Subject had
scarce any.

Fig. 253.

We come now to the *Anatomy*; having therefore Divided the *Muscles* of the
Belly, we took notice of the Remarkable Structures of the *Stomachs*; for it had
Three. Into the Middlemost was inserted the *Oesophagus*, or *Gullet*; which
we therefore shall call the *First Ventricle*, or *Stomach*. From this, on one side
was a Large Passage into the *Second*, which Pouching out had its Two Ends
winding like a *Horn*, and on the other side of the *First* or *Middle-Stomach*,
was a free Open Passage into the *3d.* which Emptied it self into the *Duodenum*.
The *First Stomach* was Lined within, with a White thick Hard *Membrane*;
almost like the inward Pellicle of the *Gizzard* of *Fowls*: with which none of the
other *Stomachs* were endowed. For the *Inward Surface* of the *Second*, was
smooth and soft; its *Membranes* thin, and more Enclining to the Common make
of that of *Carnivorous Animals*: The *3d.* somewhat like this, but Thicker and
Rimpled within, with large *Plicæ*, or *Folds*. *Dr. Grew* takes Notice that in the
Common Hog, against the *Pylorus*, stands a Round *Caruncle*, as big as a small *Fil-
berd kernel*, like a stopple to the *Pylorus*; for Preventing (as he Conjectures) a too

Fig. 254.

Sto. and Guts of
Quadrup. c. 3.

Suc

Sudden and Copious Irruption of the *Aliment*. This is sufficiently Provided for in our Subject, by the great streightning of the *Pylorus* here, and the great Ascent it must take, before it can go out: which may be the Reason too; of Natures making these several Cells, or Partitions, for the better *Digestion* and *Maceration* of the *Food*; for it being *Frugivorous*, *Graminivorous*, and *Carnivorous* too, the *Stomachs* are so Contrived, that as the *First* here, by its *Inward Pellicle* somewhat resembles that of *Birds*, that are *Carpophagous*, so the others, those of *Quadrupeds*.

Fig. 252.

The *Small Guts*, which in other Animals being fastened to a Large *Mesentery*, usually do Hang down, were here Closer gathered, by the shortness of this *Membrane*, to the *Spine*: and the *Colon*, which in others is Suspended, here by its Peculiar structure lies Loose, and Falls down; For the *Duodenum*, arising from the *Pylorus* with a Short Turn, and the other *Small Intestines*, made abundance of *Convolution*s and *Windings*. And altho' the *Mesentery* was but very short from the *Spine*, and its Circumference seemingly but very little, yet in this Compass it contained 27 *Foot* of these *Intestines*; for so much they measured from the *Pylorus* to the *Colon*. The *Colon* was not fastened to the *Periphery* or *Rim* of the *Mesentery*, as ordinarily: but arising from the *Center*, or *Middle*, made a *Spiral Line*, its End hanging Loose, and its Turnings Closely United one to another by *Membranes*. This *Colon* was very Large, in respect of the other *Guts*; and as I measured it, it was 9 *Foot* long. It had a short *Cæcum*, but pretty Wide, and fill'd with *Fæces*. What Dr. *Grew* observes, that 'tis peculiar to the *Cæcum* of a *Hog*, and that of a *Horse*, to have the same Structure with the *Colon*, is true Here too: And it may be reckoned as an *Appendix* of the *Colon*. The *Mesaraick Vessels* were also extraordinary: for Here we observed a large *Vein* and *Artery*, running a small and equal Distance from the *Intestines*; and from them, arising an infinite Number of Lesser, but Straight *Vessels*, which going Regularly to the *Guts*, and in great Numbers, afforded a very pleasant Prospect.

The *Spleen* was about 10 *Inches* long almost; almost of the same breadth throughout, and in the Middle was one *Inch* and half broad; it was of a *Lead-Colour*, a little Speckled, or Marbled. The *Liver* consisted of 4 large *Lobes*, and was of a *Dark Red* Colour; it appeared plainly *Glandulous*; and had no *Vesica fellea*; but it had a *Ductus Biliaris*, which went from the *Liver* to the *Duodenum* as usually. The *Pancreas* was about 5 or 6 *Inches* long; and was made up of several *Glands*:

The *Testes* were two *Inches* long; Larger at the Upper end, than the Lower; and in the Middle, about an *Inch* broad; they were placed in the *Scrotum*. Their Colour *White*, their Structure Close, so that the *Vessels*, which composed them, did not so plainly appear as in an Ordinary *Boar*. Notwithstanding which, no doubt their whole Compages was *Vascular*, tho' here Closer wrought together, and United. Their Use is to Prepare the *Semen*; which is conveyed thence by the *Vasa Deferentia* to the *Vesiculæ Seminales*.

These *Deferentia* arise near the Lower part of the *Testes*; and are so Inserted, that they might also equally empty themselves, either into the *Vesicæ Seminales* or *Urethra*. The *Vesiculæ Seminales* were $1\frac{1}{2}$ Inches Long; in some places $\frac{1}{4}$; in others half an Inch broad.

Tho' call'd *Vesiculæ*, yet here they appeared more *Glandulous*; nor was their Cavity any thing considerably Large. The common Orifices to them, and the *Vasa Deferentia*, made a Riling in the Inside of the *Urethra*; which *de Graef* calls, *Caput Gallinaginis*.

In other Animals at this place, is seated that *Glandulous* Body, called the *Prostata*: But the *Vesiculæ* Here being so *Glandulous*, possibly they may perform their Office; unless we should ascribe their Use to those two *Glands*; which lay on each side the *Urethra*, and Emptied themselves, with two Orifices, near the Root of the *Penis*. These *Glands* were *Cylindrical*, of a *Whitish Yellow* Colour; an Inch and half long; and $\frac{1}{8}$ of an Inch in Diameter. Their Substance Close, like that of the *Testes*, and no perceptible Cavity within; and they lay along the Outside the *Urethra*, reaching from the *Musculi Erectores Penis*, to the *Glandulous Vesiculæ* before described. These *Vesiculæ Seminales* being *Glandulous* must therefore secrete some Juice; which in all likelihood is some ways serviceable, tho' not Principally, in *Generation*. The *Penis* was a long slender Body; made up of several *Muscles* whereof two were very long. The *Vesica Urinaria*, or *Bladder of Urine*, was Rounder than in some other Animals, where usually 'tis more Oblong. The *Ureters* were inserted at the Neck of the *Bladder*, not *Sides*, as in some.

In the *Thorax* we were surpris'd at the strange Formation of the *Arteria Aorta*; which as it Descends along the *Spine*, in all other Animals, I have observed its *Trunk* is almost of an Equal Bigness, only a little Tapering downwards: But Here, between the *Heart* and its Branchings into the *Iliac Arteries*, we found 3 large *Swellings* out. The Largest was that nearest the *Heart*, which after a small straightning again, Emptied it self into the *Second*; which though something less than the *First*, yet was much larger than the *3d*, which was near the Division of the *Aorta* into the *Rami Iliaci*. Two of these *Swellings* I opened, and found within several Unequal Cells, or Hollows; but withal could not perceive but the *Membranes* here were altogether as Thick as where the *Artery* was nothing Extended. But this being the only one of the Kind I have Dissected, I know not how far it may be *Præternatural*.

The Aperture of the *Eye* was but small, as in the *Hog kind*; The *Membrana Nictitans*, Plainer than usually in *Quadrupeds*, which might be convenient, since wallowing in Mud, they might the better rub off any Filth that might happen there; the *Muscles* not so Distinct, as in some Brutes, and hence the *Motion* of their *Eyes* not so Quick nor Regular; the *Pupil* Round; the *Optick Nerve* inserted almost in the Axis of the *Eye*, and on the Inside made a small Dint; The *Choroïdes* of a *Pale Violet*, and *Brownish* Colour.

Just on the Ridge on the *Back*, over the Hinder Legs, is seated a *Glandulous*

dulous Body, which all Authors call the *Navel*. It is so Covered by the Long *Bristles* there, that it was not to be Observed, but by opening of them with the Hand: And then you shall find a small space there almost Bare; only beset with Fewer, Shorter and Finer *Hairs*; and in the Middle of it, the Protuberant Orifice of the *Gland*, by which it discharges it self of the Liquor, which is separated by it within. This Orifice, or *Foramen*, had its Lips a little Reflected, and Protuberant above the Surface of the Skin. It would easily admit of a Large *Probe*, which I could turn into several parts of the *Gland*. Upon a gentle Pressure with my Finger, I could observe a small Quantity of a *White Yellowish* Juice, and some part of it of a little *Darker* Colour; which yielded a very Pleasant and agreeable Scent, and was judged by my self, and several others who smelt it, to be much like that of *Musk* or *Civet*. The *Gland* it self was seated between the Skin and some part of the *Panniculus Carnosus*: For in the Middle of that Part, or Surface, which respected the Back, 'twas Bare, and not Covered with that *Muscle*, but only the Edges of it inclosed within it; so that in taking off the Skin, the *Gland* too, as I have observed, could not easily escape, but go with it. However this *Muscle* may be assisting to it, by its Contractions, in Pressing out of its Liquor; as the *Sphincter Muscle* is to those *Scent Bags* placed at the Extream of the *Rectum* of other Animals. This *Gland* was *Conglomerated*, or made up of several Minute, and Small *White Glandules*; it had no considerable *Cystis*, or Cavity within: but like the *Pancreas* or *Salivatory Glands*, it had abundance of *Secretory Ductus's*, which terminating at last in one, Discharged its separated Juice by a Common *Orifice*.

Fig. 251.

This *Orifice*, having something of a Resemblance of a *Navel*, has imposed almost upon all who have writ of this Animal, (and have only superficially Viewed this Part, without Examining any thing further,) to believe it an *Umbilicus*; and those who have deviated from this Sentiment, have been as Unhappy, in delivering altogether as Absurd, and Extravagant Conjectures about it.

But there is nothing I can Parallel this *Gland* with, more than those *Scent-Bags*, or *Scent Glands*, I have formerly mentioned to be in other Animals. This I first took notice of in *Polecats*; in which, just at the Extream of the *Rectum*, were placed *two Bags* fill'd with a *Crasse* and *Whitish* Liquor, whose *Stink* was so very great, that I could not well endure the Room, till I had removed them; and then the whole Body seem'd very inoffensive. The same I have Observed in abundance of other Animals; as in all the *Polecat-kind*; in our Common *Cats*; in a *Lyon*; in *Dogs*; in a *Fox*, &c. Those *Bags* in the *Civet Cat*, or *Hyæna Odifera* are nothing but the same; as are likewise those of a *Musquash* mentioned above: For they are not the *Testicles* of that Animal, for having seen the Skins here in Town, and those *Musk-Cods*, I find them to be only these *Scent Bags*. So the *Castoreum* we have in our *Shops*, is not the *Stones* of a *Beaver*, as formerly Reputed; but of the same Nature altogether with our *Scent-Bags*.

Plot's Nat. Hist. Oxfordshire.

Vid. Sup. S. CVII.

Vid. Sup. S. CVL.

And.

And indeed in most *Species* of Animals, there may be observed something the same, or Analogous to it, which gives them their peculiar *Fætors*, or *Smells*. Thus I have observed in *Reptiles*, as in the *Rattle-Snake*, in *Vipers*, in our common *Snake*, &c. Two long *Bags* in the *Tail*, which Empty their *Fætid Liquor*, near the *Verge* of the *Rectum*. But in All Animals, I find not these *Bags* or *Glands* seated Here, but in some, in different parts of the *Body*. In *Fowl* and *Birds*, in the *Rumps* you will meet with two *Glands*, which have 3 *Pipes*, or *Secretory Ductus*, arising on the *Top* of it; above the *Surface* of the *Skin*, which discharges a *Fætid Liquor*. I find these *Glands* the Largest in *Geese*, and the *Duck-kind*, which use the *Water*; and any one at the *Table*, by *Tasting*, may perceive in a *Duck* how strong *Scented* they be: In *Turkeys* 'tis less *Glandulous*; but they have a larger *Cystis* within. In the *Oestridge* indeed, I did not observe it on the *Rump*, but something higher on the *Back*, where it made two *Bunchings* out, and under the *Skin* I found a *Cystis* fill'd with a *Concreted Yellowish Juice*. This something approached near the *Place*, where was seated the *Gland* in our *Mexico-Hog*, which I call the *Scent-Gland*; and it yielding so *Grateful a Perfume* (for so it was esteemed by my self, and several others who smelt it) from it, I have named it, the *Mexico Musk-Hog*. But this is Remarkable; that as our *Musk-Hog* has its *Scent-Gland* seated on the *Back*, so the *Gazella*, or *Musk-Deer* has his *Musk-Bag* on the *Belly*, near the *Umbilicus*. Every one Observes what an *Horrid Stink* the *Urine* of *Catts* will make where it Lights; perhaps in rendring their *Urine*, at the same time, they may empty their *Scent-Bags* seated at the *Rectum*, which *Mixing* with it, in a great *Measure*, may give it its strong *Fætor*. So the same of *Rats* and *Mice*, of a *Fox* when *Hunted*, &c.

No Author indeed has called the *Scent* of this Animal a *Perfume*; on the contrary, they have all branded it as a *Stink*: But even the Best *Perfumes* sometimes makes the greatest *Stinks*. *Civet*, nay, *Musk* it self, when *Fresh* and *Green*, and in large *Quantities*, are no ways agreeable, but very offensive to the *Smell*, as many have observed: And what is more too, such is *Ambergrease* at the first, as *Gul. Piso* does Assure us.

Our *Tajacu* therefore, when young, and when but a small *Quantity* of this *Liquor* is separated by this *Gland*, may afford but little or no *Scent*; and *Foxes*, till they are well *Grown*, do not much *stink*; but afterwards when in great *Plenty*, this *Juice* is voided, by its *Copiousness*, and being *Thin* and *Fluid*, and so more *Vapourable*, it may strike our *Organs* with such *Brisk* and *Nimble Strokes*, as to create a *Pain*; whereas a more *Leisurely Appulse* of its *Particles* from a *Lesser*, and *Concreted Body*, may give a *Pleasure*. So our *Tajacu*, when this *Gland* does very *Liberally* discharge its *Liquor*, may be thought to *stink*; and yet this *stink* in time, may become a *Perfume*. Thus that *Fætid Liquor* in the *Scent Bags* of a *Weasel*, having formerly put it on a *Paper*, and kept

kept it a little while, afforded me a *Pleasant Smell*. Why therefore we perceived no *Stink* at first, upon the Dissection of this *Gland*, but rather a *Sweet and Pleasant Smell*, (if it is otherwise in the Countries where they Breed,) this may be the Reason; because it had been Dead some Days, before I examined this Part; and then I found but a small Quantity of an incrassated Liquor there; tho' I must acknowledge that I was informed, that when it was Alive, it was observed by the Family where 'twas kept, that wherever it went, it left a good *Perfume* behind it. This I am sure of, that when 'twas Dead, and observed by me, and several others, it Yielded a *Fragrant* one: which I think is sufficient to Justify, or at least to excuse, the name I have given it.

We further observed, that the *Cranium* seem'd entire, without *Sutures*; From the *Nose* to the End of the *Pole*, $8\frac{1}{2}$ Inches. Here the *Cranium* grew very Narrow, and then did spread it self again Triangularwise, and Behind made a Large Hollow where it Respected the *Back*; and where were inserted strong *Muscles*, and the *Ligament* from the *Back*, I formerly mentioned, by which means the *Head* is kept so straight up, that when Alive he seem'd to have but a very Short, if any *Neck* at all. The *Porus Auditorius*, or Passage to the *Ear*, was something Remarkable; being placed near the *Pole*. In the *Upper Jaw* before, were 4 *Teeth*, or *Incisores*; a little farther, was placed a large Flat *Tusk*, Sharp Edged, and standing Outwards; and beyond that, of each side, six *Double Teeth*, or *Molares*. The *Lower Jaw* was $6\frac{1}{2}$ Inches long, $1\frac{1}{2}$ Broad at the *First Double-Tooth*, of which there were 6 of each side. The Bone of the *Lower Jaw* here, from the *Dentes Molares* to the *Incisores*, seem'd Spongy and Curious; and the *Tusks* in this *Jaw*, were Rotted out; as were one or two of the *Incisores*, which in all were about four.

There were 7 *Vertebrae* of the *Neck*, which measured in length $4\frac{1}{2}$ Inches; The *first* or *Atlas*, had two Broad *Transverse Processes*, but no *Spine*; The *Second* had a Broad Large *Spine*; The *3d*, *4th*, *5th*, had no *Spines*; the *6th* and *7th* had Large *Acute* ones. There were 19 *Vertebrae* of the *Back*; the *Spines* of the *first*, *2d*, and *3d*, were about 3 Inches long, but they gradually Decreased, as they approached the *Tail*. The *First Vertebra* of the *Os Coccygis*, was 2 Inches long: But I thought, that at first it might have been several, tho' now it was but One Bone. There were about 6 *Vertebrae* more, which ran no farther than the Extent of the *Os Ischii*. There were 14 *Ribbs* of each side; the *Os Sterni* jutt'd out about an Inch beyond the setting on of the *First Ribbs*.

The *Scapula* was 5 Inches long; the *Os Femoris* of the *fore Foot*, $5\frac{1}{2}$ Inches long; The *Os Tibiae* of the *Fore-Foot*, about the same Length in the whole: but from the Juncture with the *Os Femoris* to the *Os Metatarsi*, was but 4 Inches; for from the Juncture with the *Thigh-bone*, it jutt'd out farther, as in the *Figure*. The *Bones* of the *Tarsus* were 5, of the *Metatarsus* 3, about 2 Inches long; the *Bones* of the *Digiti* 9, there being 3 to each *Claw*, and 3 *Claws* to each *Fore-Foot*. The *Os Femoris* of the *Hinder Foot*, was almost 6 Inches long; and near its Juncture with the *Os Tibiae*, it had a small Bone,

like

like the *Patella* in the *Knee* of a *Man*. In the *Leg* Here were 2 *Bones*; the *Focile Majus* and *Minus*, 5 *Inches* and a *half* *Long*: But this part in the *Fore-Leg* was only a *Single Bone*; tho' in a *Dog*, a *Munkey*, and some other *Animals*, there are *Two Bones* in the *Fore-Leg* likewise. The *Os Calcis* was almost 2 *Inches* long; and there were 4 other *Bones* of the *Tarsus* or *Instep*. The *Metatarsus*, or *Foot*, was composed of 4 *Bones*; and the *Two* inwardmost much the *Largest*, being $2\frac{1}{4}$ long; there were 4 *Digiti*, and in each 3 *Bones*, whereof the *Last* was Covered with a *Nail*.

Explication of
the Figures.

Fig. 248.

Fig. 248. Represents the Natural Shape of this *Mexico-Hog*: and the *Line a.* points to the *Scent Gland*.

Fig. 249.

Fig. 249. The *Skeleton*. *a.* The *Fore-Teeth*; *b.* The *Tusk*; *cc.* The *Grinders*, or *Molares*; *d.* The *Lower-Jaw*; *e.* That part of the *Lower-Jaw*, which was *Carious*; *f.* The *Cranium*; *g.* The *Orbit* of the *Eye*; *h.* The *Porus Auditorius*, or *Passage* to the *Ear*; *i.* The *Triangular Expansion* of the *Cranium* Backwards; *k.* the *Vertebræ* of the *Neck*; *ll.* the *Vertebræ* of the *Back* and *Loyns*; *m.* the *Vertebræ* of the *Os Coccygis*; *nn.* the *Ribs*; *o.* the *Protuberant Bone* of the *Sternum*; *p.* the *Scapula*, or *Shoulder-Blade*; *q.* the *Os Ischii*; *rr.* the *Os Femoris*, or *Thigh-Bones*; *s.* the *Patella* of the *Hinder-Legs*; *t.* the *Tibia* of the *Fore-Leg*; *v.* a *Large Protuberancy* of the *Tibia*; *w.* the *Tibia*, or *Fossile Majus* of the *Hinder-Leg*; *x.* the *Fibula*, or *Fossile Minus* of the *Hinder-Leg*, *yy.* the *Tarsus*, or *Instep*, on *Both Legs*; *z.* the *Calx*, or *Heel*, in the *Hinder Leg*; *aaa.* the *Bones* of the *Metatarsus*, or *Foot*; *βββ.* the *Digiti*, or *Toes*; *γγγ.* the *Nails*.

Fig. 250.

Fig. 250. The *Orifice* of the *Scent-Gland*, as it *Naturally* appeared on the *Outside* of the *Skin* of the *Back*: A little space round this *Orifice* was almost *Bare* of *Bristles*.

Fig. 251.

Fig. 251. The *Scent-Gland* it self, which was *Conglomerated*.

Fig. 252.

Fig. 252. Most of the *Viscera*; *a.* the *Oesophagus*, or *Gullet*, *b.* the *First Ventricle*, or *Stomach*; *c.* the *2d. Ventricle*, or *Stomach*; *dd.* the *Cornua* or *Horns* of the *2d. Stomach*; *e.* the *3d. Stomach*; *f.* the *Pylorus*; *ggg.* the *Intestina Tenuia*, or *Small Guts*. *bbb.* the *Colon*; *i.* the *Cæcum*; *k.* the *Rectum*; *l.* the *Mesentery*; *mm.* the *Mesaraick Vessels*; *n.* the *Pancreas*. *o.* the *Spleen*; *p.* the *Liver*; *q.* the *Ductus* of the *Gall* from the *Liver* to the *Duodenum*.

Fig. 253.

Fig. 253. The *Outside* of the 3 *Stomachs*, more in their *natural Situation*; *a.* the *Gula*; *b.* the *First Stomach*; *c.* the *2d. Stomach*; *d.* the *3d. Stomach*; *e.* the *Pylorus*; *fff.* the *Blood Vessels*.

Fig. 254.

Fig. 254. The *Stomach* opened; *a.* the *Oesophagus*, or *Gula*; *b.* The *Entrance* of the *Gula*, or *Gullet*, into the *First Stomach*; *cc.* the *Inside* of the *First Stomach*, which was invested with a *Strong Thick White Pellicle*, or *Membrane*; *dd.* the *Second Stomach*, *ee.* the *Third Stomach*, in which were remarkable several *Plicæ*, or *Folds*; *f.* the *Pylorus*.

Fig. 255.

Fig. 255. The *Genital Parts*, and the *Bladder*; *a.* the *Bladder* of *Urine*; *b.* the *Neck* of the *Bladder*, *cc.* the *Ureters*, *dd.* the *Testes*, or *Stones*, *ee.* the *Vasa Deferentia*, *ff.* the *Vesiculæ Seminales*, which here were *Glandulous*, *g.* the

g. the *Caput Gallinaginis*, where the *Vesiculæ Seminales*, and *Vasa Deferentia* Empty themselves into the *Urethra*; *h h*. Two Glandulous Bodies, which possibly may be reckoned the *Prostata*; *i*. the Orifices, by which these *Glandulous Bodies* Empty themselves into the *Urethra*; *k*. the *Urethra* Opened; *l*. the *Penis*; *m m*. two *Muscles* belonging to the *Penis*; *n n*. Other *Muscles* assisting to the same.

Fig. 256. The Heart, and the *Aneurismata* of the *Arteria Aorta*, or Great Artery; *a*. the Heart; *b b*. the *Ascending Branches* of the Great Artery; *c*. the *Descending Trunk* of the Great Artery; *d*. the First *Aneurisma* or Distension, of the Great Artery Opened to shew its several *Cells* within; *e*. A straightening of the Artery again; *f*. the 2d. *Aneurisma* Opened likewise; *g*. the 3d. or Smallest *Aneurisma*; *h h h*. the *Iliac Branches* of the Great Artery.

Fig. 256.

CIX. This Animal, which was brought alive from *Virginia*, has many Names given it by Different Authors: And Generally, by the *English*, it is called *Opossum* or *Possum*. In *Latin*, it is Named *Simi-Vulpa*, and *Vulpi Simia*; as if it were of a Middle Nature between a *Fox* and an *Ape*. But I think a *Denomination* might be best given it, from that Particular wherein 'tis most Distinguishable from all other Animals; which is that remarkable *Pouch*, or *Marsupium*, it has in the *Belly*, into which upon any Occasion of Danger it can receive its Young; whence it may properly be Named *Marsupiale Americanum*: And I am apt to think it may be Reduced to the *Vermine-kind*.

The Anatomy of
an Opossum; by
Dr. Edw. Tyson. n. 239.

P. 105.

Fig. 257.

It Measured, from the Extremity of the *Nose* to the Tip of the *Tail*, 31. *Inches*; the Length of the *Head* was 6 *Inches*; the *Tail* was one Foot Long; the *Neck* and the *Body* was the Complement of the first Dimension, the *Girth* of the *Body*, now Dead, was 15½ *Inches*; when alive and Well, it seemed much Thicker. The *Fore-Legs* were 6. *Inches* long; the *Hinder-Legs* but 4½ *Inches*. The *Girth* of the *Tail*, near the Root, was 3 *Inches*; near the Tip but one *Inch*. The *Head*, about the *Ears* was Largest, measuring on the *Fore-head*, from one *Ear* to the other, 3 *Inches*; thence gradually *Tapering* towards the *Nose*, and more resembling that of a *Pig* than a *Fox*. The *Aperture* of the *Eye-Lids* were not *Horizontal*, but lying in a *Strait Line* from the *Ears* to the *Nose*; and not *Large*. The *Ears* were about one *Inch* and an *half* long; not *Sharp* but of a *Roundish Figure*. The *Rictus* of her *Mouth*, from the *Corner*, on one side, to the end of the *Nose*, measur'd 2½ *Inches*.

The *Fore-Feet* had 5 Long *Claws* or *Fingers*, equally ranging with one another, and a *Hooked Nail* at the end of each *Finger*. The *Hinder-Feet* had 4 *Fingers*, armed with *Hooked Nails*, and a Perfect *Thumb*, set off at a Distance from the Range of the other *Fingers*; and as in a *Humane Body*, this *Thumb* was shorter than the other *Fingers*, and had not a *Hooked* or *Curved* prominent *Nail*, but a *Tender Flat One*. This Contrivance of the *Legs*, *Feet*, and *Nails*, seems very *Advantageous* to this Animal in *Climbing up Trees* (which it does very *Nimbly*) for *Preying upon Birds*, which it is most *Fond of*; tho it *Eats* other Things too. These *Fingers*, *Toes*, or *Claws*, were *Naked*, without *Hair*; the *Skin* looking of a *Reddish Colour* here.

They were about an *Inch* long, and the *Thumbs* almost as long. The *Palms* of all, especially if Dilated, as it does in *Climbing*, were large; but so contrived, as to be able to be Contracted, as in *Walking*: but that they might here be better secured from injury, I find at the Setting on of Each *Toe*, in the *Palms*, a Protuberant Fleshy and almost *Cartilaginous* Body. In *Feeding* it self, it makes use of the *Fore-Foot* in bringing the Food to his Mouth; as do the *Monkey* and *Squirrel-kind*. The *Tail* was without *Hair*, (only for a little way near the setting on, and Tapering from the Root towards the Tip was Covered with a Regular Order of small *Whitish Scales*; which, for the most part, were Oblongish *Hexagons*: between each of which one might Observe a little Skin or *Membrane* in which they are Fixed. The Colour of these *Scales*, makes the *Tail* to appear *Whitish*, though the Skin seems of a *Darker Colour*.

The *Ears* were also Bare, and without *Hair*: And although Soft and Slender and in Colour and substance almost resembling the *Membrane* of a *Bat's Wing*, yet they were Erect and of an Oval Figure. I could not perceive that *Cartilaginous* Body, which Usually is to be met with in the Structure of this Part: so that if it did at all enjoy a *Cartilage*, 'twas at least much Finer than in most other Animals. The *Concha*, or Passage to the *Porus Auditorius*, was very Capacious. But 'twas Observed that when our Subject began to grow ill, the Verge or Rime of the Outward *Ear* seemed to be Crimped; and when it Dyed, to be so Shrivell'd, as if Burnt up; not making a Smooth, but a Jagged Edge.

The *Upper Jaw* was somewhat Longer than the *Under*; the *Nostrils* were large; The *Eyes* Black, Small, Vivid, and Exerted, when Alive; now Dead very much Sunk. The *Neck* was short, and the *Breast* Broad. It had *Mustacio's* like a *Cat*. The *Fur* upon the *Face*, was shorter and *Whiter* than the rest of the Body; On the *Back* and sides it was of an *Ash Colour*, or Dappell'd with *Black-Hair* in Spots, intermixt with *White*, especially on the *Back*; on the *Belly* 'twas more of an *Umber-Colour*; and of a *Darker* on the *Legs*. The Longest *Hairs*, which were Stronger and Courser than the rest, measured 3 *Inches*; being *White* towards the Ends: But perhaps the *Fur* may Vary in Different Subjects.

Fig. 258.

At the Bottom of the *Belly*, in the Middle between the *Two Hinder Legs*, we observed a *Slit*, or aperture, moderately Extended about 2 *Inches* Long; capable of a Larger Extension by dilating it with ones Fingers, even when it is Alive. It can so exactly close and contract it, that the Eye does not readily discover it. On each side of this Aperture there is a *Reduplication* of the skin inwards, which forms a *Hairy Bag*: But the *Hairs* here are so Thinly set, that almost every where you may Observe the Skin. All Authors agree that the Use of this *Bag*, *Pouch*, or *Marsupium*, is for the Preservation of the *Young Ones*, and Securing them upon any Occasion of Danger: And the Design of Nature is admirable in forming and adapting this Part so suitably to that End. There are Two Remarkable Strong Bones not to be met with in any other *Skeleton*, which from their Office I take Leave to call *Ossa Marsupialia*, or *Fanitores Marsupii*. These Bones are so

Fig. 257.

Fig. 260. 15. 15.

fastened

fastened to the Upper and inward Edge of the *Ossa Pubis*, that at their *Basis* here, they Touched one another, just at the Coalition of the *Bones* that form the *Ossa Pubis*: The other Extremes of these *Bones* were so Distant from one another; that it measured $2\frac{1}{2}$ Inches. The *Basis* of these *Bones*, where Joyned to the *Ossa Pubis*, was $\frac{1}{2}$ Inch broad, having two *Heads*; the Larger lying near the Coalition of the *Ossa Pubis*, and the Lesser towards the *Os Coxendicis*; having in the Middle a *Sinus*, into which was received a Protuberance of the *Ossa Pubis*. By this Contrivance it appears, there can be no *Motion* of these *Bones*, nearer or Farther from one another, but that they must stand always at an Equal Distance: Nor did I, upon Trial, find it otherwise, but Observed they were capable of a small *Motion* inwards towards the *Spine*, and Outwards from it. These *Bones*, as they ascended from the *Os Pubis*, grew Slenderer, being about the Middle but $\frac{1}{4}$ of an Inch broad: and they were each 2 Inches Long. To these *Bones* there were bestowed 4 Pair of *Muscles*: and there was another Pair that did run Over them, to which these *Bones* did perform the Office of a *Trochlea*. The First Pair of *Muscles* (*i. e.* which First came to be Dissected upon the Pronation of the Animal, and which from its Figure I shall call *Triangularis*) arises *Fleshy* from the whole Length of the internal side of these *Bones*, and inserted their Opposite *Tendons* on Each side of the *Rima*, or Aperture of the *Marsupium*. Under part of these *Muscles*, lay another or a 2d. Pair, Flat and Thin, having their Origin from the Upper part of the Internal side of the *Ossa Marsupialia*, and inserting their opposite *Tendons* a little above the *Tendons* of the former *Muscles*: The Tendance or Direction of the *Muscular Fibres* of this Pair, in Relation to the First, made a *Decussation*. The Third Pair of *Muscles*, we shall take Notice of, had their Rise from the Fore-part of the *Basis* of these *Bones*, where they were Joyned to the *Os Pubis*; and were afterwards inserted into the *Linea Aspera* of the *Thigh-bone*. The Fourth Pair did arise from the External side of these *Bones* near the *Basis*, and are inserted into the Fore-part of the *Thigh Bone* near the Middle. The Last Pair of *Muscles* arises more immediately from the *Marsupium*, or *Pouch*, it self. For spreading their *Muscular Fibres* all over this *Bag*, as they issue from it, by joyning their *Fibres* together, they more remarkably Form a *Solid Muscle*; which of each side passing Over the middle of these *Bones*, (*i. e.* in the Prone Posture we are Dissecting it) at length were inserted into the *Spine* of the *Os Ilii*. The Two First of these *Muscles* must serve towards the Dilatation or Opening this *Marsupium* or *Pouch*: For these *Bones* are a Fulciment or *Basis*; their *Articulation* will not admit of a *Contraction* Inwards or Nearer to one another, wherefore, when the First and Second Pair of *Muscles* Act or Contract, they must necessarily Open or Dilate the Mouth of the *Marsupium* or *Pouch*. The Third and Fourth Pair of these *Muscles* may serve to Extend these *Bones* Outward: so that when this Animal Hangs by its Tail (as it does frequently) the Weight of the *Fætus* in this *Pouch* by this means will not Press so much upon the inward *Viscera*. The Fifth and last

last Pair, as they may serve to *Dilate* the *Capacity* of the *Pouch* itself, so likewise may serve the better to suspend it's *Weight*, when the Animal is *Prone Capite*: and if it *Gravitates* too much, they may *Retract* it up; and the *Easier*, because passing Over these *Bones* like a *Pully*, their force is more *Augmented*. The *Antagonist* to these *Muscles* is, the *Sphincter Marsupii*; an *Oval Series* of *Strong Fleshy Fibres*, which serve to *Constringe* and *Close* the *Orifice* of the *Pouch*: which it does so *Perfectly* (as I have already observed,) that one would think the *Skin* here not to be *Slit*.

Fig. 259. A.

The *Pouch* or *Marsupium* it self, was a *Membranous* Body, not very *Thick* tho' consisting of several *Coats*: and is to be reduced into the *Class* of the *Vesiculous Parts* of the *Body*; which according to my *Notion*, are part *Muscles*, part *Glands*; and do Perform the *Office* of both *Motion* and *Secretion*. For the *Concave* or *Hollow* of this *Pouch* (as I have remarked) was somewhat *Hairy*, and at several places I could Observe them *Matted* or *Cling'd* together by a *Yellowish* Substance, which did *Ouze* out of the *Cutaneous Glands* there; as under the *Arm Pits* in a *Man*, it is *Observed*.

This *Liquor* thus *Emptied* into the *Pouch* from the *Glandulous Coat*, I found was *Strong Scented*, and had more of the *Peculiar Factor* of this Animal, than any part besides: being no ways *Grateful*, but *Unpleasant* to the *Smell*; as has been *Observed* of this Creature when *Alive*. But after the *skin* with the *Pouch* had been kept for some *Days*, and was grown *Dry*, I found so great an *Alteration* here in the *Smell*, that what before was so *Disagreeable*, now was become a perfect *Perfume*, and *Smelt* altogether like *Musk*; which made me Call to mind what formerly I had remarked of these *Scent Baggs* in other Animals. And I am apt to think that 'twas by *Removing* this *Marsupium*, rather than taking away the *Kidneys*, that these Animals are made *Edible*, which otherwise *Stink* so much, that the *Barbarous Nations* *Refuse* them, as out of *Lerius*, *Job Faber* takes Notice: for I could not smell in the *Kidneys*, or *Fat* about them, any thing *Ungrateful* or *Ill-Scented*. This *Marsupium* had likewise a *Muscular Coat*, besides those several other *Muscles* bestowed upon it, which we have *Observed* already, that gave it *Motion*. It had likewise a *Vascular Coat* too, being plentifully *Irrigated* with *Blood Vessels*: especially by *Two Large Branches* that came from the *Upper part* of the *Thorax*, and might be reckoned the *Mammaria*, as they are *Stiled* in other Animals.

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This *Pouch* was fastened by several *Membranes* to the *Muscles* of the *Abdomen*, and the *Skin*, but so as I could separate it, for the most part, with my *Fingers*.

In this *Marsupium* or *Pouch*, most Authors place the *Mammæ* or *Teats*; and they tell very odd *Stories* about it: But upon what *Observation* I could make, I did not Find any *Teats* here; nor indeed could I find them in the *Outward Skin*, as is *Usual* in other *Multiparous* Animals.

Possibly

Possibly this Subject never had a Litter ; so for want of Drawing they might be Less ; so as to Escape our View. The *Male* also (if we may believe *Piso*, or the Author of the *Present State of his Majesty's Territories in America*, has such another *Purse* under His *Belly* and takes his *Turn* to carry the *Young Ones*, to Ease the *Female*.

This Contrivance of Nature for *Securing* the *Young Ones* from any Danger, till they are able to shift for themselves; I think is not to be Parallel'd in any *Species* of Animals, at least of the *Quadruped-Kind*, besides.

Oppianus indeed, in his Excellent *Poem* of *Fishes*, tells us of the *Dog-Fish*, that upon any Storm, or Danger if pursued, the *Young Ones* run into the *Mother's Belly*; and when the Fright and Danger is over, they come out again; He also instances the same Care in the *Squatina* and the *Glaucus*, tho' these receive their *Young* into Different Receptacles: but if there be any *Truth* in these stories, 'tis Requisite that it were Confirm'd by more Evident Proof and Observation.

In the *Thorax* of the *Possum*, I observed that the *Lungs* had 3. *Lobes* on one side, and but *One* on the other: But this *One* was as large as the other *Three*. They were Soft and Spongy, and easily Dilated, and Large, proportionably to the Animal. The *Heart* was Included in a *Pericardium*, as usual, but the *Heart* it self I thought proportionably Larger, in respect to the Bulk of the Body, than is commonly; nor was it's *Cone* so sharp, but rather more Obtuse. It had *Two Auricles*, and *Two Ventricles*. About the *Throat* there were Large *Glandulæ Maxillares*; the *Tongue* was a little above 3. *Inches* Long and about $\frac{1}{4}$ of an *Inch* broad; 'twas Rough, having Protuberance whole Points looked Inwards; the *Voice*, or *Noise* it made, was a little *Growing*.

The *Abdomen*, or *Belly*, was Divided from the *Thorax*, or *Breast*, by a Large, Strong *Fleshy Diaphragm*: For the *Compass* of the *Thorax* in this place was very Great and Large, which might be rendered so the more, by Reason it often *Hangs* by it's *Tail*, and when it does so, the *Viscera* in the *Abdomen* can't but Press upon it

The *Ventricle* or *Stomack* something resembled the Figure of a *Half-Moon* as usually; but the *Two Orifices* of the *Gula* and *Pylorus* were placed so near one another, that they seemed to touch or meet; and when I Opened the *Stomack*, I found only a very Slender *Isthmus*, or *Wall*, parted them. These *Orifices* were Inserted almost in the Middle of the Upward part, but more inclining towards that, that respects the *Duodenum*. It appeared but small being much Contracted; for it had not Eaten any thing for some Days; it measured about $3\frac{1}{2}$ *inches* in Length, and about 2. *Inches* in Depth. The *Gula*, which conveys the Food into the *Stomack*, consisted of Strong *Muscular Fibres*, and was in all about 9. *Inches* in Length. The *Pylorus*, that Carries out, seem'd to have its Passage Free and Open, without that *Annular Constriction*, or *Valve*, as in most other Animals; though here we Observed a Larger Body of *Muscular Fibres*, than in the other *Intestines*.

Fig. 263. BB₃

Fig. 263. C.

At one side I observed a *Perforation*, or *Hole* through, about the bigness of an ordinary *Pea*, and *Round*. That this was occasioned by an *Ulcer* there, I plainly perceived by the *Lips* or *Edges*, which were not *Fresh*, but had an *Ulcerated* Matter about them; and this, without doubt, was the *Occasion* of its *Death*; for it had fallen from its *Food*, and had *Pined* away for some *Time* before, and by its *Uneasie* Motion, made its *Keeper* suspect, it had swallowed something that stuck in its *Throat*, or *Injured* its *Stomach*. A like *Accident* I have three times met with in the *Dissection* of *Humane Bodies*. Perhaps some of the *Glands* in the *Stomach* (such as *Payerus* and *Dr. Grew* describe in the *Intestines*) being become *Scrophulous*, or *Steatomatous*, might *Impostumate*, and so *Corrode* the *Coats* of the *Stomach*, and *Cause* this *Perforation*: And the rather I am of this *Opinion*, because I found, in other *Places* of the *Stomach*, these *Glands* very *Large* and *Steatomatous*; tho' *Naturally* they are but *Small*, and often not *Observed*. Where there is a *Perforation* of the *Stomach* upon an *Inflammation*, and upon that an *Impostumation*, there the *Foramen* is *Larger* and not *Regular*; as remarkably I once met with it in a *Child*, where a *Large* part of One side of the *Stomach* was *Sphacelated*. So likewise upon a *Corrosive* *Poison* taken, its *Effects* dilates it self more, and is not confined to so *Narrow* a *Compass*; as I observed once in one who had taken *Rats-Bane*.

De Glandul. Intestin.

Comparative Anat. of the Stom. and Guts.

[Fig. 266.

There was nothing *Contained* in the *Stomach*, but a *Body* of *Clotted Hair*, formed into the *Shape* and *Figure* of the *Stomach*, somewhat like an *Half-Moon*; covered with a *Slimy* *Viscid* Substance, which did serve the better to glue these *Hairs* together. These *Hairy Tophy* are frequently to be met with in the *Stomachs* of *Oxen*; and the *Butchers* inform me, that they chiefly meet with them in the *Winter* Season, after the *Hair* begins to shed, and the *Cattle* feed upon *Hay* or *Dry Meat*; but after the *Spring*, and in *Summer*, they do more seldom find them; as if the *New Grass*, which *Purges* them, did contribute to *Dissolve* these *Tophi* likewise. But our *Animal* is *Carnivorous* and (in which all *Accounts* agree) most *Rapacious* of the *Winged Kind*; and where it can't find its *Prey* on the *Land*, it will *Hunt* for it in the *Trees*, most *nimbly* *Climbing* them up; and if the *Tender Bough* cannot *Bear* the *Weight* of its *Body* on its *Feet*, by *twisting* its *Tail* about the *Twig*, it can *Hang* thereby, and stretch it self the farther, to *Obtain* its desired *Food*, or *Rob* a *Nest*. Nay, if I am not *misinformed*, by this *Means* it can *Fly*, or *Pass* from one *Tree* to *Another*, without *descending* down; for thus *Hanging* by its *Tail*, and *Waving* and *Swinging* its *Body* like a *Pendulum*, it can fling it self into the *Boughs* of a *Neighbouring Tree*, where his *Tail* is sure to take fast hold of the first *Bough* it lights on, if otherwise it misses its *Footing*; and, as I have shewn, his *Hinder Legs* being made like *Hands*, with a *Thumb*, it can more readily raise its *Body* up by them. But tho' these *Animals* be *Carnivorous*, yet when *Need* drives them, they can take up with other *Food*; for this we *Dissected* would *Eat* Any thing that was brought from the *Table*.

The *Mesentery* is that *Membranous* Part, which Colligates the *Intestines*, and Fixes their Situation; and gives to them the Order of their Figure. For the *Intestines* are not just Fastened to the *Peripherie*, or Outward Circumference of the *Mesenterie*; but the Outward *Membrane* of the *Mesenterie* of both sides, is entirely Projected and Continued over the whole *Canalis*, or *Duct* of the *Guts*; and is to them the Outward or Common *Membrane*. So that often, by separating this Outward *Membrane* from what lies under it, the *Muscular*, I have Extracted the whole length of the *Guts*, leaving only the Common *Membrane*, as 'tis Continued from that of the *Mesenterie*; which I could Inflate, as if the whole of the *Guts* Remained. Now here we observed that Remarkable Difference from what is in many other Animals, that we cannot but make *Two Mesenteries*: one peculiar to the *Small Guts*, the other belonging to the *Great Ones*.

Fig. 269.

The Former I shall call *Mesenterium Minorum*, and the Latter *Mesenterium Majorum Intestinorum*: For as the *Duodenum* Descended from the *Stomach*, it ran under the *Colon* (just where 'tis joined to the *Cæcum*) towards the Middle of the *Spine*. Hence I found a *Projection* of the *First Mesenterie* into a *Spiral Line*, like a *Cochlea* or a winding Pair of *Stairs*: so that upon *Inflation*, these *Intestines* here made several *Convolution*s tho' not exactly *Spiral*. The *Second Mesenterie* was Projected more in a *Plain*; and made almost a *Circular Figure* at its *Peripherie*: So that the *Cæcum*, and *Colon*, did almost entirely Encircle the *Small Guts*.

The Reverse of this Structure of the *Intestines* I formerly found in the Anatomy of the *Tajacu*, for there the *Colon* made a *Spiral Figure*, and the *Small Guts* made a *Plain*. But this *Spiral Convolution* of the *Intestines* is also to be met with in several other Animals, though their Structure be Different; as in the *Goat* and *Deer kind*; and very Remarkably in a *Wood Cock*.

Vid. Sup:
S. CVIII.

The *Small Guts* Measured about $6\frac{1}{2}$ Feet in Length; the *Cæcum* was about 6 Inches Long; and the *Colon* and *Rectum* 2 Foot long. The Girth of the *Duodenum* (I mean all along here as inflated) was 3 Inches; the *Ileon* $2\frac{1}{2}$ Inches; the Girth of the *Cæcum*, in the Largest place, was 6 Inches; of the *Colon* 4 Inches: And the *Rectum* was 3 Inches about. From the *Spine* to the Utmost Projection of the *Small-Guts*, (under the same Circumstance of Inflation) we Measured about 6 Inches; the greatest Diameter that the *Colon* in this *Circular Figure* made, was somewhat above 7 Inches. In the whole *Duct* or *Canalis* of the *Intestines*, I could not observe any *Valves*; no not at the *Cæcum* it self. 'Tis True, that the *Foramen* into the *Cæcum*, was a great deal less than the Capacity of the *Gut* it self: However the Passage into it was so Open and Wide, as readily to Receive or Emit its Contents.

But the Length and frequent Gyration and Windings of the *Intestines* supply this want of *Valves*; they Prevent the Danger of a Too Hasty Descent of the *Fæces*, and give a greater Opportunity to the Separation of the *Chyle* into the *Vasa Chylifera*. And the *Cochlea* or *Spiral Figure* of the *First Mesentery*

Mesentery easily Prevents the *Regurgitation* of the *Contents* of the *Intestines* again into the *Stomach*, upon a *Declivity* of the *Body* of this *Animal*; as it is frequently in, when it *Hangs* by its *Tail*. For tho', as I observed, the *Passage* from the *Stomach*, by the *Pylorus* into the *Duodenum*, is *Large* and *open*, yet in this *Posture* of the *Body*, there cannot but be a *Reduplication*, or *Folding over* of the *Duodenum*; since the *Great Bulk* or *Wallet* of these *Intestines* must *Incline* and *Swag* towards the *Diaphragm*: by which *Reduplication*, the *Passage* at the *Pylorus* must, in a *great Measure*, be *Occluded*; and the *Ascent* of the *Contents* now, be altogether as *Difficult* and *Great*, as when the *Animal* stands upon its *4 Feet*.

Fig. 267. BBB.

The *Pancreas* was *Large*, having one part (if I misremember not) running towards the *Spleen*, and the other *Down* by the *Duodenum*. The *Liver* was very *Large*, of a *Bright Red* Colour, consisting of *3 Lobes*; two of them were much *Larger* than the *3d.* which was not to be seen, but upon *Inverting* the *Liver*. And here we found not only at the *Edges* of one of the *Larger Lobes*, *Deep Incisures*, which rendered it *Jagged*: but also in the *Middle* of the *Concave* part of the same *Lobe*, several *Deep Fissures*; possibly for this *Reason*, that so it might *Yield* and *give way* the better, when 'tis *Inverted*, as 'tis always, when this *Animal Hangs* by its *Tail*. The *Bladder* of *Gall* was very *Large*. The *Kidneys* of each side were a little above an *Inch* and *half Long*, about $\frac{3}{4}$ of an *Inch* broad, and of the *Figure* almost of a *Kidney Bean*. The *Emulgent veins* and *Arteries* were very plainly *Seen*: But on the *Inside* of the *Kidneys*, towards the *Upper* part, were placed the *Glandulæ Renales*, which were very *Large* and of the same *Colour* with the *Kidneys* themselves; which was a *Deep-Red*.

Fig. 264. AA.

Fig. 264. f.

The *Ureters* were about $5\frac{1}{2}$ *Inches Long*, and were *Inserted* into the *Neck* of the *Bladder* of *Urine*, as is represented, first running *Under*, then *Ascending* up by the two *Extreams* of each *Uterus*, as they lie *Duplicated*. The *Bladder* of *Urine*, being *Inflated*, was about the *bigness* of a *Hen's Egg* and of that *Figure*. The *Neck* of the *Bladder*, or *Urethra*, (which was about an *Inch Long*) lay over the *vaginæ Uteri*: and here the *Urethra* and the *vaginæ Uteri* *Emptied* themselves into one *Common Canalis* or *Passage*, which *Measured* about an *Inch* and *Half* in *Length*. In most *Animals*, about the *Kidneys* there uses to be observed a *large Body* of *Fat* *Covering* them, being contained in the *Membrana Adiposa*: But here we found *4 Large Protuberant Lumps* of *Fat*, two of each side; two of them lying in the *Pelvis* of the *Abdomen*, near the *Bladder* of *Urine*, and the *Uterine Parts*, and the two others, between them and the *Kidneys*.

They *Consisted* of *Regular Large Laminae*; which were easily *Separable* from one another, in *broad Fleaks*; so as I have never *Observed* before.

Fig. 264. 265.

Amongst the *Uterine Parts*, which were very *Surprising*, we found *Two Ovaria*, *Two Tubæ Fallopiantæ*, *Two Cornua Uteri*, *Two Uteri*, and *Two vaginæ Uteri*. The *Ovaria* were placed one of each side near the *Extreams* of the *Cornua Uteri*, being fastened to the *Alæ Uteri*, and were about the *Bigness* of a *vetch*. The *vasa Preparantia* (the *Arterie* and the *vein* that did go to and from them) were

were very plain, and as I have represented them; though the greatest part of these *Vessels* were bestowed upon the *Cornua Uteri*. Near the *Ovaria*, I observed the *Fimbriæ Foliaceæ*, and thence a Passage into the *Tubæ Fallopianæ*. The *Tubæ Fallopianæ* were Two Fine Slender *Canales* or *Ducts*, supported by the *Alæ Uteri*, and running waving, and Led into the Extrems of the *Cornua Uteri*. The *Cornua Uteri*, being inflated, were about the bigness of a *Goose Quill*, about an *Inch* and *half* long; and were fastened to the *Alæ Uteri*; towards both Ends a little Crooked, but where they pass into the *Uteri*, they were Reflected Inwards, and at the other Extream Reflected Outwards. Their Substance seemed rather Thicker than the *Uteri* themselves, and not so Transparent, by Reason of the numerous *Blood-Vessels* which irrigated them almost all over; for in the Inside, both above and under, there ran the whole length of the *Cornua*, large *Trunks* of *Blood-Vessels*, sending from the sides all along Numerous Branches; which is very Requisite: For in Animals that are *Multiparous*, as is our Subject, (having 5 or 6 *Young Ones* at a time) the *Litter* or *Fetus* do Lie, and are Formed in the *Cornua Uteri*. And I did here take notice of some little Risings of the *Inward Membrane* of the *Cornua*, whereby they were somewhat Divided into *Cells*, but very imperfectly. However for the *Nourishment* and *Formation* of the *Embrio's* here, so great a Number of *Blood-Vessels* is Highly Necessary, and they were far more Numerous here than in the *Uteri* themselves. These two *Cornua* do Empty themselves into the *Two Uteri*, just in the Middle where they are Conjoined together, and so outwardly seem to form, but as it were one Continued Body. In *Lobsters* and *Crabs*, in the *Female* there are *Two Uteri*, as in the *Male* there are *Two Penes*; so *Two Penes* and each *Forked* too, I have observed in the *Rattle Snake*: But I think this is the only Instance of a *Land Quadruped*, that has *Two Uteri*; and each of these too, seemingly Double by the *Reflection* they make, and by an Imperfect *Diaphragm*, which Divides the Cavity of each *Uterus* a considerable way.

These *Uteri* are not fastened to the *Alæ*, as are the *Ovaria*, *Tubæ* and *Cornua*; but where they are Conjoined near the Insertion of the *Cornua*, they do Adhere very Firmly to the *Neck* of the *Bladder*, not easily to be separated thence; and by *Membranes* to the *Rectum*, where they are more separable. So that the *Neck* of the *Bladder* lies over that *Diaphragm*, or *Membrane*, which parted them (as I said) into *two* Distinct *Uteri*. Here the Body of the *Uteri* measur'd in *Compass* (thus Inflated) about $1\frac{3}{4}$ *Inch*: Hence they were Projected towards Each Side, and not according to the Length of the *Spine*, gradually Inlarging the inward Cavity, as 'tis Extended; For here about the Angle of *Reflection*, if Measur'd in *Compass* 2 *Inches* and an *Half*. The *Uteri* being thus Extended towards Each side about the Space of $1\frac{3}{4}$ *Inch*, are then Reflected back again towards the *Neck* of the *Bladder*; and so pass into the *Two Vaginae* which lie under the *Urethra*. From this Angle of *Reflection*, the Cavity of each *Uterus* gradually Lessens, and is much smaller than the other part of the *Uterus*; the Capacity of Each *Uterus* being the Largest at the Outward Elbow, where it Begins to be Reflected; for

Fig. 264.
mm. 0000.

Fig. 264. xx.
Fig. 265. cc.

Vid. Sup.
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here it was made, as 'twere, one Common Cavity for almost the Length of an *Inch*. But on the Inside, I observed a *Membrane* to be Projected from the Internal side of the *Uteri*, just from the Corner where the sides of the *Uteri* are *Doubled*, whereby this Cavity is in part Divided; and for this Reason, shall call this *Membrane*, the *Second*, or an *Imperfect Diaphragm* of the *Uteri*. In these *Uteri* I observed four large *Trunks* of *Blood Vessels*, which did run the whole Length of them, sending from their sides Numerous *Branches* and *Ramifications* all along. These *Trunks* were Propagated from the *Hypogastrick* and *Spermatick Vessels*. I did also here observe in these *Uteri* (this by *Inflation* Extended and Dried) several *Fasciuculi* of *Muscular Fibres*, placed at a Regular Distance from one another; which did Run the whole Length of the *Uteri* likewise: By means of whose *Contraction*, the *Fætus* may be more easily forced out:

These *Two Uteri* Empty themselves into the *two Vaginae*; for at this Extream, the *Uteri* making a *Turn* at the *Neck* of the *Bladder*, are continued thence into the *two Vaginae*, which lie just under the *Urethra*, and are much of the same length with it, which was about an *Inch*. Their Capacity was about the bigness of a *Wheat-Straw*: Both these *Vaginae*, and *Urethra* too, Emptied themselves into a *Common Passage*, or *Canalis*, which was as Large as all the other *Three*, and about $1\frac{1}{2}$ *Inch* Long. It looked *Reddish* by means of the Numerous *Blood Vessels* it enjoyed, and at last had its Exit so near the *Fundament*, that when alive, there was not observed any other *Foramen* outwardly, but that which led into the *Rectum*: But when I came to Dissect it, by Elevating the *Skin* here, which seemed to cover it, like a *Valve*, I observed the *Foramen* that led into this *Common Passage*, and putting a *Blow-Pipe* into it, at the same time, by *Inflation*, I extended the *Bladder* of *Urine*, and the *Uterine Parts* too, *viz.* The *Vaginae*, the *Uteri*, and the *Cornua*. So that in the *Skin* here, there was only one *Foramen* for the Exit of the *Fæces*, and the *Urine* and the *Fætus* too.

I have not had an Opportunity of Dissecting a *Male Possum*; and the Account we find of it in Authors is very Short and Imperfect; so that Mr. *Ray*, with good Reason, Queries whether the *Tai ibi* of *Brazile*, described by *Margrave*, differs from our Subject, the *Possum*, only in *Sex*.

[Fig. 260.

The *Skeleton* of the *Head*, from the End of the *Occiput*, to the Extream of the *Nares*, was 4 *Inches* and $\frac{3}{4}$ long; of which the *Rostrum* measured 3 *Inches*; and just where the *Rostrum* and the *Cranium* met, the *Bones* were so Pinched in at the sides, that here 'twas very narrow; and I may say, in proportion to the Bulk of the Animal, this was the least *Cranium* I ever met with in a *Quadrupede*. On the *Forehead*, the *Rostrum* was an *Inch* broad, having on each side a *Protuberance* jetting out. There was a large *Suture*, just in the Middle, which divided the *Upper Bones* of the *Nares* lengthways; and though they ran slender towards the Extream of the *Nares*, yet these *Bones* towards the *Forehead*, spread into a *Triangular Figure*, and as they are Joined together, they form a *Rhomboide*, or a *Lozinge*. There was a Remarkable *Rising Ridge* like a *Crest*, that runs the

the Length of the *Cranium*, from the *Forehead* to the *Occiput*, just in the middle; where the *Sutura Sagittalis* is in other *Skuls*. This Ridge, for Distinction sake, I shall call, *Protuberantia Ossea Longitudinalis*; and I observed, it Jutted out from the *Cranium*, above a *Quarter* of an *Inch*. Just at its Upper Edge, I could perceive a *Seam* like a *Suture*: So that though now, these *Bones* are so well United together, that they appeared as one Entire Body, yet in the *Fætus*, without doubt, they are separable, and are two; and this I rather think, because in the upper part of the *Cranium* I could not find any *Sutures* at all. So likewise answerable to the *Lambdoidal Suture*, may be those other *Ridges* in the Extream of the *Occiput*, which I shall call, *Protuberantiæ Osseæ Laterales*: Which arising on each side from the *Processus Styloides* ascend obliquely up the Hinder part of the *Occiput*, and just in the Middle at the Top, are joyned with the *Longitudinal Ridge*, I have Described. These *Ridges*, although as Deep as the *First*, yet were not standing so Upright, but Projected rather like a *Pent-house*, over this Hinder part of the *Cranium*: By both which *Ridges*, the *Cranium* is so well Guarded and Defended, that 'tis almost impossible, the *Skull* should be any ways *Cracked* or Broken. Something like these *Ridges*, but nothing so Large, I have observed in the *Skull* of a *Weasel*. The *Eyes* likewise are very well Guarded, and Defended, by the *Os Zygomaticum*; which is very Broad and Strong; in the Broadest place being above $\frac{3}{4}$ of an *Inch*, and in the Narrowest half an *Inch*; being very Thick on its Under Edge, but at its Upper, growing Thin and Sharp. But for the Greater strengthning this *Bone*, (which is Formed by a *Process* from the *Os Temporum*, and another from the *Maxilla Superior*) where they Meet they Lap Over one another, and so become the Stronger. This *Os Zygomaticum* was $2\frac{1}{2}$ *Inches* long, and standing off from the *Cranium* an *Inch* in Distance. In the Orbit of the *Eye*, at the *Inward Canthus*, there was a Large *Foramen*, which Led into the Cavity of the *Nose*: and by a *Duct* placed here, the *Tears*, or *Moisture* from the *Eyes*, is Conveyed into the *Nostrils*. In the *Upper Jaw Bone* likewise, there was a Large *Foramen*, which was for the Passage of some *Vessels* from the *Inward Orbit* of the *Eye*. The *Cranium*, which encompassed the *Brain*, in the largest place, was about an *Inch* over, and about an *Inch* and half in Length; but its Cavity Jutted out somewhat farther towards the *Nares*, making as it were, a particular *Cell* here, and pretty Capacious, for the receiving the *Processus Mamillares*, and that Fore-part of the *Brain*. And afterwards I observed the *Os Cribriforme*, very Remarkably Perforated with Holes like a Sieve; and indeed in Forming this *Organ* of Smelling, nature seems very Careful, and Solicitous, the *Rostrum* making so great a part of the *Head*, that the *Cranium* it self seemed very inconsiderable in Respect to it; its inward Capacity containing not above the Quantity of a *Walnut*. The *Os Spongiosum* in each *Nostril*, seemed very Curiously Contrived, by the Abundance of *Laminæ* it enjoys; so that the *Membrane* that Covers them, by this means, is Rendered more Capacious, and Capable of receiving more plentifully the *Effluvia's* of those Animals, it would either Catch, or Avoid; and in this *Sensory* 'tis known that *Brutes* excel even *Man* himself, and their *Organ* is more Adapted for it.

The *Under-Jaw* consisted of Two Strong Bones, Joyned together only at the *Mentum*; each Measured 4 Inches in Length. The *Head* of this Bone (which was half an Inch broad) was Received into a *Sinus* of the *Os Temporum*, and very firmly *Articulated* there. It had two *Processus*; the *Anterior* or *Superior* is Large and Thin, into which is inserted the *Temporal Muscle*: The *Inferior Processus* is smaller, and runs to a Sharp Point; Here at this *Process*, the Edge of the *Mandible* is so Dilated, that it Measured above half an Inch. On the Inside of the *Jaw* here is a Large *Sinus*, which leads to a *Foramen* that goes into the Body of the *Jaw Bone*, and affords a Passage for the *Vessels* thither. In the *Upper Jaw* before were 8 small *Dentes Incisores*, 4 of each side; then a *Void Space*, almost a quarter of an Inch; then two Large Prominent *Dentes Canini*, one of each side, which Jutted out of the *Jaw* about half an Inch; these were succeeded of each side, with 3 *Dentes Incisores*: but these were much stronger and Larger than the *Fore-Teeth*, and imitated the *Dentes Molares*, in that they were inserted into the *Jaw-Bone* with *Two Phangs*: But the *Heads* of these *Incisores* were *Acuminated*, whereas the *Heads* of the *Molares* were *Flat* and almost of a *Triangular Figure*; There were 4 *Dentes Molares* of each side; in all 24 *Teeth* in the *Upper Jaw*. But the *Double Phangs* of the *Molares* and the *Incisores Majores*, were such as at first Sight, one would think them two *Distinct Teeth*; each *Phang* being inserted into a *Distinct Alveolus*, or *Socket*, in the *Jaw*, and remaining Separated some Way above the *Jaw-Bone*, and only Joyned at the *Head*. In the *Under-Jaw Bone*, there were likewise of Each side, 4 *Dentes Incisores Minores* Before; then a little *void Space*; after that, the *Dens Caninus*; then 3 *Dentes Incisores Majores*; and last of all 4 *Dentes Molares*; answerable to those in the *Upper Jaw*, but somewhat smaller. In both *Jaws*, in all 48 *Teeth*.

There were 7 *Vertebrae* of the *Neck*; 13 of the *Back* or *Thorax*; 6 of the *Loins*; 3 of the *Os Sacrum*; and 22 of the *Tail*; 51 in all. The *First Vertebra* of the *Neck* (to which the *Head* is fastened, and is therefore call'd the *Atlas*) had two Broad *Transverse Processes*, but no *Spine*. The 2d. *Vertebra* of the *Neck* had a very large and thick *Spine* of a *Triangular Figure*: and in it was observed a large *Semi-circular Sinus*, which was so Deep as to receive into its Bosom, a great part of the *First Vertebra*; by which means, the *Articulation* was very much strengthened. This *Vertebra* is called *Dentata*, from that *Tooth-like Protuberance* I have Represented, and which is receiv'd into the *Hollow* of the *First Vertebra*, where the *Medulla Spinalis* runs. This *Vertebra* backwards, had two *Processus obliqui Superiores*, and two *Obliqui inferiores*. The 3d. *Vertebra* of the *Neck*, had the same *Processes* both before and Behind; but the *Spine* here was about 3 quarters of an Inch in Height; about the 3d. of an Inch Thick; and just at the Top seemed to be a little *Cleft*. The 4th. and 5th. *Vertebrae* had the same *Processes*, as the 3d. *Vertebra*; and the *Spine* here likewise was very Thick, and *Cleft* at the Top; but gradually Lessening in Height, as also Thickness. The 6th. *Vertebra*, besides the former *Processes*, had likewise an *Acute-Transverse One*, on each side; and its *Spine* much shorter and more *Acuminated* than the Former. The 7th. *Vertebra* of the *Neck* had only two *Oblique Processes* before, and none Behind; and two *Acute Transverse Processes*, and a very short and Sharp *Spine*: So that upon hold-

Fig. 268.

Fig. 268. d.

Fig. 269.

ing-up the *Head*, the *Spine* of the *First Vertebra* of the *Thorax* would touch the *Top* of the *5th Vertebra* of the *Neck*. These *Vertebra* are so strongly and Closely locked into one another, that though each of them are Large in themselves; yet thus *Articulated*, they do not make full 2 *Inches* in Length This Thickness and Strength of the *Vertebra* of the *Neck*, and likewise of several of the *Vertebra* of the *Thorax* and *Loins*, and the *Prominent Bony Ridge* in the *Cranium*, so well secure his *Neck*, *Back*, and *Head*, that should it happen to *Fall* to the *Ground* there would be no *Danger* of *Breaking* any of them.

The *First 7 Vertebra* of the *Thorax*, have *two Oblique Processes* forwards, which runs Under the *Hinder Oblique Processes* of the *Preceding Vertebra*, and have *Two Oblique Processes* backwards, which ride Over those of the *Succeeding Vertebra*; as likewise *Two Transverse Processes*, which at their *Ends* have small *Acetabula's* or *Sinus's*, for the *Receiving* the *Heads* of the *Ribs*, which are fastened to them. The *Spines* of these *Vertebra* are *Slender*, *Thin*, and *sharp*; about $\frac{3}{4}$ of an *Inch* long. The *6 following Vertebra* of the *Thorax*, have *short*, *Thick*, and *Flat Spines*. The *Oblique Processes* being continued on each side of the *Spine* make, as 'twere, a *Gutter*: and the *Transverse Processes* here, are somewhat *Different* from the *Former*. The *Spines* of the *Vertebra* of the *Back*, or *Loins*, the more they *Approached* the *Os Sacrum*, so they *Lessened* *Gradually* in their *Thickness* on the *Edge*. But here were *Double Oblique Processes*, viz. *4* at each end of the *Vertebra*; and the *Undermost* spreading themselves out *Broad*. The *3 Vertebra* of the *Os Sacrum*, are firmly fastened to the *Os Ilium*; but the *Last* not so entirely as the *two Former*: But this at each side had a *Broad Transverse Process*, and the *Spines* of these were *Thin*. The *Two First Vertebra* of the *Tail* had only one small *Acute Spine*: But in all the other *Vertebra* of the *Tail*, both at the *Head* and *Tail* of each *Vertebra*, I observed *Two Spines*; but those at the *Head* of the *Joynt*, the larger. In the *6 First Vertebra* of the *Tail*, there was, of each side, a *Broad Transverse Process*, the length of the *Joynt*: In the other *Vertebra*, only at the *Head* and *Tail*, a *Jutting* out at the sides. The *Vertebra* about the *Middle* of the *Tail*, were the *Longest*; being there about an *Inch* long; near the *Root* of the *Tail*, and at the *End*, not so Long.

The *Spines*, or *Hooks*, placed in a *Line*, in the *Middle* of the *Underside* of the *Vertebra* of the *Tail*, are a *Wonderful Piece* of *Natures Mechanism*. 'Tis true, the *First 3 Vertebra* had none of these *Spines*, but in all the rest they were to be observed; but as they *approached* the *Extream* of the *Tail*, they grew *Lesser* and *shorter*. These *Spines* (where *Longest*) were about a *quarter* of an *Inch*, or somewhat more. They were placed just at the *Articulation* of each *Joynt*, and in the *Middle* from the sides; and seemed to be *Articulated*, both to the *Preceding* and *following Vertebra*; not being an *Entire Solid Body*, but arising from the *Vertebra* with *two Legs* or *Crura*, become afterwards perfectly *United* at the *Ends*. By this means, the *Bones* are rendered more *Firm* and *Strong*; and this *Hollow* serves for the *Transmitting* of the *Blood Vessels* through them; and one may *Observe* here a *Stria*, or *Furrow*, all the *Length* of the *Vertebra*, for the *receiving* them, whereby they are the better secured from *Compression*, when this *Animal Hangs* by his *Tail*. And for the

Fig. 270.

Fig. 271.

Fig. 272.

the Performing this Office, nothing, I think, could be more Advantageously Contrived: For when the *Tail* is Twirled or Wound about a Stick, this *Hook* of the *Spine* easily sustains the Weight, and there is but little Labour of the *Muscles* required; only enough for the Bowing or Crooking the *Tail*; for then, as by a *Hook*, the Weight of the whole Body is hereby Suspended. And for the doing this, 'twas Observed, that in each Preceding *Vertebra*, there did a *Muscle* arise, which was inserted on each side of the Succeeding *Vertebra*; which *Acting*, or *Contracting*, must necessarily Bend and Curve that *Joynt*. But for the Strengthening the whole, there was observed 4 *Muscles* to arise from the *Os Sacrum*, which did run the whole Length of the *Tail*; Two on the Upper side, and two on the Under: sending each a *tendon* to each *Internode* or *Vertebra*. So that when the Skin was stript off, the Outward parts of these *Muscles* seemed to have Tendinous Expansions over them the whole length of the *Tail*, and almost to be Covered by them: which must needs very much Contribute and add strength to the *Tail*; besides what may be the Effect of their Insertion of *Tendons* into each *Joynt*, or *Vertebra*, in *Curling* and *Unbending* the *Tail*.

Fig. 266.

To the *Vertebrae* of the *Thorax* are fastened the *Ribs*, and there are 13. of each side. The 7 Foremost are more perfectly *Articulated* with the *Sternum*. The 6 succeeding may be reckoned in some sense, *Costæ Nothæ*: For though they are Long, and as they proceed from the *Vertebrae*, are Inclined Backwards towards the *Hinder-Legs*, yet afterwards they are Reflected Forwards towards the *Sternum* or *Cartilago Scutiformis*. And tho' in other Animals, that part of the *Ribs* that is fastened to the *Os Pectoris*, or *Sternum*, be usually *Cartilaginous*; yet here, in our Subject, I Observed it to be all *Bony* throughout. However, this Difference I found, that the *Ribs* did look *Redder*, by Reason of the *Blood Vessels* in them, and this Part was *Whiter*, and where it was Fastened to the *Ribs*, one might plainly see; so that it may well pass for a *Bony Cartilage*, as often the *Cartilages* do become *Bony*.

The *First Rib* was only an *Inch* long, and its *Bony Cartilage* a quarter of an *Inch*: hence Gradually the *Ribs* Encrease in Length; for the 7th. *Rib* was 3 *Inches* Long, and its *Cartilage* one *Inch* and a half. The 4 *Last* of the *Costæ Nothæ* gradually Lessen again in Length; for the *Last Rib* of all was only one *Inch* and $\frac{3}{4}$ Long; and its *Cartilage* did not run Home to the *Os Pectoris* or *Sternum*, though the *first*, *second* and *third* of the *Costæ Nothæ* did. The *Os Pectoris*, or *Sternum*, consisted of 7 *Bones*, according to the Number of the *Fore Ribs*, that are Fastened to them. At the Beginning of the *Sternum*, there Jutted out a sharp *Bony Cartilage*, which, from its Figure I shall call *Cartilago Ensiformis*: And here was fastened one Extream of the *Claviculae*. At the End of the *Sternum*, towards the *Belly*, there was a Broad Roundish *Cartilage*, which therefore I shall call *Cartilago Scutiformis*.

There were 2 *Claviculae*, or *Collar Bones*, each an *Inch* and $\frac{1}{2}$ long; having one Extream Fastened to the *First Bone* of the *Sternum*, or the *Cartilago Ensiformis*, and the other End to the *Spine* of the *Scapula*, near the *Conjunction* of it to the *Os Humeri*. By means of this *Bone*, it can more advantageously bring

bring its *Fore-Feet* to its *Mouth*: as it uses to do when it Feeds its self, as do the *Monkey-kind*, who have *Claviculae* too as well as *Man*; though many *Animals* want these *Bones*.

The *Scapula*, or *Shoulder-Blade*, was about 2 *Inches* long, about an *Inch* and $\frac{1}{2}$ broad: its *Spine*, though *Thin*, yet the nearer it approached the *Shoulder* it grew *Larger* and *Flatter*. Into the *Sinus* of the *Neck* of the *Scapula*, was received the *Head* of the *Shoulder-Bone*, or *Fore-Thigh-Bone*; as to that *Protuberance* called the *Acromium*, was fastened the *End* of the *Clavicula*. This *Thigh Bone* of the *Fore Legs* was about $2\frac{3}{4}$ *Inches* Long: 'twas *Thick* and *Strong*, having a large rough *Spine* jutting *Forward*, and running half the *Length* of it. The *Lower Extream* of this *Thigh Bone*, to which was fastened the *Tibia* and *Fibula*, grew very *Broad*, being almost an *Inch* broad. Above, where this *Bone* began to grow *Broad*, on the *Outside* was a *Large Protuberance*: and on the *Inside* there was a great *Oblong Foramen*, or *Hollow Passage*, formed by a small *Bone* arising from the *Inward Fore-part* of the *Thigh-Bone*, where it begins to grow *Larger*, and was afterwards *United* to that part of the *Basis* of this *Bone*, where the *Fibula*, or *Minus Facile*, is *Joyned*. Just in the *Middle* of the *Basis* of this *Bone*, there was a *Large Sinus*, which *Backwards* appeared *Deeper*, which did look into another *Deep Sinus* of the *Tibia*: by which *Means* these *Bones* were so firmly *Articulated* together, as they were not easily, if possibly, to be put out of *Joynt*. The *Tibia*, or *Focile Majus*, was a *strong Bone*, about 3 *Inches* Long, which was *Extended upwards* about $\frac{1}{4}$ of an *Inch* above its *Articulation* with the *Thigh Bone*: and at the *Other End* was fastened to the *Outward Bone* of the *Tarsus*. The *Fibula*, or *Focile Minus*, was a *Smaller Bone*, placed more *Inward* and *Forwarder*, and not so long as the *Tibia*; being *Articulated* Above (but not so *Firmly*) with the *Thigh Bone*, and *Below*, with the *Inward Bone* of the *Tarsus*; For there were but 2 *Bones* of the *Tarsus*, having each a *small Sinus*, for the receiving the *Heads* of the *Two Fociles*. The *Bones* of the *Metatarsus* were 4 or it may be 5, to which were *Joyned* the 5 *Fingers* or *Toes*, of the *Fore-Feet*. The *Innermost Toe* had but 2 *Articulations*, or *Joynts*; but at the *End* had a *Large Hooked Strong Nail*: The other 4 *Fingers* had each, 3 *Articuli* or *Joynts*, armed with *Hooked Nails*, as the *First*.

The *Hinder Legs* were fastened to the *Trunk* of the *Body* by the *Os Innommatum*; which in the whole in a *Straight Line* was 3 *Inches* long. In the *Os Ischii* was the *Acetabulum*, being a *Large Socket*, for the receiving the *Head* of the *Hinder Thigh Bone*, and *Deeper* in, there was a space for the *Fastening* the *Ligament*; from which *Space*, there was a *Sinus* which led *Outward*; so that the *Brim* of the *Acetabulum* was not an entire *Circle*, but *Broken* off here.

Here also are the *Ossa Marsupialia*, or *Fanitores Marsupii*. The *Hinder-Thigh Bone* was a little above 3 *Inches* Long; 'twas *Roundish*, and a *strong Bone*: But the *Tibia*, or *Majus Focile*, of the *Hinder Leg*, was somewhat *Longer*, a little *Curv'd*. The *Fibula*, or *Minus Focile*, was about the same *Length*, *Straighter* and *Slenderer*. This, towards the *Foot*, was *Articulated*

Fig. 262.

Fig. 267.

to the *Os Calcis*, as the *Tibia* was to the *Talus*, or *Astragalus*; and these two *Bones* I make the *Tarsus*; and Joyning to them, were the *Bones* of the *Metatarsus*; and to these the *Phalanges* of the *Fingers* or *Toes*. In the Innermost, or the *Thumb*, there were only *Two Articuli*, or *Bones*: in the other 4 *Toes*, or *Digiti*, in each there were 3 *Articuli*, or *Joynts*. The end of the *Thumb* was more Flatted, than the Ends of the other *Toes*: For the *Thumb*, as I have Observed, had a *Flat Nail*, like a *Human Thumb*; in the Others, the *Nails* were long, and Curved. I observed likewise, at the *Articulation* of each *Joynt* of the *Toes*, on the Underside, there were *Two Small Bones*, that are called *Ossa Sesamoidea*; and these both in the *Fore*, and *Hinder-Feet*.

Fig. 257. Represents the *Possum* drawn from the *Life*.

Explanation of
the Figures.

Fig. 257.

Fig. 258.

Fig. 259.

Fig. 258. The *Slit*, or *Aperture*, in the *Belly* that goes to the *Marsupium*, or *Pouch*.

Fig. 259. A. The *Marsupium* Turned the Inside Outwards; where may be observed the *Hair*, or *Fur*, that Covers it, and may help the better to keep the *Young ones* Warm. BB. The two *Hinder Legs* Cut off. C. The *foramen* of the *Anus*; which is also the *Common Outward Vent*, or *Exit*, to the *Rectum*, the *Bladder of Urine*, and the *Uteri* too. D. The Beginning of the *Tail*.

Fig. 260.

Fig. 260. The *Skeleton*. AA. The *Nostrum*, or *Snout*. bb. The *Cranium*, or *Skull*, that did contain the *Brain*. ccc. A *Bony Ridge*, or *Protuberantia Ossea Longitudinalis*, that did run the length of the *Cranium*, and over a part of the *Rostrum*. d. the *Lateral Ridge*, which like a *Pent-house*, Jutted over the *Hinder* part of the *Cranium*; *Protuberantia Ossea Lateralis*. e. f. the *Os Zygomaticum*; e. its *Process* from the *Os Temporum*, and f. that from the *Maxilla Superior*, or *Upper Jaw*. g. A *Foramen*, or *Hole*, in the *Inward Canthus* of the *Orbit* of the *Eye*, that leads into the *Nostrils*, and by a *Duct* conveys the *Tears*, or *Moisture* of the *Eyes* into them. h. A *Foramen*, or *Hole*, in the *upper Jaw*, for a *Passage* to the *Vessels*. i. A *Protuberance* of the *Os frontis*. K. A *Suture* of the *Os Narium*. ll. The *Lower Mandible*, or *Jaw Bone*; *Maxilla Inferior*. m. The *Superior Process* of the *under Jaw*. n. The *Inferiour Process* of the *under Jaw*. o. The *Clavicula* of *One side*. p. The *Cartilago Ensi-formis* of the *first Bone* of the *Sternum*. q. The *Scapula* or *Shoulder Blade Bone*. r. The *Spine* of the *Scapula*. S S S S. The *Thigh Bones* of all the *Feet*. T T T T. The *Tibia* or *Focile Majus*, of all the *Feet*. uu. Part of the *Tibia* in the *Fore Legs*, Extended beyond the *Articulation*. W W W W. The *Fibula*, or *Focile Minus*, in all the *Legs*. xxxxx. The *Bones* of the *Tarsus*. yyy y. The *Bones* of the *Metatarsus*. z z z z. The *Toes*. aa The *Thumbs* in the *Hinder Feet*. 1. The *First Vertebra* of the *Neck*; called the *Atlas*. 2. 3. 4. 5. 6. 7. The 2d. 3d. 4th. 5th. 6th and 7th. *Vertebra* of the *Neck*. 8. The *First Vertebra* of the *Thorax*. 9. The *First Vertebra* of the *Loyns*. 10. The *First Vertebra* of the *Os Sacrum*. 11. The *First Vertebra* of the *Os Coxygis*, or *Tail*. 12. 12. 12. 12. the *Spines*, or *Hooks*, on the *Inside* of the *Tail*. 13. 14. the *Os Innominatum*; where 13 is the *Os Ilium*, 14 the *Os Ischii*, or *Coxendicis*. 15. 15. the *Ossa Marsupialia*, seu *Fanitores Marsupii*. * * * *. the *Ribs*, 13 in all. ©. the *Cartilago Scutiformis*.

Fig.

Fig. 261. The Situation of the *Ossa Marsupialia*, &c. *aa*. The *Ossa Pubis*. *b*. The Coalition, or the Joyning of the *Ossa Pubis*. *cc*. The Two *Ossa Marsupialia*, or *Fanitores Marsupii*. *d e*. The Basis of the *Ossa Marsupialia*, where Joyned to the *Ossa Pubis*; *d*. the Inward Head of the Basis, *e*. the Outward. *ff*. The *Acetabulum*, or Socket, for receiving the Head of the Thigh-Bone. *g g*. The *Os Ilium*. *hb*. The *Vertebræ* of the *Os Sacrum*. *ii*. The *Os Ischii*, or *Coxendicæ*.

Fig. 261.

Fig. 262 The Fore side of the Thigh-Bone of the Fore Leg. *a*. The Head of the Thigh Bone, where 'tis Fastened to the *Scapula*. *b*. A large Rough Spine, which runs above Half the Length of this Thigh Bone. *c*. A Protuberance of this Bone on the Out side. *d*. A large Foramen, or Hollow Passage. *e*. A Sinus for Receiving the head of the *Tibia*. *f. g*. The Basis, or lower Extream of the Thigh-Bone.

Fig. 262.

Fig. 263. The Stomach, and Guts. *A* the *Gula*. *BB*. The Stomach. *c*. A Perforation of the Stomach, caused by an Ulcer there. *dd*. The two Pouchings out of the Stomach at the two Ends. *e* The *Pylorus*. *f*. The Beginning of the *Duodenum*. *g h i K L M N o p q*. Represent the *Small Guts*, and the *Coyles* and *Convolutions* they do make; some of the *Coyles* lie Hid, and out of Sight: but the Order how they follow one another, is signified by the Order of the Letters of the *Alphabet*; so that *g*. Follows *f*. and *g*. is Succeeded by *i*. and *i*. by *K*. and so on to *q* where the *Ilion* is Discharged and Emptied into the *Cæcum*, or if that is full, into the *Colon*, at the first Letter *S.RR*. The *Cæcum*. *SSS*. The *Colon*. *T*. The *Rectum*. *V*. The *First Mesenterie*, or *Mesenterium Minorum Intestinorum*. *w*. The *Second Mesenterie*; or *Mesenterium Majorum Intestinorum*.

Fig. 263.

Fig. 264. The Urinary, and Uterine Parts. *AA*. the Two *Kidneys*. *bb*. the *Emulgent Veins*, *c c*. the *Emulgent Arteries*. *d d*. the *Glandulæ Renales*. *e e*. the two *Ureters*. *f*. the Insertion of the *Left Ureter*, into the Neck of the *Bladder*. *G*. the *Bladder of Urine*, turn'd aside. *h*. the *Urethra*. *ii*. the two *Vaginæ Uteri*. *K*. the *Common Passage* from the *Urethra*, and the two *Vaginæ*. *l*. the *Arteria Aorta*, or *Great Arterie*. *m*. the *Vena Cava*. *n n n*. the *Spermatick Arteries*. *o o o o*. the *Spermatick Veins*. *p p p*. the *Hypogastrick Arteries and Veins*. *r r r*. the *Alæ Uteri*, seu potius *Cornuum*. *S S*, the *Ovaria*. *t t*. the *Tubæ Fallopianæ*. *u u*. the *Cornu Uteri* of the *Left Side* opened. *w*. the *Cornu Uteri* of the *Right Side* not Opened. *x x*. the two *Uteri* Opened. *y*. the *Diaphragm* that Divides the Two *Uteri*. *z z*. the *Imperfect Diaphragm* which Partly Divides each *Uterus*, and lies over the Passage of that part of the *Uterus*, which is Doubled and Tends to the *Vaginæ*.

Fig. 264.

Fig. 265. The Uterine Pars more Particularly. *A A*. the two *Ovaria*. *b b*. the *Fimbria Foliacea*. *c c*. the *Tubæ Fallopianæ*. *d d*. the two *Cornua Uteri*. *E E*. the Two *Uteri* Reduplicated. *f*. A Slit in the Neck of the *Left Uterus* to shew its Passage into the *Vagina* on that side. *g*. the *Left Vagina* Opened. *h*. the *Ostium*, or *Mouth*, of the *Right Vagina*. *i*. the *Common Passage* from the *Urethra* and *Vaginæ*. *K*. the *Urethra*. *ll*. the *Bladder of Urine* cut off.

Fig. 265.

Fig. 266. the Hairy Topus.

Fig. 266.

- Fig. 267. The Liver. *A.* the *Vena Cava.* *BBB.* the 3 Lobes of the Liver. *C.* the Bladder of Gall. *d d d.* the Fissures in the Body of the Liver. *e e e.* the Incisures at the Edges of the Liver.
- Fig. 268. *A.* the Spine of the 2^{d.} Vertebra of the Neck. *b.* Represents its Thickness. *c.* A Large Sinus for the Receiving the First Vertebra. *d.* the Dens, or Tooth, of this Vertebra. *e* the *Processus Obliquus Superior* of one side. *f.* the *Processus Obliquus Inferior* of the same side.
- Fig. 269. *A.* the Spine of the 3^{d.} Vertebra of the Neck, where is shewn its Natural Thickness. *b* the hole through which the *Medulla Spinalis* Passes. *cc.* two small *Foramina* for the Passage of the Vessels. *d.* Represents the Cleft at the Top of the Spine. *e e.* the Two *Processus Obliqui Superiores* Before. *ff.* the Two *Processus Obliqui Inferiores* Before.
- Fig. 270. The First Vertebra of the Thorax. *A.* the Spine, which is Long and Acute. *bb.* the Oblique Processes Before. *cc.* the Oblique Processes Behind. *dd.* the Transverse Processes. *ee.* Where the Ribs are Fastened. *f.* the Hollow where the *Medulla Spinalis* passes.
- Fig. 271. The 4th Vertebra of the Loins. *a a.* the Two Upper Oblique Processes Behind. *b.* the Spine. *cc.* the two under Oblique Processes Behind
- Fig. 272. the 2^{d.} and 3^{d.} Vertebra of the Tail. *aa.* Two Vertebrae of the Tail. *b b b.* the Spines, or Hooks, on the Inside, by means of which it can better Hang by its Tail. *cc.* A Hollow, or Foramen, in the Middle of these Spines, through which Blood Vessels Pass.

A Monstrous Double Turkey; by Sr. J. Floyer, n. 259. p. 434.

CX. At Thorpe in Staffordshire, two Young Turkeys, were taken out of one Egg, (of the Ordinary Size,) when the rest of the Eggs were well Hatched, which Grew together by the Flesh of the Breast Bone, but were in all other Parts Distinct. They seemed Less than the Ordinary thickness of Turkeys: for there wanted both Nutriment and Room for their Growth; which was the Occasion of their Cohesion and Smallness. They had Distinct Cavities in their Bodies, and two Hearts: so that they had two Distinct Cicatricula's, and consequently the Eg had two Yolks in it, from whence they were Produced; which Accident is very Common. But I have a dryed Monstrous Chicken which had but one Head, 4. Wings, 4. Legs, and one Cavity in the Body, and consequently had but one Heart: in this Case this Monstrous Chicken was Produced from one Cicatricula. So Paræus mentions a Double Infant with one Heart. In these Cases the Original of the Infant was One, and the Vessels Regular; but in the Extremity, the Arteries and Nerves were divided into more Branches than Ordinary, and Produced Double Parts. And this is like the double Flowers of Plants, which are Produced so, by the Richness of the Soil. And, thus it is in the Eggs of Quadrupeds; they are Joyned in the Ovarium, and as they Grow, their Bodies do Externally Cohere. So that I may Observe, that there are these two Reasons of the Multitude of the Parts in an Embryo; the Joyning of two Perfect Animals, or else the Extraordinary Division of the Original Vessels, the Arteries and Nerves.

CXI. The *Body* of this *Colt* appeared to the *Eye* *Completely Formed*, without any *Monstrosity* to be taken Notice of in it : But the *Head* being Opened, and Examined, it was Found, that it had no Sign of any *Nose* in the Usual place. The *Two Eyes* were United into *One Double Eye*, which was Placed just in the Middle of the *Brow*, the *Nose* being Wanting which should have Separated them : Whereby the two *Eye-Holes* in the *Skull* were United into *One* very Large Round *Hole*, into the Midst of Which, from the *Brain*, entered *One* pretty Large *Optick Nerve*, at the End of which Grew a Great *Double Eye* ; that is, that *Membrane*, called *Sclerotis*, which Contained *Both*, was *One* and the same, but seem'd to have a *Seam*, by which they were Joyned, to go quite Round it, and the *Fore* or *Pellucid Part* was distinctly Separated into *two Cornea's*, by a *White Seam* that divided them. Each *Cornea* seem'd to have it's *Iris*, (or *Rainbow-like Circle*) and *Apertures*, or *Pupills*, *Distinct* ; and upon Opening the *Cornea*, there was found within it *two Balls*, or *Chrystalline Humours*, very well Shaped. The *Eye Lids* were also a little *Divided* in the Middle. Just above the *Eyes*, as it were in the Midst of the *Forehead*, was a very *Deep Depression*, and out of the Midst of that, Grew a kind of *Double Purse* or *Bag*, Containing Little or Nothing in it : but to some it seem'd to be a *Production* of the Matter Design'd for the *Nose*, but *Diverted* by this *Monstrous Conception* ; perhaps the *Processus Mammillares*, Joyned into *One*, and were Covered with a *Thin Hairy Skin*.

A Monstrous
Colt ; by Mr. R.
Boyle, n. 5. p. 85.

Fig. 273.

CXII. A *Butcher* (at *Limmington* in *Hampshire*) having Killed a *Fatted Cow*, and Opening the *Womb*, found in it a *Monstrous Calf*, which begun to have *hair*. The *Feet* of this *Calf* were so Parted as to be like the *Claws* of a *Dog* ; the *Legs* had no *Joints* ; and the *Tongue* was, *Cerberus like*, *Tripple*, to each side of his *Mouth* *One*, and one in the Midst. Between the *Fore Legs* and the *hinder Legs* was a *Great Stone*, on which the *Calf* *Rid*. The *Skin* of the *Breast*, and between the *Legs*, and of the *Neck* (which Parts lay on the smaller End of the *Stone*) was much thicker, than on any other Part. The *Stone* (which was Bigger at one End than the other) Weighed $20\frac{1}{2}$ *Pounds* ; the outside was of a *Greenish Colour* ; and not *Plain*, but full of little *Cavities* ; when Broke, it appeared full of small *Pebble Stones*, of an *Oval Figure* ; its *Colour* *Gray* like *Freestone*, but intermixt with *Veins* of *Yellow* and *Black*.

A Monstrous
Calf ; by Mr.
Dav. Thomas,
n. 1. p. 10. n. 2.
p. 20.

CXIII. *Jan. 11. 1677*. A *Cow* of Mr. *Will. Dabs's*, at *Milnecote* in *Warwickshire*, brought forth a *Monstrous Calf* ; having *one* perfect large *Head*, and on the *Right Side* of that, grew another, almost as Large, and of true Shape, having both *Tongue* and *Teeth* ; and from the *Roof* of the *Mouth* of the *Monstrous Head*, hung down a piece of *Flesh*, with the shape of a *Tongue* upon it, and a *Row* of *Teeth*, as on an *Under Jaw* : which occasioned the Man who shewed it, to say that it had *3 Mouths*. It had to each *Head* *2 Eyes*, only those of the *Monstrous* were very small, and I believe had *no Sight*. It had only *2 Ears* to both *Heads*, one of which was Placed on the *Far-side* of the *Monstrous Head*, the other as

A Monstrous
Calf with 2.
Heads ; by Sr.
Rob. Southwel,
n. 238. p. 79.

Usual in other Calfs. It Breathed equally at Both Mouths, and had Communication with the Same Throat, but took its Nourishment only at the Perfect Mouth, the Under-jaw of the Other being so Weak, that the Mouth always stood open and Drivell'd. It appeared on the Left side to be a Perfect Calf, and look'd very Lively, and was at 3 Days Old, as Large and Strong as Other Calfs Usually are at 10 Days, or a Fortnight.

Two Monstrous Lambs, by Mr. Colepreff. n. 26. p. 480.

CXIV. Feb. 24. 1666⁶. Rob. Cloak, of Beer Ferris in Devonshire, had a Black Ram-Lamb Fallen with One Head, but 2 Distinct Bodies, with 8 Legs, which Bodies were Joined in the Neck. It had 2 Eyes and as many Ears, in the Usual Places; and One Extraordinary Eye in the Niddock, with One Single Ear, about an Inch distant from the Eye Backwards. Its Dam usually brought forth Two Lambs every Year, as she did this Year also; which with the Ewe remains Alive; but this Monster was found Dead by the Hedge.

About the same time, John Cauce, of the same Parish, had a White Lamb Fallen, with 2 Distinct Heads and Necks, joined at the Shoulders, but One Only Body; and that well Formed, yet having Double Entrals in all Respects. The Ewe remains Well, but the Monster Dy'd.

A Monstrous Pig, by ----- n. 147. p. 188.

CXV. In Decemb. 1682. Among many Pigs of a Sow, there was One which had No Passage for the Faeces, either Solid or Liquid, although the Anus was not outwardly Closed Up; and being Dissected, we found the Guts very much Distended and Transparent, and thro' them appeared the Faeces very Liquid, accompanied with no Small Quantity of Wind. The End of the Rectum was entirely Closed like a Bladder, and Sealed, as it were, Hermetically, Pendulous in the Cavity, and not in the least Continued to a Sphincter, of which there was no Sign. There was No Bladder to be found, nor Uterus, nor any Mark of what Sex it was designed for: But both the Ureters were Inserted into the Rectum, within an Inch, or thereabouts, of the End. The Stomach was Full, even to Distension, of an Hard Substance, which appeared exactly the Same with Hard Press'd Curds. The Chyle came Freely enough out of the Ductus Pecquelitanus, where it was inserted into the Jugular, upon the smallest pressure of the Intestines: But I could not Urge the Liquid or Flatulent Contents of the Guts Upwards, within two Inches of the Pylorus, tho' I pressed them till they Brake.

Two Monstrous Pigs; by Sir J. Eloyer. n. 259. p. 431.

CXVI. In May. 1699. There was shewed to me a Pig at Weeford in Staffordshire, with a Face something Representing that of a Man's, and the Chin was very like that of an Humane Fætus. But when I had well considered the Head, I Observed there was a Depression of the Bones of the Nose, in that Place which was betwixt the Eyes, in which the Pigs Face seemed to me to be Broken, and the Nose drawn Up to appear like an Humane. The Under-Jaw was Inverted, to grow up to meet the Upper; the Tongue and Mouth were made more like an Humane, being altered by some External Pressure upon the Mouth of the Pig, which Broke the Bones

of the *Nose*, and Caused their *Depression* towards the *Palate*, and the *Inversion* of the *Under-Jaw*. This *Pressure* on the *Mouth* Forced the *Bones* Upward, so much as to Cover the *Eye-Holes*; and the *Pig* appears *Blind*. *A* is the Place of the *Bone Depressed*; *B*. is the *Depth* of it. It Closed it self with a *Spring*, when we Opened it by *Force*; so that it had Grown Closed up, ever since it was *Cartilaginous*. By this *Breach*, or *Depression* of the *Pig's Face*, I was first Convinced, that this *Monster* was not produced by the *Copulation* of *Two Species*, as was Usually Apprehended, but only Occasioned by the *Perversion* of the *Compression* of the *Womb*, or *Placenta*, or *Other Pigs* in the same Part of the *Womb*. And that the *Pig's Head* was streightened in its Growth, appeared by the *Flatness* of the *Ears*; and that this *Depressure* happen'd whilst the *Bones* were *Cartilaginous*, appears by the *Bones depressed*, which remain'd *Cartilaginous*, and at the same time the *Under-Jaw* was *Inverted*, and the *Head* made more *Round*. I farther Observed, that All the *Head* was Covered with *Hair*, as the *Other Pigs* were; that the *Teeth* in the *Mouth* were *Pig's Teeth*; the *Hair* of the *Pig's Head* was *Yellow*, as that of the *Sow's* was; the *Monstrous Pig* was as Big, and as well Grown as the rest of the *Pigs*, and therefore begot by the *Boar* at the *Same Time*; the *Nose* was a *Perfect Pig's Snout*, and there was no *Upper Lip*, as in the *Humane Kind*. In all the *Other Parts*, it appeared to be a *Perfect Pig*; no *Parts* were wanting, but those of the *Face*, Distorted by some *External Accident*. At the Beginning of the *17th Week*, from that Time when the *Sow* took the *Boar*, which is the Usual Time the *Sow* Pigg'd 8 *Pigs*, the first 5 were *Perfect Pigs* the 6th. was the *Monster*, and after that two more *Perfect Pigs*. This *Monster* was Pigg'd *Alive*, but *Dyed* because it could not *Suck*, the *Nose* being *Stopped*. The *Cry* of the *Pig* was not like the *Other Pigs*, because of the *Stoppage* of its *Nose*, and the *Alyeration* of the *Figure* of its *Mouth*.

This Kind of *Monstrous Pigs*, produced by the *Unnatural Situation* of *Parts*, by some *External Compression*, I believe is very *Frequent*; because I had Another of the same Kind, sent me out of *Derbyshire*; which had a *Resemblance* of a *Man's Face*, and All the *Other Parts* of a *Pig*, and This had the same *Chin*, and *Depression* betwixt the *Eyes*, the *Roundness* of the *Head*, and *Flatness* of the *Ears*, I have above Described. But this *Derbyshire Monster* wanted *Hair*, as *Pigs* which come too Soon do; and No *Sex* could be Distinguished in it: But the Former Described. was a *Boar-Pig*.

CXVII. This *Monstrous Catling* was *Dead* when I met with it; and I am perswaded that it was so brought forth; the *Lungs* being *Compact* and *Free* from *Air*, which they could not be, if it had ever *Inspired*. It was *Double* from the *Navel* downwards, having 4 *Hind feet*, *Two Tails*, *Two Anus's*, and *Two Pudenda*; for they were *Females*. They were *Joined* into *One Trunk* at the *Navel*, and were *Continued* so *Upwards*: but yet this *Monster* had *Two Pair* of *Fore feet*, one of them on the *Back*, and the other on the *Breast*. The *Head*, though *single*, had *Two Pair* of *Ears*; one *Naturally Seated*, and another at the *Hinder part* of the *Head*, between the *Processus Mamillares*, to which the *Vertebrae* of both the *Necks* were *Joined*. There

The Anatomy of
a Monstrous
Double-Cat;
by Dr. Mullen.
n. 174. p. 1135

Fig. 275.

There was only *One Stomach* under the *Liver* in the Right side, reaching under another *Liver* in the Left. The *Guts* were *Single* till within 6 or 7 *Inches* of the *Anus*; and there was a *Division* into *Two Branches*, one going to each *Fundament*; below the *Division* there were plainly to be seen *Two Cæcums*, within about 3 *Inches* of the *Anus* each. There were *Two Livers*, one much smaller than the other; that which was in the Right side was the least, the other lay Lower down in the Left side; they were both Entire without any *Division* or *Lobes*. There was a *Vena Umbilicalis* inserted into Each of them. There were *Two Arteries* inserted into the *Liver* in the Left side, both coming from the *Aorta*; and these I shall call the *Cæliacæ*; But there was only *One* inserted into the *Liver* placed in the Right side. There was no *Vena Cava* Below the *Livers*; for all the *Veins* coming from the Lower parts entered the *Livers* as the *Vena Porta* does naturally. There was a Branch of a *Vein* on Each side proceeding from the *Loins* inserted into the *Back-parts* of the *Liver*; and besides these, there was not a Branch to be seen, but what was inserted into the Middle of the *Livers*. There were *Two Kidneys* on Each side furnished with *Ureters*. There was neither *Spleen* nor *Pancreas* in Either side.

There was a *Double Diaphragm* meeting in the Middle between the *Two Back Bones*, and making a *Membrane*, which to me seemed to be a *Mediastinum*; for it reached up to the *Thymus*. There were *Two Hearts* in it; one placed above the other, and a little to the Right side, it was much Higher than ordinary, and it had a *Vein* coming to it from the little *Liver* in the Right side, which (together with 3 other small *Veins*, one from each of the *Fore-Foots*, and one from the *Head*) furnished this *Heart* with what *Blood* was to be *Circulated* by it. It had only *One Auricle*, and *One Ventricle*: so that it seemed to be but *Half a Heart*. There was a pretty large Passage into the *Arteria Aorta*, the Contrivance of which was very Singular; For above this *Heart* it was made like an Arch of a *Circle*, into which there was a Direct Passage from the *Heart* for the *Blood*. When I further Examined this *Artery*, I found that it went down on Each side on the *Vertebrae* of the *Backs* between the *Kidneys*, and Divided it self on Each side after the Usual manner, after it had Lent Each *Kidney a Branch*, the *Liver* in the Right side *One*, and the *Liver* in the Left side *Two*. Below the former, a little towards the Left side of it, there was another *Half Heart*, having only *One Auricle* and *One Ventricle* like the Former. This received a little *Blood* but what was Transmitted from the *Large Liver* in the Left side, by that that is call'd the *Truncus Ascendens* of the *Vena Cava*. The *Artery* carrying the *Blood* from this *Heart*, was inserted into the *Artery* lately Describ'd, as well as that of the other *Heart*. So that if the *Blood* *Circulated* through either of them the Whole Animal must necessarily be supplied with *Blood*; a Contrivance not unlike that of the *Arteries* under the *Brain*, where the *Arteriae Carotides* and *Vertebrales* do Empty themselves into *One Common Channel*, from which all parts of the *Brain* may easily be supplied with *Blood*.

The *Head* was *Joyned* to *Two Necks* about the *Processus Mamillares*.

Fig. 278.

There were 4 *Orders of Ribs*, though the *Body* was but *One* above the *Navel*.

Fig. 279.

Fig. 275. Expresses to the *Life* the *Outward Shape*, when placed on its *Back*.

Explication of
the Figures.

Fig. 275.

Fig. 276.

Fig. 276. The *Cat Opened* 1. the *Stomach*, Pull'd from behind both the *Livers*, so as to be plainly seen. 2. the *Beginning* of the *Guts* below the *Pylorus*. 3. the *Division* of the *Gut* into two *Branches*, whereof *One* went to Each *Anus*. 4. 4. the *Two Cæcums*. 5. 5. 5. 5. the *Two Pair* of *Kidneys*, furnished with *Emulgent Arteries* and *Veins*. 6. A *Large Liver* in the *Left side*, much *Lower* situated than the *Liver* in the *Right side*. 7. the *Liver* in the *Right side*, with a *Vein*, 8. Coming from the *Kidneys* of the same side, after it had *United* above the *Emulgents*; This supplies the *Office* of the *Vena Cava* and *Vena Porta*. 9. 9. *Two Large Branches* of the *Big Artery* going into the *Body* of the *Big Liver*. 10. 10. 10. 10. the *Great Artery*, Supplying both sides with *Blood*, and Receiving of it from the *Two Hearts*. 11. the *Vein*, bringing the *Blood* from the *Lower Parts* of the *Left side* into the *Liver*, 6. of the same side. 12. 12. the *Big Artery*, sending *Branches* to each of the *Kidneys*. 13. the *Upper Heart*. 14. The *Artery* that supplied the *Head* with *Blood*. 15. 15. The *Axillary Arteries*. 16. the *Vena Cava*, coming from the *Liver* in the *Right side* to the *Heart*. 13. 17. The *Passage* from the said *Heart* to the *Aorta*.

Fig. 277. 1. The *Liver* in the *Left side*, Freed from all things that kept it any way out of *Sight*. 2. the *Vena Cava* passing from it to the *Lower Heart*, 6. 3. A *Skirt* of the *Diaphragm* turned to the *Left side*, that the former *Vein* should better appear. 4. the *Stomach*, Displaced for the former Reason. 5. 5. 5. 5. the *Kidneys*. 6. the *Lower Heart*, in its *Due Situation*. 7. the *Upper Heart*, drawn out of its place *Upwards* that the *Other*, 6. with the *Passage*, 11. from from it to the *Aorta*, 9. 9. might be well Represented. 8. 8. the *Liver* in the *Right side*, Doubled and Turn'd over the *Heart*, 6. that it might be the better set forth. 9. 9. 9. the *Aorta*, where it is not Hid by the *Parts Display'd* for the former Reason. 10. the *Lungs*, not well Represented. 11. the *Passage* from the *Lower Heart* into the *Aorta*.

Fig. 277.

Fig. 278. The *Skull Opened*, and Freed from the *Brain*. 1. 1. the *Hollows*, through which the *Medulla Oblongata* was Continued to the *Medulla Spinalis*. 2. 2. the *Two Necks*.

Fig. 278.

Fig. 279. 1. 1. The *Two Diaphragms* separated from the *Cartilages* of the *Ribs*, that their *Junctures* may be seen. 2. 2. 2. 2. The *Vertebrae* of *Both* the *Backs*. 3. 3. 3. 3. 3. the *Juncture* of the *Two Setts* of *Ribbs* that were at the *Back*. 4. 4. 4. 4. the *Two Setts* of *Ribbs* that were *Joyned* to the *Breast*. 5. the *Tips* of the *Diaphragms*, pull'd downwards to shew the *Ribbs* plainly. 6. 6. the *Vertebrae* of the *Two Necks*.

Fig. 279.

An Animal re-
sembling a
Whelp Voided
per Anum by a
Male-Grey-
hound; by Mr.
Edm. Halley.
n. 222. p. 316.

CXVIII. The Account you had from *Chester*, in 1695. of a *Greyhound* Dog that Voided an Animal, Resembling a *Whelp*, per Anum, as strange and incredible as it may seem, is yet here stedfastly Believed; and the Creature was kept for some Time in *Spirit of Wine*, having Lived for some short time after it came into the World; and it was seen Alive by Mr. *Roberts* of the *Society*, then in *Chester*. They say, it Exactly Resembled a *Greyhound-Whelp*, and had on its side a large spot, in the same place, as the Dog it proceeded from, had such another; and that with it was Voided a Whitish Mucous matter, so that the People here at *Chester* will not permit me to Question the Truth thereof.

A Bitch with
Puppy tho she
had lost the
Spleen; by
n. 105. p. 117.

CXIX. 'Tis Notorious all over *London*, that divers Years since, a *Bitch*, yet Alive, of a considerable *Noble-man*, after she had lost her *Spleen*, hath been several Times with *Puppys*; of which some, out of Curiosity, were Opened, and found to have a very *Fair Spleen*. Vid. *Diemerbroeck de Anat. Corp. Hum*

A Cow with
Four Calves; by
Sir J. Floyer.
n. 259. p. 435.

CXX. I am informed, that this Year 1699. at *Dunburch* in *Warwickshire*, a Cow Calved *Four Calves*, Perfect and all Living.

A Hen with a
perfect Chick
in the Ovarium;
by n. 50.
p. 1019.

CXXI. About 2 or 3 Years since, there was a *Hen* at *Wackton* in *Northfolk* which being big with *Eggs*, upon some account could not Lay, but after a time Dyed; and then being Opened, there was found in the *Ovarium* a *Perfect Chick*.

An Egg found
within Another
Egg; by
n. 230. p. 632.

CXXII. In *France*, a *Small-Egg* of about 7 Lines from End to End, and $4\frac{1}{2}$ of bigness, was found Included in a *Hen's Egg*, which appeared to have nothing Extraordinary on its Outside. The *Small Egg-Shell* was fastened to the *Shell* of the *Greater* by one of its Extremities.

Ova found in a
Cow; by
n. 74. p. 2218.

CXXIII. There hath been very Lately made, by two Physicians at *Paris*, a Dissection of a *Cow*, in *cujus Testiculis Ova reperta fuerint, uti Kerkringius observasse se scripserat, in Anthropogeniæ Ichnographia*.

The Ova, after
a 2d. Conception,
dispersed in
the Abdomen
of a Bitch, tho'
the Cornua U-
teri were Fill'd
with the Bones
and Flesh of a
Former Con-
ception; by ...
n. 147. p. 183.

CXXIV. The Sagacious *Harvey*, after many repeated Dissections of *Impregnated Deer* asserts, that nothing for about 6 or 7 Weeks can be seen in the *Horns* of their *Wombs*; that then there appeared somewhat like an *Egg*, a Transparent Liquor included in a very thin *Membrane*, in which after a *Week* he could plainly see the *Rudiments* of a *Fœtus*. He is well satisfy'd (after several Tryals) that no *Liquor* can be so Forcibly injected into the *Womb*, as to make its Passage into the Place of *Conception*: Nor would he suspect that the *Seed* of the *Female* Lay till the *Egg* appear'd, in any *Crannies* or *Recesses* of the *Horns*; which he asserts are then as Smooth and Soft, as the *Corpus Callosum* of the *Brain*, After Dr. *Harvey* had thus sufficiently Confuted the Opi-
nion

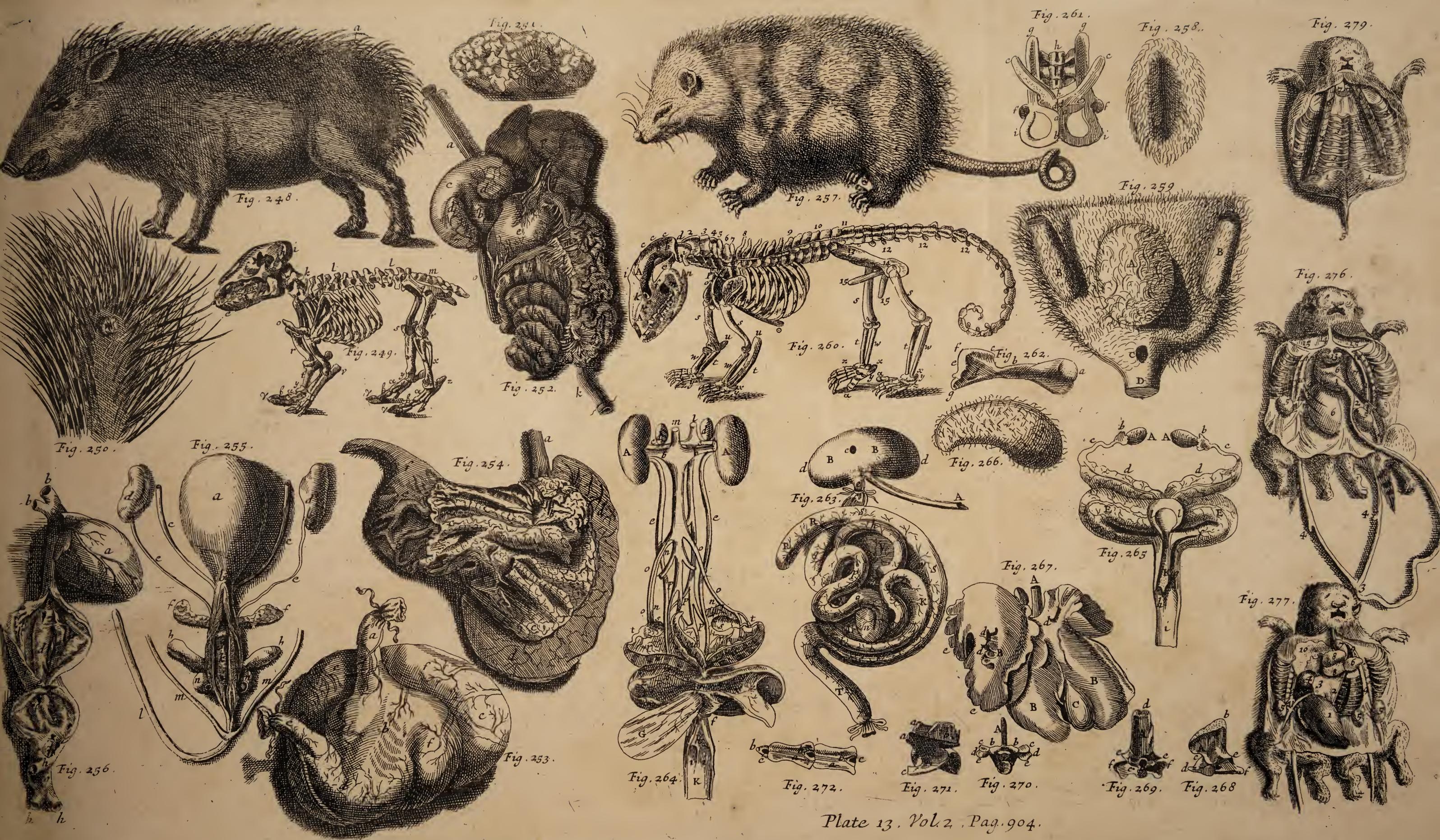


Fig. 273.



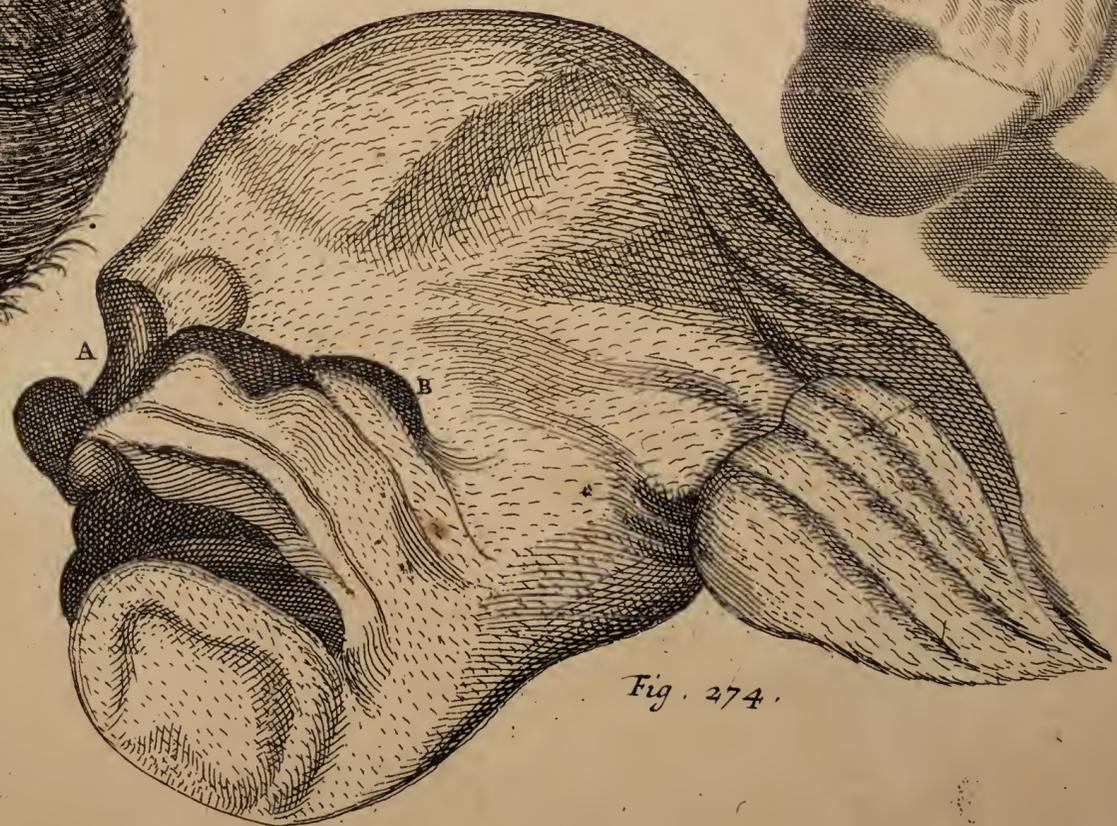
Fig. 275.



Fig. 278.



Fig. 274.



nion of the *Production of Animals* from the *Mixture of the Seminal Matter of Both Sexes*, 'twas not so Difficult to Discover, whence the *Egg* came, which he saw about 7 *Weeks* after *Impregnation*. The *Fallopian Tubes*, which joyn to the *Horns*, and Terminate very near the *Ovaria* (as the *Testes Muliebres* are generally now call'd) directed the ingenious and industrious *de Graff* to make more Accurate Dissections of them: And he has so very Nicely Observ'd the Progress of the *Eggs* in *Conies*, the very time of their Passing into the *Tubes*, and appearing in the *Horns* of the *Womb*, (which comes very near that Proportion of Time *Dr. Harvey* observed the *Eggs* in his *Deer*) that the Opinion of the *Production* of all *Animals* from *Eggs* is now almost Universally Received.

Some time since indeed the Learned *Diemerbroeck*, and very lately *M. Verney*, have endeavoured to Confute this Opinion and Expose it. The most Considerable Argument they Use is taken from the *Narrowness* of the *Fallopian Tubes*, where they Open into the *Womb*, and at their Extremities. But *Dr. de Graff* Prevented this Objection, by alledging that the *Hole* by which it has its Exit out of the *Ovarium* is as *Narrow*; that no Force is used to Open it, but it Expands it self, as the *Os Uteri* before the *Birth*: As *Nuts* and *Peach-Stones*, &c. give Way to the *Germinating Plant*, which is less able to make its way than the *Egg*. But besides, (which these Authors urge,) tho' the Extremity of the *Tube* be *Membranous* in most *Quadrupeds*, in which its Possible a *Seminal Liquor* might be Transmitted to the *Womb*, in *Women* its *Divided*, like a *Knot of Ribbon*, and is no more Adapted to receive any thing but an *Egg*, than the *Fingers* Expanded to Receive and Contain a *Fluid*. The *Egg* has not been able sometimes to get into the *Womb*; *Riolanus* speaks of a *Humane Fœtus* seen in one of the *Tubes*: and *Dr. Harvey* assures you he has seen it himself.

*Vid. inf. Vol. III.
Cap. IV.
§. CVIII. &c.*

In the Dissection of a *Bitch* at *Oxford* it was Observ'd, that the *Embryo's* either could not get into the *Womb*, the *Membranous Expansion* being Hindered from ascending to and Clipping the *Ovaria*, by the Fulness of the *Womb*, or from the same Cause were Forc't Back again. She had been with *Whelp*: by a Blow she received the *Fœtus* Died within her. She Discharged by the *Pudendum* a great Quantity of Putrid Flesh and Matter. She was afterward able to Run in the *Pack*. After the 2d. *Impregnation* she was observed to have a very Ill Shap't Belly. When Dead the Owner, a Person of Quality, sent her to *Oxford*. The *Horns* of the *Womb* were so Stuft up with the *Bones* and Firmer *Muscles* and Thicker *Skin* of the *Fœtus's*, (some of them lay in the Usual Posture, the *Skeletons* of which were Entire, the interstices of the *Bones* only fill'd up with *Skin* and *Flesh*;) that no *Seminal Matter*, or *Aura Seminalis*, could possibly find a Passage to the *Ovarium*. The *Eggs* Affected in the 2d. *Impregnation*, finding no Room in the *Horns*, were Forc't Back into the *Abdomen*: Where they were found Affixt to the *Mesentery*, *Kidney*, &c. Only *Two* of the *Bags* had a Communication with the *Womb* by a slender *Duct*. These I suppose fell into the *Horns* First, and began to Fasten to them, but growing Larger were forc't to Retire: The other *Three* had no Reception there at all. The *Membranes* which Contained the *Embryo's*

were all of them very Thin, and the *Animalcles* in them had wanted a Due supply of *Nutritious Matter*. This seems to give as Clear a Proof of the Truth of the *Modern Opinion*, as can be Expected or Desired.

But if *Anatomy* had not Discovered *Eggs*, and Demonstrated their *Use*, and Progress to the *Womb*, it would be very Difficult to Conceive how an *Animal* could be Produced from the *Mixture* of the *Seminal-Liquors* of *Both Sexes*. Every *Animal*, (tho' upon other Accounts esteem'd the most Despicable,) is made up of so many Different Parts, and those of so Excellent a Contrivance, and so Wonderful a respect to one another, that 'tis not to be Imagined, that the *Seminal Fluids* lying Loose and at Large in the Capacity of the *Womb*, and Exposed to so many Accidents, could give a *Production* so Admirable. Every Jog of it from the Frequent Motions of the *Female*, would Disturb and Distract the Present Designs of the *Plastick Power* they speak of. The *Humors* and *Vapours* which have a Passage to, and Humect all the Parts of the Body, would in the *Womb* break in on the Soft *Seminal Mass*, and break off the Tender *Filaments* when first a forming. In *Quadrupeds* the *Peristaltick Motion* of the *Horns* wou'd perpetually separate the Parts of the *Seminal Collection*, and scatter those Pieces, which *Nature* is putting carefully together into the *Fabrick* of an *Animal*. From this Way of *Conception*, *Monsters* would be very frequently brought forth, and would be much less Wondred at, than a Perfect Production is Now. Wee see how very industrious *Nature* is in Preserving the *Species* of *Vegetables*. When the Tender *Seed* is first Formed, its secured from External injuries by Various sorts of *Cases*. The *Embryo* of the *Plant* contained in the *Seed* hath 3 or 4 *Coats* to Enclose it; the Outermost is Design'd of sufficient strength to Preserve it. None of the *Juices* of the *Earth* are Permitted to Enter in, but such as are Fit to put into Motion, or supply the *Liquor* contained in the *Inner Membrane*, from whence it has its First Encrease. And as the *Eggs* of *Animals* are Designed for the same Purpose the *Seeds* of *Vegetables* are, so there is very great Agreeableness between them. The *Shell* and *Membranes* of *Eggs* (except those which are brought to Perfection in the *Female*) are very like those of *Seeds*; both have a *Colliquamentum*, or more Fine and Spirituous *Liquor*, which is First to be Spent before those which are Groffer can be Receiv'd in the Extremely Fine and Small *Pores* of the *Fetus*, when only just Begun to be Formed; and in Both, the Parts of the *Embryo* are designed and drawn out, before the *Egg* has been at all Affected by the *Masculine-Seed*, or the *Vegetable-Seed* put into the *Womb* of the *Earth*: The *Figure* of the *Plant* may be seen in the Larger *Seeds*, and *Miniature* of a *Chick* in the *Spot* of the *Yolk*.

But if so great and so Various an Artifice is necessary to Raise a *Plant*, shall *Nature* be thought Less Careful and industrious in the *Propagation* of *Animals*, whose Parts are more Numerous and of a much Finer Texture? And since those *Animals* and *Vegetables* are by some Allowed to take their Original from *Eggs* and *Seeds*, whose Largeness will permit them to Observe them, it seems an Opinion with too much Precipitancy taken up, that sup-
poses

poses some of the *Greater Animals*, and the *Least of These*, and *Plants*, are supplied from *Equivocal Generation*; that *Corrupted Matter* from the *Warmth* of the *Air*, or the *Motions* of its *Own Principles*, can Form the *Parts* of the *One* or the *Other*. For the *Heat* of the *Air* endeavours to *Dissipate* and *Remove* the *Thinner Parts* from the more *Gross*; since no *Membrane* is supposed to *Confine* them: And the more *Active Principles* are from their *Own Nature* always struggling to be quit of them: And this *Way*, the *Parts* of an *Animal* would be sooner *Broken* into pieces, than a *New one* *Generated*.

But they believe it may allowed, that the *Least* and most *Inconsiderable Animals* and *Plants*, are this way *Formed*. But their *Minuteness* makes the *Difficulty* *Greater*: A *Membrane* to include the *Conception* with its *First Nourishment* seems more *Necessary* Here, where the *Parts* are more *Delicately* put together, and from their exceeding *Fineness* might more *Easily* *Miscarry*. But if after this *Method* some *Animals* and *Plants* can be *Produc'd*, why is the same *Species* and these very *Individuals* they suppose so made, furnish'd with *Organs* for *Univocal Generation*? If *Slime* and *Mud* can afford *Frogs* and *Eels*, why does the first *Spawn* so many *Eggs*, and are the other *Viviparous*? Why does not so great a *Diversity* of *Putrid Parts* in the *Earth*, *Differently Affected* by unaccountable *Accidents*, often present us with *New Living-Creatures*, and *Vegetables* of *Peculiar Species*? But no such *New Plants* are taken *Notice* of; and the *Mites* are of the same sort from *Cheese* and from *Meal*. The *Objection* which is offered against *Epicurus*, will be made with the same *Force* against *This Opinion*: If the *Earth* at *First Equivocally* *Produc'd Men, Quadrupeds, Birds,* and *Fish*, why has it not done it very frequently or at least some *Times* since? We begin to *Suspect* the *Cheat*, when the *Artist* is not *Able* to *Perform* the same *Again*.

CXXV. 1. Upon comparing the *Observations* and *Discoveries* of *Dr. Harvey, S. Malpighi, Dr. de Graaf* and *M. Leewenboeck*, with one another, these *Three things* seem to me very *Probable*. 1. That *Animals* are *ex Animalculo*. 2. That the *Animalcles* are *Originally in Semine Marium & non in Fæminis*. 3. That they can never come *Forward* nor be *Formed* into *Animals* of the respective *Kind*, without the *Ova in Fæminis*.

The *First* of these seems *Probable* from these 3 *Observations*; 1. That some such thing has been so often observed by *Malpighius* in the *Cicatricula* of an *Egg* *Before Incubation*, as the *Rudiments* of an *Animal* in the *Shape* of a *Tadpole*; as may be seen in his *First*, and in his *Repeated Observations de Formatione Pulli in Ovo*. 2. The sudden *Appearance* and *Displaying* of all the *Parts*, after *Incubation*, makes it *probable*, that they are not then *Actually Formed* out of a *Fluid*, but that the *Stamina* of them have been *formerly* there *Existent*, and are now *Expanded*. The *First Part* of the *Chick* which is *Discovered* with the *Naked Eye* is, you know, the *Punctum Saliens*, and that not till *Three Days* and *Nights* of *Incubation* be past: and then

on the *Fifth Day* the Rudiments of the *Head* and *Body* do appear. This made *Dr. Harvey* Conclude, that the *Blood* had a Being before any other Part of the *Body*, and that from it all the *Organs* of the *Fœtus* were both *Formed* and *Nourished*; but by *Malpighius's* Observations, we find that the *Parts* are then only so far *Extended*, as to be made visible to the *Naked Eye*, and that they were actually *Existent* before, and discernable by *Glasses*. After an *Incubation* of 30 *Hours*, are to be seen the *Head*, the *Eyes*, and the *Carina*, with the *Vertebræ*, distinct, and the *Heart*. After 40 *Hours* its *Pulse* is visible, and all the other *Parts* more distinct, which cannot be discerned by the *Naked Eye* before the beginning of the *Fifth Day*; from whence it seems very *Probable* that even the so early *Discovery* of those parts of the *Fœtus*, by the *Microscope*, is not the *Discerning* of *Parts* newly *Formed*, but only more *Dilated* and *Extended* by receiving of *Nutrimment* from the *Colliquamentum*; so that they seem all to have been actually *Existent* before the *Incubation* of the *Hen*. And what *Swammerdam* has discovered in the *Transmutation* of *Insects*, gives no small *Light* to this, whilst he makes appear in the *Explanation* of the 13th *Table* of the *General History of Insects*, that in those *Large Erucas* which *Feed* upon *Cabbage*, if they be taken about the time they *Retire* to be *Transformed* into *Aurelias*, and *Plunged* often in *Warm Water* to make a *Rupture* of the *Outer Skin*, you will discern through the *Transparency* of their *Second Membrane*, All the *Parts* of the *Butterfly*, the *Trunk*, *Wings*, *Feelers*, &c. folded up: But, that after the *Eruca* is *Changed* into an *Aurelia*, none of these *Parts* can be *Discerned*, they are so drencht with *Moisture*, though they be there *Actually Formed*.

Another *Consideration* is from the *Analogy*, which we may suppose, between *Plants* and *Animals*. All *Vegetables* we see, do Proceed *ex Plantula*, the *Seeds* of *Vegetables* being nothing else but *Little Plants* of the same *Kind* folded up in *Coats* and *Membranes*; and from hence we may probably *Conjecture*, that so curiously an *Organized Creature* as an *Animal*, is not the sudden *Product* of a *Fluid*, or *Colliquamentum*, but does much rather proceed from an *Animalcle* of the same *Kind*, and has all its little *Members* *Folded* up according to their several *Joints* and *Plicatures*, which are afterwards *Enlarged*, and *Distended*, as we see in *Plants*. Now though this *Consideration* alone may seem not to bear much weight, yet being *Joined* to the two former, they do mutually *strengthen* each other. And indeed all the *Laws* of *Motion* which are as yet *Discovered*, can give but a very *Lame Account* of the *Forming* of a *Plant* or *Animal*. We see how wretchedly *Des Cartes* came off when he began to *Apply* them to this *Subject*. They are *Formed* by *Laws* yet *Unknown* to *Mankind*; and it seems most *Probable*, that the *Stamina* of all the *Plants* and *Animals* that have been, or ever shall Be in the *World*, have been formed *ab Origine Mundi*, by the *Almighty Creator* within the *First* of Each *Respective Kind*. And he who considers the *Nature* of *Vision*, that it does not give us the *True Magnitude*, but the *Proportion* of *Things*, and that what seems to our *Naked Eye* but a *Point*, may

may truly be made up of as many Parts as seem to us to be in the Whole Visible World, will not think this an Absurd or Impossible thing.

But the *Second* thing which later Discoveries have made Probable is, that these *Animalcles* are Originally in *Semine Marium* & not in *Fæminis*: And this I Collect from these Considerations.

1. That there are Innumerable *Animalcula in Semine Masculo Omnium Animalium*. M. *Leewenhoek* has made this so Evident by so many Observations, that I do not in the least Question the Truth of the thing.

2. The Observing of the *Rudiments* of the *Fætus* in Eggs, which have been *Fæcundated* by the *Male*, and the seeing no such thing in those which are not *Fæcundated*, as appears from *Malpighius* his Observations, makes it very Probable, that these *Rudiments* proceeded Originally from the *Male*, and not from the *Female*.

3. The Resemblance between the *Rudiments* of the *Fætus in Ovo*, both Before and After *Incubation*, and the *Animalcule*, makes it very Probable, that they are One and the Same. The same Shape and Figure which M. *Leewenhoek* gives us of the *Animalcule*; *Malpighius* likewise gives us of the *Rudiments* of the *Fætus*, both before and after *Incubation*; yea, and even the *Fætus's* of *Animals* do appear so at first to the *Naked Eye*, so that Dr. *Harvey* does Acknowledge that all *Animals*, even the most Perfect, are Begotten of a *Worm*.

De Gen. Anim.
Ex. 18.

4. This gives a Rational Account of *Many Fætus's* at *One Birth*, especially that of the Countess of *Holland*, and how at least a *Whole Cluster* of Eggs in a *Hen* are *fæcundated* by *One Coition* of the *Male*.

5. This gives a New Light, as it were, to the *First Prophecy* concerning the *Messiah*, that the *Seed of the Woman shall bruise the Head of the Serpent*: All the rest of *Mankind* being thus most Properly and Truly the *Seed of the Man*.

6 The *Analogy* I have already mention'd, which we may rationally suppose between the Manner of the *Propagation* of *Plants* and *Animals*, does likewise make this Probable. Every *Herb* and *Tree* bears its *Seed* after its *Kind*; which *Seed* is nothing else but a *Little Plant* of the same kind, which being thrown into the *Earth*, as into its *Uterus*, spreads forth its *Roots*, and Receives its *Nourishment*, but has its *form within it self*; and we may rationally conjecture some such *Analogy* in the *Propagation* of *Animals*.

The 3^d. particular which Later Discoveries make Probable is, that *Animals* cannot be *Formed* of these *Animalcula* without the *Ova in Fæminis*, which are necessary for supplying of them with Proper *Nutrimment*; and this these Considerations seem to Evince. 1. It is probable that an *Animalcle* cannot come Forward if it do not fall into a proper *Nidus*. This we see is the *Cicatricula* in Eggs, and tho' a *Million* of them should fall into *One* Egg, None of them would *come forward*, but what were in the *Center* of the *Cicatricula*; and perhaps the *Nidus*, necessary for their *Formation*, is so Proportioned to their *Bulks*, that it can hardly contain more than

One

One *Animalcle*; and this may be the Reason why there are so Few *Monsters*. This we see is absolutely necessary in *Oviparis*, and the only Difference which seems to be between them and the *Vivipara* in this Matter, is in this, that in the Latter the *Ova* are properly nothing more but the *Cicatricula*, with its *Colliquamentum*, so that the *Fœtus* must spread forth its Roots into the *Uterus* to receive its *Nourishment*; but the *Eggs* in *Oviparis* may be properly termed an *Uterus* in relation to the *Fœtus*; for they Contain, not only the *Cicatricula* with its *Amnion* and the *Colliquamentum*; which is the Immediate *Nourishment* of the *Fœtus*, but also the Materials which are to be Converted into that *Colliquamentum*, so that the *Fœtus* spreads forth its Roots no farther than into the *White* and *Yolk* of the *Egg*, from whence it derives all its *Nourishment*. Now that an *Animalcle* cannot come forward without some such proper *Nidus*, M. *Leewenhoeck* will not readily Deny; for if there were nothing Needful but their being thrown into the *Uterus*, I do not see why many *Hundreds* of them should not come forward at Once, at least whilst scatter'd in so Large a Field.

Now 2. That this *Cicatricula* is not Originally in *Utero*, seems Evident from the frequent *Conceptions* which have been found *extra Uterum*; Such as the *Child* which continued 26 Years in the *Woman* of *Tholouse's* Belly; and the *Little Fœtus* found in the *Abdomen* of *Mad. de S. Mere*, together with the *Testicle* Torn and full of Clotted Blood; such also seem to be the *Fœtus* in the *Abdomen* of the *Woman* of *Copenhagen*, mentioned in the *Nouvelles des Lettres*, for Sept. 85. all the *Members* of which were easily to be felt thro' the *Skin* of the *Belly*, and which she had carried in her *Belly* for 4 Years: And the 7 Years *Gravidation* related by *Dr. Cole*. Now granting once the Necessity of a *Proper Nidus*, for the *Formation* of an *Animalcle* into the *Animal* of its respective Kind, these Observations make it probable, that the *Testes* are the *Ovaria* appropriated for this Use; for though the *Animalcles* coming thither in such Cases, may seem to be Extraordinary, and that usually the *Impregnation* is in *Utero*, yet it may be Collected from hence, that the *Cicatriculae* or *Ova* to be *Impregnated*, are in *Testibus Fœmineis*; for if it were not so, the Accidental coming of *Animalcles* Thither, could not make them come forward more than in any other Part of the *Body*, since they cannot be *Formed* and *Nourished* without a *Proper Nidus*.

But 3. It is acknowledged by all, that the *Fœtus* in *Utero*, for some considerable Time after *Conception*, has no connexion with the *Womb*; that it sits wholly Loose to it; and is perfectly a Little Round *Egg* with the *Fœtus* in the *Midst*, which tends forth its *Umbilical Vessels* by Degrees, and at last lays hold on the *Uterus*. Now from hence it seems Evident, that the *Cicatricula*, which is the *Fountain* of the *Animalcle's* *Nourishment*, does not sprout from the *Uterus*, but has its *Origine* elsewhere, and falls in thither as into a *Fit Soil*, from whence it may draw *Nutrimment* for the *Growth* of the *Fœtus*; else it cannot be easily Imagined how it should not have an *Immediate Connexion* with the *Uterus*, from the Time of *Conception*.

Vid. Inf.
Vol. III. cap. IV.
§. CXIII. &
CIX.

Vid. Inf. Vol.
III. Cap. IV.
§. CXVII.

If you Joyn all these *Three* Considerations together, *viz.* that an *Animalcle* cannot *Come forward* without a *Proper Nidus*, or *Cicatricula*; that there have been frequent *Fœtus's extra Uterum*; and that they have no *Adhesion* to the *Uterus* for a considerable Time after *Conception*; they seem to make it Evident that *Animals* cannot be Formed *ex Animalculis* without the *Ova in Fœminis*. To all these I shall subjoyn the Proposal of an *Experimentum Crucis*, which may seem to Determine whether the *Testes Fœmineæ* be truly the *Ovaria* *viz.* Open the *Abdomen* of the *Females* of some Kinds, and Cut out these *Testicles*, and this will Determine whether they be absolutely Necessary for the *Formation of Animals*.

It is indeed Difficult to Conceive, how these *Eggs* should be *Impregnated per Semen Maris*, both because there is no *Connexion* between the *Tube* and the *Ovary* for its *Transmission*; and for that *Dr. Harvey* could never Discover any thing of it *in Utero*. But as to the last, *M. Leewenboeck* has Cleared that Difficulty, by the Discovery of Innumerable *Animalcula Seminis Maris in Cornubus Uteri*, and thole Living a considerable time after *Coition*. And as to the Former, we may either suppose that there is such an *Inflation* of the *Tubæ*, or *Cornua Uteri*, *tempore Coitionis*, as makes them *Embrace* the *Ovaria*, and such an *Approach* of the *Uterus* and its *Cornua*, as that it may easily *Transmit* the *Seed* into the *Ovary*: Or else, that the *Ova* are *Impregnated* by the *Animalcles* after they *Descend* into the *Uterus*, and not in the *Ovary*. The former seems Probable for this Reason, that at least a whole *Cluster of Eggs* in a *Hen* will be *Fecundated* by *One Tread* of the *Cock*; now this *Fecundation* seems to be in the *Vitellary*, and not in the *Uterus* as the *Eggs* pass along from *Day to Day*: for it can hardly be supposed that the *Animalcles* should *Subsist* so long, being *Scattered Loosely* in the *Uterus*, as to wait there, for *Many Days*, for the *Fecundation* of the *Eggs* as they pass along. The *Latter Conjecture* has this to *Strengthen* it, that the *Animalcles* are found to *Live* a considerable Time in the *Uterus*, and that if they should *Impregnate* the *Ova* in the *Ovary* its self, the *Fœtus* would encrease so Fast, that the *Ova* could not pass through the *Tubæ Uteri*, but would either *Burst* the *Ovary*, or fall down into the *Abdomen* from the *Orifices* of the *Tubæ*; and that from hence proceed those *Extraordinary Conceptions in Abdomine extra Uterum*.

But, *M. Leewenboeck* to weaken this Consideration, about the *Conception's* n. 174. p. 1129. being like unto an *Ovum* in the *Womb*, proposes a *Parallel* between these *Animalcles* and *Insects*, and insinuates that as the *Latter* Cast their *Skins* and appear of another *Shape*, so the *Other* which at first seem like *Tadpoles*, may Cast their *outer Skin* and then be *Round*; and that this may be the occasion of the *Round Figure* of the *Conception* in the *Womb*. To this it may be *Replied*, that according to *M. Leewenboeck's* own *Sentiment*, the *Animalcles* cannot *come forward* if they do not find the *Punctum* or *Proper Place* for their *Nourishment*, to which it seems they must have some *Adhesion*. Now the *Conception* in *Viviparis* is not *fastened* unto the *Womb* for *Many Days*, nor does *Adhere* to any point of it; so that it seems this *Roundish Body* is not the *Animalcle* thus *Changed* after having *Cast* an *outer Skin*, but is rather

rather the *Cicatricula*, or little Egg, into which the *Animalcule* has Entered as its *Punctum*, or Place of Nourishment; else I do not see why they should not be *Adhering* to the *Womb* from the *First Conception*, or why (as I have said) Many Hundreds of them are not *Conceived* and *Formed* Together.

By Sir J. Floyer.
n. 259. p. 433.

2. I have oft Reflected on the Figure of a *Mule*, that being an *Animal* Produced by the *Copulation* of an *Ass* and a *Mare*, the *Extremities* of the *Body*, the *Feet*, *Tail* and *Ears*, and that *Black-Cross* on the *Back* Resemble that of the *Asses*. By this we may Observe, that the *Female* contains in her *Eggs* the First Rudiments of the *Animal* of her Own *Species*, and that the *Impregnation* only Changes some of the *Extremities* into a Resemblance of the *Male*. This seems to Contradict our New Discoveries: For if the *Male* supplies the *Animalculum*, the *Fœtus* must always be of the same *Species* as the *Male*; if the *Female* supplies it, of Her *Kind*; whereas *Monsters* are Observ'd to be a *Mixture* of *Both Species*.

CXXVI. Papers of Less General Use, Omitted.

- n. 77. p. 3004. 1. **Q**uæries concerning *Vegetable Excrescencies*, and the *Insects* Bred in them; by Dr. Lister.
- n. 249. p. 50. 2. Several *Insects* found near *Colchester*; by Mr. Dale.
- n. 8. p. 137. 3. *Prodigious Swarms* of *Locusts* in *Ukrania*: Extracted from M. de *Beauplan's Description* of the *Countries* of *Poland*, and M. *Thevenot's Voyages*. pt. 1.
- n. 72. p. 2171. 4. Some *General Inquiries* concerning *Spiders*; by Dr. Mart. Lister.
- n. 77. p. 3002. 5. *Quæries* concerning *Tarantula's*; by Dr. M. Lister.
- n. 105. p. 96,99. 6. Some *General Quæries* concerning *Land* and *Fresh Water Snails*: And Part of a *Table* of them, with their *Figures*; by Dr. M. Lister.
- n. 222. p. 322. 7. An Account of several *Rare* and *Curious Shells* to be met with in *Scotland*; by Sir Rob. Sibbald.
- n. 100. p. 7002. 8. To Prevent the *Rot* of *Sheep*, by giving them *Spanish Salt*; Extracted from Mr. *Boyle's Usefulness* of *Experimental Philosophy*. Tom. 2 p. 15.
- n. 103. p. 50. 9. *Inquiries* and *Directions* concerning *Sheep*; to Preserve them; and to improve the *Race* of *Sheep* for *Hardiness*, and for the *Finest Drapery*; by Dr. J. Beale.

CXXVII. Accounts of Books, Omitted.

- n. 28. p. 535.
n. 64. p. 2078.
n. 76. p. 2281.
1. **H**istoriæ Generalis *Insectorum*, J. Swammerdami, Pars Prima. Ultraject. 1669. 4°.

2. Johannes

2. Johannes Goedartius of *Insects*, Done into *English*, and Methodiz'd: n. 143. p. 22.
with the Addition of Notes; by *Mart. Lister* Esqr. 1682. in 4°.

Job. Goedartius de Insectis: cum Appendice ad *Historiam Animalium Angliae*; a *Mart. Lister*. M. D. n. 166. p. 833.

3. *Marc. Malpighii* Dissertatio Epistolica de *Bombyce*; *Regiae Societati* n. 49. p. 987.
Dicata Lond. in 4°.

4. *Instructions* for the *Planting* of *White Mulberries*; the *Breeding* of *Silk Worms*; and the *Ordering* of *Silk* in *Paris*, and the *Circumjacent Parts*; by *M. Isnard*. n. 5. p. 87.

5. *Esperienze* Intorno alla *Generazione* Degli *Insetti*; fatte da *Francisco Redi*, Academico della *Crusca*. In *Firenze*. 1668. in 4° *The Opinion of that Author concerning the Generation of Insects is here Opposed by Dr. M. Lister*. n. 57. p. 1175. n. 75. p. 2254.

6. *Ricreatione* dell' *Occhio* é della *Mente*, Nell' *Osservatione* delle *Chioccioline*; dal *P. Filippo Buonanni*. &c. in *Roma*. 1681. n. 156. p. 507.

7. *Relatione* del *Ritrovamento* dell' *Uova* delle *Chioccioline*; di *A. F. M.* in una *Littera* al *S. Marcello Malpighi*. in *Bologna*. 1683. n. 152. p. 356.

8. *Dr. Kormannus*, concerning the *Tinctures* of the *Excrements* of *Insects*. n. 74. p. 2218.

9. *Swammerdam's* M. S. *Treatise de Apibus*; 'tis *Fear'd* to be *Lost* by *Dr. Hotton*. n. 257. p. 365.

10. *Mart. Lister* *Historiae Animalium Angliae* Tres *Tractatus*; Unus de *Araneis*; Alter de *Cochleis* tum *Terrestribus*, tum *Fluviatilibus*; Tertius de *Cochleis Marinis*. Quibus adjectus est *Quartus*, de *Lapidibus* ejusdem *Insulae*, ad *Cochlearum* quandam *Imaginem Figuratis*. *Lond.* 1678. n. 139. p. 982.

11. *Mart. Lister* *Exercitatio Anatomica*, in qua de *Cochleis* maxime *Terrestribus*, & *Limacibus* agitur. *Omnium Dissectiones Tabulis Aeneis*, ad ipsas *Res* a *Fabre* Incisis, illustrantur. Cui accedunt *Digressiones de Respiratione, Generatione Androgynâ, Sæpia, Loligine, & Polypo*, aliisque *Rebus Naturalibus*. 1694. in 8°. n. 208. p. 65.

12. *W. Sengwerdus* Ph. D. de *Tarantula*. In quo, præter ejus *Descriptionem*, *Effectus Veneni Tarantulae*, qui hætenus *tuere Occultis Qualitatibus* adscripti, *Rationibus Naturalibus* deducuntur, & illustrantur. *Lugd. Bat.* 1668. in 12°. n. 34. p. 660.

13. A *Dissertation* of *Vipers*; by *S. Redi*. n. 8. p. 145. n. 9. p. 160.

14. *Nouvelles Experiences* sur la *Vipre*; par *M. Charas*. a *Paris*. 1669. n. 54. p. 1091. in 8°.

Lettera di *Francesco Redi* sopra alcune *Oppositioni* fatte alle sue *Osservationi* Intorno alle *Vipre*. In *Firenze*. 1670. 4°. n. 66. p. 2036.

Suite des Nouvelles Experiences sur la *Vipre*: avec un *Dissertation* sur son *Venime*; par *Moyse Charas*, a *Paris*. 1671. in 8°. n. 83. p. 4073.

A *Letter* of *Francesco Redi* concerning some *Objections* made upon his *Observations* about *Vipers*; together with a *Reply* to that *Letter* by *Moyse Charas*. *Lond.* 1672. in 8°. n. 87. p. 5082.

15. *Recherches et Observations* sur les *Vipres*; faites par *M. Bourdelot*. a *Paris*. in 12°. n. 77. p. 3013.

- n. 178. p. 1301. 16. *Franc. Willoughbei Armig. de Historia Piscium Libri Quatuor Jussu & Sumptu Societatis Regiæ Lond. Editi Totum Opus Recognovit, Coaptavit, Supplevit, Librum etiam Primum & Secundum Integros adjecit Job. Raius. è Soc. Regia. Oxon. 1686.*
- Ph. Coll. n. 1. p. 42. 17. *Observationi Intorno alle Torpedini, fatte da Stephano Lorenzini Fiorentino. in Firenze. 1678.*
- n. 28. p. 535. 18. *Observations faites sur un Grand Poisson, & un Lion, Disseques dans la Bibliotheque du Roy a Paris, le 24. & le 28. Juin. 1667.*
- n. 205. p. 972. 19 *Phalænologia Nova; sive Observationes de Rarioribus quibusdam Balænis, in Scotiæ Littus nuper Ejectis. Auth. Rob. Sibbald. Edinb. 1692. in 4°.*
- Ph. Coll. n. 2. p. 37. 20. *Phocæna; or the Anatomy of a Porpeff, Dissected at Gresham College: With a Preliminary Discourse concerning Anatomy and a Natural History of Animals; by Edw. Tyson. M. D. Lond. 1681.*
- n. 239. p. 125. 21. *Opianus's Halienticks. Gr. Part of that Excellent Poem, Describing the Philostorgia of Fishes, is Here Turned into English Verse.*
- n. 120. p. 481. 22. *Francisci Willughbei de Middleton Armigeri, è Reg. Soc. Ornithologiæ Libri Tres, in quibus Aves omnes hæctenus Cognitæ, in Methodum Naturis suis convenientem Redactæ, accurate Describuntur: Descriptiones Iconibus Elegantissimis, & Vivarum Avium Simillimis, Æri Incisis Illustrantur. Totum Opus Recognovit, Digessit, Supplevit, Job. Raius. Lond. 1676, in Fol. Some few Notes about Birds are here added by Dr. M. Lister.*
- n. 175. p. 1159. 23. *Th. Bartholini Dissertatio de Cygni Anatome; nunc aucta à Casp. Bartholino F. Hafniæ. 1668. in 8°.*
- n. 50. p. 1021. 24. *Synopsis Methodica Animalium Quadrupedum & Serpenti Generis. Auth. Job. Raio S. R. S. Lond. 1693. in 8°.*
- n. 202. p. 849. 25. *Memoires pour Servir à l'Histoire Naturelle des Animaux. a Paris. 1671. in Fol. The same in English containing the Anatomical Descriptions of several Creatures Dissected by the Royal Academie of Sciences at Paris; by Alex. Pitfield. Esqr. Lond. 1687. in Fol.*
- n. 49. p. 991.
n. 124. p. 591.
n. 189. p. 371. 26. *Godefredi Bidloo Observatio de Animalculis in Ovino Aliorumque Animalantium Hæpate detectis. Lugd Bat. 1698. in 4°.*
- n. 263. p. 571. 27. *The anatomy of a Lyon; by S. Redi.*
- n. 8. p. 145. 28 *Elaphographia; sive Cervi Descriptio Physico Medico-Chymica. Auth. Jo. Andrea Graba. M. D. Jenæ. 1668 in 8°.*
- n. 39. p. 787. 29 *Discours de M. Stenon, sur l'Anatomie du Cerveau. a Paris. 1669. in 12°.*
- n. 51. p. 1034. 30. *Castorologia, à Jo. Mario; aucta à Job. Franco. Aug. Vindel. 1685. in 8°.*
- n. 177. p. 1249. 31. *Orang Outang; sive Homo Sylvestris: Or the Anatomy of a Pigmie, Compared with that of a Monkey, an Ape, and a Man: To which is Added a Philological Essay concerning the Pigmies, the Cynocephali, the*
- n. 256. p. 338.

- the Satyrs, and Sphinges, of the Ancients; by Edw. Tyson. M. D. Lond. 1699. in 4.
32. Marc. Malpighii, Phil. & Med. Bononiensis, Dissertatio Epistolica de n. 87. p. 5079. Formatione Pulli in Ovo. Lond. 1672. in 4°.
33. Nicolai Stenonis de Musculis & Glandulis Observationum Specimen; n. 10. p. 176. cum Duabus Epistolis Anatomicis.
34. Benjaminii à Brookhuysen *Æconomia Animalis*. 1683. in 4°. n. 147. p. 194.
35. Explication Nouvelle & Mechanique des *Actions Animales*: ou il est Traite des *Fonctions de l'Âme, &c.* par M. Duncan M. D. a Paris. 1678. n. 140. p. 1013. in 12°.
36. Job. Alphonfi Borellii Neapol. Math. Profefs. Opus Posthumum, De *Motu animalium*. Romæ. 1680. & 1681. Ph. Col. n. 2. p. 35.
37. De *Anima Brutorum* Exercitationes duæ: Prior *Physiologica*, altera *Pathologica* Auth Tho. Willis. M D. Oxon. 1672. in 4°. n. 144. p. 62. n. 83. p. 4071.
38. Le Discernement du Corps & de l'Âme; par M. de Cordemoy. n. 17. p. 306.
39. Tractatus de *Natura Substantiæ Energetica*; seu de *Vita Naturæ*, e- jusque *Tribus Primis Facultatibus, Perceptiva, Appetitiva, Motiva, &c.* Auth. Franc. Glissonio. M. D. Lond. 1672. in 4°. n. 87. p. 5076.
40. Discours de la Conoissance des Bestes; par le Ignace Gaston Pardies. n. 82. p. 4054. S J. a Paris. 1672. in 12°.
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42. De *Mente Humana*, Libri 4, &c. Auth. J. B. du Hamel. Paris. 1672. n. 87. p. 5081. in 12°.

F I N I S.